

## Suspension System

### Inspection and Verification

1. Road test.
  - Verify the customer concern by carrying out a road test on a smooth road. If any vibrations are apparent, refer to [Section 100-04](#).
2. Inspect tires.
  - Check the tire pressure with all normal loads in the vehicle and the tires cold. Refer to the Vehicle Certification (VC) label.
  - Verify that all tires are sized to specification. Refer to the VC label.
  - Inspect the tires for incorrect wear and damage. Install new tires as necessary.
3. Inspect chassis and underbody.
4. Inspect for aftermarket equipment.
  - Check for aftermarket changes to the steering, suspension, wheel and tire components (such as competition, heavy duty, etc.). The specifications shown in this manual do not apply to vehicles equipped with aftermarket equipment.

### Visual Inspection Chart

Mechanical
<ul style="list-style-type: none"><li>• Front wheel bearing(s)</li><li>• Loose or damaged front or rear suspension components</li><li>• Loose, damaged or missing suspension fastener(s)</li><li>• Incorrect spring usage</li><li>• Damaged or sagging spring(s)</li><li>• Damaged or leaking shock absorber(s)</li><li>• Worn or damaged suspension bushing(s)</li><li>• Loose, worn or damaged steering system components</li><li>• Damaged axle components</li></ul>

5. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the next step.
6. If the fault is not visually evident, GO to [Symptom Chart - Suspension System](#) or GO to [Symptom Chart - NVH](#).

### Symptom Chart — Suspension System

### Symptom Chart — Suspension System

Condition	Possible Sources	Action
• Incorrect thrust angle (dogtracking)	• Rear suspension components	<ul style="list-style-type: none"> <li>INSPECT the rear suspension system. CHECK the rear alignment for the correct thrust angle. REPAIR or INSTALL new suspension components as necessary. REFER to <a href="#">Section 204-02</a>.</li> </ul>
• Vehicle drifts/pulls	<ul style="list-style-type: none"> <li>Unevenly loaded or overloaded vehicle</li> <li>Tires/tire pressure</li> <li>Alignment is not within specification</li> <li>Brake drag</li> <li>Steering components</li> </ul>	<ul style="list-style-type: none"> <li>GO to <a href="#">Pinpoint Test A</a>.</li> </ul>
• Front bottoming or riding low	<ul style="list-style-type: none"> <li>Worn, damaged or incorrect springs</li> <li>Worn front shock absorbers</li> </ul>	<ul style="list-style-type: none"> <li>MEASURE the ride height. REFER to <a href="#">Ride Height Measurement</a> in this section. INSTALL new springs as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>INSTALL new shock absorbers as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> </ul>
• Abnormal/incorrect tire wear	<ul style="list-style-type: none"> <li>Incorrect tire pressure (rapid center rib or inner and outer edge wear)</li> <li>Incorrect tire rotation intervals</li> <li>High-speed cornering</li> <li>Excessive front or rear toe (inner or outer edge wear)</li> <li>Excessive negative or positive camber (inner or outer edge wear)</li> <li>Front or rear suspension components</li> </ul>	<ul style="list-style-type: none"> <li>ADJUST the tire pressure. REFER to the Vehicle Certification (VC) label. REFER to <a href="#">Section 204-04 Diagnosis and Testing</a> for further tire wear diagnosis.</li> <li>REFER to <a href="#">Section 100-03</a>.</li> <li>REFER to <a href="#">Section 204-04 Diagnosis and Testing</a> for further tire wear diagnosis.</li> <li>INSPECT the front and rear suspension system. REPAIR or INSTALL new suspension components as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> </ul>

<ul style="list-style-type: none"> <li>Sticky steering, poor returnability</li> </ul>	<ul style="list-style-type: none"> <li>Binding ball joints</li> <li>Steering components</li> <li>Caster out of specification</li> </ul>	<ul style="list-style-type: none"> <li>REFER to the Ball Joint Inspection Component Test in this section.</li> <li>INSPECT the steering system. INSTALL new components as necessary. REFER to <a href="#">Section 211-02</a>.</li> <li>CHECK the wheel alignment. REFER to <a href="#">Camber and Caster Adjustment</a> in this section. ADJUST as necessary.</li> </ul>
<ul style="list-style-type: none"> <li>Steering wheel off-center</li> </ul>	<ul style="list-style-type: none"> <li>Unequal front toe setting (side-to-side)</li> <li>Steering components</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the wheel alignment. REFER to <a href="#">Toe Adjustment — Front</a> in this section. ADJUST as necessary.</li> <li>INSPECT the steering system. INSTALL new components as necessary. For vehicles equipped with Electronic Power Assist Steering (EPAS), refer to <a href="#">Section 211-00A</a>. For vehicles equipped with Hydraulic Power Assist Steering (HPAS), refer to <a href="#">Section 211-00B</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Sway or roll</li> </ul>	<ul style="list-style-type: none"> <li>Overloaded, unevenly or incorrectly loaded vehicle</li> <li>Loose wheel nut(s)</li> <li>Shock absorber(s)</li> <li>Loose stabilizer bracket-to-frame bolts</li> <li>Worn stabilizer bar bushings or links</li> <li>Damaged or broken stabilizer bar</li> <li>Damaged spring(s)</li> </ul>	<ul style="list-style-type: none"> <li>NOTIFY the customer of incorrect vehicle loading.</li> <li>TIGHTEN the wheel nut(s) to specification. REFER to <a href="#">Section 204-04</a>.</li> <li>INSTALL new shock absorbers as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>TIGHTEN the bolts to specification. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>INSTALL new stabilizer bar bushings or links as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>INSTALL a new stabilizer bar as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>INSTALL new springs as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> </ul>
<ul style="list-style-type: none"> <li>Vehicle leans to one side</li> </ul>	<ul style="list-style-type: none"> <li>Unevenly loaded or overloaded vehicle</li> <li>Front or rear</li> </ul>	<ul style="list-style-type: none"> <li>NOTIFY the customer of incorrect vehicle loading.</li> <li>MEASURE the ride height. REFER</li> </ul>

	suspension components	<p>to <a href="#">Ride Height Measurement</a> in this section. If the ride height is not within specification, INSPECT the front and rear suspension systems. INSTALL new suspension components as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</p>
• Wander	<ul style="list-style-type: none"> <li>• Overloaded, unevenly or incorrectly loaded vehicle</li> <li>• Ball joint(s)</li> <li>• Loose, worn or damaged front wheel bearing(s)</li> <li>• Loose, worn or damaged suspension component(s)</li> <li>• Loose suspension fasteners</li> <li>• Steering components</li> <li>• Wheel alignment (excessive total front toe out)</li> </ul>	<ul style="list-style-type: none"> <li>• NOTIFY the customer of incorrect vehicle loading.</li> <li>• INSPECT the ball joints. REFER to the Ball Joint Inspection Component Test in this section.</li> <li>• INSPECT the wheel bearings. INSTALL new wheel bearings as necessary.</li> <li>• INSTALL new suspension component(s) as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>• INSPECT the suspension fasteners. TIGHTEN to specification. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>• INSPECT the steering system. INSTALL new components as necessary. For vehicles equipped with Electronic Power Assist Steering (EPAS), refer to <a href="#">Section 211-00A</a>. For vehicles equipped with Hydraulic Power Assist Steering (HPAS), refer to <a href="#">Section 211-00B</a>.</li> <li>• ADJUST as necessary. REFER to <a href="#">Toe Adjustment — Front</a> in this section.</li> </ul>

#### Symptom Chart — NVH

##### Symptom Chart — NVH

**NOTE:** NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to [Section 100-04](#). Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to [Section 100-04](#) for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Squeak or grunt — noise	<ul style="list-style-type: none"> <li>• Front stabilizer</li> </ul>	<ul style="list-style-type: none"> <li>• Under these conditions, the</li> </ul>

<p>from the front or rear suspension, occurs more in cold ambient temperature with or without the presence of moisture. More noticeable over rough roads or when turning</p>	<ul style="list-style-type: none"> <li>• bar insulators</li> <li>• Leaf spring bushings</li> </ul>	<p>noise is acceptable.</p>
<ul style="list-style-type: none"> <li>• Clunk — noise from the front suspension, occurs in and out of turns</li> </ul>	<ul style="list-style-type: none"> <li>• Loose front suspension</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT for loose nuts or bolts. TIGHTEN to specification. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> </ul>
<ul style="list-style-type: none"> <li>• Clunk — noise from the rear suspension, occurs when shifting from REVERSE to DRIVE</li> </ul>	<ul style="list-style-type: none"> <li>• Loose rear suspension components</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT for loose or damaged rear suspension components. REPAIR or INSTALL new components as necessary. REFER to <a href="#">Section 204-02</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Click or pop — noise from the front suspension. More noticeable over rough roads or over bumps</li> </ul>	<ul style="list-style-type: none"> <li>• Worn or damaged ball joint(s)</li> </ul>	<ul style="list-style-type: none"> <li>• CARRY OUT a ball joint inspection. INSTALL new ball joint(s) or control arm(s) as necessary. REFER to <a href="#">Section 204-00</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Front suspension noise — a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads</li> </ul>	<ul style="list-style-type: none"> <li>• Front suspension components</li> <li>• Loose or damaged shock absorber(s) or shock absorber bushing(s)</li> <li>• Damaged spring or spring mount(s)</li> <li>• Damaged or worn control/radius arm bushing(s)</li> <li>• Worn or damaged stabilizer bar bushings or link(s)</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT the front suspension. INSTALL new components as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> </ul>
<ul style="list-style-type: none"> <li>• Rear suspension noise — a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads</li> </ul>	<ul style="list-style-type: none"> <li>• Loose or damaged rear shock absorber(s) or shock absorber bushing(s)</li> <li>• Rear leaf spring tip isolator or bushing</li> <li>• Damaged leaf spring or leaf spring mount(s)</li> <li>• Worn or</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT the rear suspension. INSTALL new components as necessary. REFER to <a href="#">Section 204-02</a>.</li> </ul>

	<p>damaged stabilizer bar bushing(s) or link(s)</p> <ul style="list-style-type: none"> <li>Rear leaf spring or bushing contaminated with dirt, sand or mud</li> </ul>	<ul style="list-style-type: none"> <li><b>NOTE:</b> To avoid the re-occurrence of noise, make sure that all contamination and moisture trapped between the individual leaf spring components have been completely removed.</li> <li><b>NOTE:</b> Do not apply any lubricant or grease to the leaf springs as this will attract dirt and moisture.</li> </ul> <p>PRESSURE WASH the leaf springs between the individual spring leafs and the gaps between the spring bushings, mounting brackets and shackles to remove any trapped debris. USE compressed (shop) air to remove any remaining debris and to completely dry between all of the individual spring components.</p>
<ul style="list-style-type: none"> <li>Shudder — occurs during acceleration from a slow speed or stop</li> </ul>	<ul style="list-style-type: none"> <li>Incorrect ride height causing incorrect driveline angle</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 205-00</a> for driveline angle diagnosis.</li> </ul>
<ul style="list-style-type: none"> <li>Shimmy</li> </ul>	<ul style="list-style-type: none"> <li>Loose wheel nut(s)</li> <li>Loose front suspension fastener(s)</li> <li>Loose front wheel bearing(s)</li> <li>Shock absorber(s)</li> </ul>	<ul style="list-style-type: none"> <li>TIGHTEN the nut(s) to specification. REFER to <a href="#">Section 204-04</a>.</li> <li>TIGHTEN the fastener(s) to specification. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>INSPECT the front wheel bearing(s). INSTALL new bearing(s) as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> <li>INSTALL new shock absorbers as necessary. Refer to the appropriate section in Group <a href="#">204</a> for the procedure.</li> </ul>
<ul style="list-style-type: none"> <li>Shimmy — most noticeable on coast/deceleration. Also hard steering condition</li> </ul>	<ul style="list-style-type: none"> <li>Excessive positive caster</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the wheel alignment. REFER to <a href="#">Camber and Caster Adjustment</a> in this section. ADJUST as necessary.</li> </ul>

<ul style="list-style-type: none"> <li>• Rough/harsh ride</li> </ul>	<ul style="list-style-type: none"> <li>• Incorrect tire pressure</li> <li>• Shock absorber(s)</li> <li>• Spring(s)</li> <li>• Loose, worn or damaged suspension component(s)</li> </ul>	<ul style="list-style-type: none"> <li>• ADJUST the tire pressure. REFER to the <u>VC</u> label.</li> <li>• INSTALL new shock absorbers as necessary. Refer to the appropriate section in Group <u>204</u> for the procedure.</li> <li>• MEASURE the ride height. REFER to <u>Ride Height Measurement</u> in this section. INSTALL new springs as necessary. Refer to the appropriate section in Group <u>204</u> for the procedure.</li> <li>• INSTALL new suspension component(s) as necessary. Refer to the appropriate section in Group <u>204</u> for the procedure.</li> </ul>
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## Pinpoint Tests

### Pinpoint Test A: Vehicle Drifts/Pulls

This pinpoint test is intended to diagnose the following:

- Unevenly loaded vehicle
- Tire pressure
- Tire forces
- Brake drag
- Incorrect vehicle alignment
- Steering system

### PINPOINT TEST A: VEHICLE DRIFTS/PULLS

Test Step	Result / Action to Take
<b>A1 CHECK FOR UNEVENLY LOADED VEHICLE</b>	<p><b>Yes</b> ADVISE the customer of uneven loading condition.</p> <p><b>No</b> GO to <u>A2</u>.</p>
<b>A2 CHECK THE TIRE PRESSURES AND TIRE CONDITIONS</b>	<p><b>Yes</b> GO to <u>A3</u>.</p>

<p>uneven/abnormal wear. Refer to Diagnosis and Testing — Wheels and Tires in <a href="#">Section 204-04</a>.</p> <ul style="list-style-type: none"> <li>• <b>Are the tire pressures and tire conditions OK?</b></li> </ul>	<p><b>No</b> ADJUST the tire pressures to the specified pressure or INSTALL new tires as necessary.</p>
<p><b>A3 ISOLATE TIRE DRIFT/PULL CONDITION</b></p> <ul style="list-style-type: none"> <li>• Cross the front wheel and tire assemblies from left-to-right. Refer to <a href="#">Section 204-04</a>.</li> <li>• <b>Does the vehicle drift/pull?</b></li> </ul>	<p><b>Yes</b> If the vehicle drifts/pulls in the opposite direction, tire forces are causing the drift/pull. ROTATE the wheel and tire assemblies front-to-rear. REFER to <a href="#">Section 204-04</a>. If the vehicle drifts/pulls in the same direction, GO to <a href="#">A4</a>.</p> <p><b>No</b> Tire forces were causing the drift/pull and the concern has been corrected.</p>
<p><b>A4 CHECK FOR BRAKE DRAG</b></p> <ul style="list-style-type: none"> <li>• Spin all 4 wheel and tire assemblies by hand and check for brake drag.</li> <li>• <b>Do the wheels spin freely?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">A5</a>.</p> <p><b>No</b> REFER to <a href="#">Section 206-00</a> to diagnose brake drag condition.</p>
<p><b>A5 CHECK THE WHEEL ALIGNMENT</b></p> <ul style="list-style-type: none"> <li>• Using alignment equipment and the manufacturer's instructions, check the wheel alignment.</li> <li>• <b>Is the wheel alignment out of specification?</b></li> </ul>	<p><b>Yes</b> ADJUST the alignment as necessary. REFER to General Procedures in this section.</p> <p><b>No</b> REFER to <a href="#">Section 211-00A</a> or <a href="#">Section 211-00B</a> to diagnose steering system drift/pull/wander condition.</p>

## Component Tests

### Ball Joint Inspection

1. Prior to inspecting the ball joints for wear, inspect the wheel bearings. Refer to [Section 100-04](#).
2. **NOTE:** In order to obtain accurate measurements, the suspension must be in full rebound with the weight of the vehicle supported by the frame.  
  
Raise and support the vehicle by the frame to allow the wheels to hang in the rebound position.
3. Inspect the ball joint and ball joint boot for damage.
  - If the ball joint or ball joint boot is damaged, install a new ball joint as necessary. Refer to [Section 204-01A](#) for Rear Wheel Drive (RWD) vehicles and [Section 204-01B](#) for Four-Wheel Drive (4WD) vehicles.

**NOTE:** Carry out Steps 4 through 6 to inspect the lower ball joint. Carry out Steps 7 through 9 to inspect the

upper ball joint.

4. **NOTICE:** Do not use any tools or equipment to move the wheel and tire assembly or suspension components while checking for relative movement. Suspension damage can occur. The use of tools or equipment will also create relative movement that may not exist when using hand force. Relative movement must be measured using hand force only.

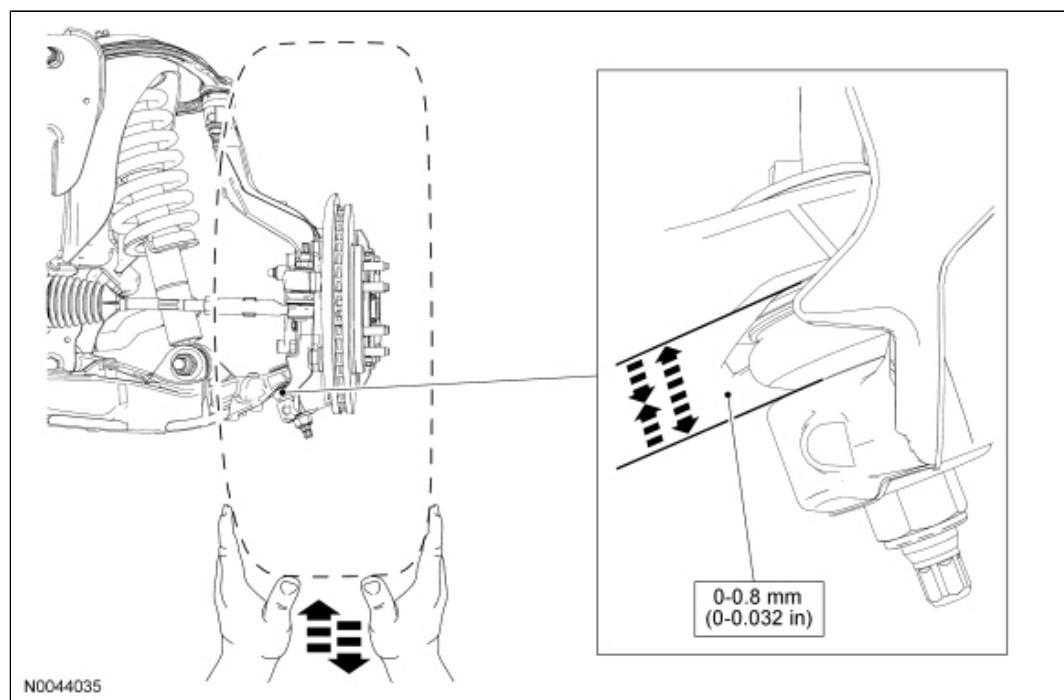
**NOTE:** The weight of the wheel and tire assembly must be overcome to obtain an accurate measurement on the dial indicator.

Inspect the ball joint for relative movement by alternately pulling downward and pushing upward on the wheel and tire assembly by hand. Note any relative vertical movement between the wheel knuckle and lower arm at the lower ball joint.

- If relative movement is not felt or seen, the ball joint is OK. Do not install a new ball joint.
- If relative movement is found, continue with Step 5.

5. **NOTE:** In order to obtain an accurate measurement, the dial indicator should be aligned as close as possible with the vertical axis (center line) of the ball joint.

To measure ball joint deflection, attach a suitable dial indicator with a flexible arm between the lower control arm and the wheel knuckle or ball joint stud.



6. Measure the ball joint deflection while an assistant pushes up and pulls down on the wheel and tire assembly, by hand.
  - If the deflection exceeds the specification, a new ball joint must be installed. Refer to [Section 204-01A](#) for RWD vehicles and [Section 204-01B](#) for 4WD vehicles.
  - If the deflection meets or is below the specification, continue with the procedure.
7. **NOTICE:** Do not use any tools or equipment to move the wheel and tire assembly or suspension components while checking for relative movement. Suspension damage can

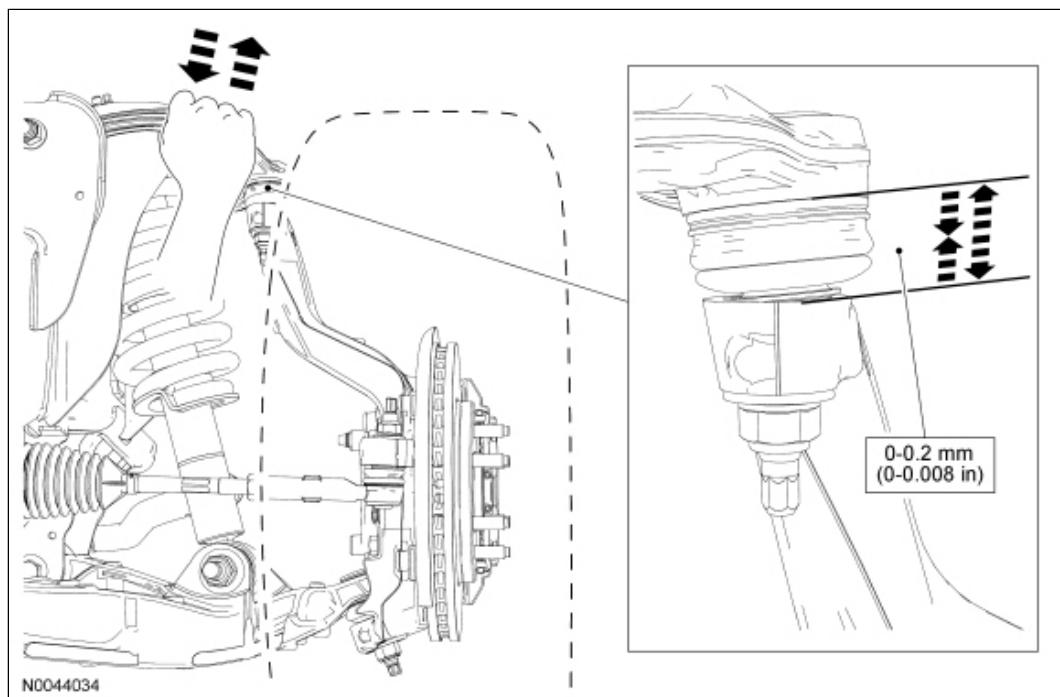
**occur. The use of tools or equipment will also create relative movement that may not exist when using hand force. Relative movement must be measured using hand force only.**

Inspect the ball joint for relative movement by alternately pulling downward and pushing upward on the upper control arm by hand. Note any relative vertical movement between the wheel knuckle and upper arm at the upper ball joint.

- If relative movement is not felt or seen, the ball joint is OK. Do not install a new ball joint.
- If relative movement is found, continue with Step 8.

8. **NOTE:** In order to obtain an accurate measurement, the dial indicator should be aligned as close as possible with the vertical axis of the ball joint.

To measure ball joint deflection, attach a suitable dial indicator with a flexible arm between the upper control arm and the wheel knuckle or ball joint stud.



9. Measure the ball joint deflection while an assistant pushes up and then pulls down on the upper control arm, by hand.
- If the deflection exceeds the specification, a new ball joint must be installed. Refer to [Section 204-01A](#) for RWD vehicles and [Section 204-01B](#) for 4WD vehicles.
  - If the deflection meets or is below the specification, no further action is required.

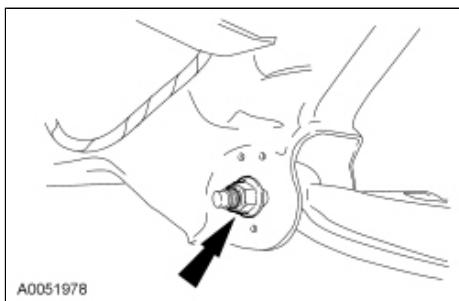


## Camber and Caster Adjustment

**NOTICE:** Do not remove the stabilizer bar brackets until the stabilizer links have been disconnected or damage to the stabilizer bar links may occur.

**NOTE:** To allow for adjustment of the lower arm in the frame slots, the lower arm bolts and nuts must be removed and discarded. They are replaced with cam bolt kit 3C333. The vehicle should be supported by the frame to ease movement of the lower arm in the slot.

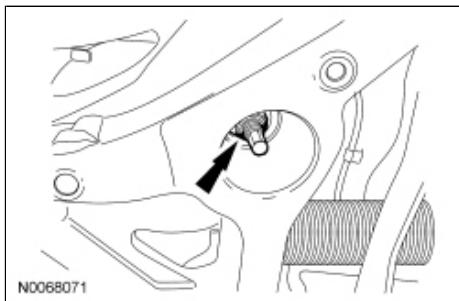
1. Using alignment equipment and the manufacturers instructions, measure the front caster and camber.
  - Refer to Alignment Specifications in the Specifications portion of this section for optimal alignment settings.
  - If the caster and camber values are not within specification, go to the next step.
2. Remove and discard the lower arm front and rear nuts and bolts.



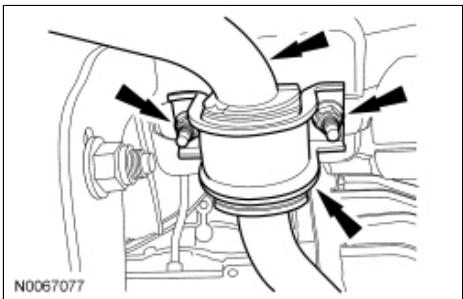
3. **NOTICE:** Do not hold the stabilizer link boot with any tool as damage to the boot will occur.

**NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nuts.

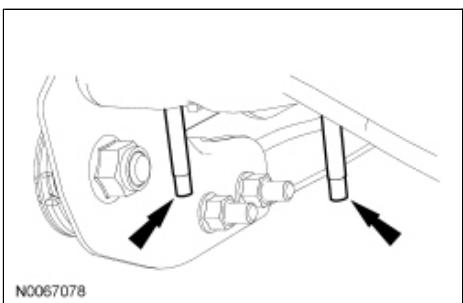
Remove and discard the stabilizer bar link lower nuts.



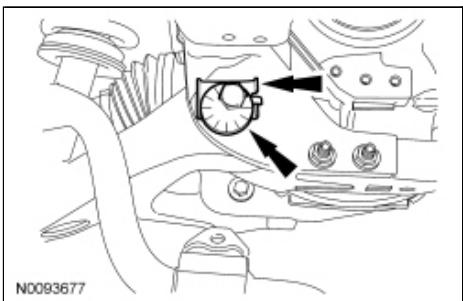
4. Remove the 4 stabilizer bar bracket nuts, 2 stabilizer bar brackets and position the stabilizer bar aside.
  - Discard the nuts.



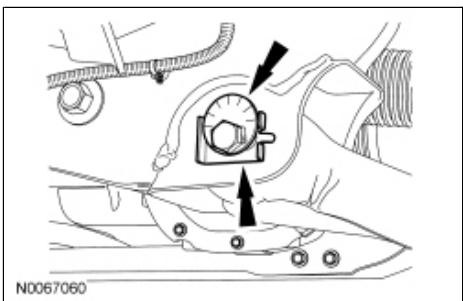
5. Remove the stabilizer bar bracket bolts and plate assembly.



6. Install the front cam bolt kit and loosely install the nut.



7. Install the rear cam bolt kit and loosely install the nut.

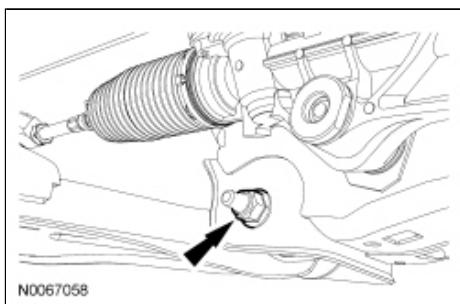


8. To adjust the caster and camber, refer to the following chart.

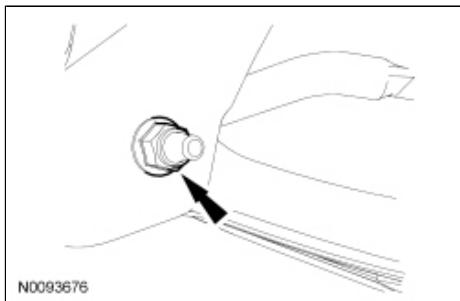
- Adjustments that require moving the front and the rear of the lower arm should be made equally.

Adjustment	Front of Lower Arm	Rear of Lower Arm
Increase caster	In	Out
Decrease caster	Out	In
Increase camber	In	In
Decrease camber	Out	Out
Increase caster and camber simultaneously	In	—
Decrease caster and camber simultaneously	Out	—

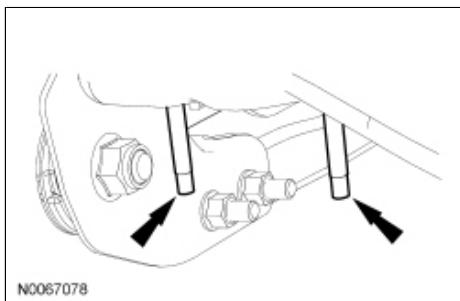
9. With the weight of the vehicle resting on the wheel and tire assemblies, hold the front cam bolt and tighten the nut to 350 Nm (258 lb-ft).



10. With the weight of the vehicle resting on the wheel and tire assemblies, hold the rear cam bolt and tighten the nut to 350 Nm (258 lb-ft).

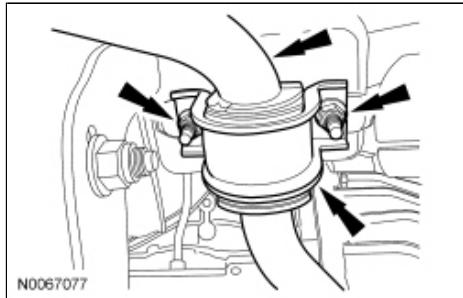


11. Install the 2 stabilizer bar bracket bolts and plate assembly.



12. Position the stabilizer bar, install the 2 stabilizer bar brackets and the 4 new stabilizer bar bracket nuts.

- Tighten the nuts to 55 Nm (41 lb-ft).

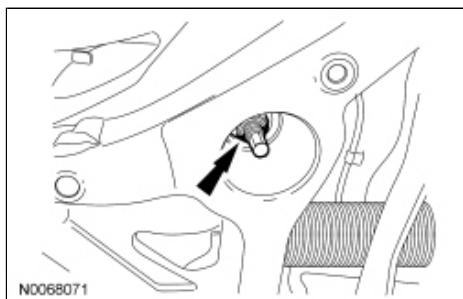


13. **NOTICE:** Do not hold the stabilizer link boot with any tool as damage to the boot will occur.

**NOTE:** Use the hex-holding feature to prevent the stud from turning while installing the nuts.

Install the 2 new stabilizer bar link lower nuts.

- Tighten the nuts to 80 Nm (59 lb-ft).



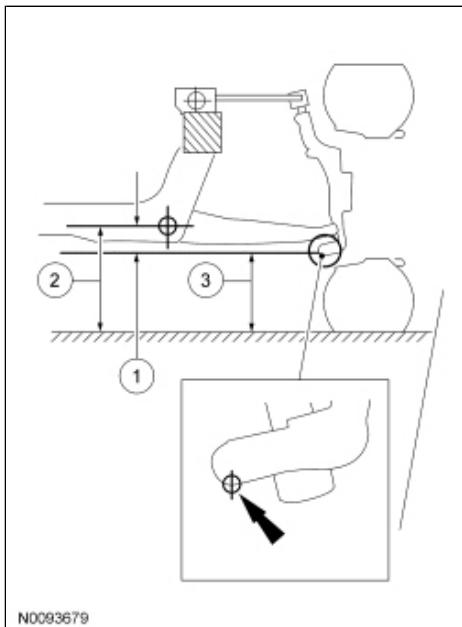
14. Check and, if necessary, adjust the front toe. For additional information, refer to [Toe Adjustment — Front](#) in this section.

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## Ride Height Measurement

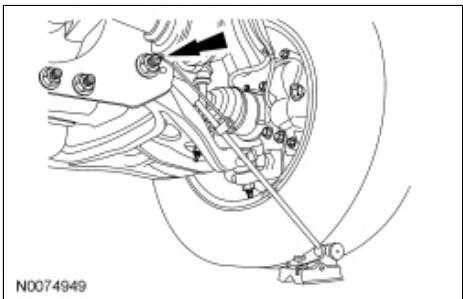
### Front Ride Height Measurement



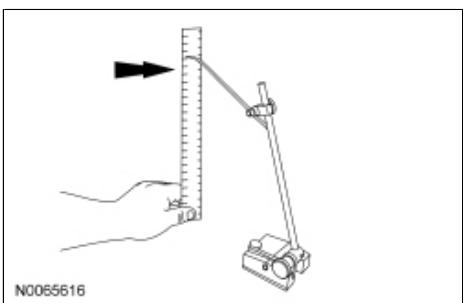
Item	Description
1	Ride height = 2 - 3
2	Measurement 2
3	Measurement 3

**NOTE:** Make sure that the vehicle is positioned on a flat, level surface and the tires are inflated to the correct pressure. Vehicle should have at least one-half tank of fuel.

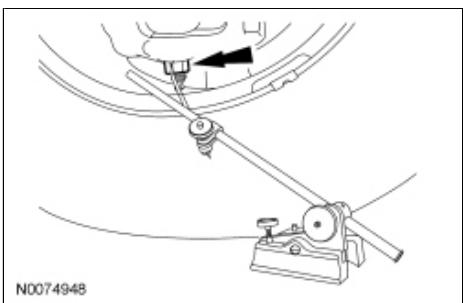
1. Position a suitable surface gauge (such as Starrett 57D Surface Gauge) on a flat, level surface and adjust the gauge arm until the scribe point is located in the center of the rearward lower arm bolt.
  - Lock the surface gauge in this position.



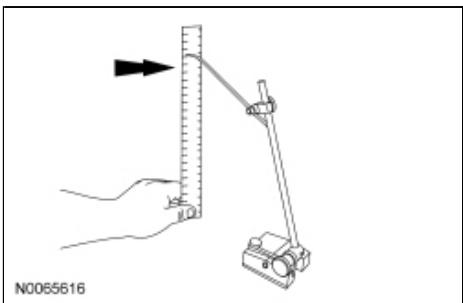
2. With the surface gauge positioned on a flat, level surface, record the measurement of the surface gauge position (measurement 2).



3. Position the surface gauge on the same flat, level surface as used in Step 1 and adjust the gauge arm until the scribe point is located at the lowest point on the wheel knuckle.
  - Lock the surface gauge in this position.

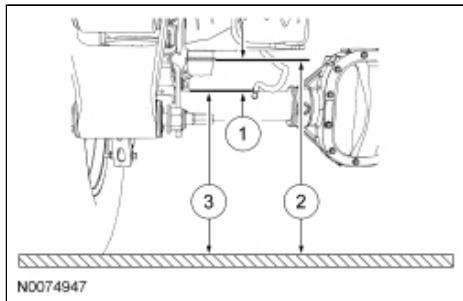


4. With the surface gauge positioned on a flat, level surface, record the measurement of the surface gauge position (measurement 3).



- Subtract measurement 3 from measurement 2 to obtain the front ride height.
  - Refer to Specifications in this section.

#### Rear Ride Height Measurement (All Except SVT Raptor)

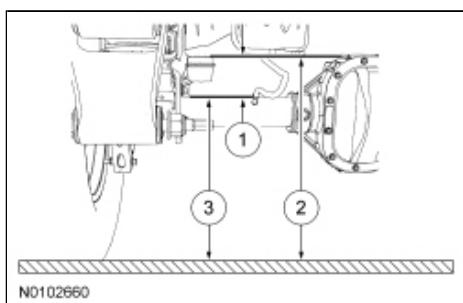


Item	Description
1	Ride height
2	Rear axle jounce stop
3	Top of the rear axle tube

**NOTE:** Make sure that the vehicle is positioned on a flat, level surface and the tires are inflated to the correct pressure. Vehicle should have at least one-half tank of fuel.

- Measure the distance between the rear axle jounce stop (Item 2) and the top of the rear axle tube (Item 3) to obtain the rear ride height (Item 1).

#### Rear Ride Height Measurement (SVT Raptor)



Item	Description
1	Ride height
2	Rear frame rail
3	Top of the rear axle tube

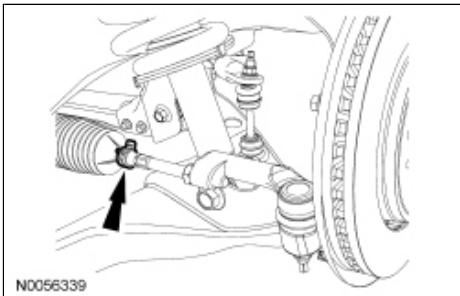
**NOTE:** Make sure that the vehicle is positioned on a flat, level surface and the tires are inflated to the

correct pressure. Vehicle should have at lease one-half tank of fuel.

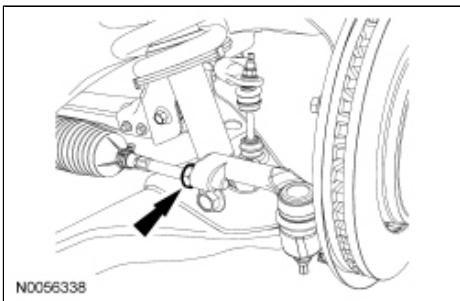
1. Measure the distance between the rear frame rail (Item 2) and the top of the rear axle tube (Item 3) to obtain the rear ride height (Item 1).
-

## Toe Adjustment — Front

1. Using alignment equipment and the manufacturer's instructions, measure the front toe.
  - Refer to Alignment Specifications in the Specifications portion of this section for optimal alignment settings.
  - If the front toe values are not within specification, go to the next step.
2. Start the engine and center the steering wheel.
3. Turn the engine off and, using a suitable steering wheel holding device, lock the steering wheel in the straight-ahead position.
4. Remove the steering gear bellows clamp(s).

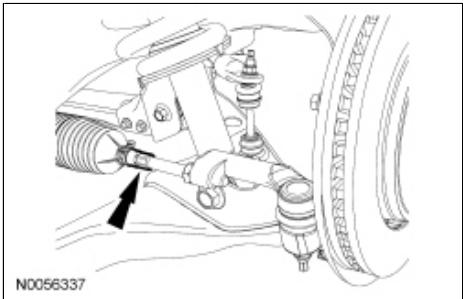


5. Loosen the tie-rod end jam nut(s).



6. **NOTE:** Do not allow the steering gear bellows to twist while rotating the tie rod.

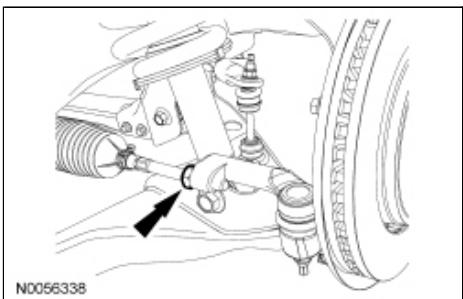
Rotate the tie rod(s) to achieve the desired toe setting.



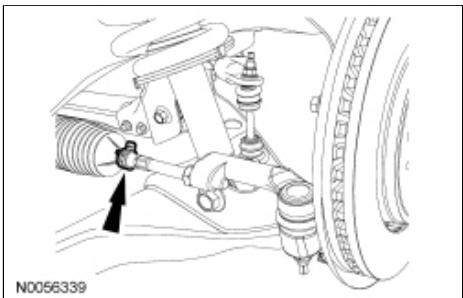
7. **NOTICE:** Make sure to hold the tie-rod end stationary while tightening the jam nut or damage to the boot may occur.

**NOTE:** Make sure that the toe settings are not disturbed while tightening the jam nuts.

Tighten the tie-rod end jam nut(s) to 103 Nm (76 lb-ft).



8. Install the steering gear bellows clamp(s).



---



**Torque Specifications**

Description	Nm	lb-ft	lb-in
Brake disc shield bolts	17	—	150
Brake hose bracket bolt	12	—	106
Lower arm forward and rearward nuts	350	258	—
Lower ball joint nut	175	129	—
Shock absorber lower nuts	90	66	—
Shock absorber upper mount nuts	63	46	—
Shock rod nut	55	41	—
Stabilizer bar bracket nuts	55	41	—
Stabilizer bar link nuts	70	52	—
Tie-rod end nut	115	85	—
Upper arm-to-frame nuts	150	111	—
Upper ball joint nut	115	85	—
Wheel bearing and wheel hub bolts	175	129	—
Wheel speed sensor bolt	18	—	159
Wheel speed sensor harness bracket bolt	12	—	106

---

## **Front Suspension**

The Rear Wheel Drive (RWD) front suspension consists of the following components:

- Lower ball joints
- Lower control arms
- Shock absorber and coil spring assemblies
- Stabilizer bar and links
- Upper control arms
- Wheel bearings and wheel hubs
- Wheel knuckles
- Wheel studs

The vehicle is equipped with a front coil spring suspension. This independent-type suspension utilizes a stabilizer bar to aid in vehicle stability. The wheel hub and wheel bearing are sealed units and are serviced as assemblies. The lower ball joints can be serviced independently from the lower arms.

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## **Front Suspension**

Refer to [Section 204-00](#).

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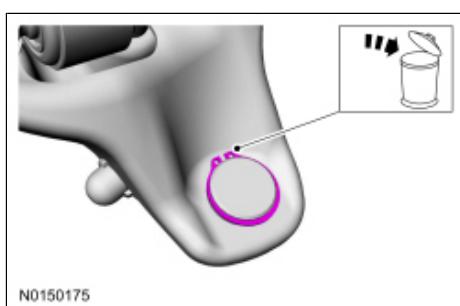
## Ball Joint — Lower

### Special Tool(s)

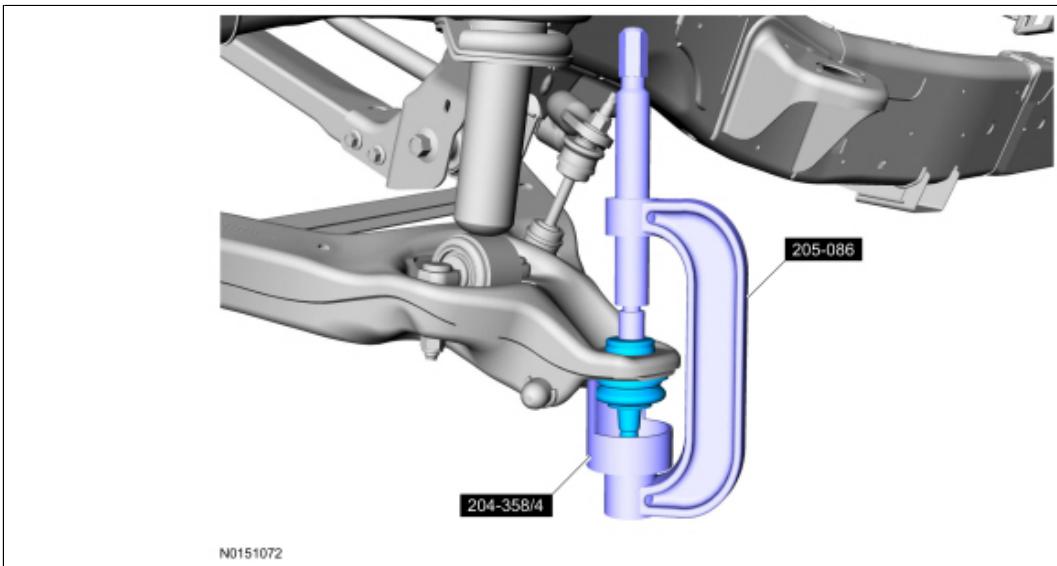
 ST2929-A	Installer/Remover, Ball Joint 204-358
 ST1172-A	Installer/Remover, C-Frame and Screw 205-086

### Removal

1. Remove the wheel knuckle. Refer to [Wheel Knuckle](#).
- 2.



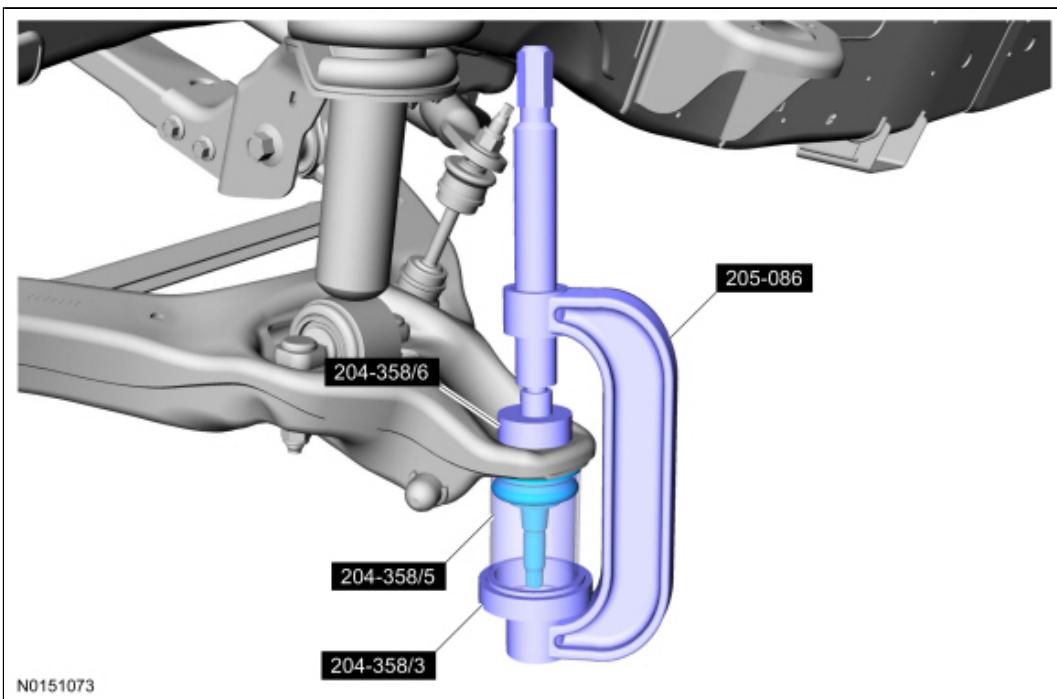
3. Special Tool(s): Installer/Remover, C-Frame and Screw 205-086. Remover, Ball Joint 204-358/4.



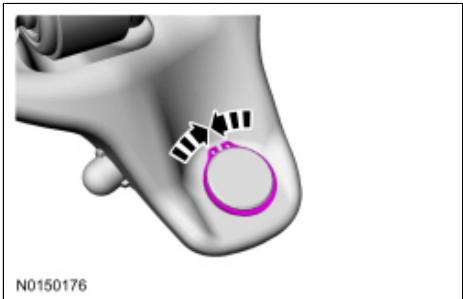
## Installation

1. **NOTICE:** Do not damage the lower ball joint boot when installing the C-Frame and Screw Installer/Remover and Ball Joint Installer/Remover or premature failure of the ball joint may occur.

Special Tool(s): Installer/Remover, C-Frame and Screw 205-086. Remover, Ball Joint 204-358/3. Remover, Ball Joint 204-358/5. Remover, Ball Joint 204-358/6.



2. **NOTE:** Make sure the ball joint snap ring is fully seated.



3. Install the wheel knuckle. Refer to [Wheel Knuckle](#).
-

## Lower Arm

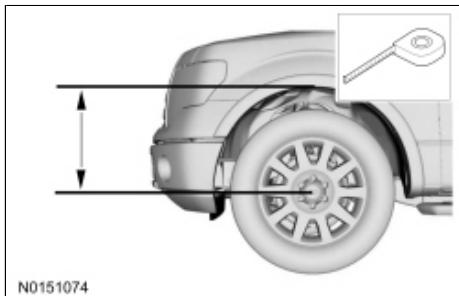
### Special Tool(s)

	Separator, Ball Joint 204-592
ST2945-A	

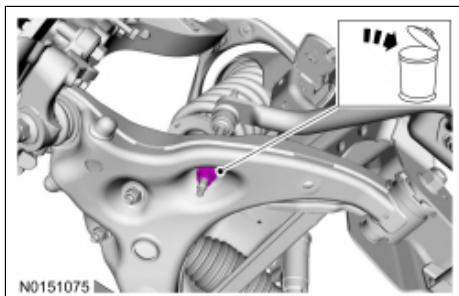
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

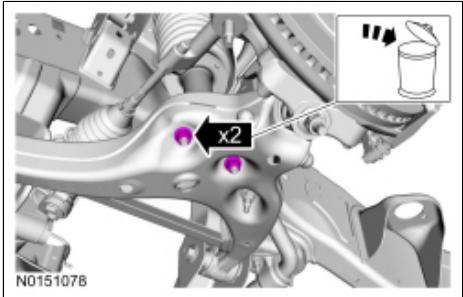
1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



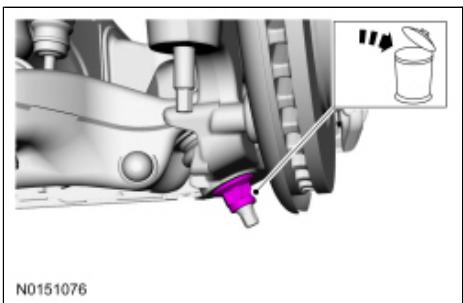
2. Remove the wheel and tire. Refer to [Section 204-04](#).
3. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



- 4.



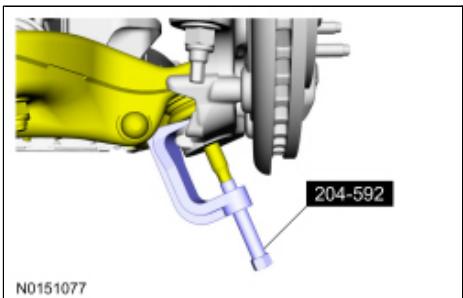
5.



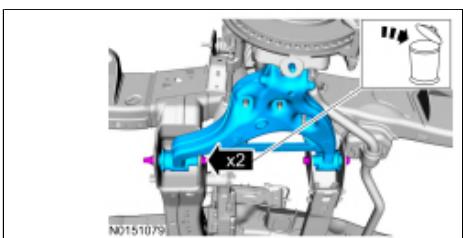
6. **NOTICE:** Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.

**NOTICE:** Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.

Special Tool(s): Separator, Ball Joint 204-592.



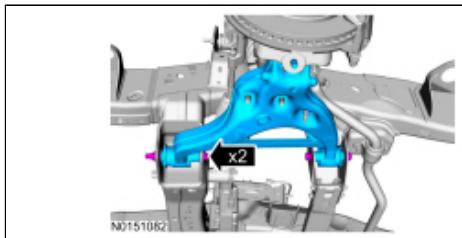
7.



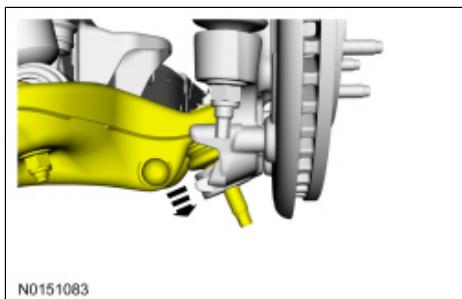
## Installation

1. **NOTICE:** Tighten the suspension bushing fasteners with the suspension loaded or with the weight of the vehicle resting on the wheels and tires, otherwise incorrect clamp load and bushing damage may occur.

Finger tight at this stage.

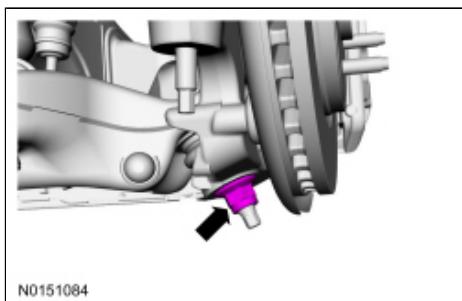


2.



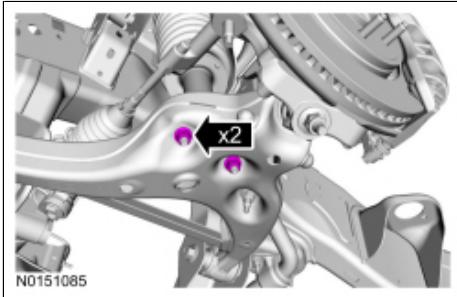
3.

- Tighten to 175 Nm (129 lb-ft).



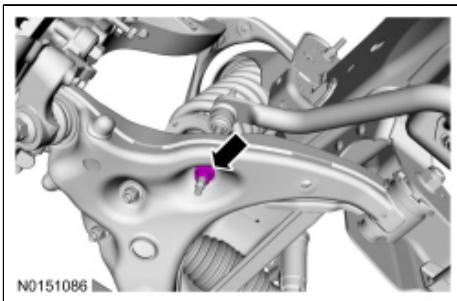
4.

- Tighten to 90 Nm (66 lb-ft).

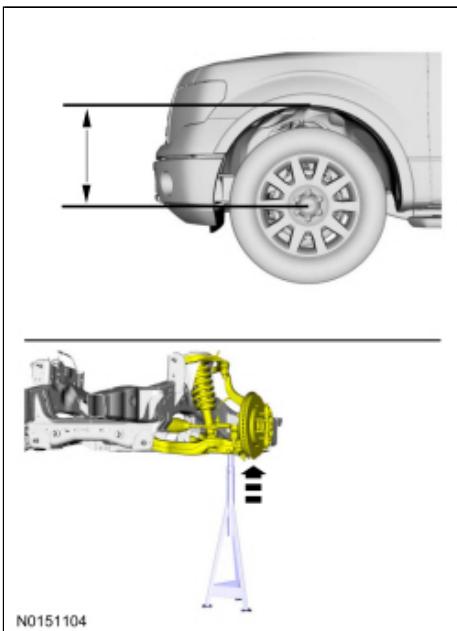


5. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

- Tighten to 70 Nm (52 lb-ft).

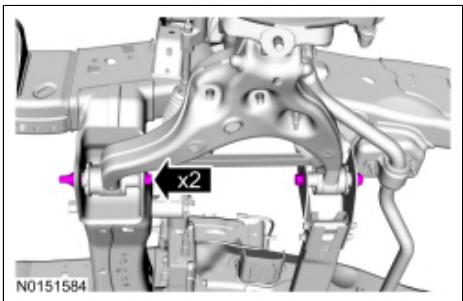


6. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



- 7.

- Tighten to 350 Nm (258 lb-ft).



8. Install the wheel and tire. Refer to [Section 204-04](#).
  9. Check and, if necessary, align the front end. Refer to [Section 204-00](#).
-

## Shock Absorber and Spring Assembly

### Special Tool(s)

	Separator, Ball Joint 204-592
---	----------------------------------

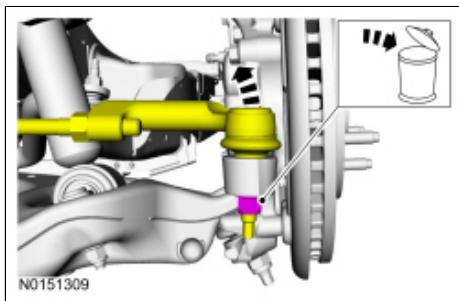
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

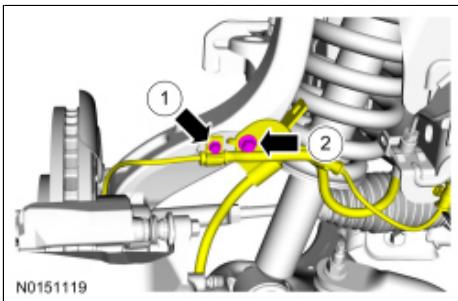
1. Remove the wheel and tire. Refer to [Section 204-04](#).
2. **NOTICE:** Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.

**NOTICE:** Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.

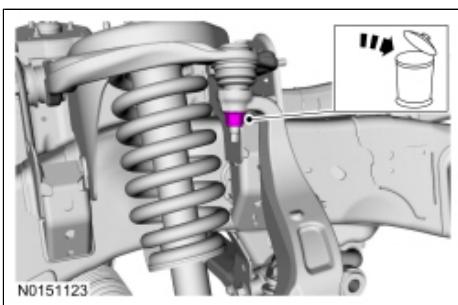
General Equipment: Tie-rod Separator.



- 3.

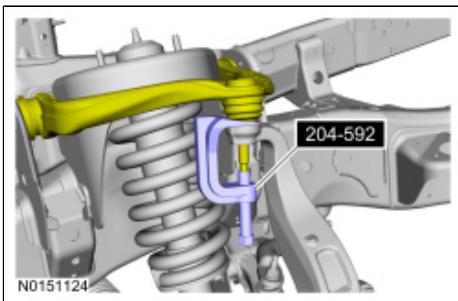


4.

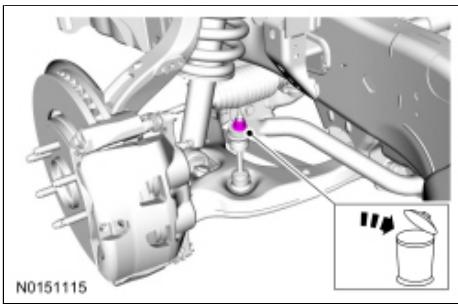


5. **NOTE:** Be sure not to damage the ball joint boot when installing the Ball Joint Separator.

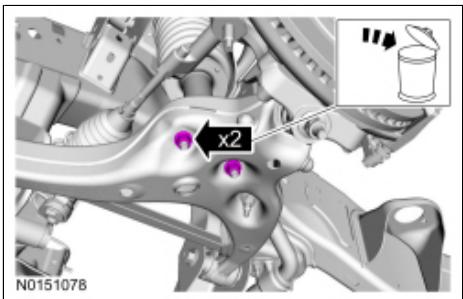
Special Tool(s): Separator, Ball Joint 204-592.



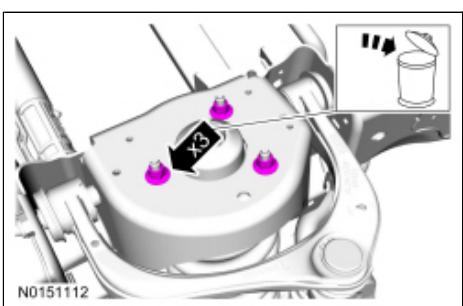
6. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



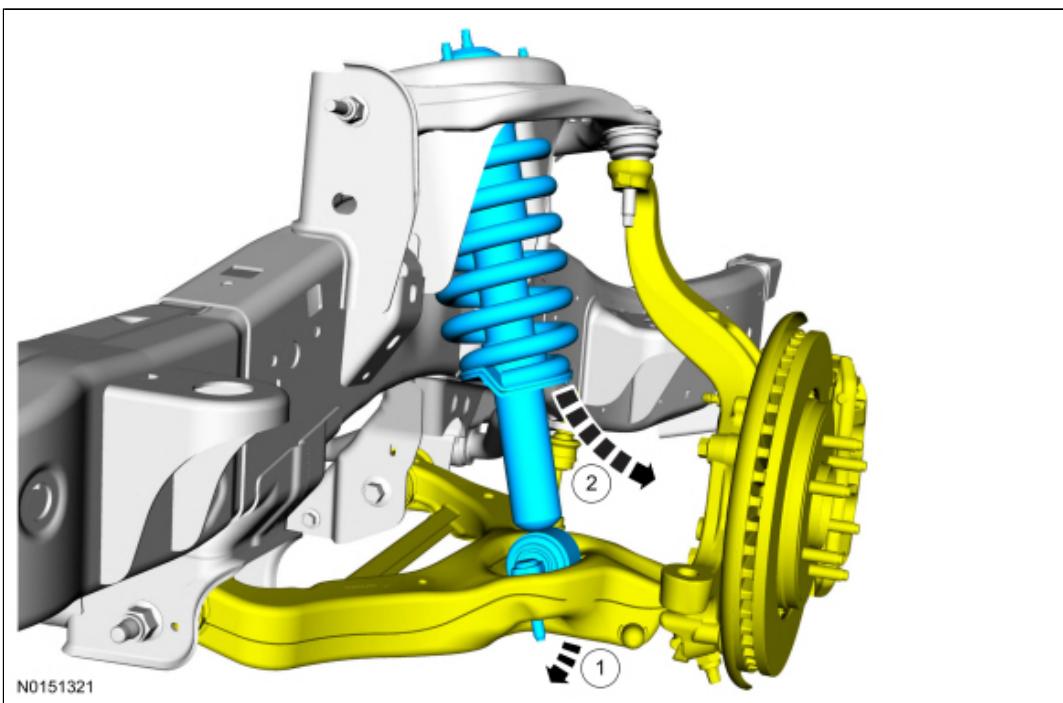
7.



8.



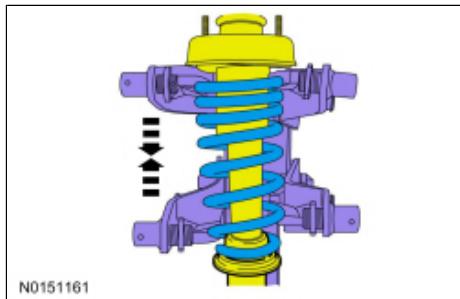
9.



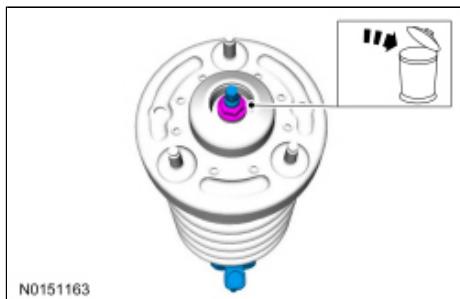
10. **NOTE:** If the individual spring and/or shock components are not being serviced, continue to the installation procedure.

**NOTE:** For reference during assembly, index the upper mount, spring and shock absorber.

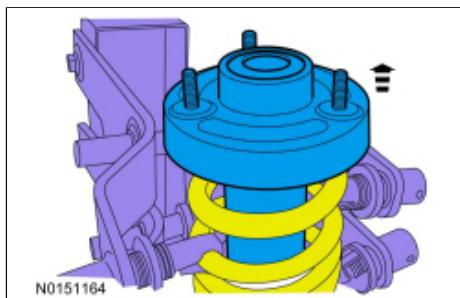
Compress the spring until the tension is released from the shock absorber.  
General Equipment: Spring Compressor.



11. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while removing the nut.

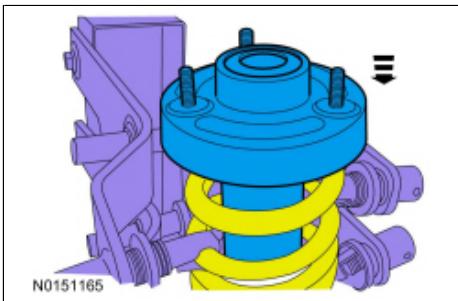


- 12.



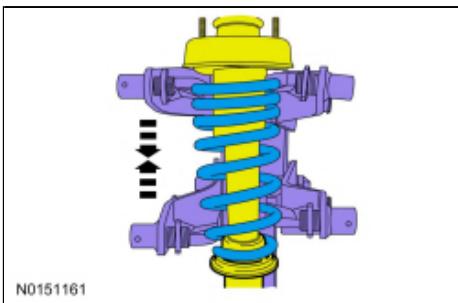
## Installation

- 1.



2. **NOTE:** Align the index marks made during disassembly.

Compress the spring until the tension is released from the shock absorber.  
General Equipment: Spring Compressor.



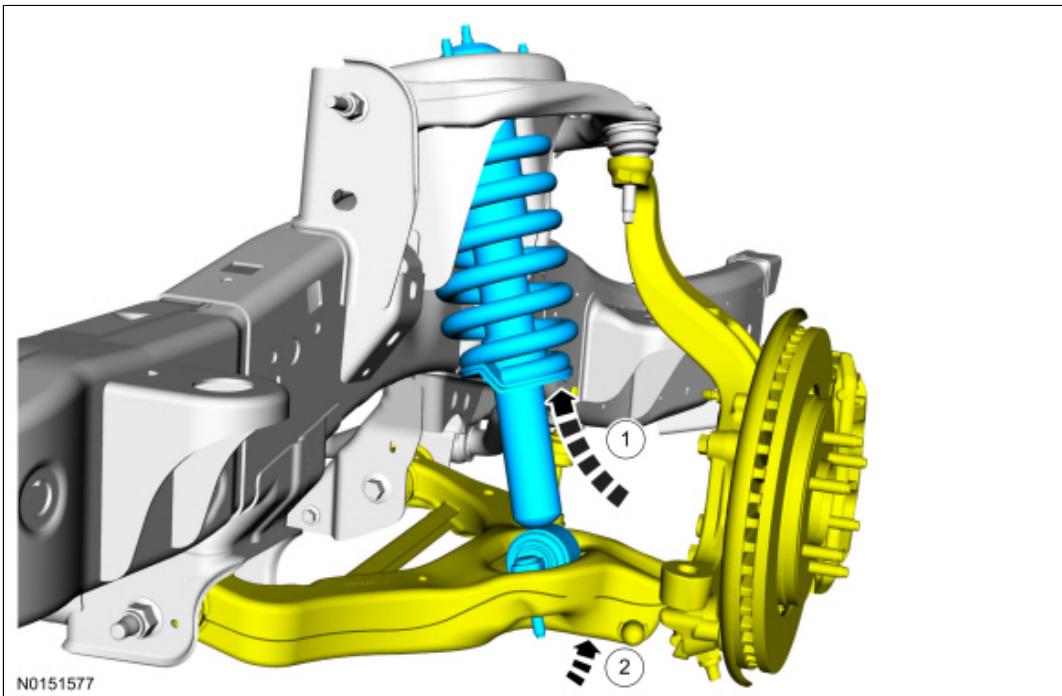
3. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while installing the nut.

While holding the shock rod, install the new shock absorber and the shock rod nut.

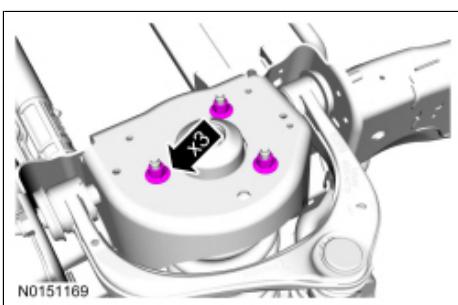
- Tighten to 55 Nm (41 lb-ft).



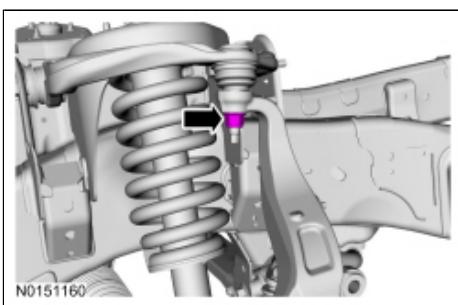
- 4.



- 5.
- Tighten to 63 Nm (46 lb-ft).

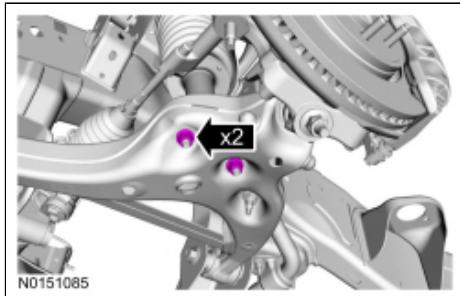


- 6.
- Tighten to 115 Nm (85 lb-ft).



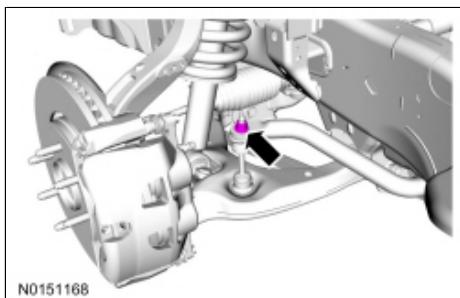
7.

- Tighten to 90 Nm (66 lb-ft).



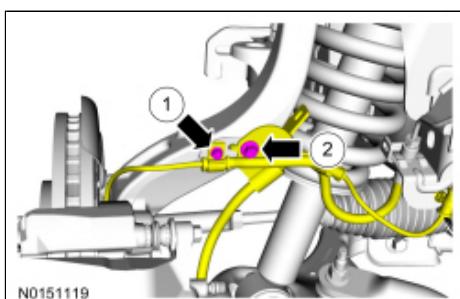
8. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

- Tighten to 70 Nm (52 lb-ft).



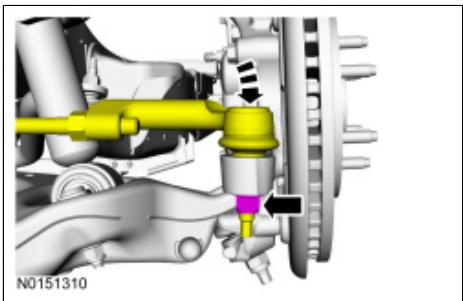
9.

- Tighten to 12 Nm (106 lb-in).



10.

- Tighten to 115 Nm (85 lb-ft).



11. Install the wheel and tire. Refer to [Section 204-04](#).
-

## Stabilizer Bar and Link

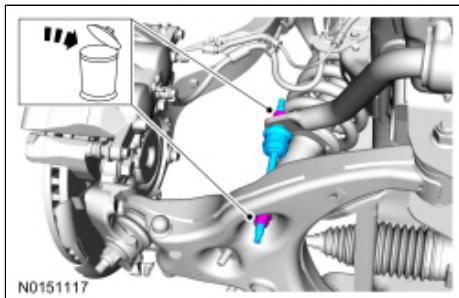
### Removal and Installation

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to [Section 100-02](#).
2. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

On both sides.

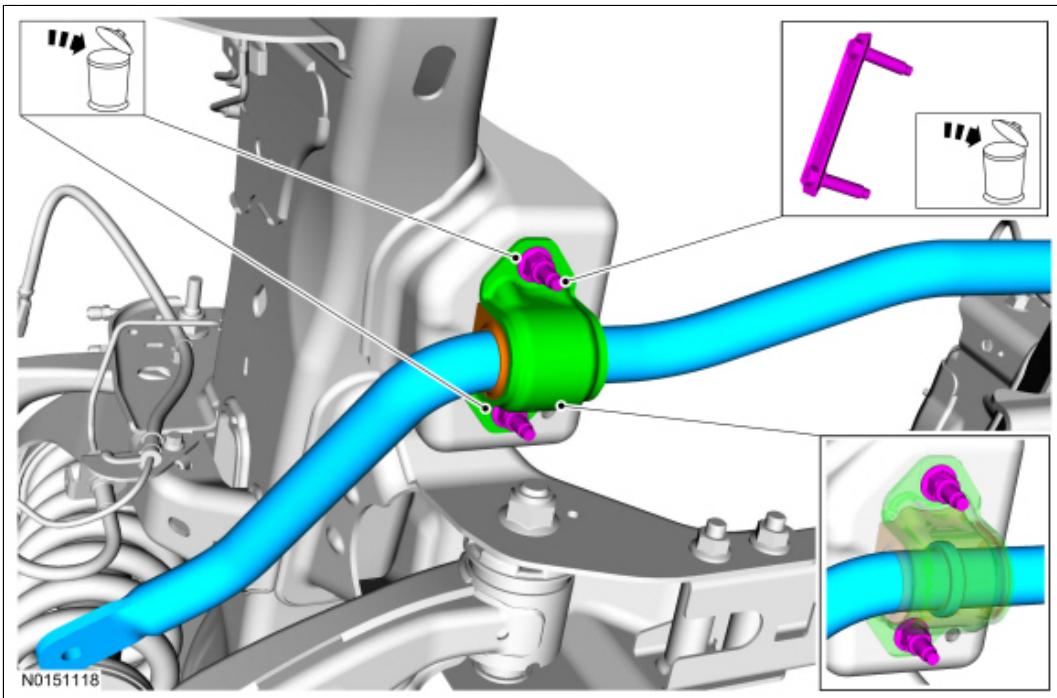
- To install, tighten to 70 Nm (52 lb-ft).



3. **NOTICE:** The raised ring on the stabilizer bar must be encapsulated inside the inner groove of the stabilizer bar bushing on the driver side of the vehicle for proper installation.

On both sides.

- To install, tighten to 63 Nm (46 lb-ft).



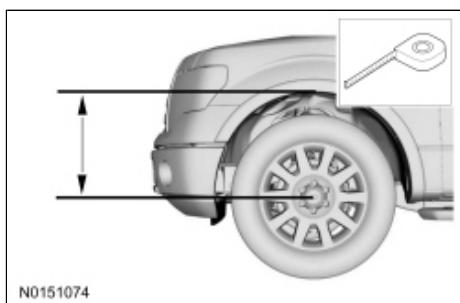
4. Inspect and, if necessary, install new stabilizer bar bushings.
  5. To install, reverse the removal procedure.
-

## Upper Arm

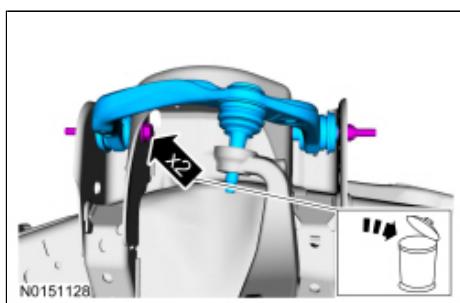
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



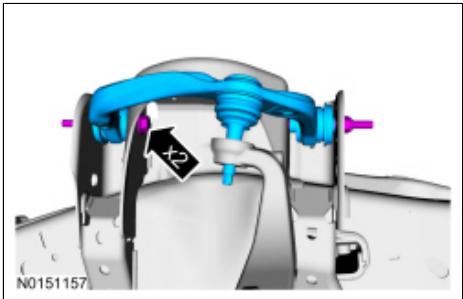
2. Remove the shock absorber and spring assembly. Refer to [Shock Absorber and Spring Assembly](#).
- 3.



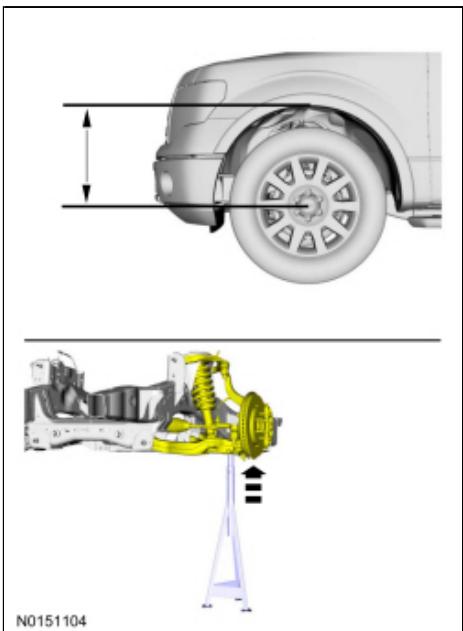
### Installation

1. **NOTICE:** Tighten the suspension bushing fasteners with the suspension loaded or with the weight of the vehicle resting on the wheels and tires, otherwise incorrect clamp load and bushing damage may occur.

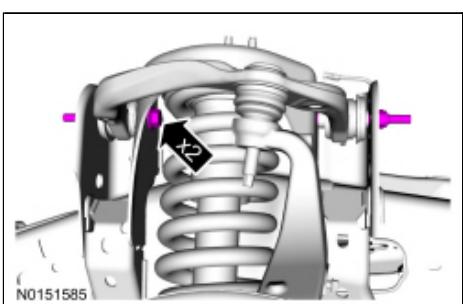
Finger tight at this stage.



2. Install the shock absorber and spring assembly. Refer to [Shock Absorber and Spring Assembly](#).
3. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



4.
  - Tighten to 150 Nm (111 lb-ft).



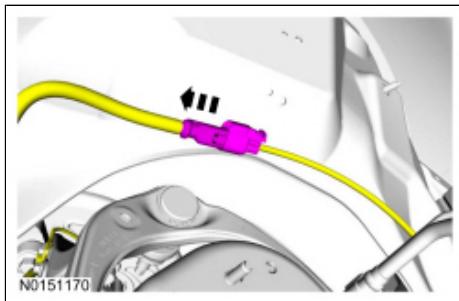


## Wheel Bearing and Wheel Hub

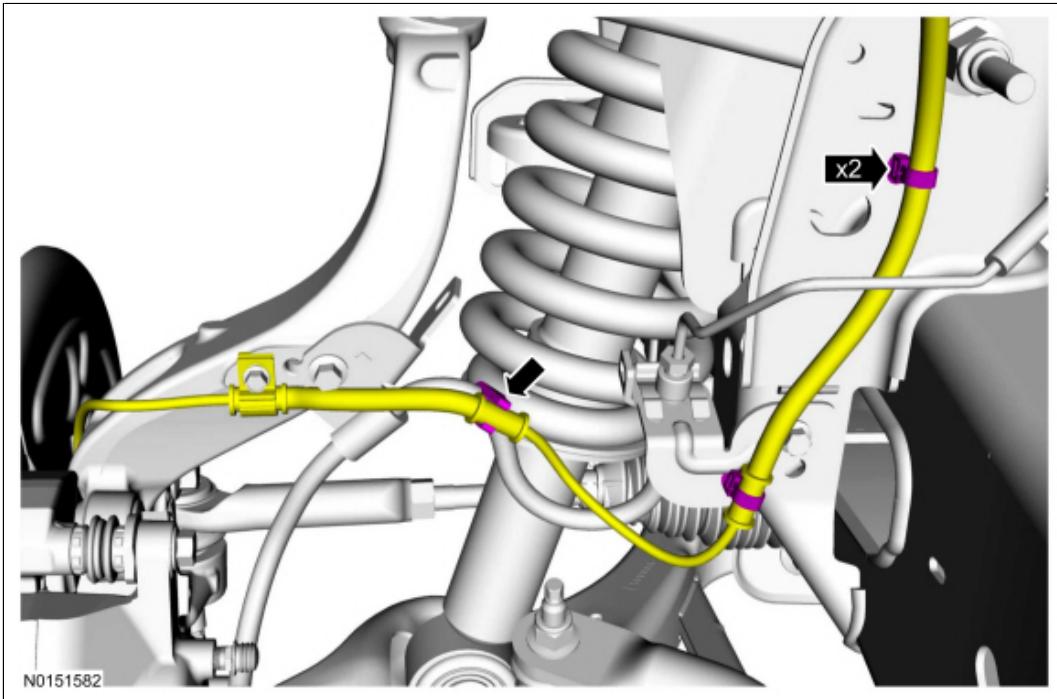
### Removal and Installation

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

1. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.

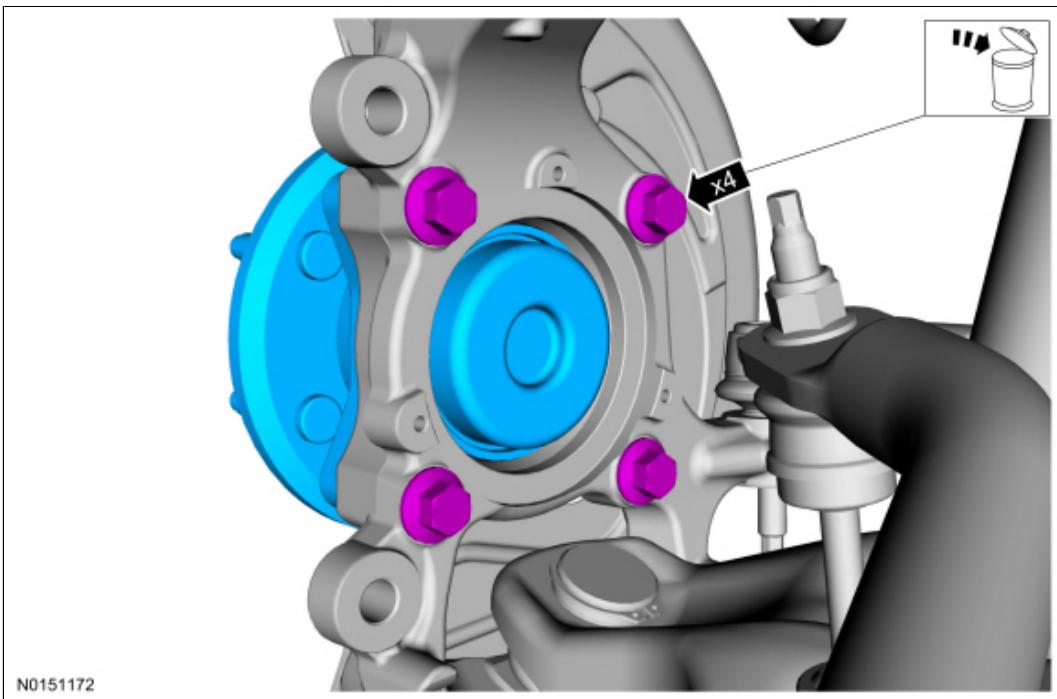


2. Remove the wheel and tire. Refer to [Section 204-04](#).
3.
  - To install, tighten to 12 Nm (106 lb-in).



4. Remove the brake disc. Refer to [Section 206-03](#).

- 5.
- To install, tighten to 175 Nm (129 lb-ft).



6. To install, reverse the removal procedure.

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## Wheel Knuckle

### Special Tool(s)

	Separator, Ball Joint 204-592
---	----------------------------------

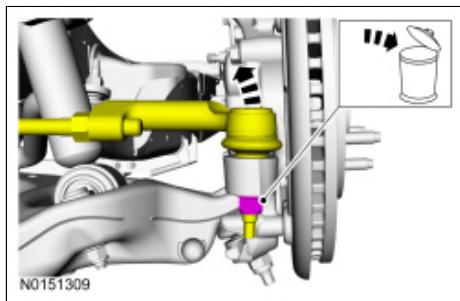
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

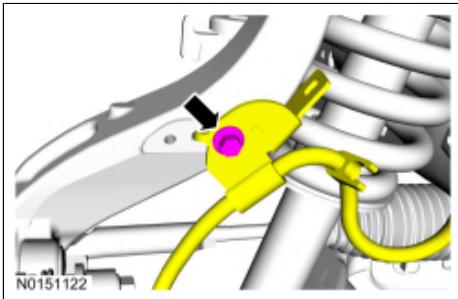
1. Remove the wheel bearing and wheel hub. Refer to [Wheel Bearing and Wheel Hub](#).
2. **NOTICE:** Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.

**NOTICE:** Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.

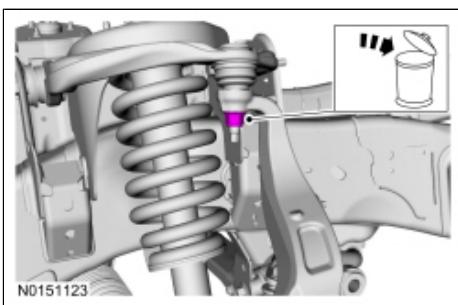
General Equipment: Tie-rod Separator.



- 3.

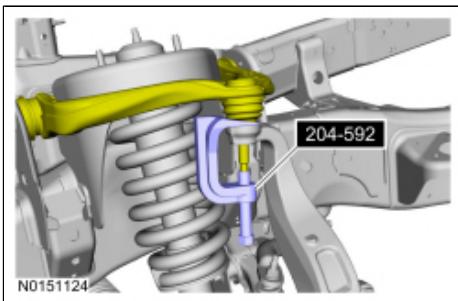


4.

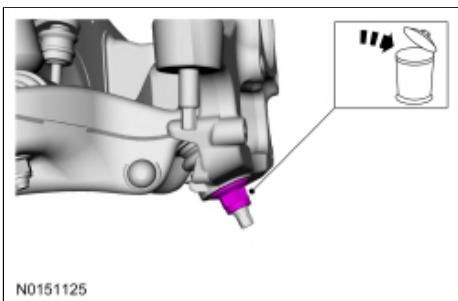


5. **NOTE:** Be sure not to damage the ball joint boot when installing the Ball Joint Separator.

Special Tool(s): Separator, Ball Joint 204-592.



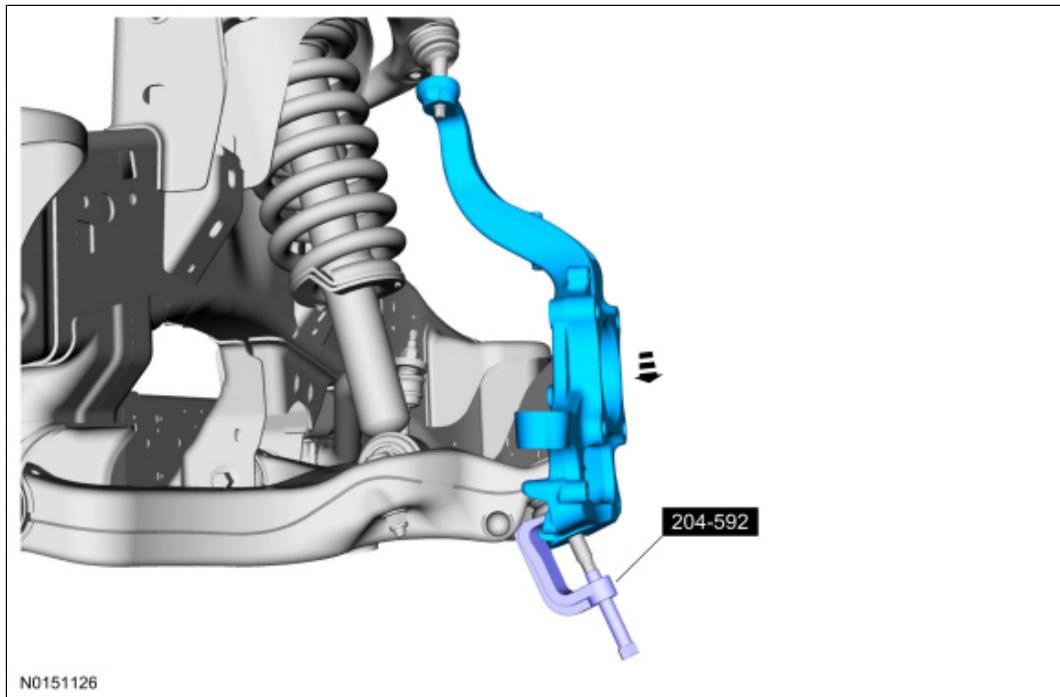
6.



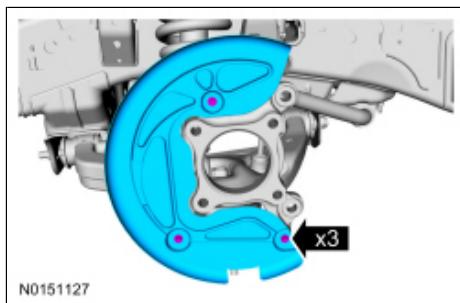
7. **NOTICE:** Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.

**NOTICE:** Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.

Special Tool(s): Separator, Ball Joint 204-592.

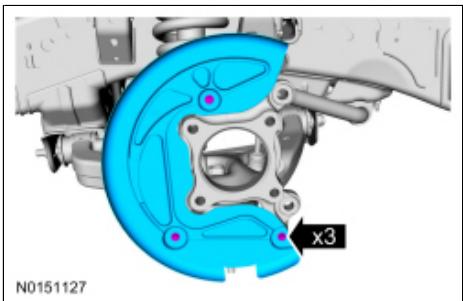


8. If necessary.



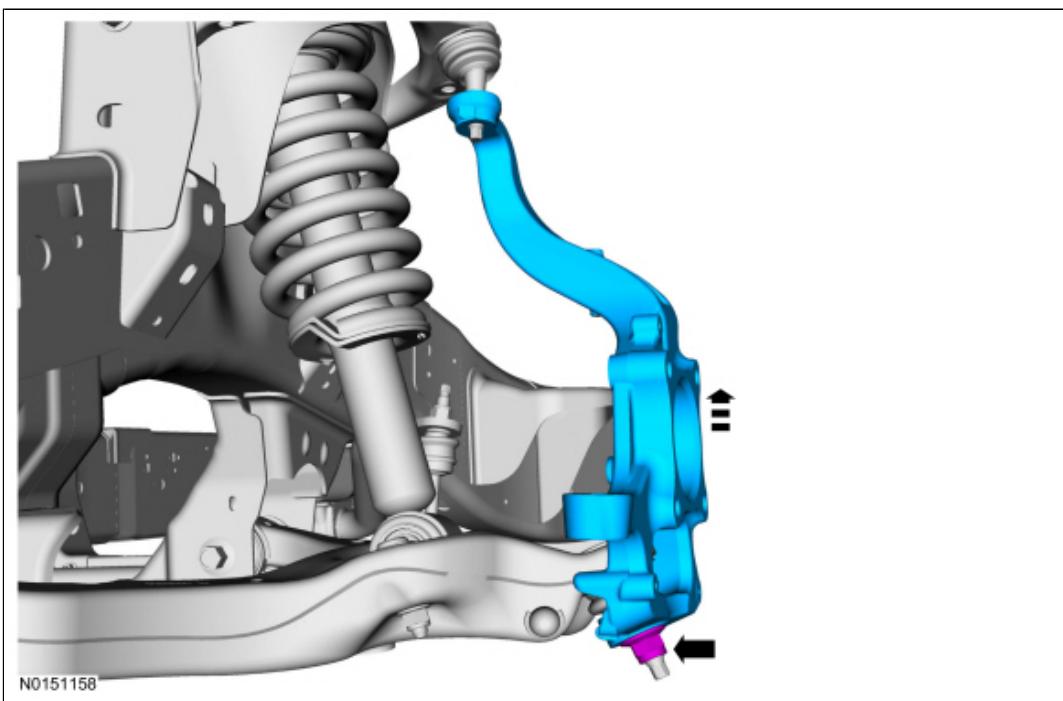
## Installation

1. If necessary.
  - Tighten to 17 Nm (150 lb-in).



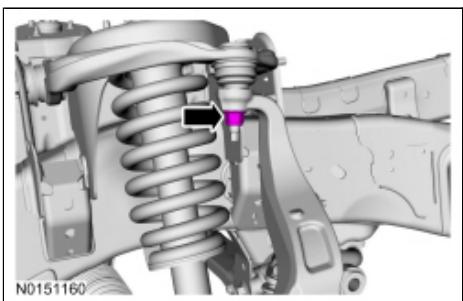
2.

- Tighten to 175 Nm (129 lb-ft).



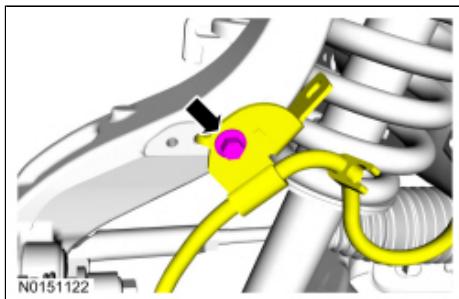
3.

- Tighten to 115 Nm (85 lb-ft).



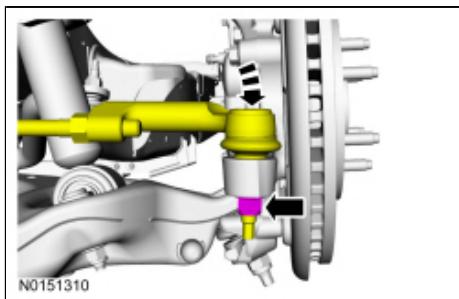
4.

- Tighten to 12 Nm (106 lb-in).



5.

- Tighten to 115 Nm (85 lb-ft).



6. Install the wheel bearing and wheel hub. Refer to [Wheel Bearing and Wheel Hub](#).

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## Wheel Studs

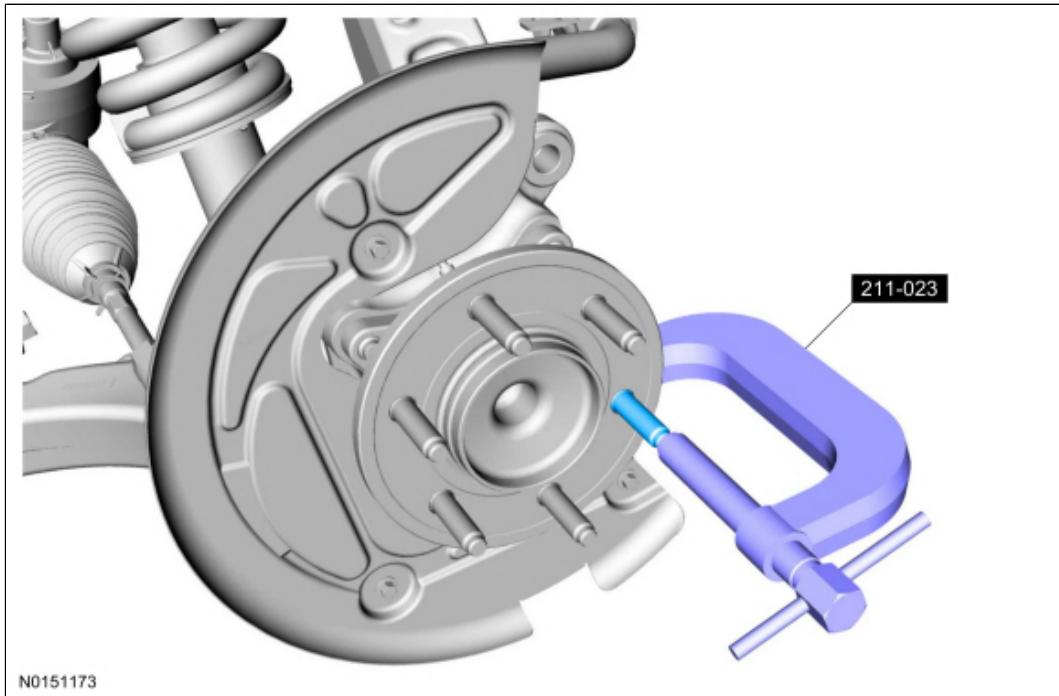
### Special Tool(s)

 ST1494-A	Installer/Remover, C-Frame and Screw 211-023 (T74P-3044-A1)
---	---

### Removal

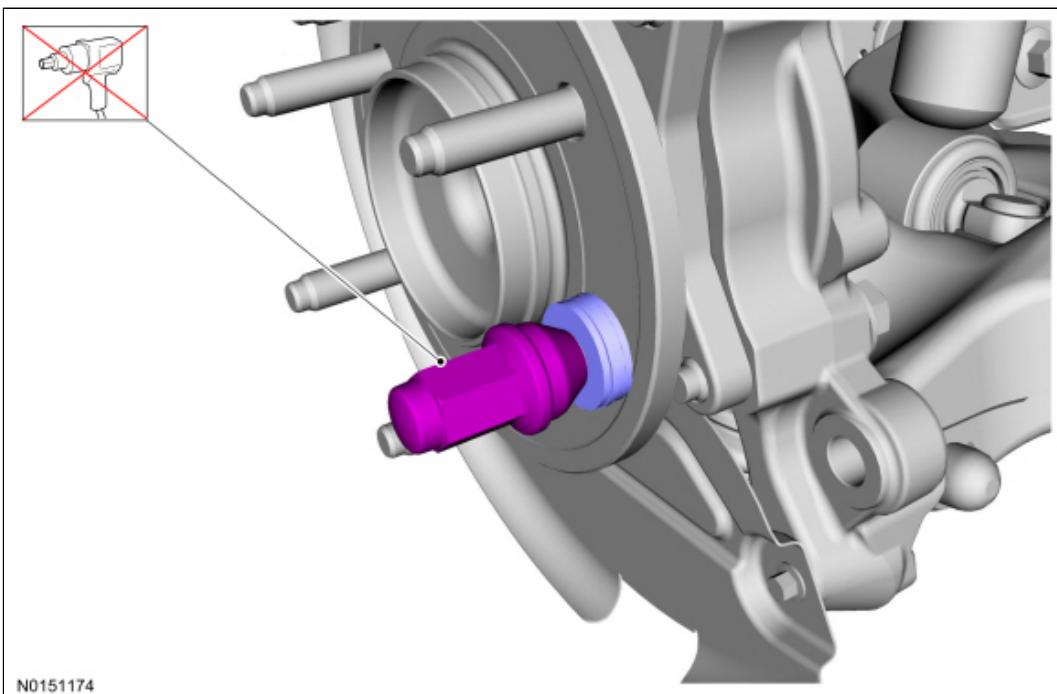
**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

1. Remove the brake disc. Refer to [Section 206-03](#).
2. Special Tool(s): Installer/Remover, C-Frame and Screw 211-023.



### Installation

1. **NOTE:** Make sure to use washers that have an ID that is larger than the OD of the wheel stud serrations. Use enough washers (approximately 3 to 4) to allow the wheel stud to fully seat against the hub flange.
  - Tighten the wheel nut until the wheel stud is seated against the hub flange.
  - Discard the wheel nut.



2. Install the brake disc. Refer to [Section 206-03](#).
-



**Material**

Item	Specification	Fill Capacity
Motorcraft® Metal Brake Parts Cleaner (US) / Motorcraft® Brake Parts Cleaner (Canada) PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—
Motorcraft® Metal Surface Prep ZC-31-A	—	—

**Torque Specifications**

Description	Nm	lb-ft	lb-in
Brake disc shield bolts	17	—	150
Brake hose bracket bolt	12	—	106
Halfshaft nut	40	30	—
Integrated Wheel End (IWE) bolts	12	—	106
Lower arm forward and rearward nuts	350	258	—
Lower ball joint nut	175	129	—
Shock absorber lower nut (SVT Raptor)	550	406	—
Shock absorber lower nuts	90	66	—
Shock absorber upper mount nuts	63	46	—
Shock rod nut	55	41	—
Skid plate bolts	48	35	—
Stabilizer bar bracket nuts	55	41	—
Stabilizer bar link nuts	70	52	—
Stabilizer bar link nuts (SVT Raptor)	80	59	—
Tie-rod end nut	115	85	—
Upper arm-to-frame nuts	150	111	—
Upper ball joint nut	115	85	—
Wheel bearing and wheel hub bolts	175	129	—
Wheel speed sensor bolt	18	—	159
Wheel speed sensor harness bracket bolt	12	—	106



## Front Suspension

The Four-Wheel Drive (4WD) front suspension consists of the following components:

- Ball joints
- Coil springs
- Lower control arms
- Shock absorbers
- Stabilizer bar and links
- Upper control arms
- Wheel bearing and wheel hubs
- Wheel knuckles
- Wheel studs

The vehicle is equipped with a front coil spring suspension. This independent-type front suspension utilizes a stabilizer bar to aid in vehicle stability. The wheel hub and wheel bearing are sealed units and are serviced as an assembly. The lower ball joints can be serviced independently from the lower arm.

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## **Front Suspension**

Refer to [Section 204-00](#).

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## Shock Absorber and Spring Assembly — SVT Raptor

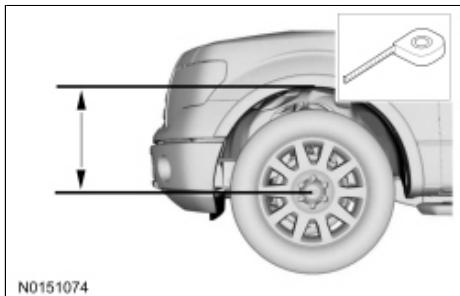
### Special Tool(s)

	Separator, Ball Joint 204-592
ST2945-A	

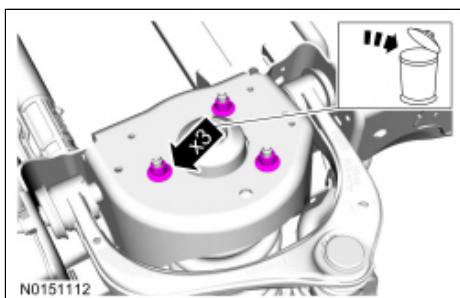
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

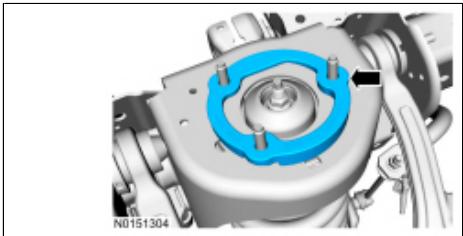
1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



- 2.



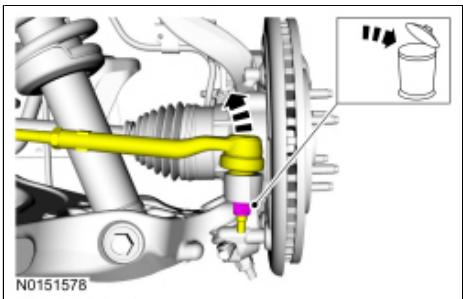
- 3.



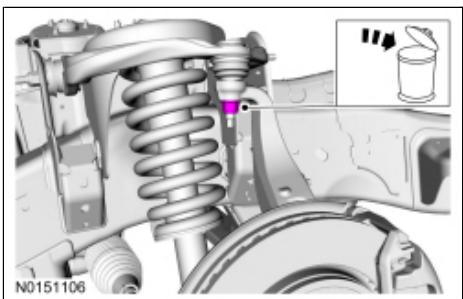
4. Remove the wheel bearing and wheel hub. Refer to [Wheel Bearing and Wheel Hub](#).
5. **NOTICE:** Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.

**NOTICE:** Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.

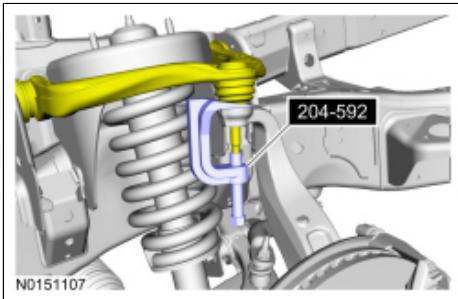
General Equipment: Tie-rod Separator.



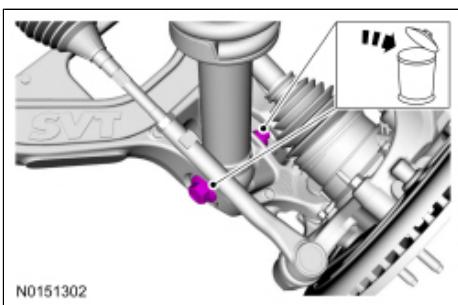
6.



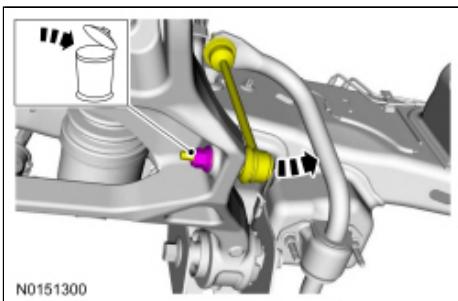
7. Special Tool(s): Separator, Ball Joint 204-592.



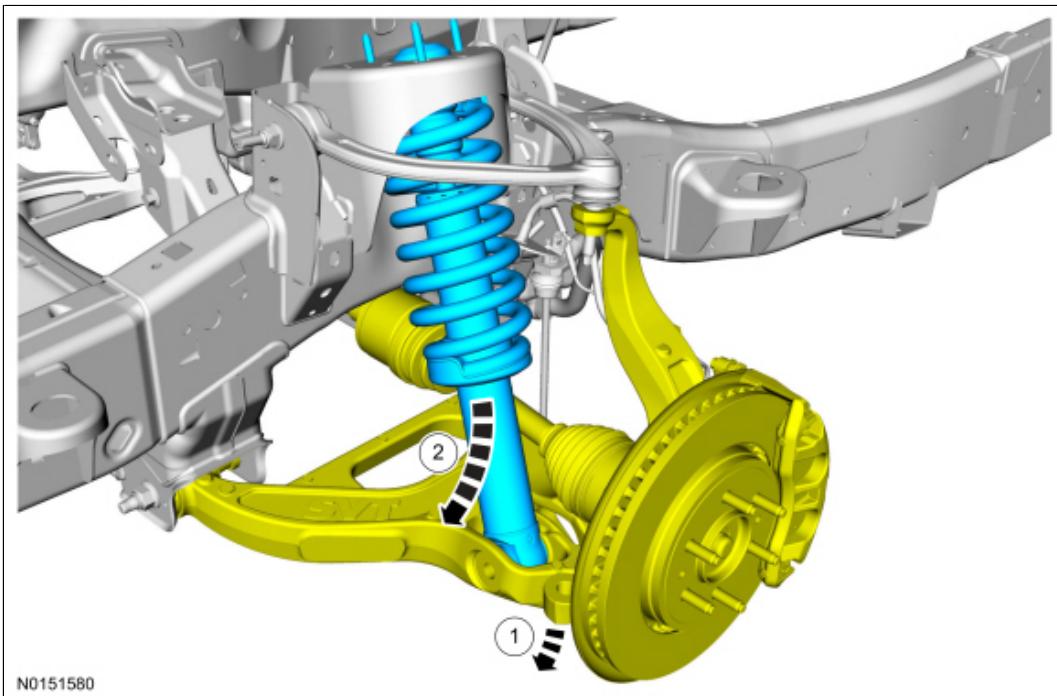
8.



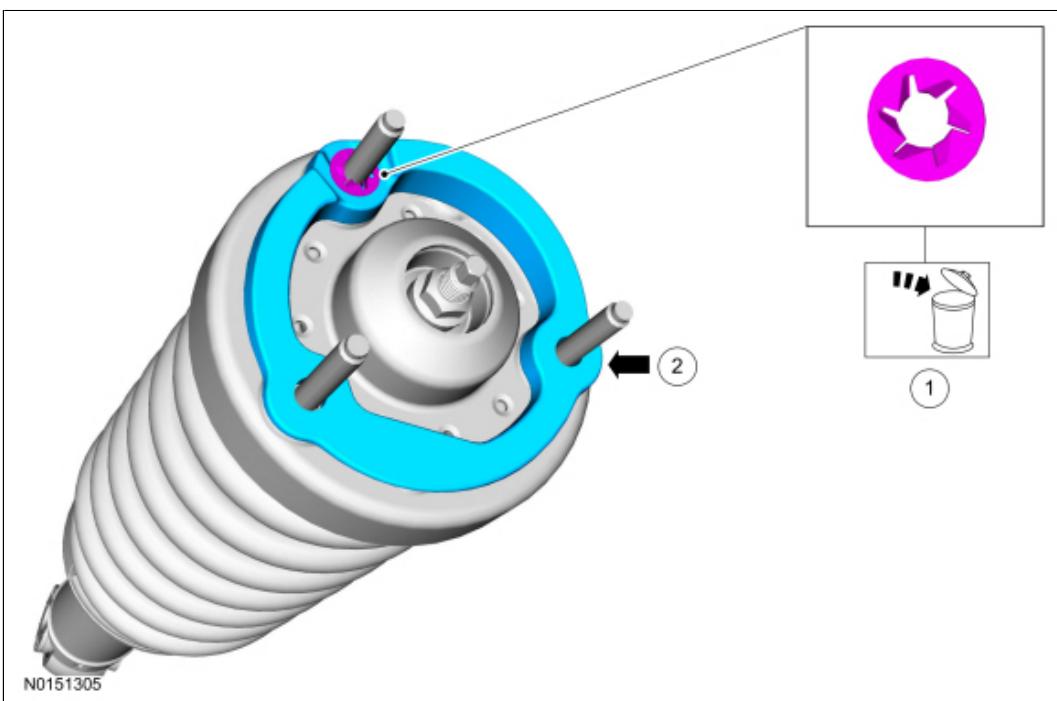
9. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



10. **NOTE:** SVT Raptor similar.



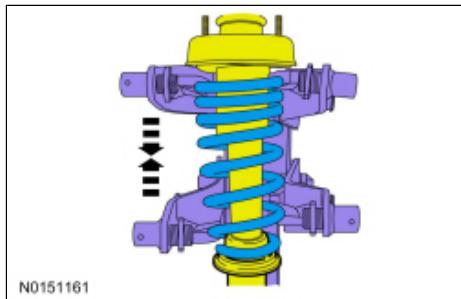
11.



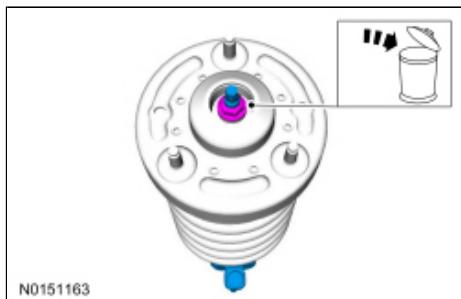
12. **NOTE:** If the individual spring and/or shock components are not being serviced, continue to the installation procedure.

**NOTE:** For reference during assembly, index the upper mount, spring and shock absorber.

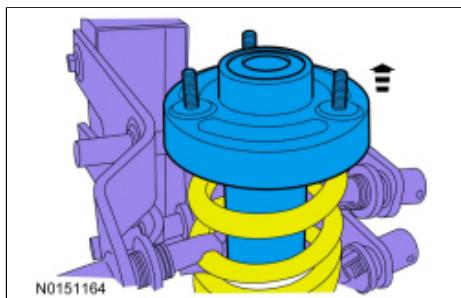
Compress the spring until the tension is released from the shock absorber.  
General Equipment: Spring Compressor.



13. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while removing the nut.

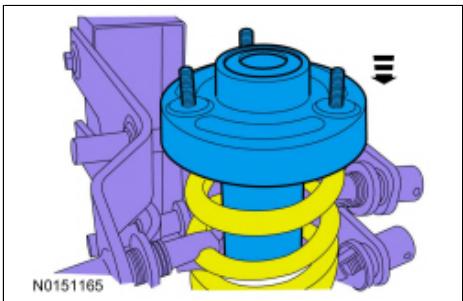


- 14.



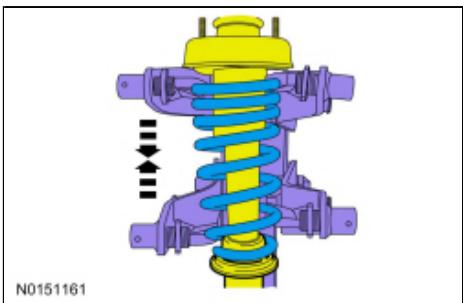
## Installation

- 1.



2. **NOTE:** Align the index marks made during disassembly.

Compress the spring until the tension is released from the shock absorber.  
General Equipment: Spring Compressor.

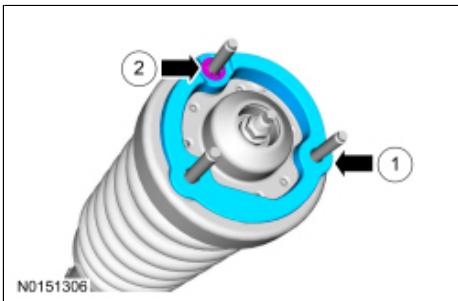


3. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while installing the nut.

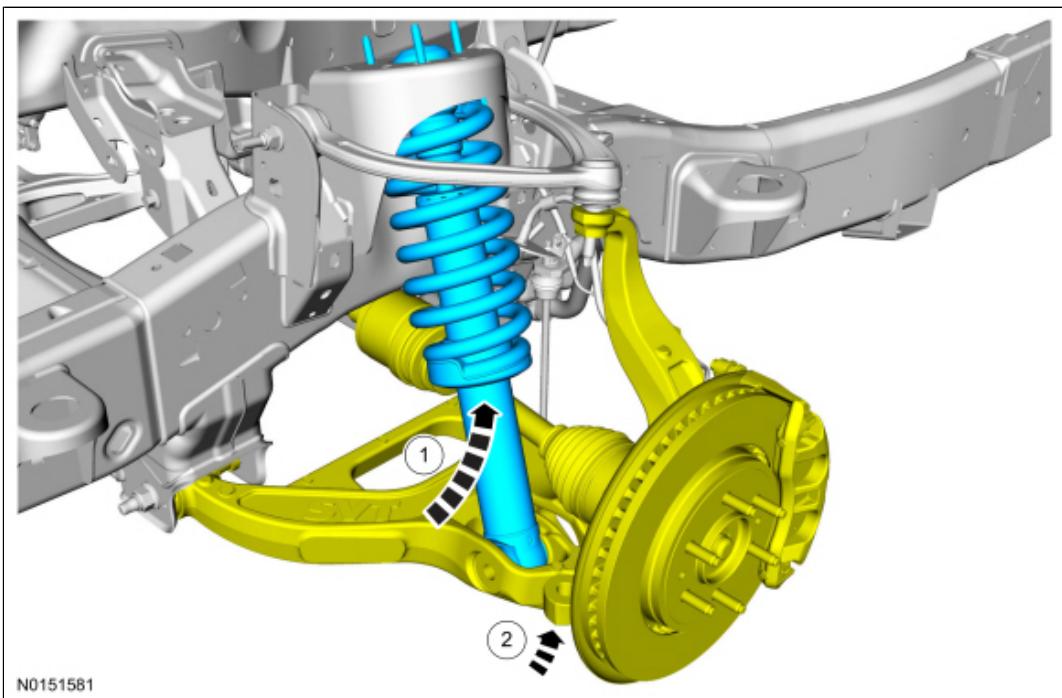
- Tighten to 55 Nm (41 lb-ft).



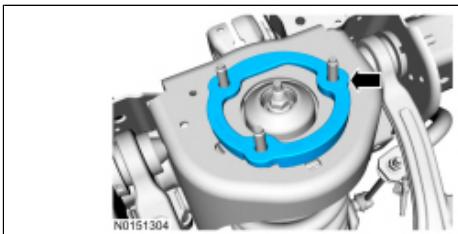
- 4.



5. **NOTE:** SVT Raptor similar

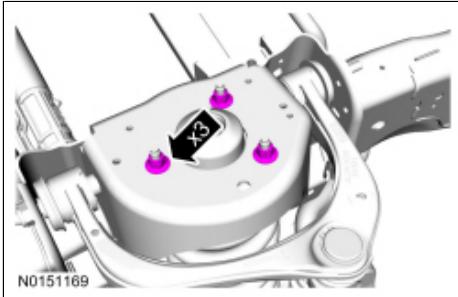


6.



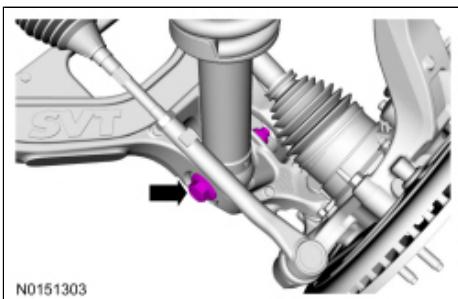
7.

- Tighten to 40 Nm (30 lb-ft).



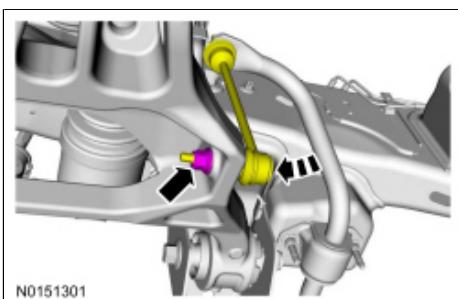
8. **NOTICE:** SVT Raptor: Do not tighten the lower shock nut until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies or incorrect clamp load and bushing damage may occur.

Finger tight at this stage.



9. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

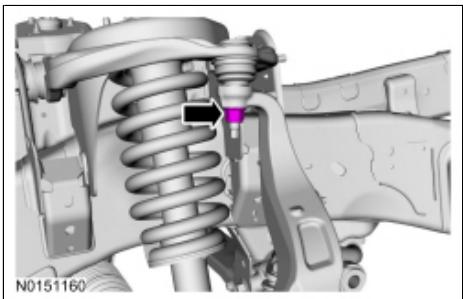
- Tighten to 80 Nm (59 lb-ft).



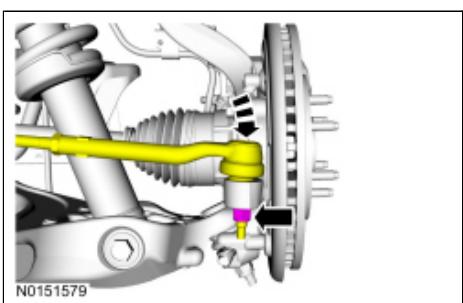
10. Install the wheel bearing and wheel hub. Refer to [Wheel Bearing and Wheel Hub](#).

- 11.

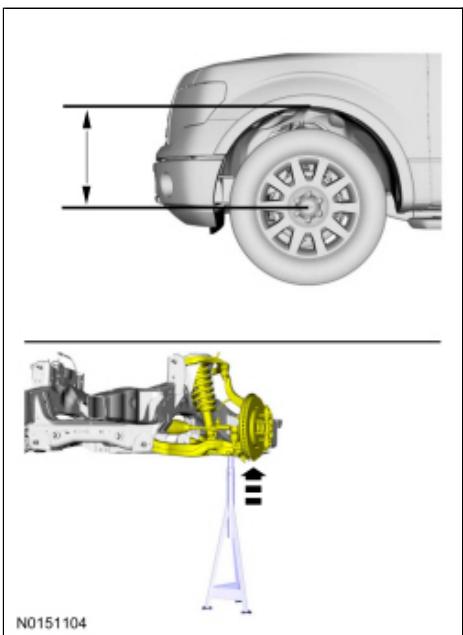
- Tighten to 115 Nm (85 lb-ft).



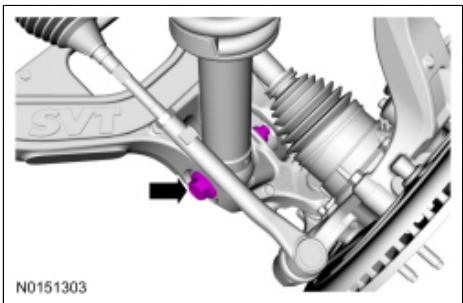
- 12.
- Tighten to 115 Nm (85 lb-ft).



13. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



- 14.
- Tighten to 550 Nm (406 lb-ft).

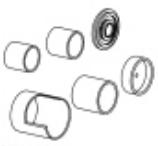


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N0151303

## Ball Joint — Lower

### Special Tool(s)

 ST2929-A	Installer/Remover, Ball Joint 204-358
 ST1172-A	Installer/Remover, C-Frame and Screw 205-086

### Material

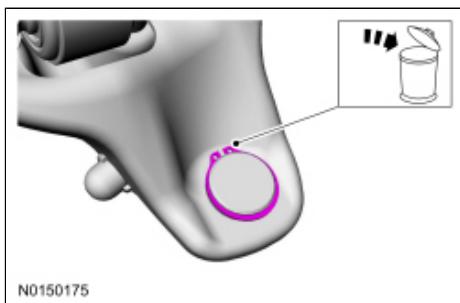
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—

### Removal

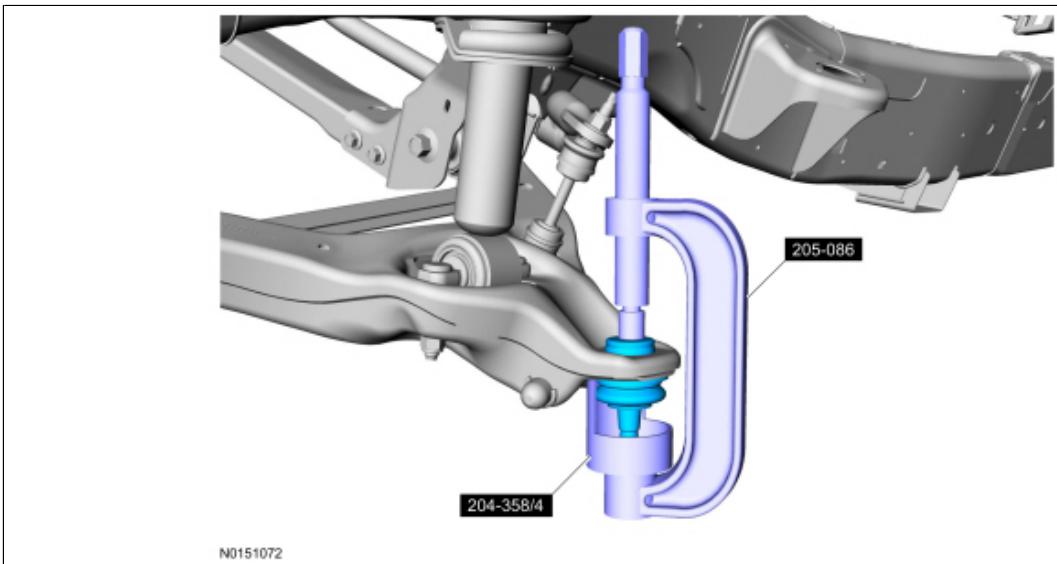
#### All vehicles

1. Remove the wheel knuckle. Refer to [Wheel Knuckle](#).

2.

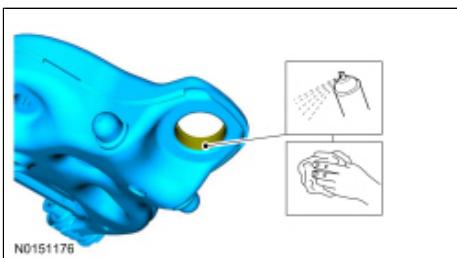


3. Special Tool(s): Installer/Remover, C-Frame and Screw 205-086. Remover, Ball Joint 204-358/4.

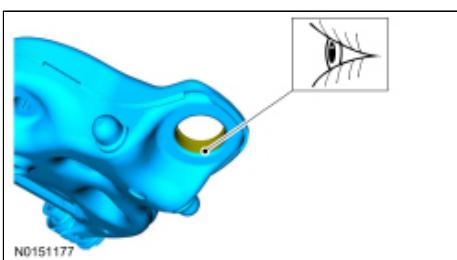


### SVT Raptor

4. Materials: Motorcraft® Metal Surface Prep ZC-31-A.



5. **NOTICE:** If there is evidence of cracks or damage, a new lower arm must be installed.



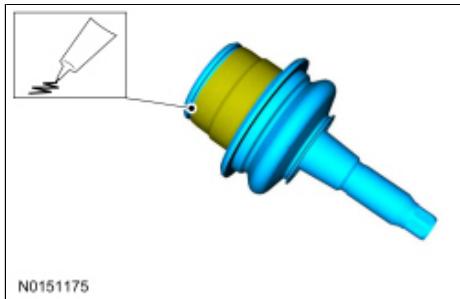
### Installation

#### SVT Raptor

1. **NOTICE:** Use care to prevent adhesive from contacting the ball joint boot or damage to the boot may occur, causing premature ball joint failure.

**NOTE:** To allow the adhesive to fully cure, the vehicle must not be driven on the road for at least one hour after the installation of a new ball joint.

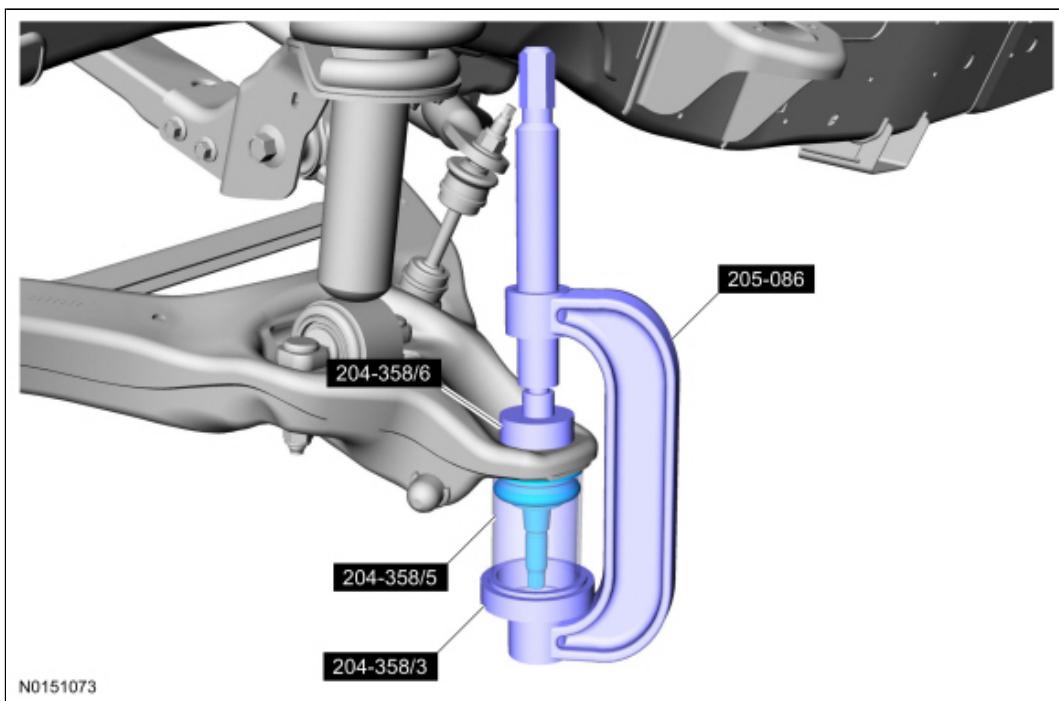
Materials: Adhesive (supplied with kit).



#### All vehicles

2. **NOTICE:** Do not damage the lower ball joint boot when installing the C-Frame and Screw Installer/Remover and Ball Joint Installer/Remover or premature failure of the ball joint may occur.

Special Tool(s): Installer/Remover, C-Frame and Screw 205-086. Remover, Ball Joint 204-358/3. Remover, Ball Joint 204-358/5. Remover, Ball Joint 204-358/6.



3. **NOTE:** Make sure the ball joint snap ring is fully seated.



#### **SVT Raptor**

4. Using a clean shop towel and the specified surface cleaner, wipe any excess adhesive from the ball joint and lower arm.

#### **All vehicles**

5. Install the wheel knuckle. Refer to [Wheel Knuckle](#).
-

## Lower Arm

### Special Tool(s)

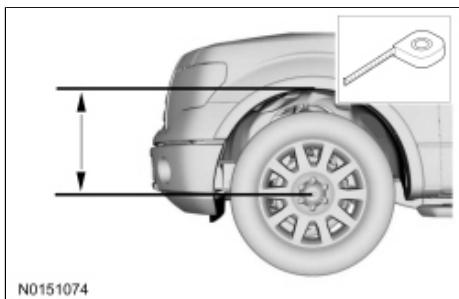
 ST2945-A	Separator, Ball Joint 204-592
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### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

#### All vehicles

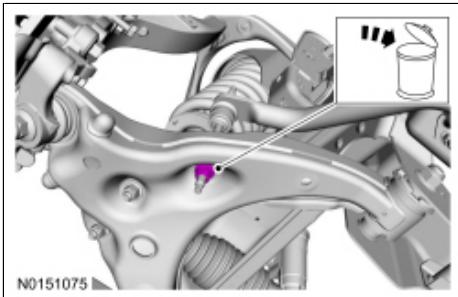
1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



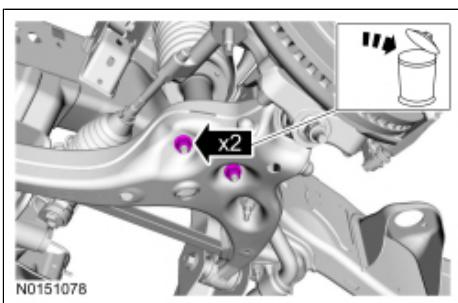
2. Remove the wheel and tire. Refer to [Section 204-04](#).

#### All except SVT Raptor

3. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

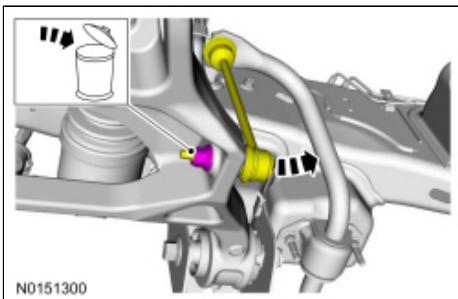


4.

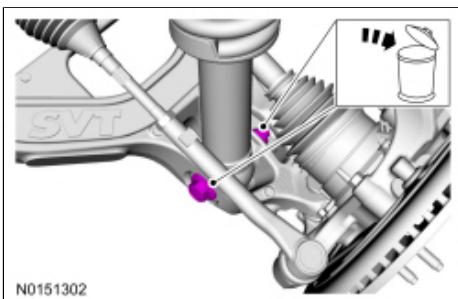


#### SVT Raptor

5. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

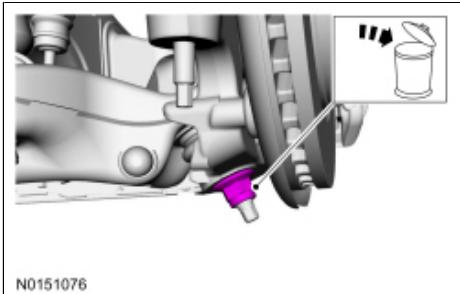


6.



#### All vehicles

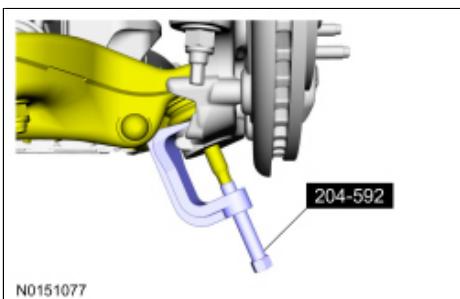
7.



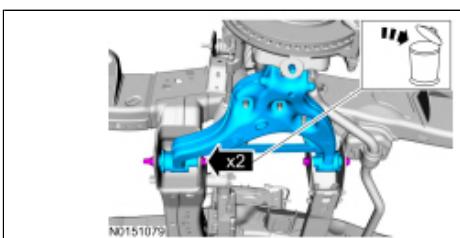
8. **NOTICE:** Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.

**NOTICE:** Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.

Special Tool(s): Separator, Ball Joint 204-592.



9.



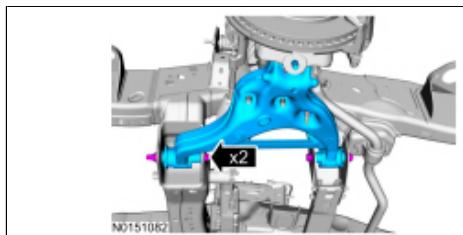
## Installation

### All vehicles

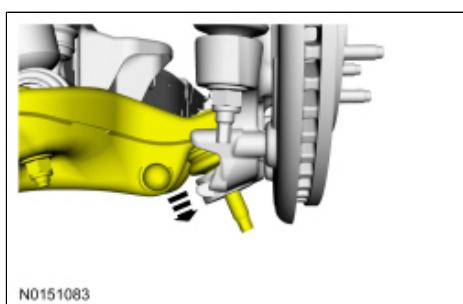
**NOTICE: SVT Raptor:** Do not tighten the shock absorber lower nut, lower arm forward nut or lower arm rearward nut until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies.

1. **NOTICE:** Tighten the suspension bushing fasteners with the suspension loaded or with the weight of the vehicle resting on the wheels and tires, otherwise incorrect clamp load and bushing damage may occur.

Finger tight at this stage.

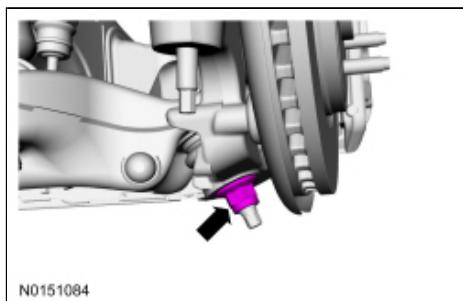


2.



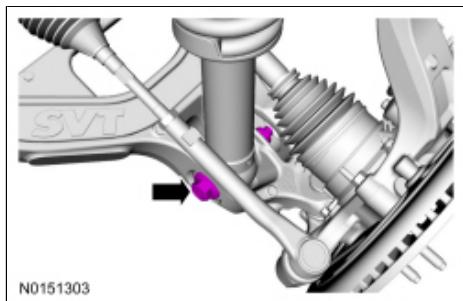
3.

- Tighten to 175 Nm (129 lb-ft).



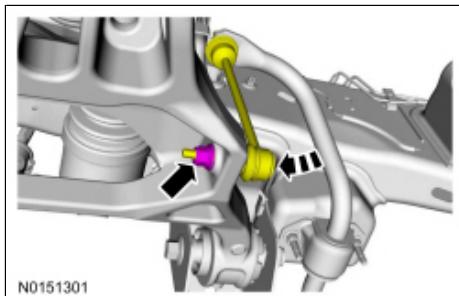
### SVT Raptor

4. Finger tight at this stage.



5. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

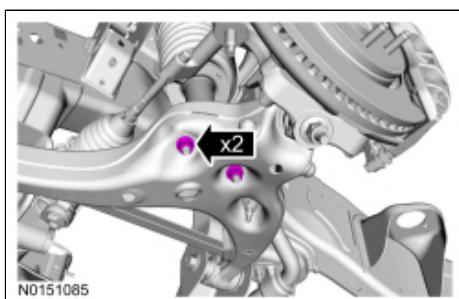
- Tighten to 80 Nm (59 lb-ft).



#### All except SVT Raptor

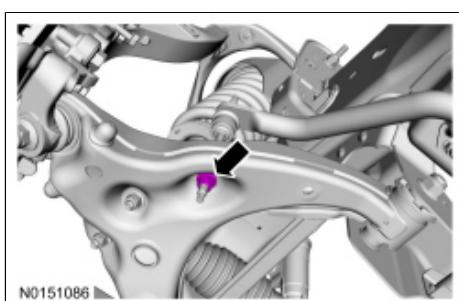
6.

- Tighten to 90 Nm (66 lb-ft).



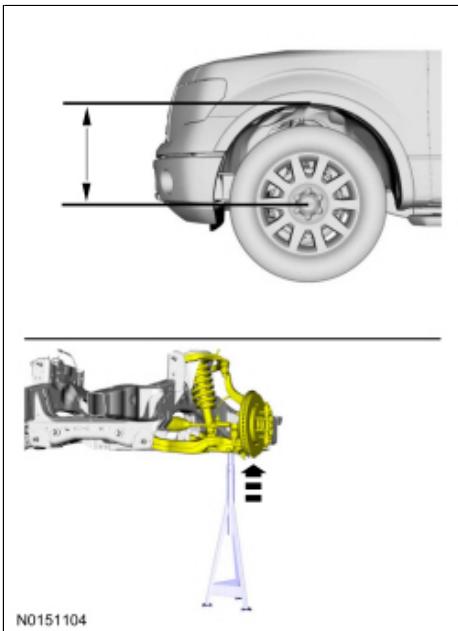
7. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

- Tighten to 70 Nm (52 lb-ft).



#### All vehicles

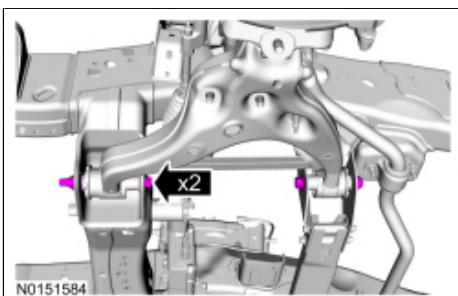
8. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



N0151104

9.

- Tighten to 350 Nm (258 lb-ft).

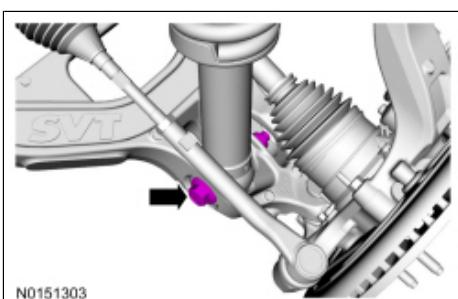


N0151584

#### SVT Raptor

10.

- Tighten to 550 Nm (406 lb-ft).



N0151303

#### All vehicles

11. Install the wheel and tire. Refer to [Section 204-04](#).
  12. Check and, if necessary, align the front end. Refer to [Section 204-00](#).
-

## Shock Absorber and Spring Assembly — SVT Raptor

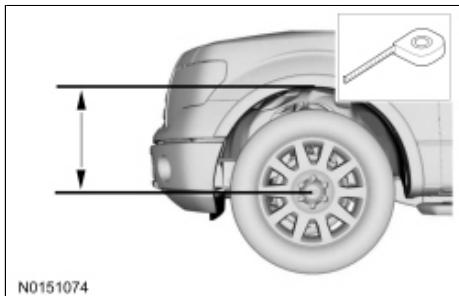
### Special Tool(s)

	Separator, Ball Joint 204-592
ST2945-A	

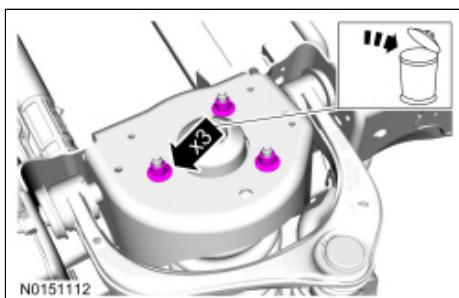
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



- 2.



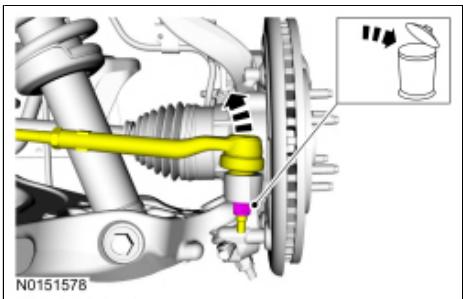
- 3.



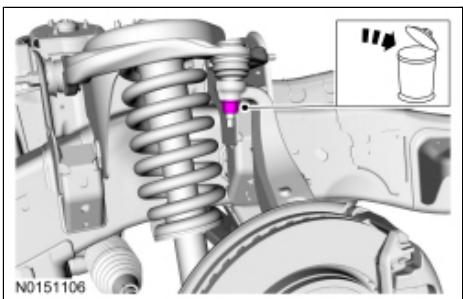
4. Remove the wheel bearing and wheel hub. Refer to [Wheel Bearing and Wheel Hub](#).
5. **NOTICE:** Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.

**NOTICE:** Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.

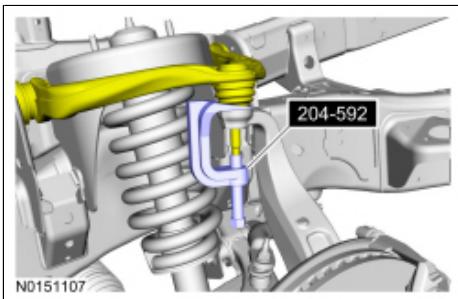
General Equipment: Tie-rod Separator.



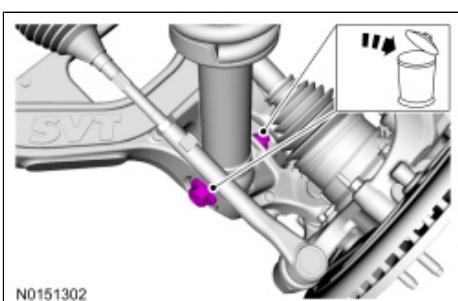
6.



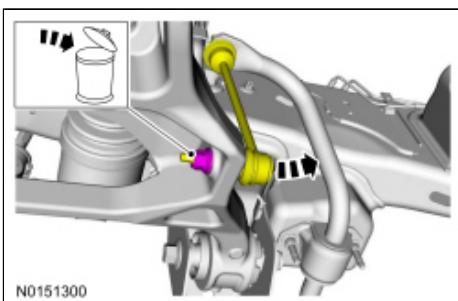
7. Special Tool(s): Separator, Ball Joint 204-592.



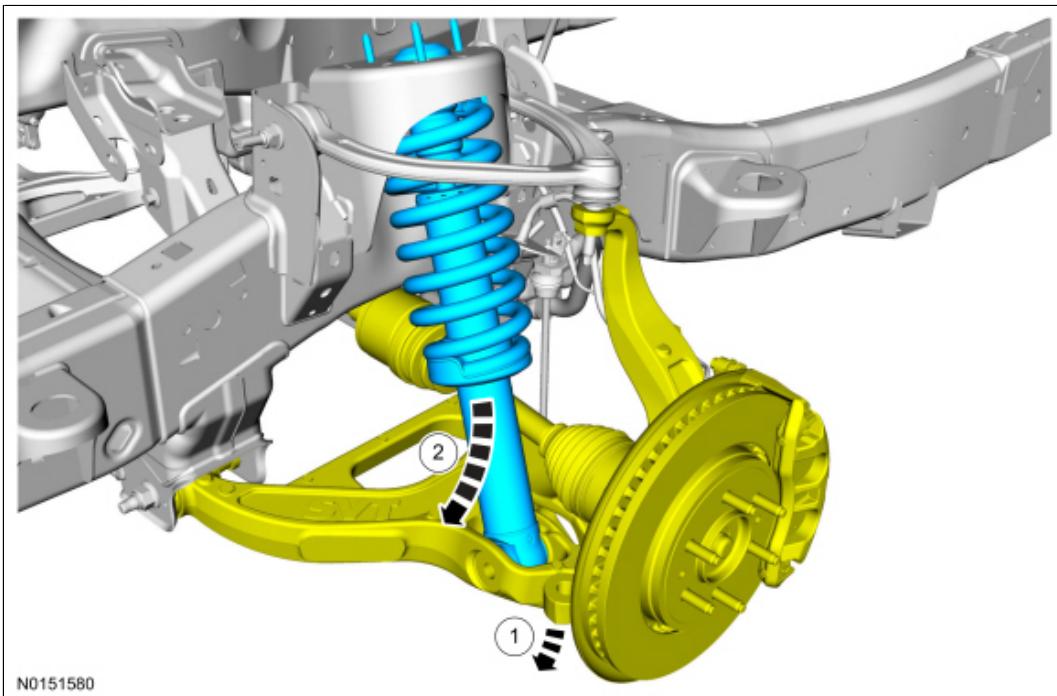
8.



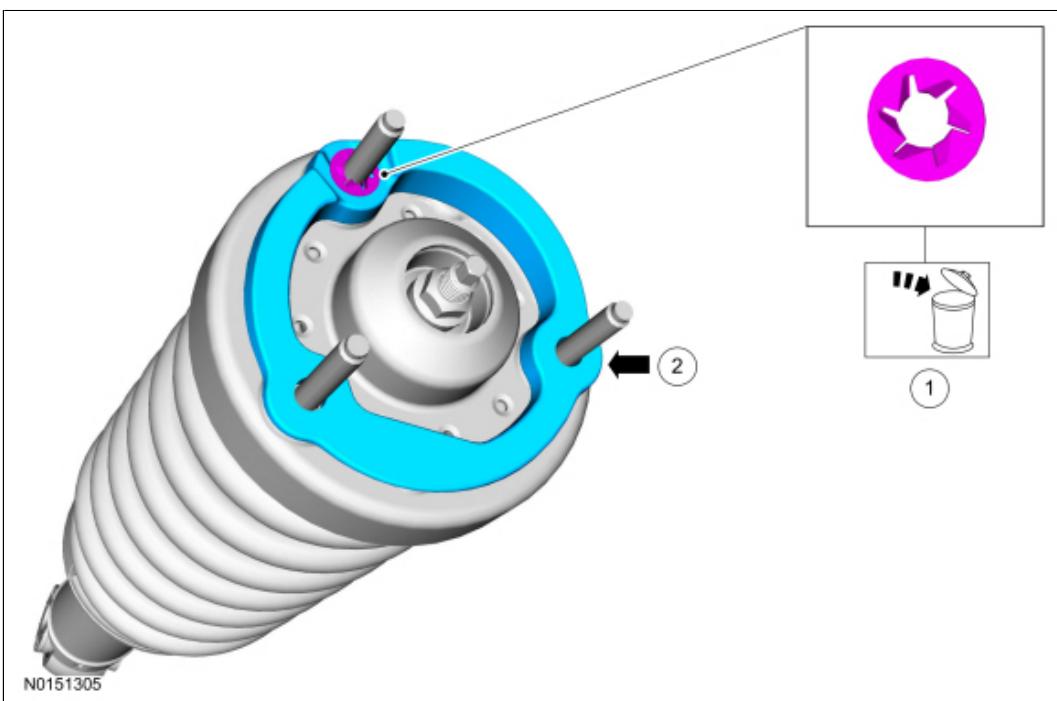
9. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



10. **NOTE:** SVT Raptor similar.



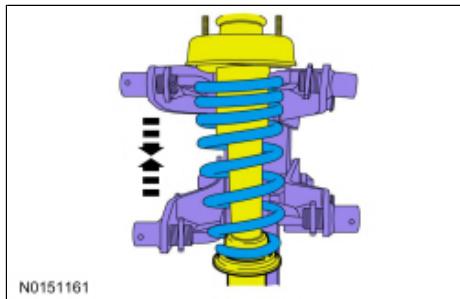
11.



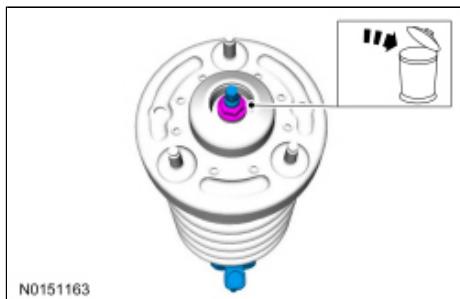
12. **NOTE:** If the individual spring and/or shock components are not being serviced, continue to the installation procedure.

**NOTE:** For reference during assembly, index the upper mount, spring and shock absorber.

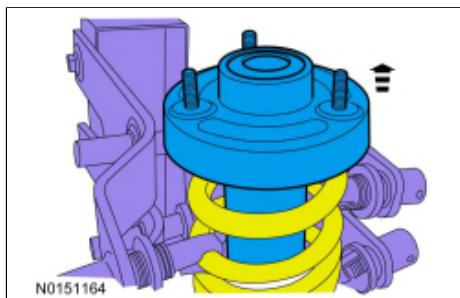
Compress the spring until the tension is released from the shock absorber.  
General Equipment: Spring Compressor.



13. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while removing the nut.

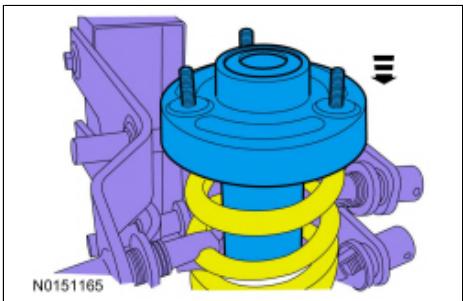


- 14.



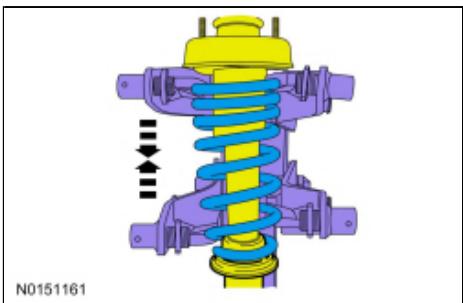
## Installation

- 1.



2. **NOTE:** Align the index marks made during disassembly.

Compress the spring until the tension is released from the shock absorber.  
General Equipment: Spring Compressor.

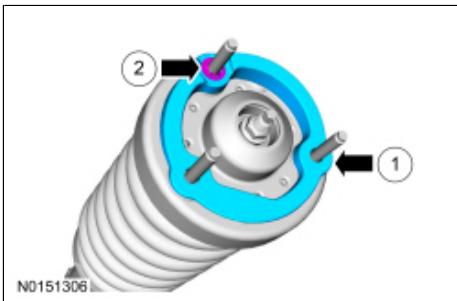


3. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while installing the nut.

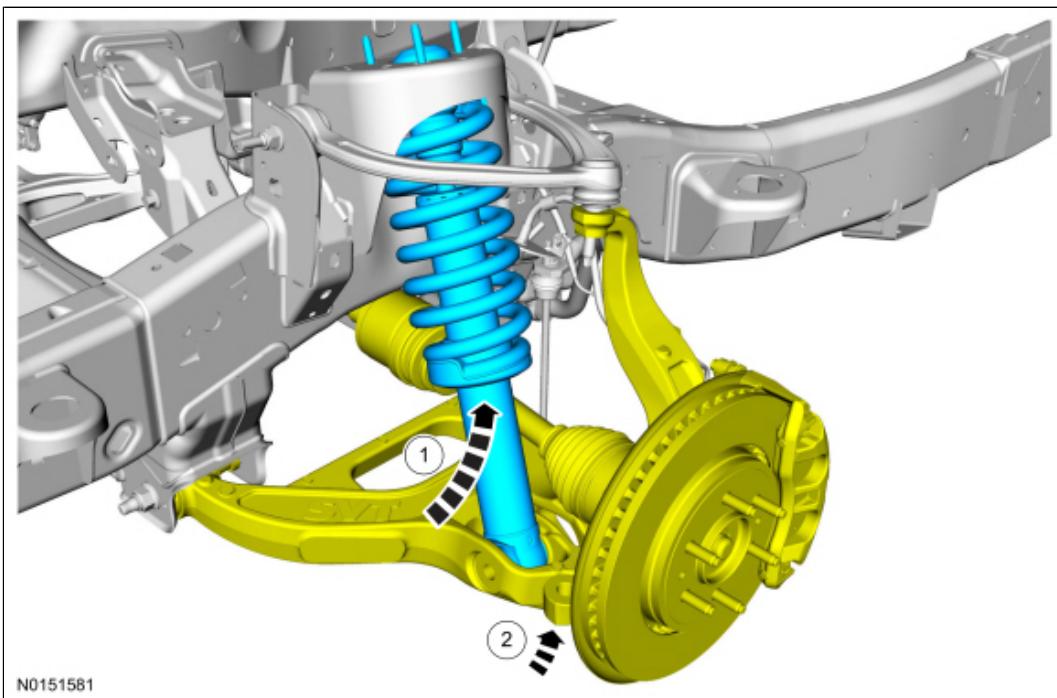
- Tighten to 55 Nm (41 lb-ft).



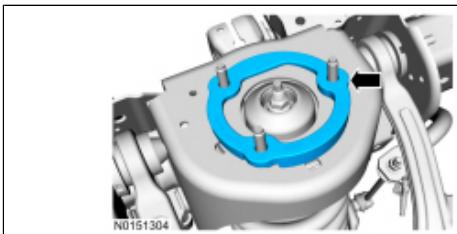
- 4.



5. **NOTE:** SVT Raptor similar

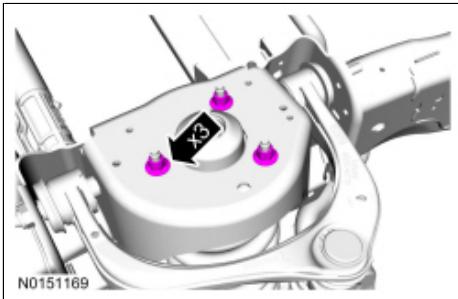


6.



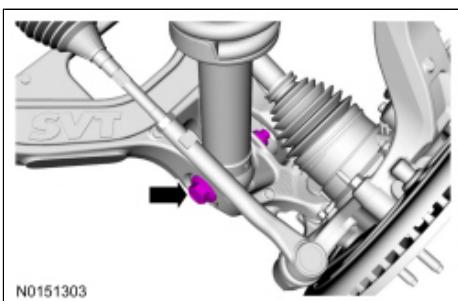
7.

- Tighten to 40 Nm (30 lb-ft).



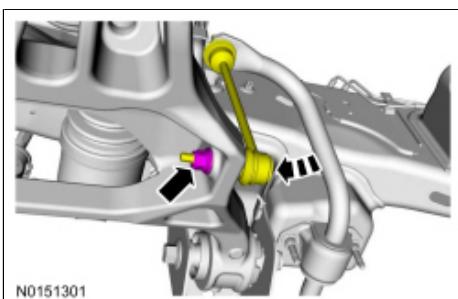
8. **NOTICE:** SVT Raptor: Do not tighten the lower shock nut until the installation procedure is complete and the weight of the vehicle is resting on the wheel and tire assemblies or incorrect clamp load and bushing damage may occur.

Finger tight at this stage.



9. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

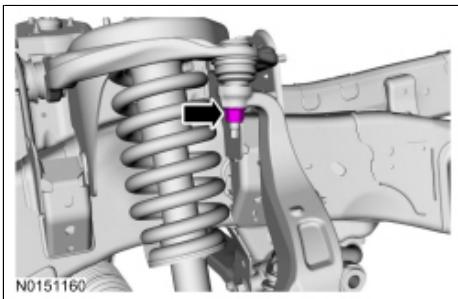
- Tighten to 80 Nm (59 lb-ft).



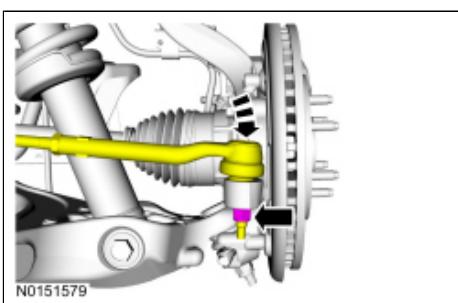
10. Install the wheel bearing and wheel hub. Refer to [Wheel Bearing and Wheel Hub](#).

- 11.

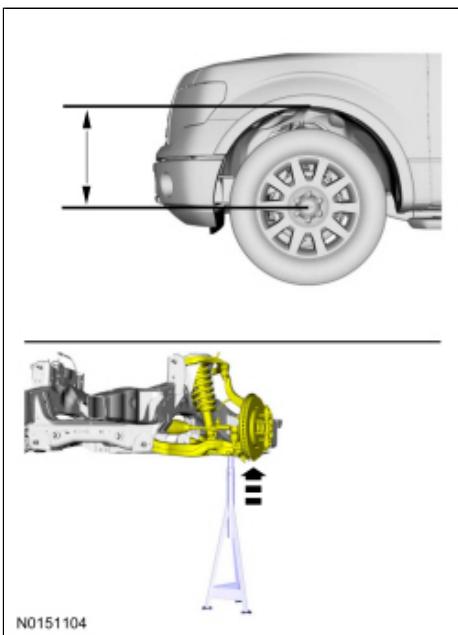
- Tighten to 115 Nm (85 lb-ft).



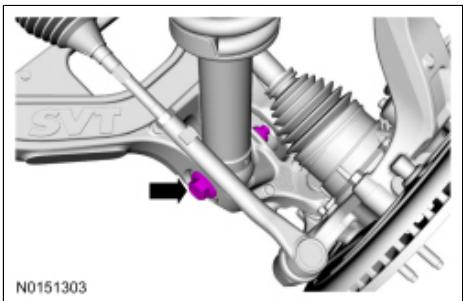
- 12.
- Tighten to 115 Nm (85 lb-ft).



13. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



- 14.
- Tighten to 550 Nm (406 lb-ft).



## Shock Absorber and Spring Assembly

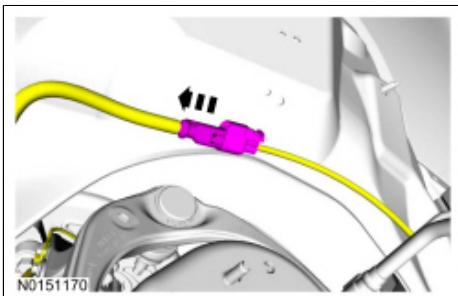
### Special Tool(s)

 ST2945-A	Separator, Ball Joint 204-592
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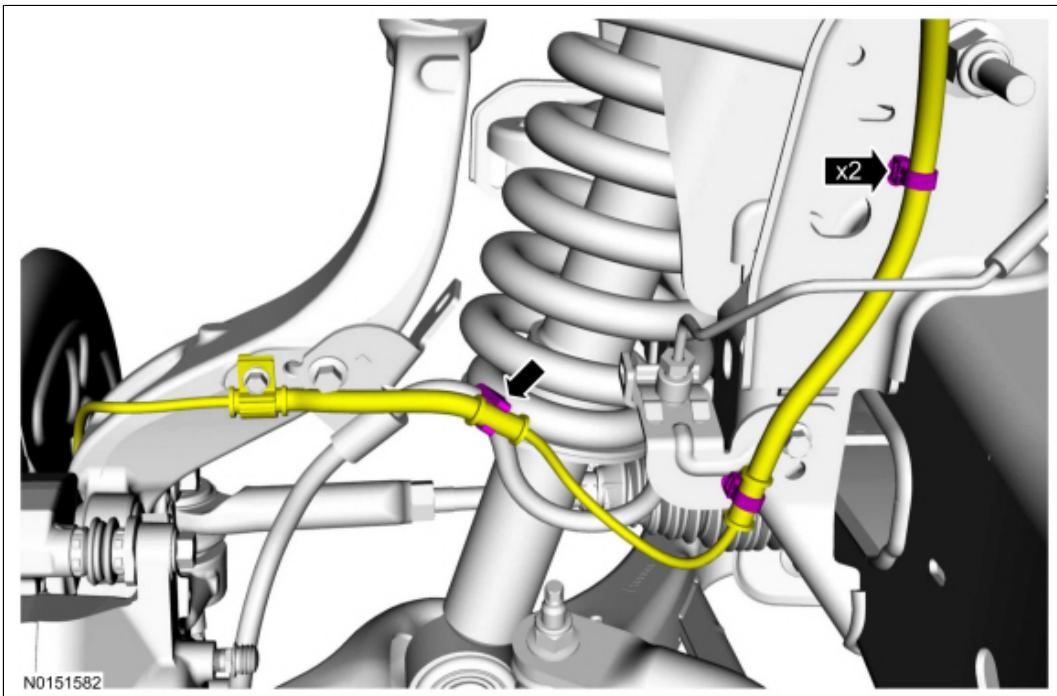
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

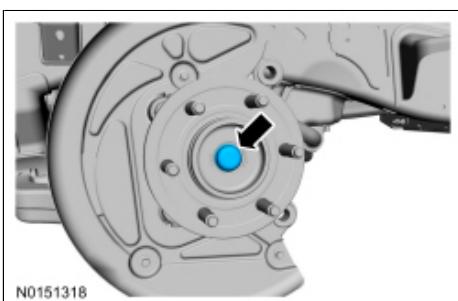
1. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.



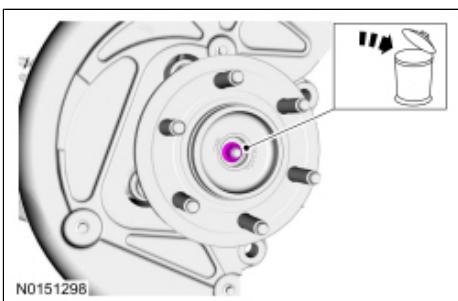
2. Remove the brake disc. Refer to [Section 206-03](#).
- 3.



4.



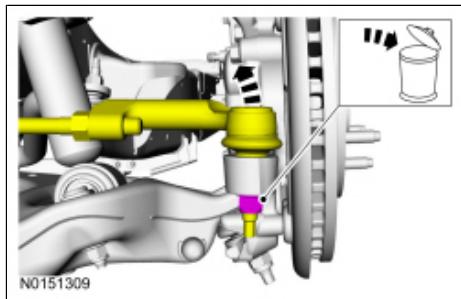
5.



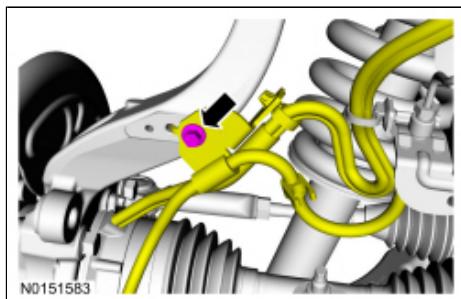
6. **NOTICE:** Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.

**NOTICE:** Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.

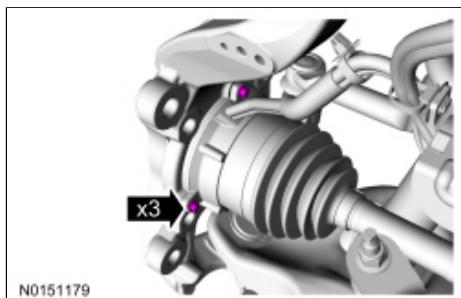
General Equipment: Tie-rod Separator.



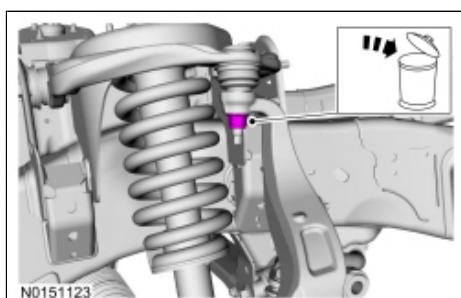
7.



8.

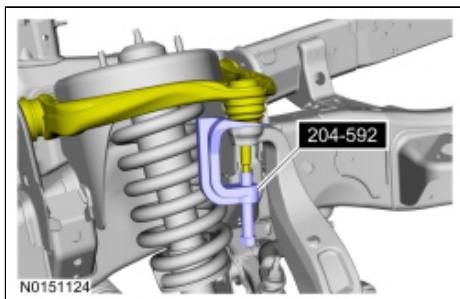


9.

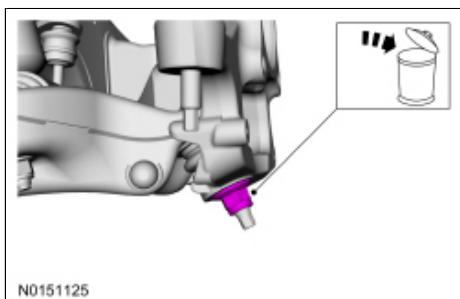


10. **NOTE:** Be sure not to damage the ball joint boot when installing the Ball Joint Separator.

Special Tool(s): Separator, Ball Joint 204-592.



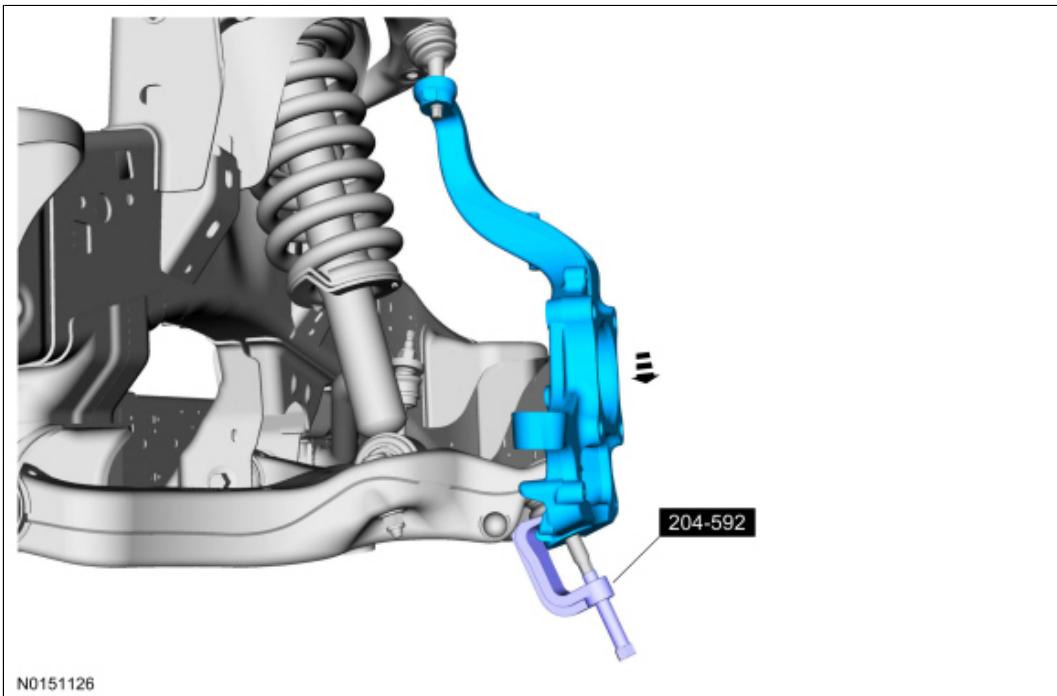
- 11.



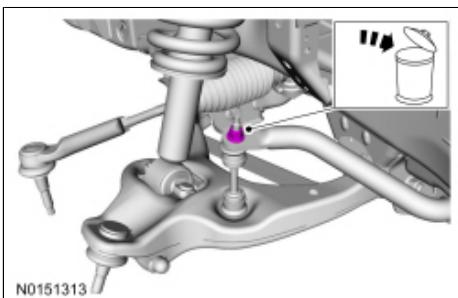
12. **NOTICE:** Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.

**NOTICE:** Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.

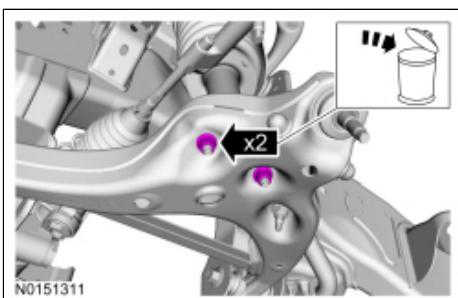
Special Tool(s): Separator, Ball Joint 204-592.



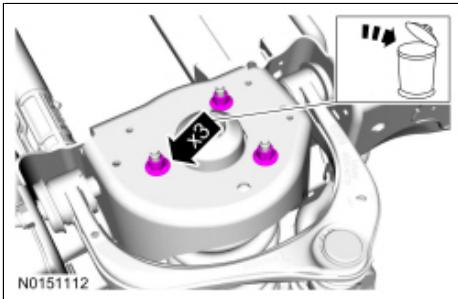
13. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.



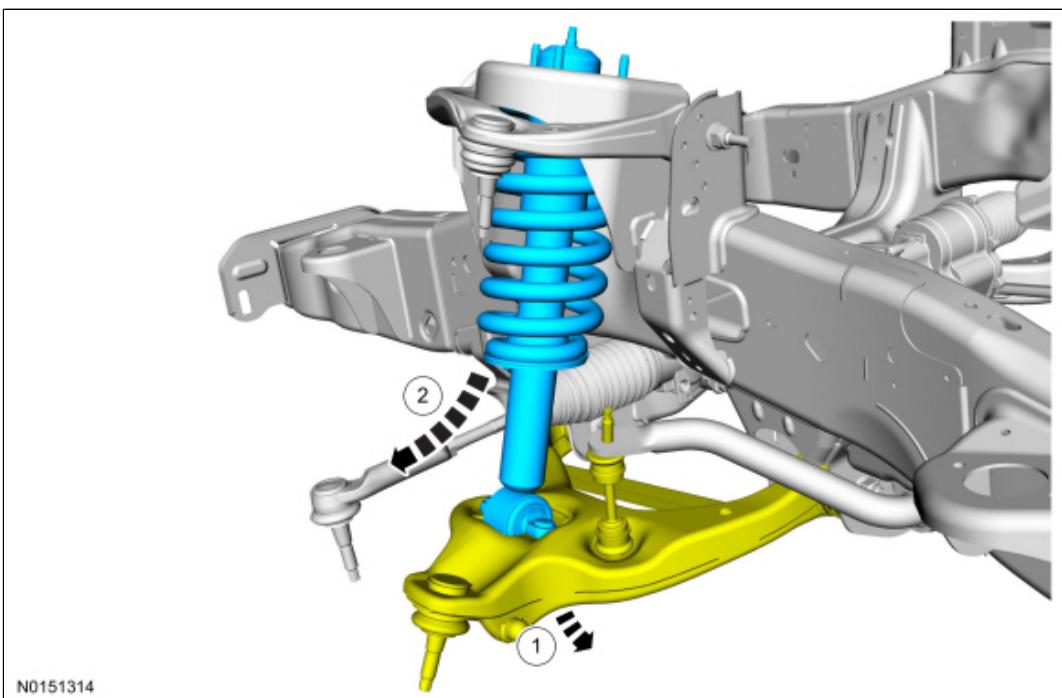
- 14.



- 15.



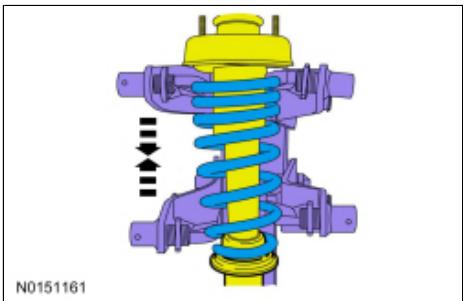
16.



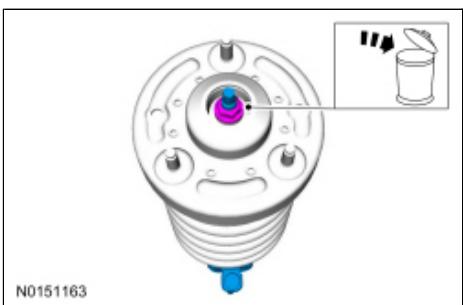
17. **NOTE:** If the individual spring and/or shock components are not being serviced, continue to the installation procedure.

**NOTE:** For reference during assembly, index the upper mount, spring and shock absorber.

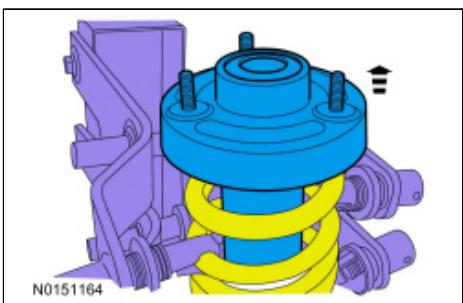
Compress the spring until the tension is released from the shock absorber.  
General Equipment: Spring Compressor.



18. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while removing the nut.

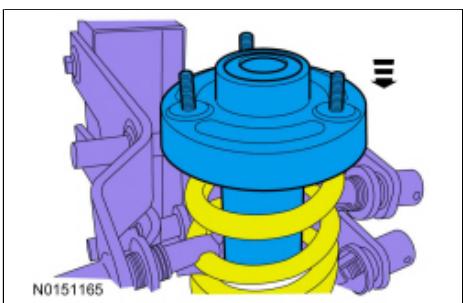


- 19.



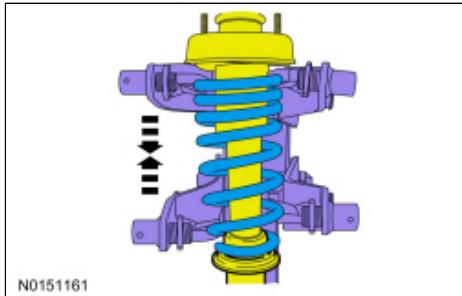
## Installation

- 1.



2. **NOTE:** Align the index marks made during disassembly.

Compress the spring until the tension is released from the shock absorber.  
General Equipment: Spring Compressor.

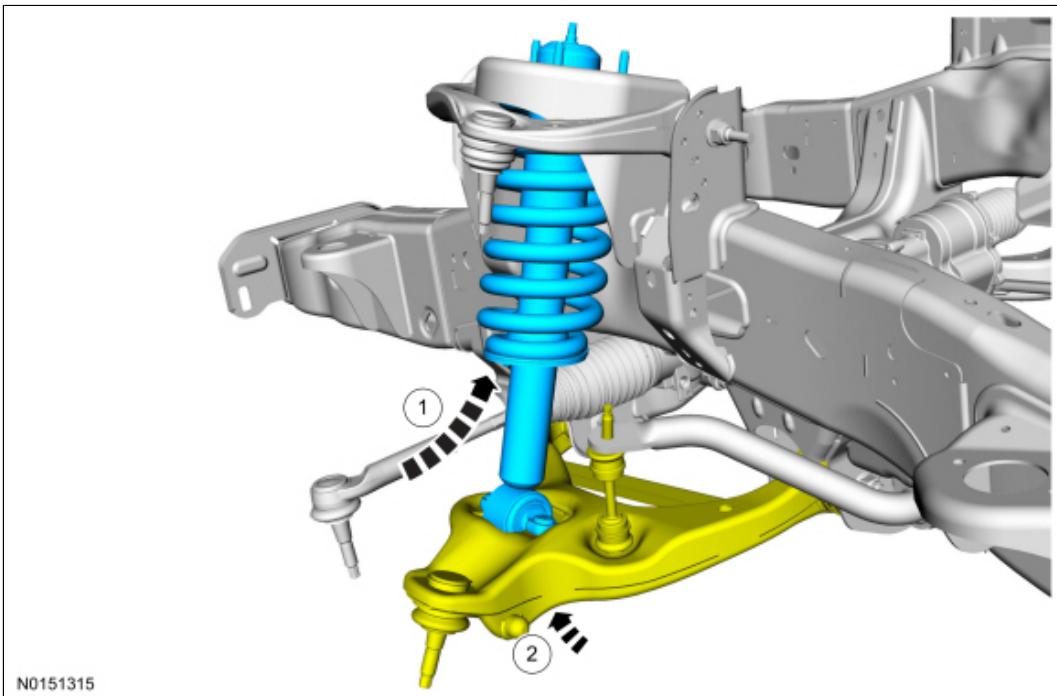


3. **NOTE:** Use the hex-holding feature to prevent the shock rod from turning while installing the nut.

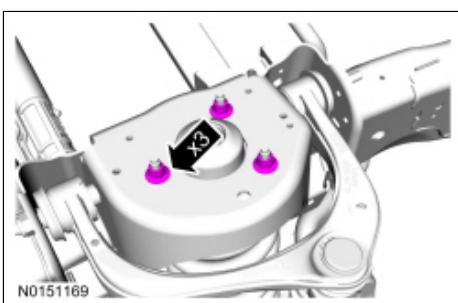
- Tighten to 55 Nm (41 lb-ft).



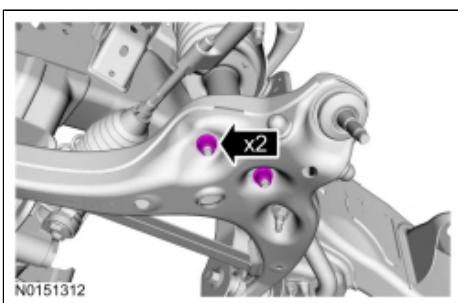
4.



5.
  - Tighten to 63 Nm (46 lb-ft).

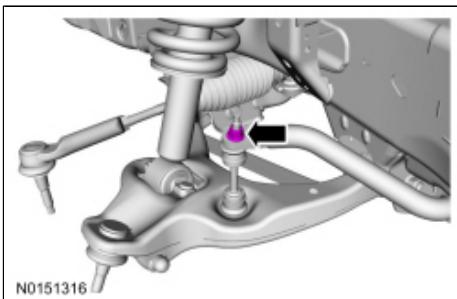


6.
  - Tighten to 90 Nm (66 lb-ft).



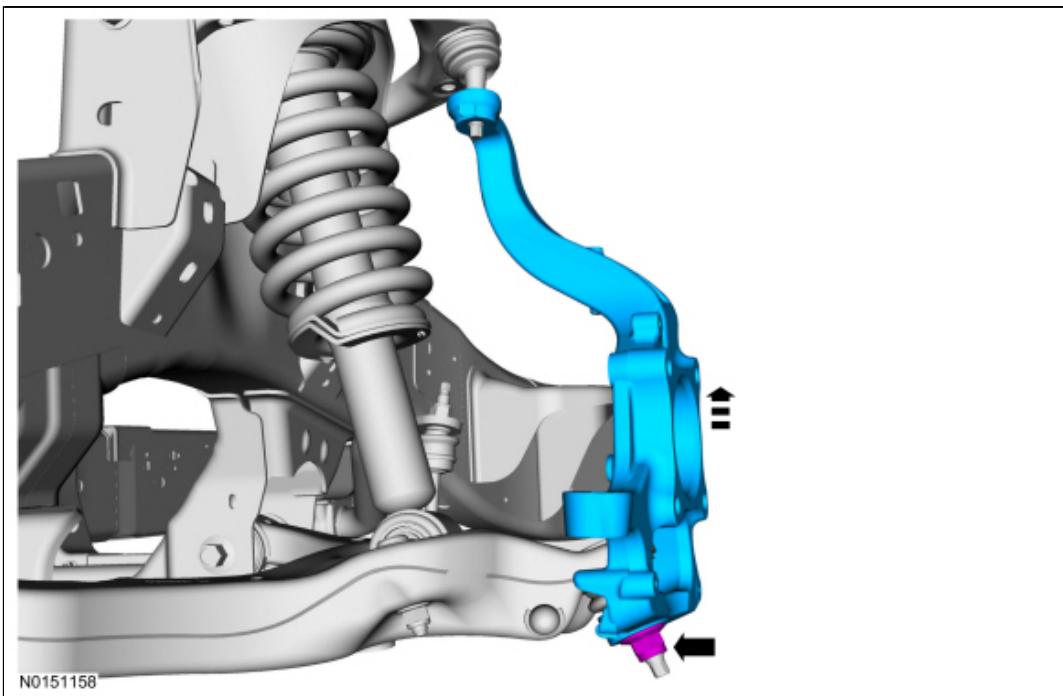
7. **NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut.

- Tighten to 70 Nm (52 lb-ft).



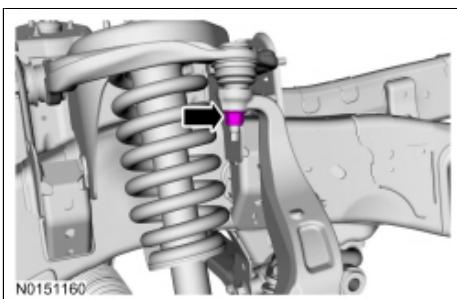
8.

- Tighten to 175 Nm (129 lb-ft).



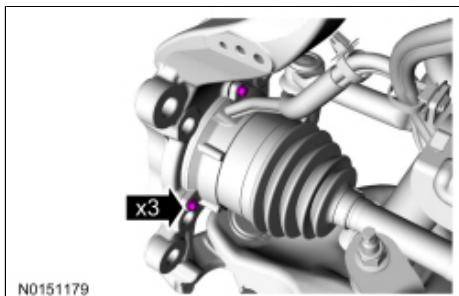
9.

- Tighten to 115 Nm (85 lb-ft).



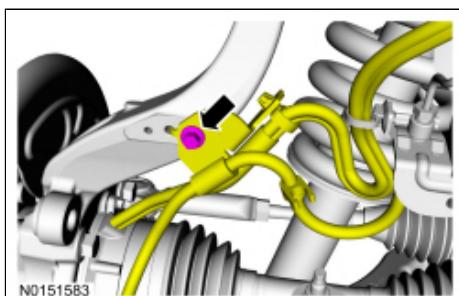
10.

- Tighten to 12 Nm (106 lb-in).



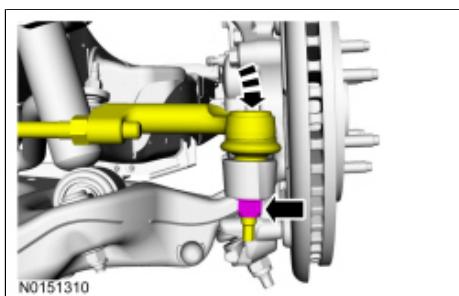
11.

- Tighten to 12 Nm (106 lb-in).



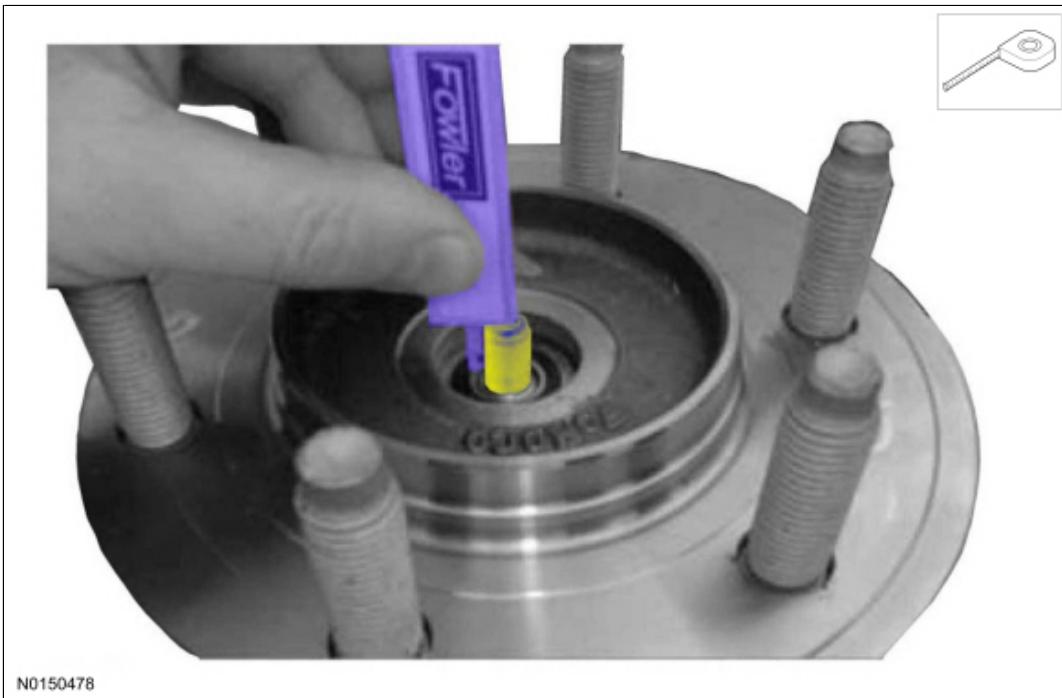
12.

- Tighten to 115 Nm (85 lb-ft).

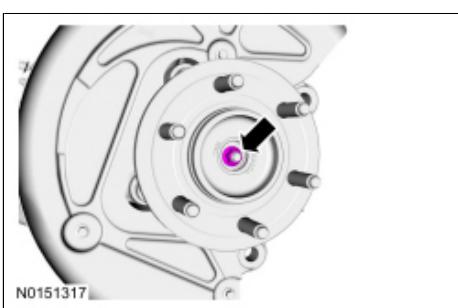


13. **NOTICE:** Measure the depth of the Constant Velocity (CV) shaft threaded end to the inner bearing race (shown in illustration). The minimum depth is 15.5 mm (0.61 in). If the depth is less than 15.5 mm (0.61 in) rotate the CV shaft to clear a binding condition between the Integrated Wheel End (IWE) and CV splines. Installing the axle nut and tightening without the proper depth of protrusion will result in damage to the IWE.

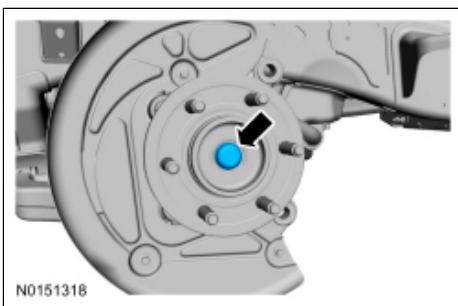
Measure the CV shaft threaded end to the inner bearing race.



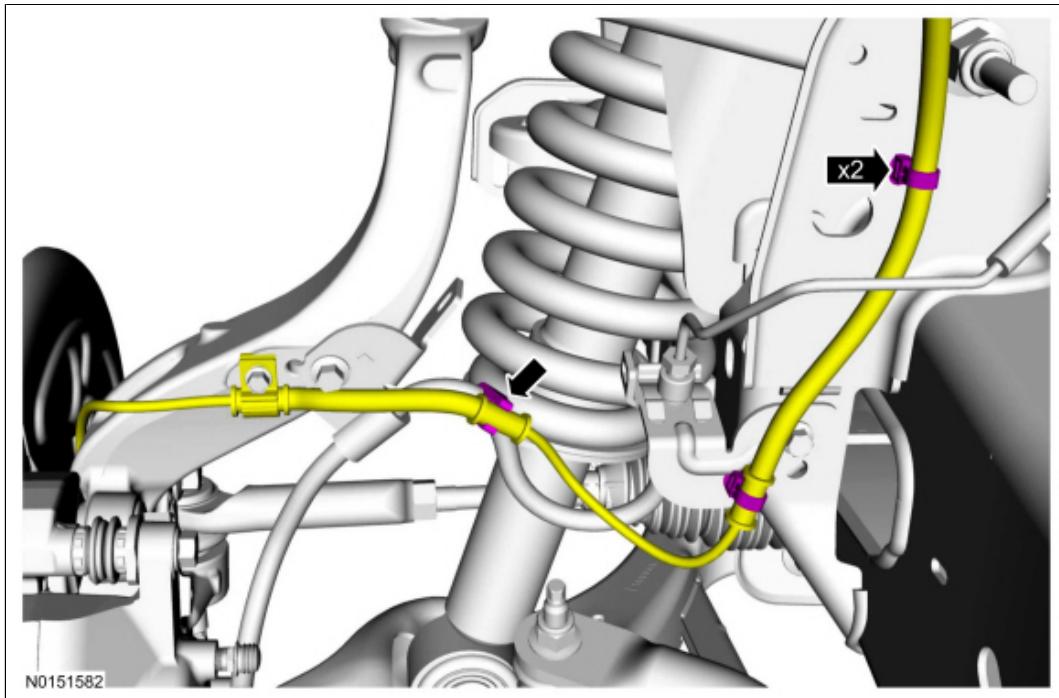
14. **NOTICE:** Verify the spline engagement by checking for spline lash before installing the axle nut or component damage may occur.
- Tighten to 40 Nm (30 lb-ft).



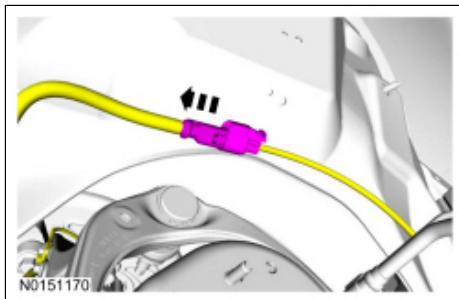
15.



16.



17. Install the brake disc. Refer to [Section 206-03](#).
18. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.



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## Stabilizer Bar and Link

### Removal and Installation

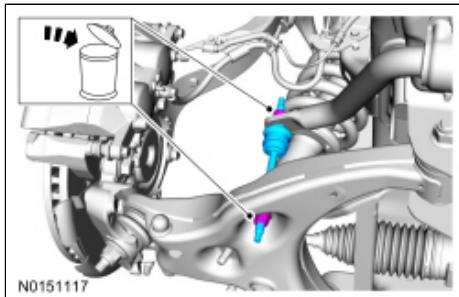
**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to [Section 100-02](#).
2. **NOTE:** SVT Raptor similar.

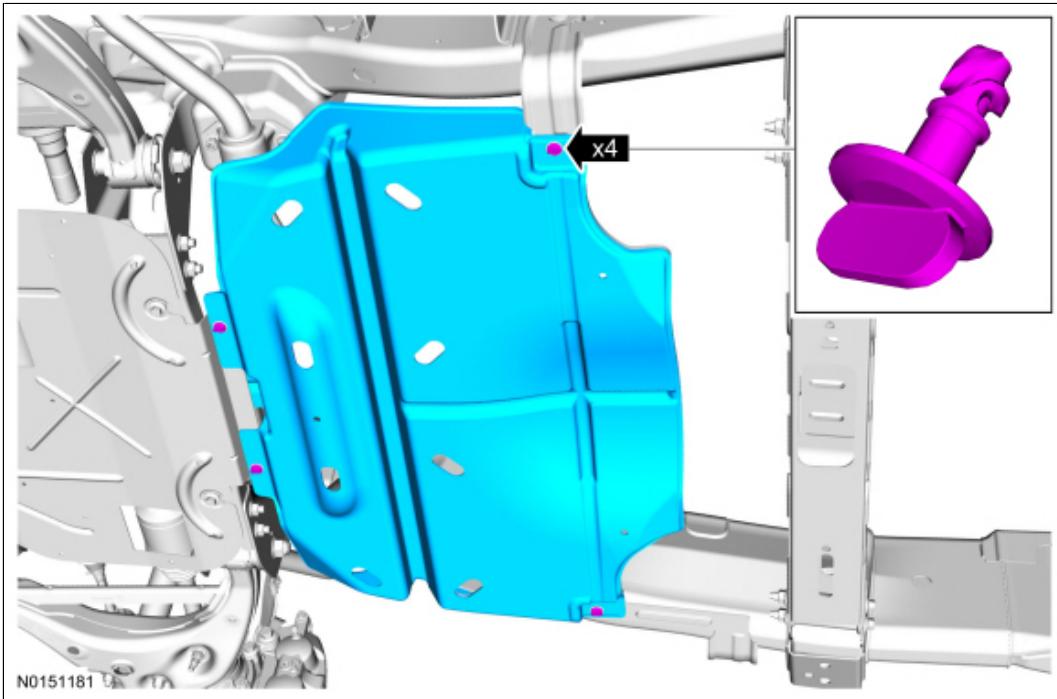
**NOTE:** Use the hex-holding feature to prevent the stud from turning while removing the nut(s).

On both sides.

- To install, tighten to 70 Nm (52 lb-ft).
- (SVT Raptor) To install, tighten to 80 Nm (59 lb-ft).



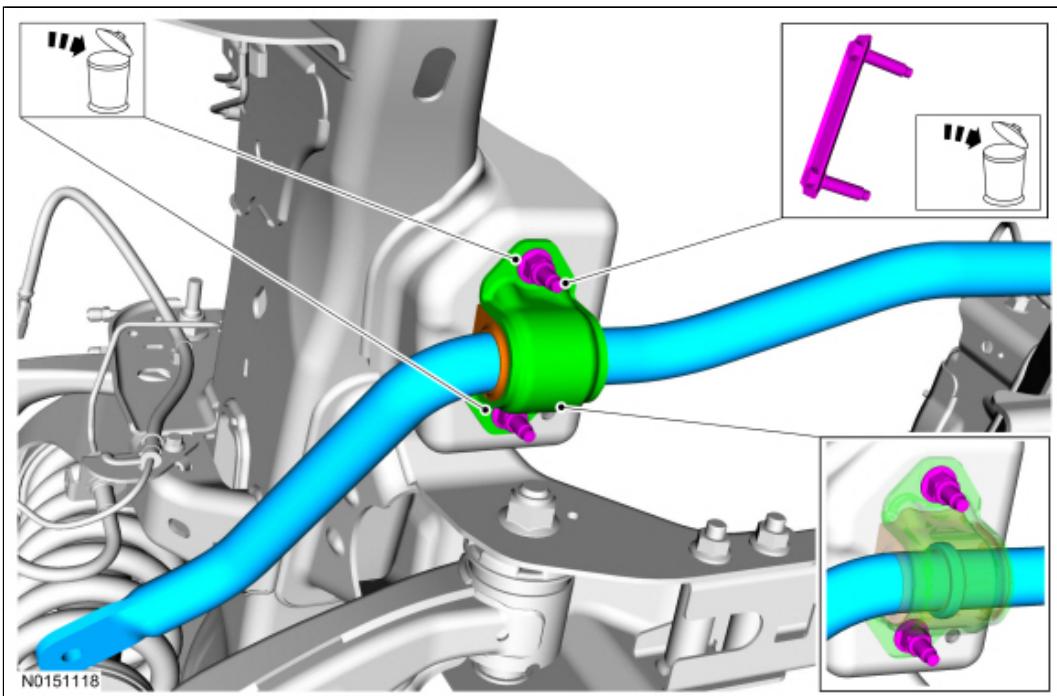
3. If equipped.



4. **NOTICE:** The raised ring on the stabilizer bar must be encapsulated inside the inner groove of the stabilizer bar bushing on the driver side of the vehicle for proper installation.

On both sides.

- To install, tighten to 63 Nm (46 lb-ft).



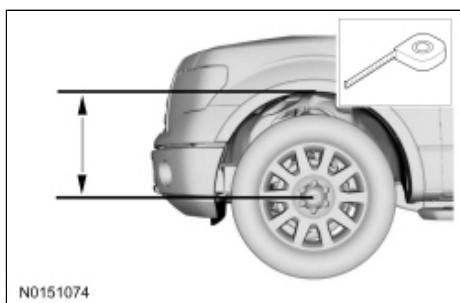
5. Inspect and, if necessary, install new stabilizer bar bushings.
  6. To install, reverse the removal procedure.
-

## Upper Arm

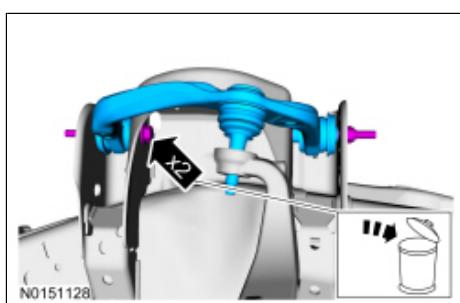
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

1. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position (curb height).



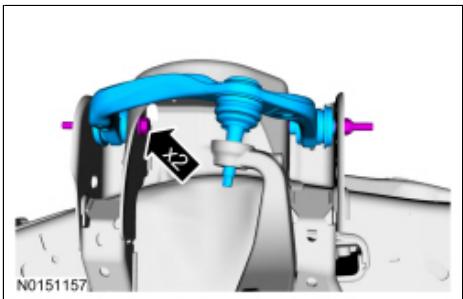
2. Remove the shock absorber and spring assembly. Refer to [Shock Absorber and Spring Assembly](#) or [Shock Absorber and Spring Assembly — SVT Raptor](#).
- 3.



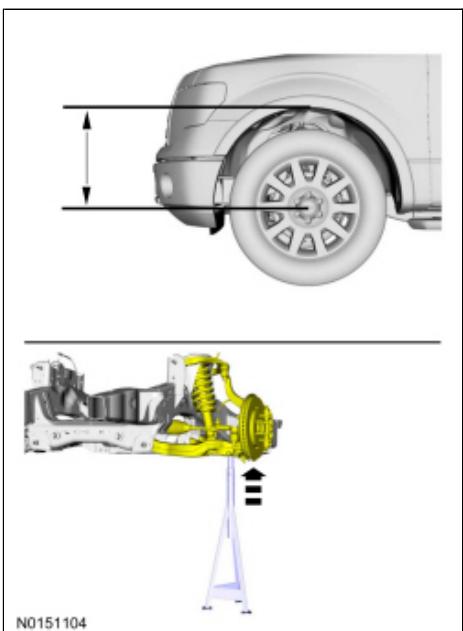
### Installation

1. **NOTICE:** Tighten the suspension bushing fasteners with the suspension loaded or with the weight of the vehicle resting on the wheels and tires, otherwise incorrect clamp load and bushing damage may occur.

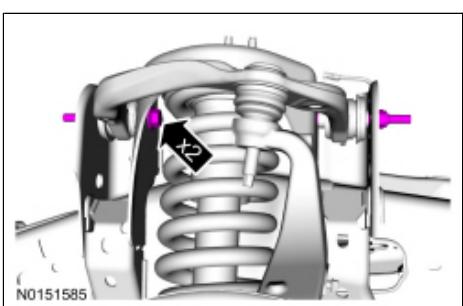
Finger tight at this stage.



2. Install the shock absorber and spring assembly. Refer to [Shock Absorber and Spring Assembly](#) or [Shock Absorber and Spring Assembly — SVT Raptor](#).
3. Use a suitable jack to raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during removal (curb height).



4.
  - Tighten to 150 Nm (111 lb-ft).



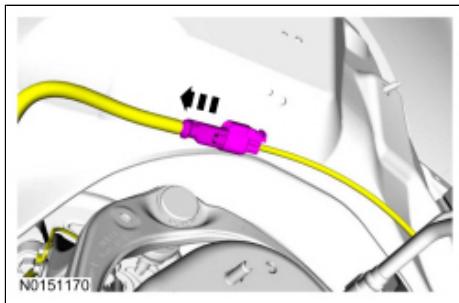


## Wheel Bearing and Wheel Hub

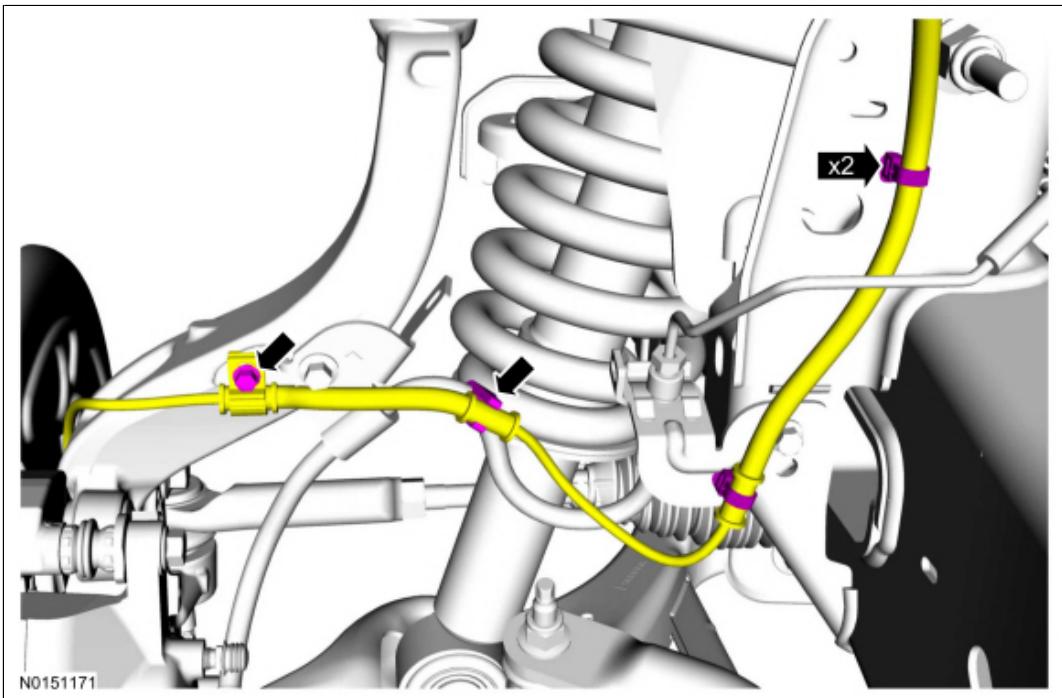
### Removal and Installation

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

1. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.

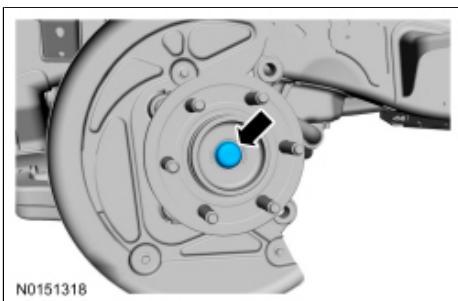


2. Remove the wheel and tire. Refer to [Section 204-04](#).
- 3.

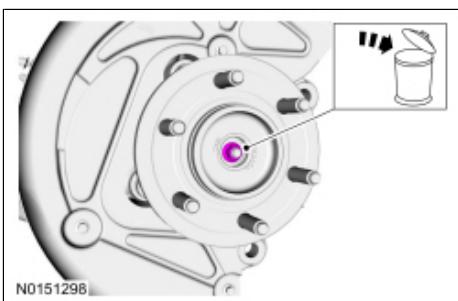


4. Remove the brake disc. Refer to [Section 206-03](#).

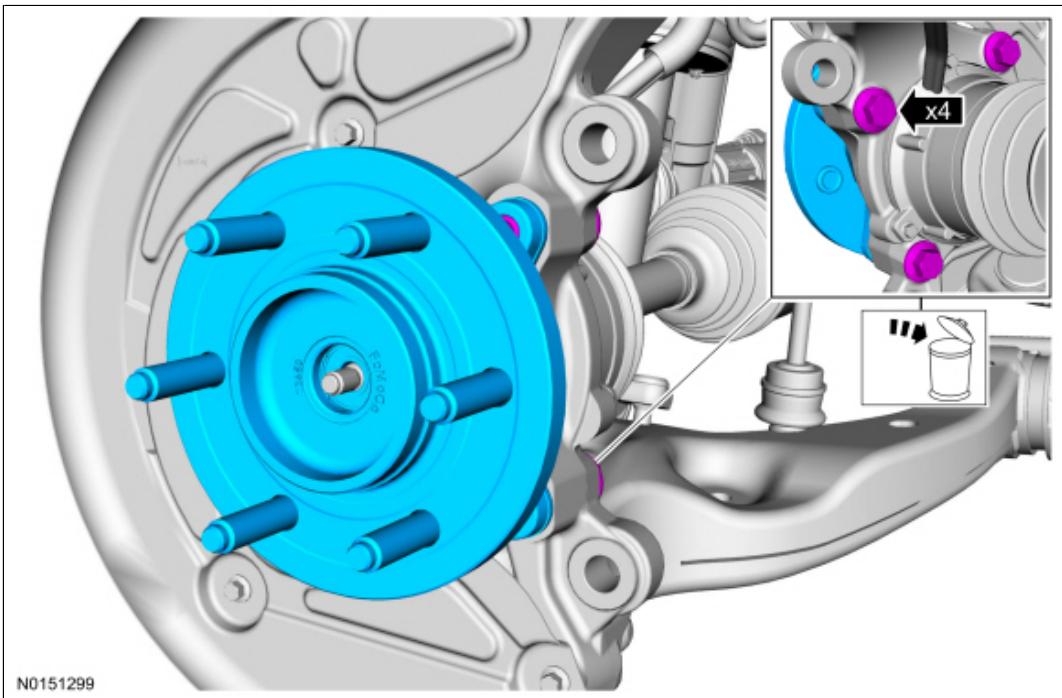
5.



6.

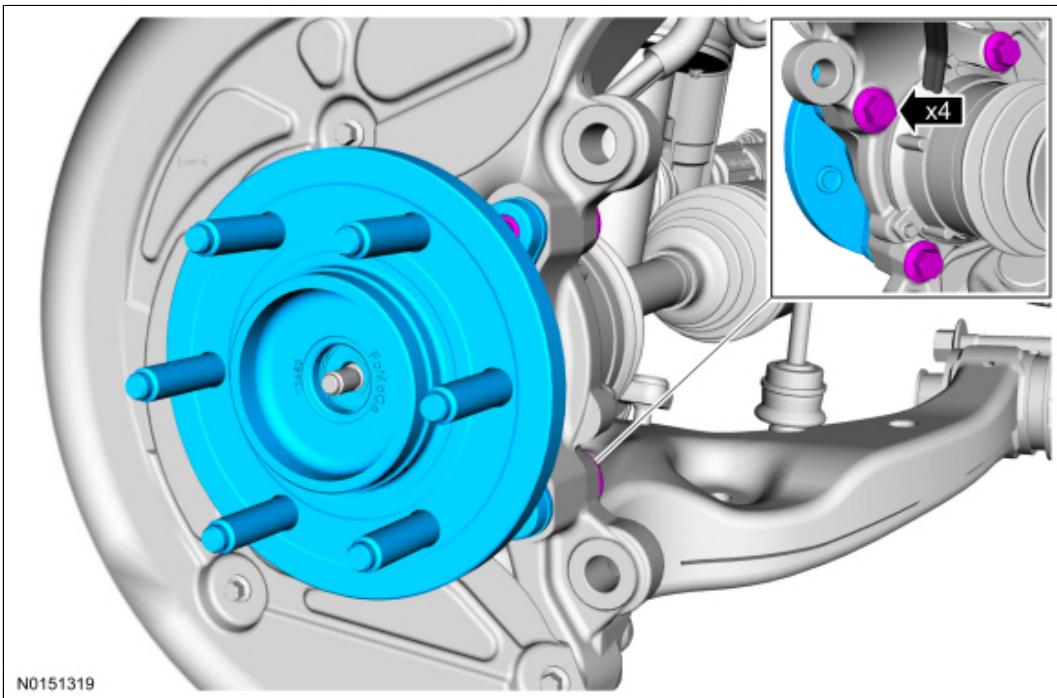


7.



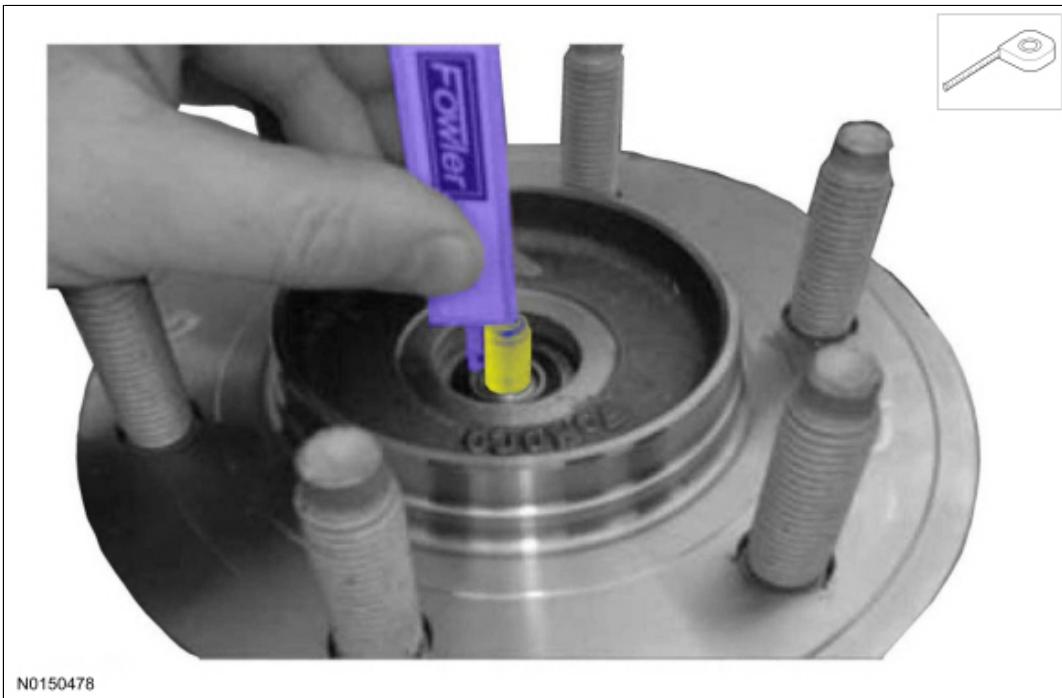
## Installation

1. **NOTICE:** If the original wheel bearing and wheel hub is being installed, install a new wheel hub O-ring seal or damage to the wheel bearing may occur.
  - Tighten to 175 Nm (129 lb-ft).

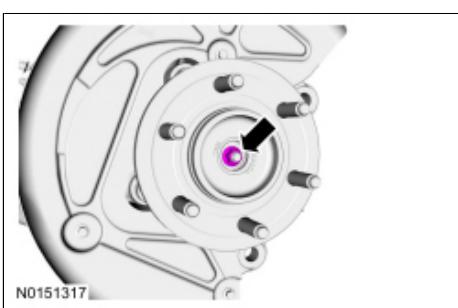


2. **NOTICE:** Measure the depth of the Constant Velocity (CV) shaft threaded end to the inner bearing race (shown in illustration). The minimum depth is 15.5 mm (0.61 in). If the depth is less than 15.5 mm (0.61 in) rotate the CV shaft to clear a binding condition between the Integrated Wheel End (IWE) and CV splines. Installing the axle nut and tightening without the proper depth of protrusion will result in damage to the IWE.

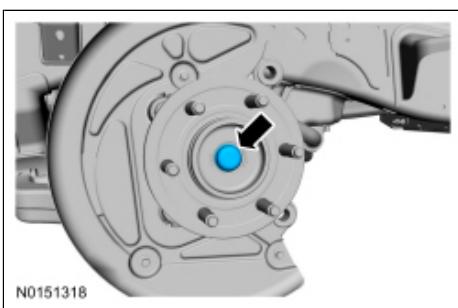
Measure the CV shaft threaded end to the inner bearing race.



3. **NOTICE:** Verify the spline engagement by checking for spline lash before installing the axle nut or component damage may occur.
  - Tighten to 40 Nm (30 lb-ft).



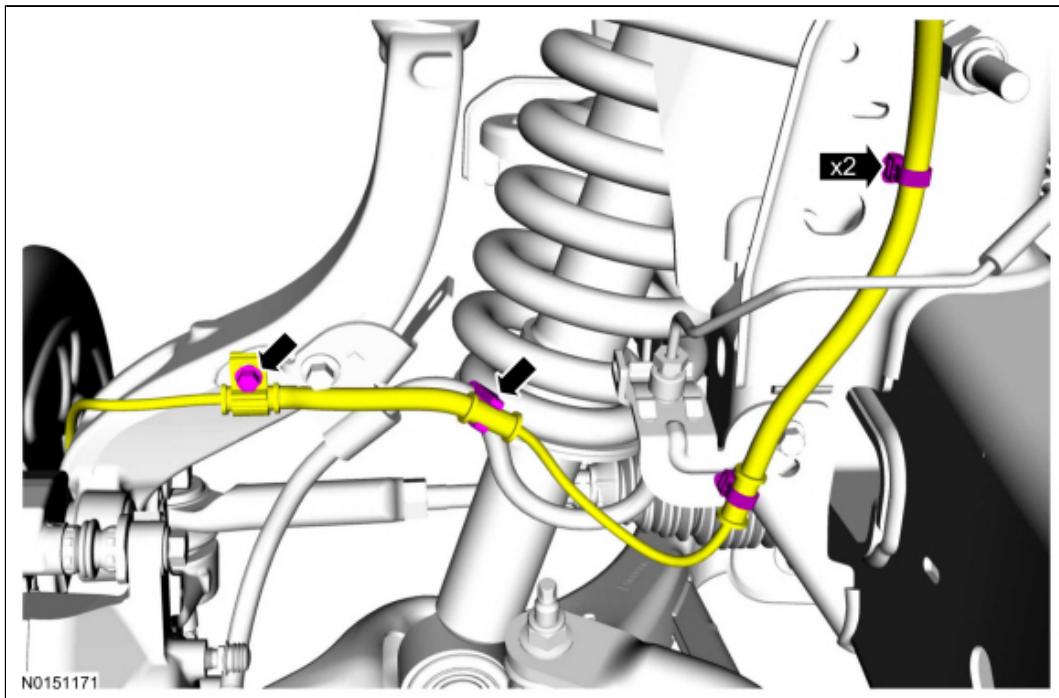
4.



5. Install the brake disc. Refer to [Section 206-03](#).

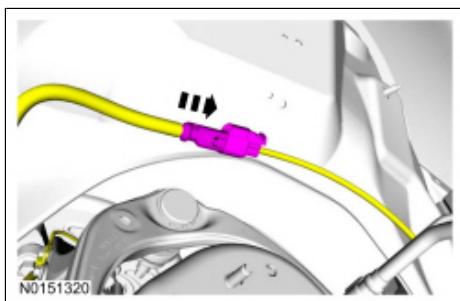
6.

- Tighten to 12 Nm (106 lb-in).



7. Install the wheel and tire. Refer to [Section 204-04](#).

8. **NOTE:** The wheel speed sensor electrical connector is located in the engine compartment secured to the fender apron.





## Wheel Knuckle

### Special Tool(s)

	Separator, Ball Joint 204-592
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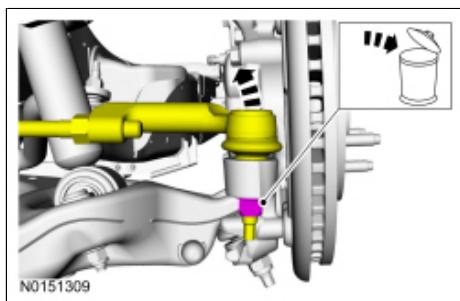
### Removal

**NOTICE:** Suspension fasteners are critical parts that affect the performance of vital components and systems. Failure of these fasteners may result in major service expense. Use the same or equivalent parts if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Tighten fasteners as specified.

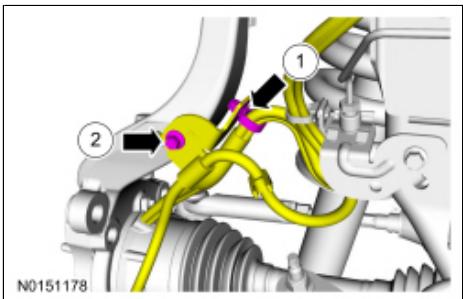
1. Remove the wheel bearing and wheel hub. Refer to [Wheel Bearing and Wheel Hub](#).
2. **NOTICE:** Do not use a hammer to separate the outer tie-rod end from the wheel knuckle or damage to the wheel knuckle may result.

**NOTICE:** Use care when installing the tie rod separator or damage to the outer tie-rod end boot may occur.

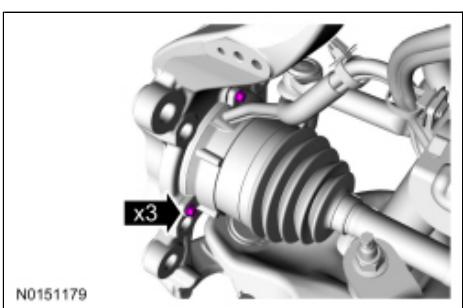
General Equipment: Tie-rod Separator.



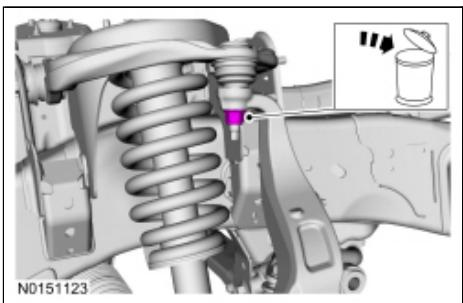
- 3.



4.

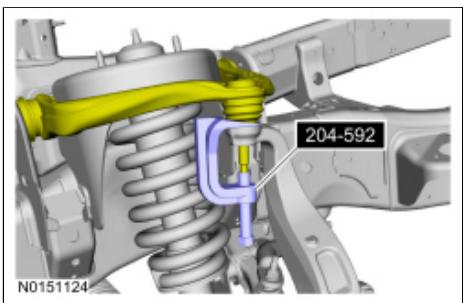


5.

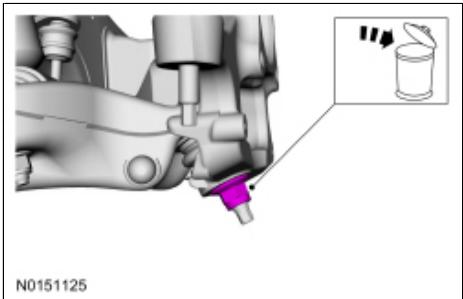


6. **NOTE:** Be sure not to damage the ball joint boot when installing the Ball Joint Separator.

Special Tool(s): Separator, Ball Joint 204-592.



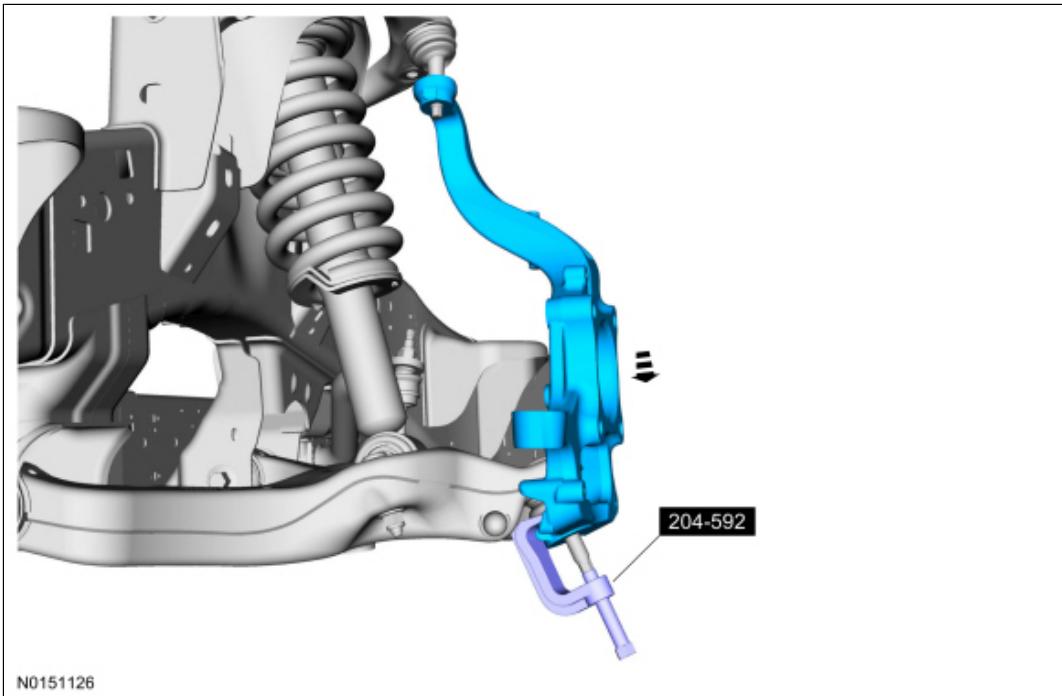
7.



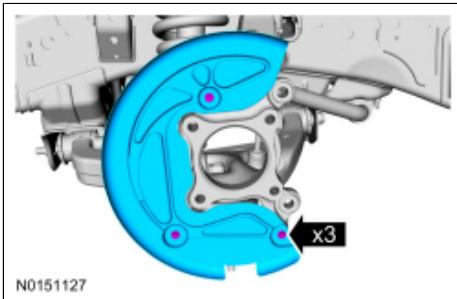
8. **NOTICE:** Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result.

**NOTICE:** Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may occur.

Special Tool(s): Separator, Ball Joint 204-592.

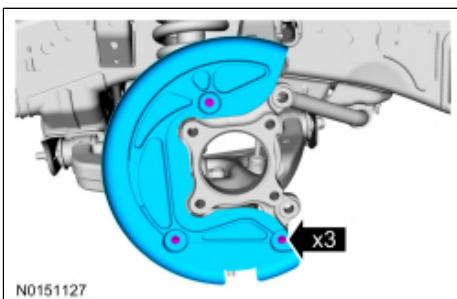


9. If necessary.

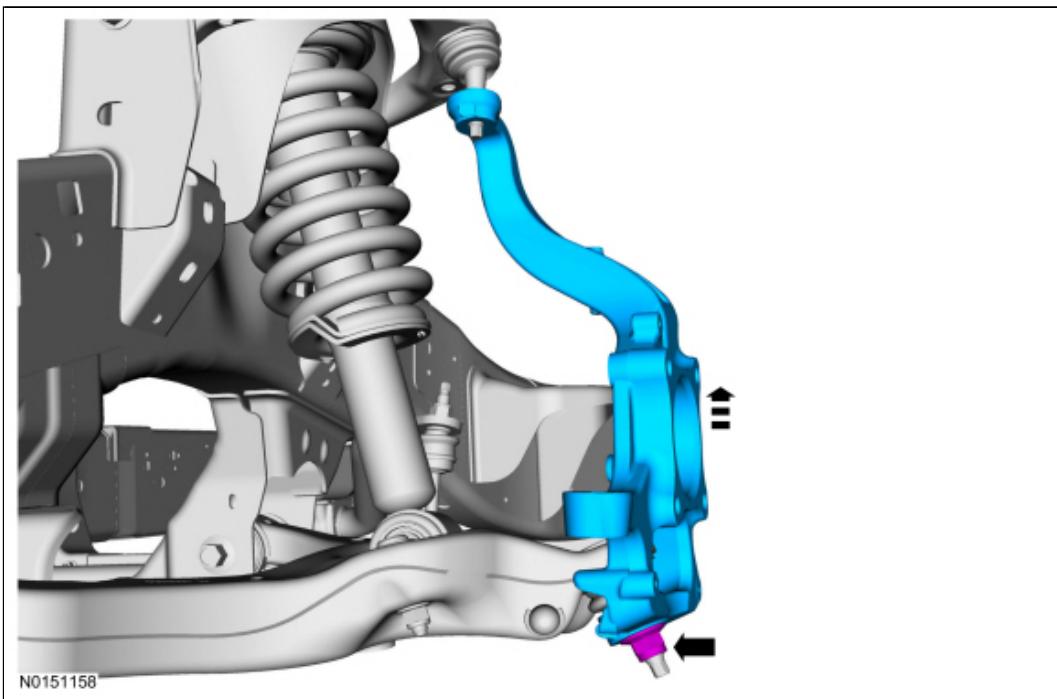


## Installation

1. If necessary.
  - Tighten to 17 Nm (150 lb-in).

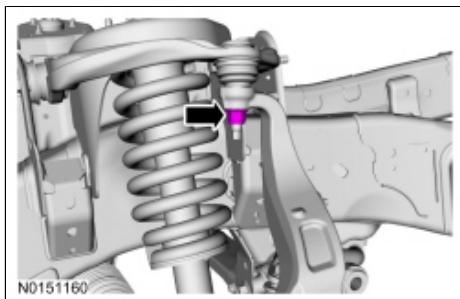


2.
  - Tighten to 175 Nm (129 lb-ft).



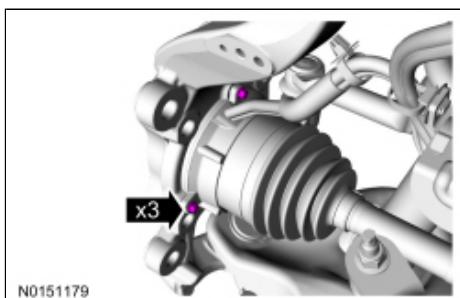
3.

- Tighten to 115 Nm (85 lb-ft).



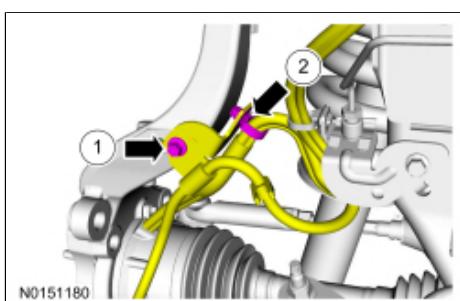
4.

- Tighten to 12 Nm (106 lb-in).



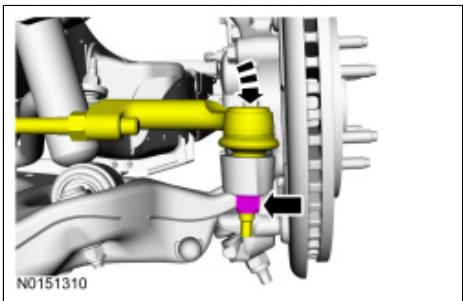
5.

- Tighten to 12 Nm (106 lb-in).



6.

- Tighten to 115 Nm (85 lb-ft).



7. Install the wheel bearing and wheel hub. Refer to [Wheel Bearing and Wheel Hub](#).
-

## **Wheel Studs**

For additional information, refer to [Section 204-01A](#).

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**Torque Specifications**

Description	Nm	lb-ft	lb-in
Shock absorber nuts	90	66	—
Shock absorber shield bolts (SVT Raptor)	4	—	35
Spring shackle-to-frame nut	185	136	—
Spring-to-frame nut	350	258	—
Spring-to-shackle nut	185	136	—
Spring U-bolt nuts <sup>a</sup>	—	—	—
Jounce bumper-to-frame bolt	35	26	—

<sup>a</sup> Refer to the procedure in this section

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## **Rear Suspension**

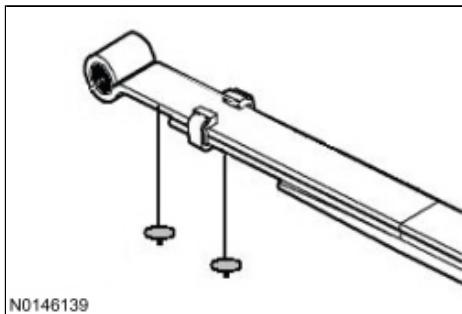
Refer to [Section 204-00](#).

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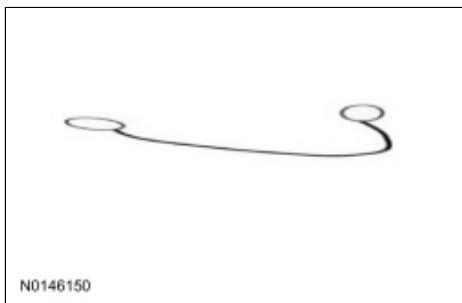
## Leaf Spring Tip Isolator

1. Position and lift the vehicle on a hoist to unload the leaf spring assembly. Refer to [Section 100-02](#).
2. **NOTE:** It is very important to use a non-metallic wedge or corrosion protection can be compromised.

Use a non-metallic wedge (such as a rubber door stop or rubber coated pry bar) near the leaf tip isolator and wedge the leaf spring apart.



3. Using a locally obtained pvc cable saw, cut the top of the leaf tip insert off and remove the insert.

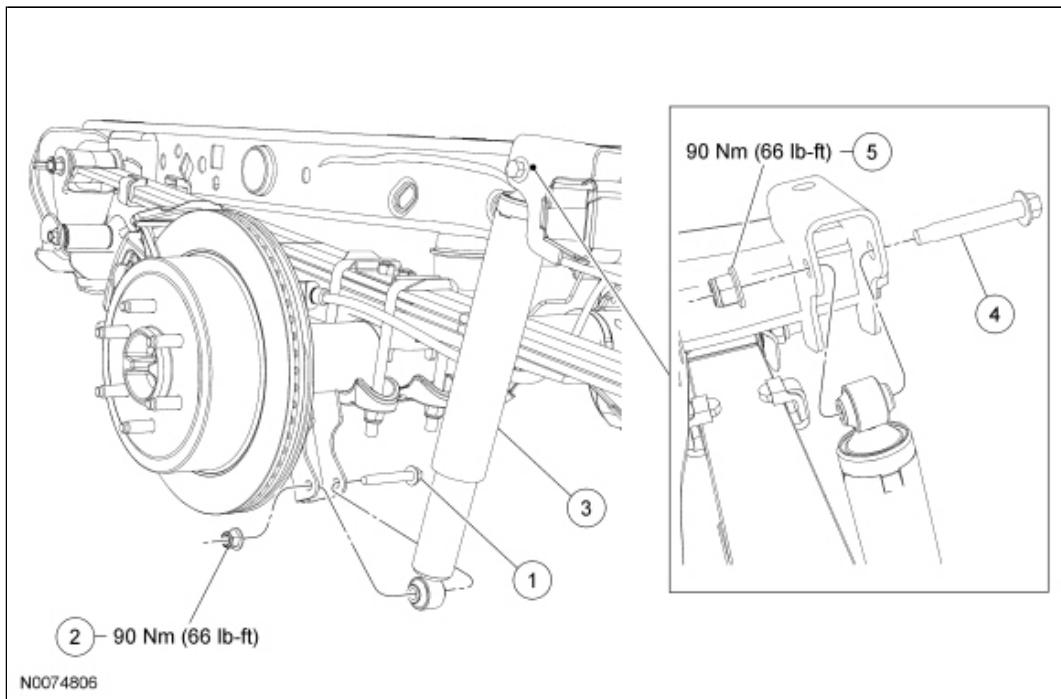


4. Thoroughly rinse the leaf tip insert area with brake clean and a clean shop rag to remove debris from the leaf tip insert seating area.
5. If required trim service tip insert post to aid installation between the leaves.
6. Once dry, install the new leaf spring tip insert and remove the non-metallic wedge.
7. Repeat steps 2-6 for remaining leaf tip inserts.
8. Lower the vehicle and wash the leaf spring assembly to remove any remaining dirt or debris using a power washer or direct stream of water.
9. Using shop air, dry the leaf spring assembly thoroughly.



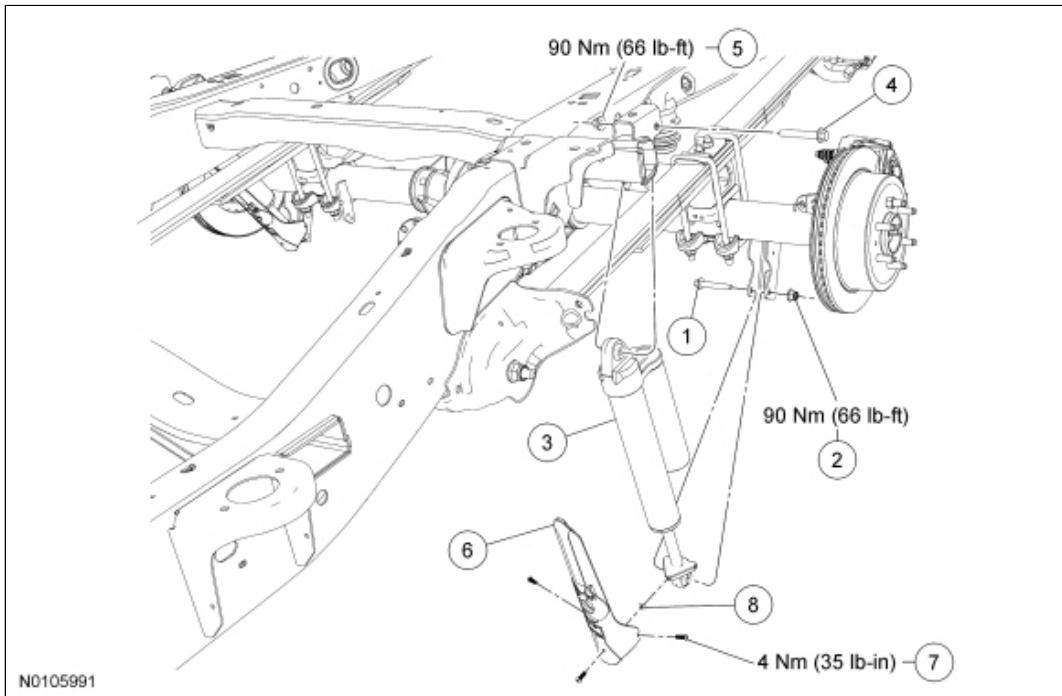
## Shock Absorber

All Except SVT Raptor



Item	Part Number	Description
1	W506545	Shock absorber lower bolt
2	W520214	Shock absorber lower nut
3	18125	Shock absorber
4	W506545	Shock absorber upper bolt
5	W520214	Shock absorber upper nut

**SVT Raptor**



Item	Part Number	Description
1	W506545	Shock absorber lower bolt
2	W520214	Shock absorber lower nut
3	18080	Shock absorber
4	W506545	Shock absorber upper bolt
5	W520214	Shock absorber upper nut
6	18159	Shock absorber shield
7	18A149-B	Shock absorber shield bolt (3 required)
8	18A149-C	Shock absorber shield washer

**⚠️ WARNING:** Do not apply heat or flame to the shock absorber or strut tube. The shock absorber and strut tube are gas pressurized and could explode if heated. Failure to follow this instruction may result in serious personal injury.

**⚠️ WARNING:** Keep all body parts clear of shock absorbers or strut rods. Shock absorbers or struts can extend unassisted. Failure to follow this instruction may result in serious personal injury.

**NOTICE:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part numbers or equivalent part, if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

#### All Vehicles

- With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-](#)

02.

2. Using a suitable jack, support the axle.

**SVT Raptor**

3. **NOTE:** Chase the threads in the shock prior to installing the screws. This is needed to prevent potential breaking the screws or reaching torque prior to full run-down.

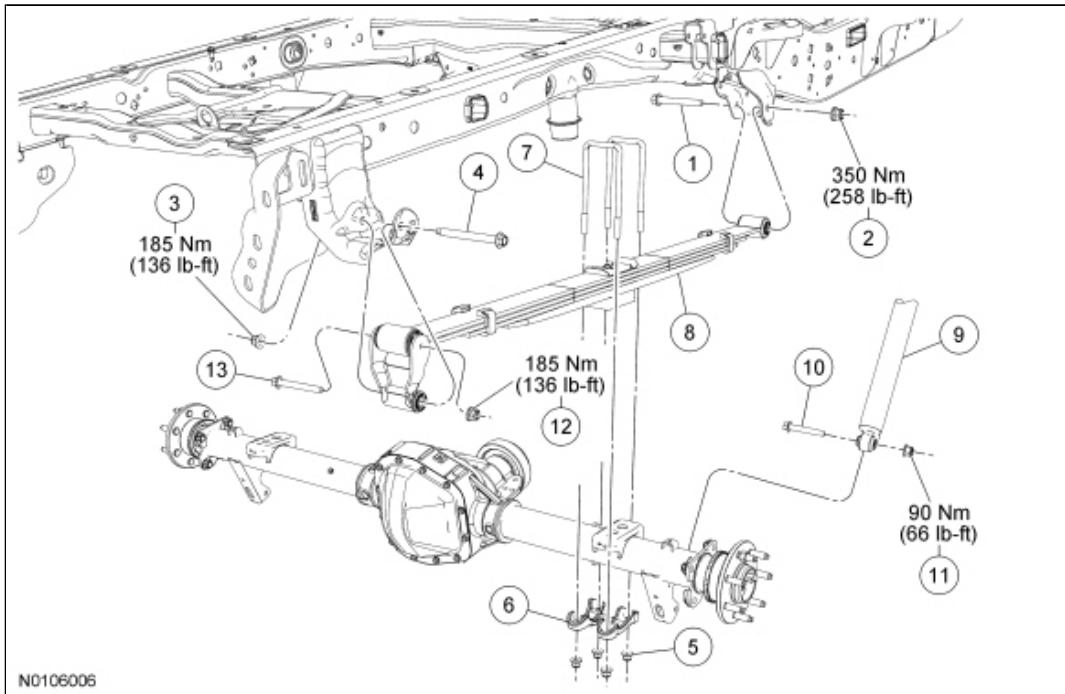
Remove the shock absorber shield.

- Remove and discard the three shield bolts and remove the shield.
- To install, tighten the three new bolts to 4 Nm (25 lb-in).

**All Vehicles**

4. Remove and discard the shock absorber upper nut and bolt.
    - To install, tighten the new nut to 90 Nm (66 lb-ft).
  5. Remove the shock absorber lower nut, lower bolt and the shock absorber.
    - Discard the nut and bolt.
    - To install, tighten the new nut to 90 Nm (66 lb-ft).
  6. To install, reverse the removal procedure.
-

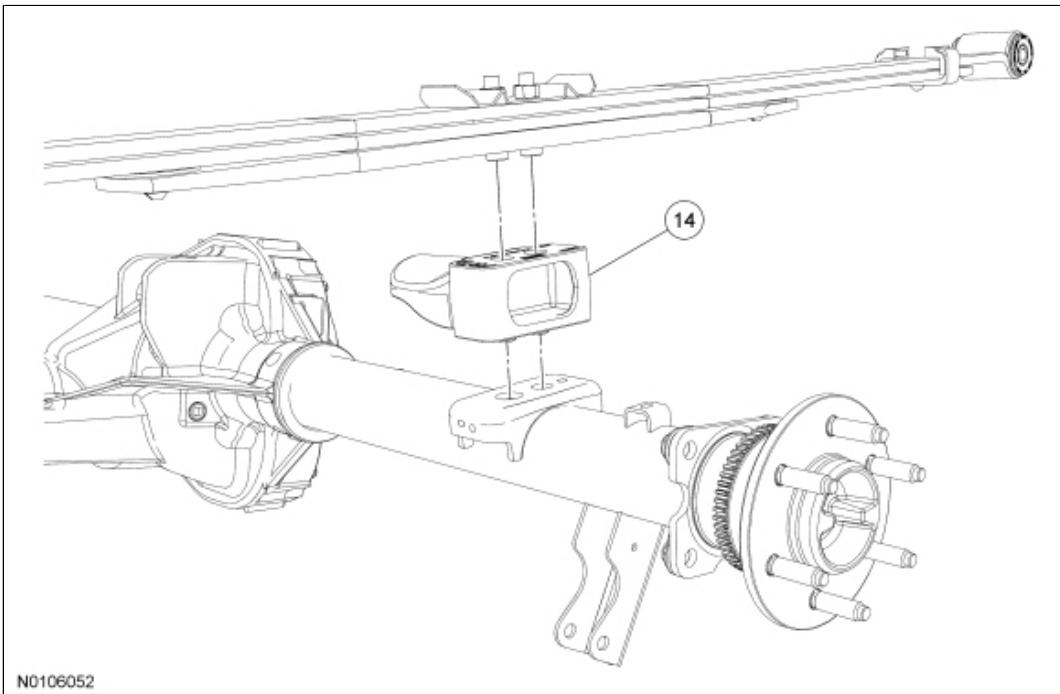
## Spring



N0106006

Item	Part Number	Description
1	W709627	Spring-to-frame bolt
2	W714297	Spring-to-frame nut
3	W705518	Spring shackle-to-frame nut
4	W715654	Spring shackle-to-frame bolt
5	W520215	U-bolt nut (4 required)
6	5798	U-bolt plate
7	5705	U-bolt (2 required)
8	5560	Spring
9	18125	Shock absorber
10	W506545	Shock absorber lower bolt
11	W520214	Shock absorber lower nut
12	W705518	Spring-to-shackle nut
13	W715654	Spring-to-shackle bolt

**NOTE:** SVT Raptor shown, others similar.



Item	Part Number	Description
14	5A799	Spring spacer — Four-Wheel Drive (4WD) only

### Removal

**⚠️ WARNING:** Do not apply heat or flame to the shock absorber or strut tube. The shock absorber and strut tube are gas pressurized and could explode if heated. Failure to follow this instruction may result in serious personal injury.

**⚠️ WARNING:** Keep all body parts clear of shock absorbers or strut rods. Shock absorbers or struts can extend unassisted. Failure to follow this instruction may result in serious personal injury.

**NOTICE:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure may result in major service expense. New parts must be installed with the same part numbers or equivalent part, if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

### All vehicles

1. Remove the wheel and tire. For additional information, refer to [Section 204-04](#).
2. Using a suitable jack, support the axle.
3. Remove the shock absorber lower nut and bolt.
  - Discard the nut and bolt.
4. Remove the 4 U-bolt nuts, the U-bolt plate and the 2 U-bolts.

- Discard the nuts and the U-bolts.
- For the LH spring, lower the fuel tank to gain access to the spring shackle-to-frame bolt. For additional information, refer to [Section 310-01](#).
  - For the RH spring, remove the muffler to gain access to the spring-to-frame bolt. For additional information, refer to [Section 309-00](#).
  - Remove and discard the spring-to-frame nut and bolt.
  - Remove and discard the spring shackle-to-frame nut and bolt.
  - NOTE:** Only lower the axle enough to gain access to remove the spring.
- Lower the jack and remove the spring and shackle assembly.
- If necessary, remove the spring-to-shackle nut, bolt and spring shackle.
    - Discard the nut and bolt.

#### Four-Wheel Drive (4WD) vehicles

- Remove the Four-Wheel Drive (4WD) spring spacer.

#### Installation

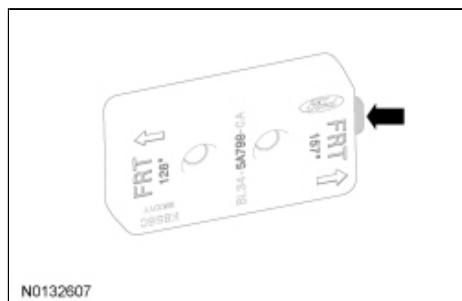
##### 4WD vehicles

**NOTE:** The SVT Raptor spring spacer must be positioned with the jounce bumper pad inboard and the arrow facing the front of the vehicle.

All other vehicles, the arrow on the spring spacer must face toward the front of the vehicle according to the wheelbase application. Use specifications on spring spacer.

- NOTE:** The protrusion on the spring spacer should face toward the front of the vehicle on 157 inch wheelbase applications and face toward the rear on 126 inch wheelbase applications.

Position the spring spacer and make sure that it is correctly seated between the axle and spring with the arrow pointed to the front of the vehicle according to the wheelbase application.



#### All vehicles

- If necessary, install a new shackle-to-spring bolt and nut.

- Tighten until snug.
3. Position the spring and install a new spring shackle-to-frame bolt and nut.
    - Tighten until snug.
  4. Position the U-bolt plate and install the new U-bolts and nuts.
    - Tighten until snug.
  5. Install a new spring-to-frame bolt and nut.
    - Tighten until snug.
  6. Install a new shock absorber lower bolt and nut.
    - Tighten until snug.
  7. Install the wheel and tire. For additional information, refer to [Section 204-04](#).
  8. Lower the vehicle until the weight of the vehicle is resting on the wheels and tires (curb height).
  9. Tighten the spring shackle-to-frame nut to 185 Nm (136 lb-ft).
  10. Tighten the spring-to-frame nut to 350 Nm (258 lb-ft).
  11. If necessary, tighten the spring-to-shackle nut to 185 Nm (136 lb-ft).
  12. For the LH spring, raise the fuel tank. For additional information, refer to [Section 310-01](#).
  13. For the RH spring, install the muffler. For additional information, refer to [Section 309-00](#).
  14. Tighten the U-bolt nuts in 4 stages.
    - Stage 1: Tighten in a cross pattern to 35 Nm (26 lb-ft).
    - Stage 2: Tighten in a cross pattern to 70 Nm (52 lb-ft).
    - Stage 3: Tighten in a cross pattern to 100 Nm (74 lb-ft).
    - Stage 4: Tighten in a cross pattern to 133 Nm (98 lb-ft).
  15. Tighten the shock absorber lower nut to 90 Nm (66 lb-ft).
-



**Material**

Item	Specification	Fill Capacity
High Temperature Nickel Anti-Seize Lubricant XL-2	—	—
Motorcraft® Wheel and Tire Cleaner ZC-37-A	—	—

**General Specifications**

Item	Specification
<b>Tire Inflation</b>	
Tires	See Safety Certification Label on driver door jamb
<b>Wheel Weights</b>	
Wheel weight type	Use a wheel weight manufacturer's rim gauge to determine the correct wheel weight application

**Torque Specifications**

Description	Nm	lb-in
Valve stem-to-Tire Pressure Monitoring System (TPMS) sensor screw	1.5	13
Wheel nuts <sup>a</sup>	—	—

<sup>a</sup> Refer to the procedure in this section.



## Wheels And Tires

### Safety Precautions

 **WARNING:** Vehicle may have multiple drive wheels. Do not use engine to power the driveline unless all drive wheels are elevated off the ground. Drive wheels in contact with ground could cause unexpected vehicle movement. Failure to follow this instruction may result in serious personal injury.

 **WARNING:** Always match the tire size to the wheel size during assembly. Incorrect matching can result in tire bead damage or tire separation from the wheel. Failure to follow this instruction may result in serious personal injury to technician or vehicle occupant(s).

 **WARNING:** Before servicing any tire, ask the customer if anyone injected a tire sealant into the tire. Tire sealants may be flammable and can burn or explode if exposed to an ignition source. Failure to follow this instruction may result in serious personal injury.

 **WARNING:** Replacement wheels must be equivalent to the original equipment wheels in:

- load carrying capacity.
- diameter, width and offset.
- pilot hole and bolt circle.

Combined load carrying capacity of replacement wheels for a given axle, must be equal to or greater than that axle's gross axle weight rating (GAWR) identified on the vehicle's Safety Compliance Certification label. All other specifications should be evaluated by measurement of both the original wheel and the replacement wheel. If specifications are not equivalent, the safety and handling of the vehicle may be degraded, which may result in serious injury to the vehicle occupant(s).

 **WARNING:** Wear eye and ear protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

 **WARNING:** Keep eyes away from valve stem when deflating tires. Reduce air pressure in tire as much as possible by pushing in valve core plunger prior to removing the core. Escaping air can carry particles that can injure the eyes. Failure to follow these instructions may result in serious personal injury.

 **WARNING:** Only use replacement tires that are the same size, load index, speed rating and type (such as P-metric versus LT-metric or all-season versus all-terrain) as those originally provided by Ford. The recommended tire and wheel size may be found on either the Safety Compliance Certification Label or the Tire Label, which is located on the B-pillar or edge of the driver's door. If the information is not found on these labels, consult a Ford dealer. Use of any tire or wheel not recommended by Ford can affect the safety and performance of the vehicle, which could result in an

**increased risk of loss of vehicle control, vehicle rollover, personal injury and death. Additionally, the use of non-recommended tires and wheels could cause steering, suspension, axle or transfer case/power transfer unit failure.**

**NOTICE:** Do not clean aluminum wheels with steel wool, abrasive-type cleaners or strong detergents. Damage to the wheel finish may occur. Use Wheel and Tire Cleaner ZC-37-A or -B or equivalent.

Factory-installed tires and wheels are designed to operate satisfactorily with loads up to and including full-rated load capacity when inflated to recommended inflation pressures.

Correct tire pressure and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration and unnecessary sharp braking increase tire wear.

To equalize tire wear, the tires should be rotated at recommended intervals.

### **Tire Pressure Monitoring System (TPMS)**

The Tire Pressure Monitoring System (TPMS) includes:

- the Body Control Module (BCM), located behind the passenger side kick panel.
- the Tire Pressure Monitor (TPM) module, located behind the instrument panel on the RH side near the glove box.
- four valve stem mounted tire pressure sensors.
- an Instrument Panel Cluster (IPC) warning indicator.
- message center warnings.

### **Tire Pressure Monitor (TPM) Module**

The TPM module is a radio receiver that collects the tire pressure data from the TPMS tire pressure sensors. The TPM module passes the tire pressure data to the BCM, where the BCM applies a predetermined pass/fail criteria.

The BCM compares the information of each tire pressure message against a pressure limit. If the BCM determines that the tire pressure has fallen below the minimum pressure, the BCM communicates this to the IPC on the vehicle communication network.

### **Tire Pressure Monitoring System (TPMS) Pressure Sensor**

The BCM uses tire pressure sensors to monitor the tire pressure in the 4 road tires. The sensors transmit radio frequency signals to the BCM approximately once every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph).

The tire pressure sensors are battery operated and mounted to the valve stem.

### **Instrument Panel Cluster (IPC) and Message Center**

The IPC illuminates the TPMS warning indicator when it receives a TPMS warning indicator on request from

the BCM and displays the appropriate message(s) in the message center.

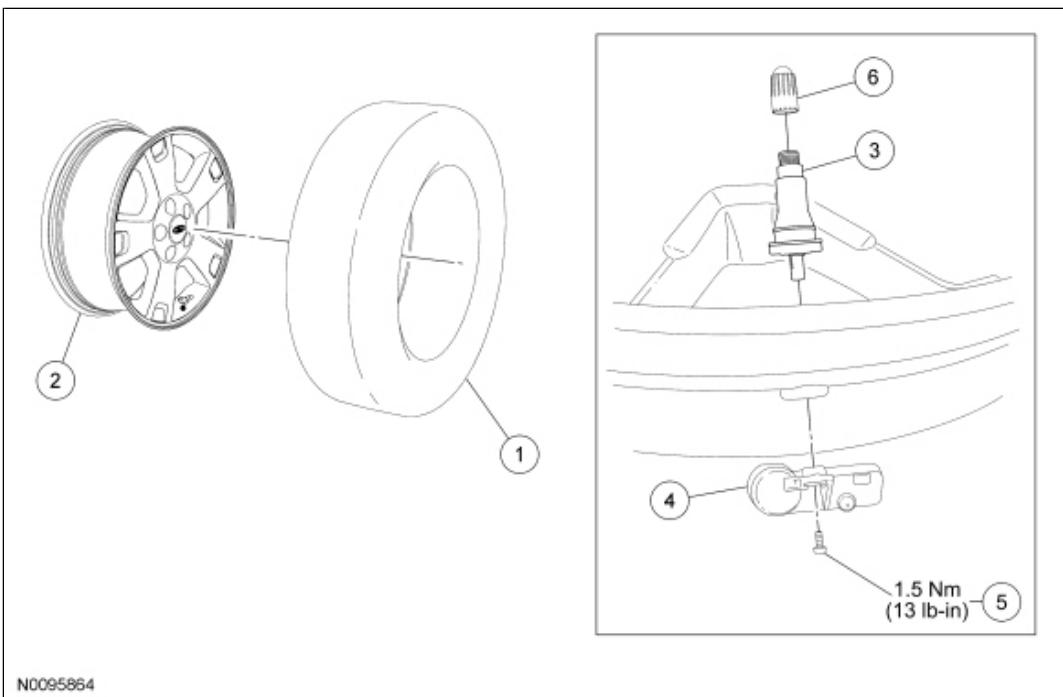
For additional information on the IPC and message center, refer to [Section 413-01](#).

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## Wheel and Tire

### Special Tool(s)

	Digital Tire Pressure Gauge 204-354
ST2869-A	



Item	Part Number	Description
1	1508	Tire
2	1007	Wheel
3	1700	Valve stem and screw (also part of 1A189)
4	1A189	Tire Pressure Monitoring System (TPMS) sensor (a new sensor assembly includes W714266 screw and 1700 valve stem and cap)
5	—	Valve stem-to- <u>TPMS</u> sensor screw (part of 1700)
6	1A163	Valve stem cap (also part of 1A189)

### Disassembly



**WARNING:** The tire pressure monitoring system (TPMS) sensor battery may release hazardous chemicals if exposed to extreme mechanical damage. If these chemicals contact the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If any part of the battery is swallowed, contact a physician immediately. When disposing of TPMS sensors, follow the correct procedures for hazardous material disposal. Failure to follow these instructions may result in serious personal injury.

**NOTICE:** Failure to follow the instructions below may result in damage to the Tire Pressure Monitoring System (TPMS) sensor.

**NOTICE:** The Tire Pressure Monitoring System (TPMS) sensor is mounted to the valve stem. Removal of the valve stem requires dismounting the tire from the wheel and removal of the TPMS sensor.

**NOTE:** Use only the Digital Tire Pressure Gauge any time tire pressures are measured to be sure that accurate values are obtained.

1. Remove the wheel and tire. For additional information, refer to [Wheel and Tire](#) in this section.
2. **NOTICE:** The valve stem is connected to the Tire Pressure Monitoring System (TPMS) sensor. Do not pull the valve stem from the wheel, or damage to the sensor will occur.

Remove the valve stem core and fully deflate all air from the tire.

- If a new Tire Pressure Monitoring System (TPMS) sensor is being installed, remove and discard the valve stem-to-sensor screw and the sensor.

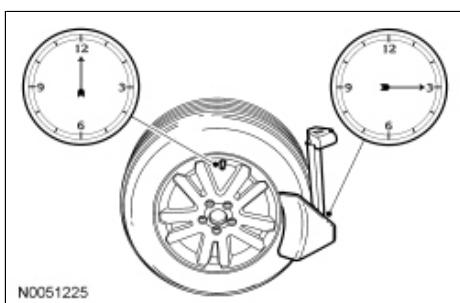
**NOTICE:** Do not allow the tire beads to move beyond the wheel mid-plane (middle of the wheel) when separating the beads from the wheels, damage to the Tire Pressure Monitoring System (TPMS) sensor may occur.

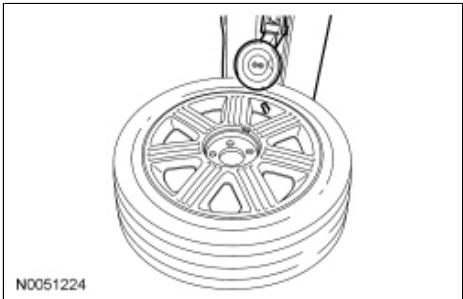
3. **NOTICE:** Tire and valve stem position is critical to prevent damage to the Tire Pressure Monitoring System (TPMS) sensor when using a paddle-type bead separator.

**NOTE:** Some machines may have a nylon roller bead separator at the 12 o'clock position instead of the paddle-type bead separator at the 3 o'clock position.

Position the wheel and tire assembly on a suitable tire machine and separate both beads of the tire from the wheel.

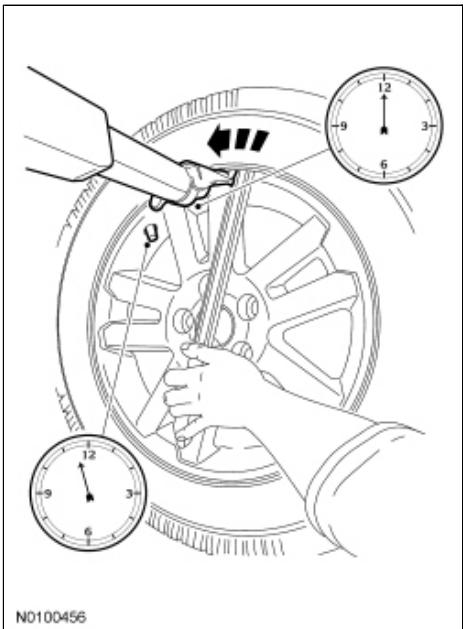
- For a paddle-type tire machine, position the valve stem at the 12 o'clock or 6 o'clock position and the paddle at the 3 o'clock position.
- For a roller-type tire machine, align the valve stem with the roller at any position.





4. **NOTE:** Index-mark the valve stem and wheel weight positions on the tire.

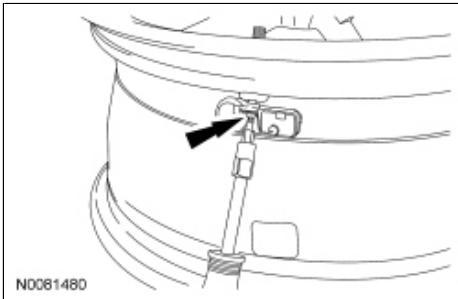
Place the wheel and tire assembly on the turntable of the tire machine with the valve stem at the 11:30 position and the machine arm at the 12 o'clock position and dismount the outer bead from the wheel.



5. Reset the wheel and tire assembly on the turntable of the tire machine with the valve stem at the 11:30 position and the machine arm at the 12 o'clock position and dismount the inner bead from the wheel.
6. **NOTE:** A new valve stem must be installed whenever a new tire or wheel is installed.

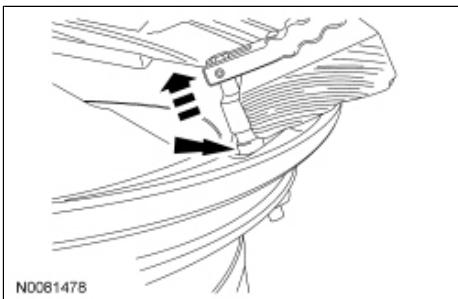
Remove the TPMS sensor in the following sequence.

1. Using a T10 Torx, remove the valve stem-to- TPMS sensor screw.
2. Carefully and firmly, pull the sensor straight down and separate it from the valve stem.



**7. NOTICE:** Use care not to damage the wheel surface when removing the valve stem.

Using a suitable valve stem puller and a wood block, remove the valve stem from the wheel.



**8. NOTE:** When installing a new wheel, always install a new valve stem and sensor screw. Reuse the TPMS sensor from the previous wheel if possible. The TPMS will not have to be trained if the sensor is reused.

If the TPMS sensor is being reused, inspect the TPMS sensor for damage and install a new sensor as necessary.

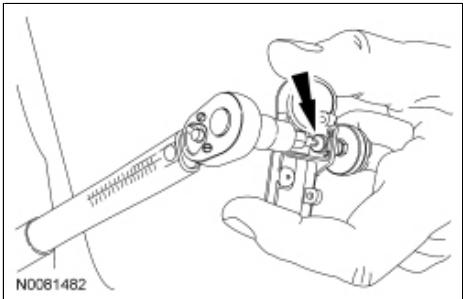
## Assembly

**NOTICE:** Damage to the Tire Pressure Monitoring System (TPMS) sensor may result if the tire mounting is not carried out as instructed.

**1. NOTICE:** To prevent Tire Pressure Monitoring System (TPMS) sensor and valve stem damage, the valve stem must be installed onto the TPMS sensor and then installed into the wheel as an assembly.

Install a new valve stem onto the TPMS sensor.

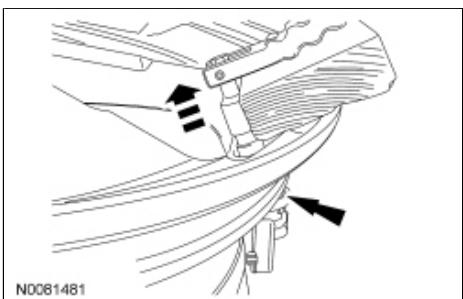
- Tighten the new valve stem-to- TPMS sensor screw to 1.5 Nm (13 lb-in).



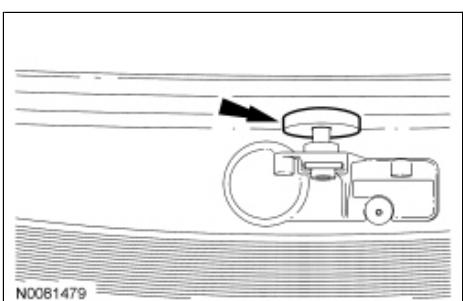
2. **NOTICE:** It is important to pull the valve stem and Tire Pressure Monitoring System (TPMS) sensor assembly through the wheel rim hole in a direction parallel to the valve stem hole axis. If the assembly is pulled through at an angle, damage to the valve stem and sensor assembly may occur.

**NOTICE:** Use care not to damage the wheel surface when installing the valve stem and Tire Pressure Monitoring System (TPMS) sensor assembly.

Lubricate the valve stem with soapy water and install the valve stem and TPMS sensor assembly into the wheel using a block of wood and a suitable valve stem installer.



3. Make sure the valve stem rubber is fully seated against the wheel.



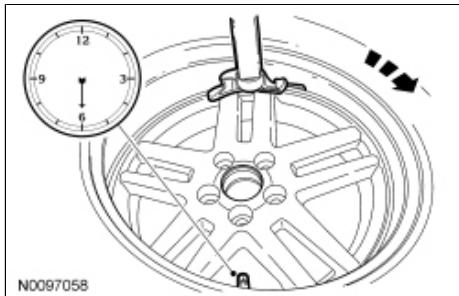
4. **NOTE:** Lubricate the tire beads using a suitable fast-drying, corrosion-inhibiting tire bead lubricant.

**NOTE:** Do not mount the tire at this time.

Position the wheel on the turntable of the tire machine, then lubricate and position the bottom bead of the tire on the wheel.

5. Position the wheel to align the valve stem with the machine arm, at the 6 o'clock position, and mount

the bottom bead of the tire.



6. Reposition the wheel to align the valve stem with the machine arm at the 6 o'clock position, and mount the top bead of the tire.
7. **NOTE:** Use only the Digital Tire Pressure Gauge any time tire pressures are measured to make sure that accurate values are obtained.  
Inflate the tire to the pressure specified on the Vehicle Certification (VC) label located on the driver door or door pillar.
  - Proceed to Step 8 if the tire beads do not seat at the specified inflation pressure.
8. **WARNING:** If there is a need to exceed the maximum pressure indicated on the sidewall of the tire in order to seat the beads, follow all steps listed below. Failure to follow these steps may result in serious personal injury.

The following steps should only be carried out if the tire beads cannot be seated by inflating the tire up to the maximum inflation pressure listed on the tire sidewall.

1. Relubricate the tire bead and wheel bead seat area.
2. Install a remote valve and pressure gauge.
3. Wear eye and ear protection and stand at a minimum of 3.65 m (12 ft) away from the wheel and tire assembly.
4. Inflate the tire using the remote valve and tire gauge until the beads have seated or until the pressure gauge is 138 kPa (20 psi) more than maximum inflation pressure on tire sidewall. If beads have not seated, deflate the tire and proceed to the next step.
5. Place the wheel and tire assembly in an OSHA-approved tire safety cage.
6. Inflate the tire using the remote valve and pressure gauge until the beads have seated or until the pressure gauge is 276 kPa (40 psi) more than maximum inflation pressure on the tire sidewall. **Do not exceed 276 kPa (40 psi) above the maximum pressure on tire sidewall. Install a new tire if the beads do not seat at this pressure.**

9. Install the wheel and tire. For additional information, refer to [Wheel and Tire](#) in this section.



## Tire Pressure Monitoring System (TPMS) Sensor

### Disassembly

1. **NOTE:** The Tire Pressure Monitoring System (TPMS) sensor cannot be removed without disassembly of the wheel and tire.

Disassemble the wheel and tire. For additional information, refer to [Wheel and Tire](#) in this section.

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## Tire Pressure Monitoring System (TPMS)

### Special Tool(s)

 ST2941-A	Activation Tool, Tire Pressure Monitor 204-363
 ST2869-A	Digital Tire Pressure Gauge 204-354
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

### Principles of Operation

**⚠ WARNING:** The tire pressure monitoring system (TPMS) sensor battery may release hazardous chemicals if exposed to extreme mechanical damage. If these chemicals contact the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If any part of the battery is swallowed, contact a physician immediately. When disposing of TPMS sensors, follow the correct procedures for hazardous material disposal. Failure to follow these instructions may result in serious personal injury.

The Tire Pressure Monitor (TPM) module monitors the tire pressure of all 4 road tires. The wheel-mounted tire pressure sensors transmit signals via radio frequency to the TPM module. The TPM module is a radio receiver that collects the tire pressure data from the tire pressure sensors. The TPMS sensor radio transmissions are sent once approximately every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The data is then sent to the Body Control Module (BCM) where a predetermined pass/fail criteria is applied. The BCM compares each TPMS sensor transmission against a low-pressure limit. If it has been determined that the tire pressure has fallen below this limit, the BCM communicates this on the vehicle communication bus to the Instrument Panel Cluster (IPC). The IPC then illuminates the TPMS warning indicator and displays the appropriate message(s) in the message center.

### Ambient Temperature Change and Tire Pressure

Tire pressures fluctuate with temperature changes. For this reason, tire pressure must be set to specification

when tires are at outdoor ambient temperatures. If the vehicle is allowed to warm up to shop temperatures, and the outside temperature is less than shop temperature, the tire inflation pressure must be adjusted accordingly.

If the tires are inflated to specification at shop temperatures, and the vehicle is moved outdoors when the outdoor ambient temperature is significantly lower, the tire pressure may drop enough to be detected by the TPMS and activate the TPMS warning indicator.

As the ambient temperature decreases by 6°C (10°F), tire pressure decreases 7 kPa (1 psi). Adjust the tire pressure by 7 kPa (1 psi) for each 6°C (10°F) ambient temperature drop as necessary to keep the tire at the specified Vehicle Certification (VC) label pressure. Refer to the following tables to adjust the tire pressure indoors for colder outside temperatures.

**Table 1. Use Table to Adjust Tire Pressure Inside Garage for Colder Outside Temperature<sup>1</sup>**  
**\*\* Do Not Inflate Tire Higher than Maximum Pressure Stamped on Tire Sidewall. \*\***

Outside Temperature (°F)	Tire Placard Pressure (PSI)																		
	30	32	34	35	38	40	41	42	45	50	55	60	65	70	75	80	85	90	
70	30	32	34	35	38	40	41	42	45	50	55	60	65	70	75	80	85	90	
60	31	33	35	36	39	41	42	43	46	51	56	61	67	72	77	82	87	92	
50	32	34	36	37	40	42	43	44	47	53	58	63	68	73	79	84	89	94	
40	33	35	37	38	41	43	44	45	49	54	59	64	70	75	80	86	91	96	
30	34	36	38	39	42	44	46	47	50	55	61	66	72	77	82	87	92	97	
20	35	37	39	40	43	46	47	48	51	57	62	67	72	77	82	87	92	97	
10	36	38	40	41	45	47	48	49	52	57	62	67	72	77	82	87	92	97	
0	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97	
-10	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97	
-20	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97	
-30	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97	
-40	37	39	41	42	45	47	48	49	52	57	62	67	72	77	82	87	92	97	

**Table 2. Use Table to Adjust Tire Pressure Inside Garage for Colder Outside Temperature (Metric Units)<sup>1</sup>**  
**\*\* Do Not Inflate Tire Higher than Maximum Pressure Stamped on Tire Sidewall. \*\***

Outside Temperature (°C)	Tire Placard Pressure (kPa)																		
	205	220	235	240	260	275	285	290	310	345	380	415	450	485	515	550	585	620	
21	205	220	235	240	260	275	285	290	310	345	380	415	450	485	515	550	585	620	
16	215	230	240	250	270	285	290	295	315	350	385	420	460	495	530	565	600	635	
10	220	235	250	255	275	290	295	305	325	365	400	435	470	505	545	580	615	650	
4	230	240	255	260	285	295	305	310	340	370	405	440	485	515	550	595	625	660	
-1	235	250	260	270	290	305	315	325	345	380	420	455	495	530	565	600	635	670	
-7	240	255	270	275	295	315	325	330	350	395	425	460	495	530	565	600	635	670	
-12	250	260	275	285	310	325	330	340	360	395	425	460	495	530	565	600	635	670	
-18	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670	
-23	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670	
-29	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670	
-34	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670	
-40	255	270	285	290	310	325	330	340	360	395	425	460	495	530	565	600	635	670	

<sup>1</sup>When Outside (Ambient) Temperature is greater than 21°C (70°F), Inflate tires to placard pressure.

<sup>1</sup>Use the table to adjust tire pressure for P-metric and LT tires only.

<sup>1</sup>Do NOT use table for Commercial Truck Tires (i.e. 19.5 inch tires for F450 & F550). See F-Super Duty Service Manual for tire inflation procedure.

## Tire Pressure Monitoring System (TPMS) Warning Indicator and Message Center Messages

The TPMS warning indicator and vehicle message center sometimes display faults that cannot be resolved by the customer. Treat these messages as TPMS faults that must be serviced.

### Tire Pressure Monitoring System (TPMS) Warning Indicator Illuminates Continuously

**NOTE:** When directed to train or re-train any TPMS sensors, use **only** the sensor training procedure outlined in [Tire Pressure Monitoring System \(TPMS\) Sensor Training](#). Do not use the TPMS reset procedure outlined in the Owner's Literature as this procedure **will not** program new sensors to the module.

The TPMS warning indicator remains on continuously and the message center displays LOW TIRE PRESSURE when any of the tire pressures are low. When this condition exists, adjust the tire pressure to the recommended cold pressure indicated on the VC label.

**NOTE:** The TPMS sensors do not transmit when the vehicle is stationary. If the vehicle has been stationary for more than 30 minutes, it is necessary to wake up the sensors so that they transmit the latest tire pressure information to the TPM module.

If the vehicle has been stationary for more than 30 minutes, carry out the [Tire Pressure Monitoring System \(TPMS\) Sensor Activation](#) procedure in this section.

### TPMS Warning Indicator Flashes

The TPMS warning indicator flashes for 70 seconds, then remains ON continuously when the ignition switch is turned to the ON position and 1 or more of the following conditions exists:

- Tire Pressure Sensor Fault — The message center displays TIRE PRESSURE SENSOR FAULT when a TPMS sensor is malfunctioning. GO to [Symptom Chart](#).
- No communication with the BCM. The TPMS indicator is illuminated when the IPC has not received any signals from the BCM for more than 5 seconds. The message center displays TIRE PRESSURE MONITOR FAULT. GO to [Symptom Chart](#).
- Tire Pressure Monitor Fault — The message center displays TIRE PRESSURE MONITOR FAULT when the TPMS is malfunctioning or communication with the IPC has been lost. GO to [Symptom Chart](#).

The TP\_STAT PID can be used to determine why the TPMS warning indicator is flashing.

## Tire Pressure Monitoring System (TPMS) PID Definitions and Intermittent Troubleshooting

### TPMS Status PID

The TPM monitors the TPMS status. The current status can be viewed by accessing the TPMS status PID : TPMS\_STAT using the scan tool. This helps identify the current system status and may aid in diagnosing the system. The PID has 4 valid states:

1. TPMS\_STAT = SENSOR FAULT.
  - If the module has not received the tire pressure status from 1 to 3 TPMS sensors for 20 minutes when the vehicle speed is above 32 km/h (20 mph), the PID displays SENSOR FAULT.

2. TPMS\_STAT = SYSTEM FAULT.
  - If the module has not received the tire pressure status from all 4 TPMS sensors for 20 minutes and the vehicle speed is above 32 km/h (20 mph), the PID displays SYSTEM FAULT.
3. TPMS\_STAT = LOW.
  - If the module has detected that at least 1 TPMS sensor is reporting low tire pressure, the PID displays LOW.
4. TPMS\_STAT = SYSTEM ACTIVE.
  - If the TPMS is functioning normally, the PID displays SYSTEM ACTIVE.

#### **TPMS Last Warning Event PID Definitions**

The TPMS uses the TPMS last warning event PIDs to store detailed information about the last 5 times the TPMS warning indicator was activated. These PIDs can be used to acquire more information about a particular TPMS event, but must be used carefully.

#### **EVT1\_AGE\_IGN through EVT5\_AGE\_IGN**

The number of key cycles since the TPMS indicator was activated. This PID cycles from zero to 255. Default is \$00, this can be used to determine how long ago a TPMS event occurred and the time (in key cycles) between events.

#### **EVT1\_TR\_LOC through EVT5\_TR\_LOC**

This is the last programmed location for the sensor identifier causing each TPMS event. Due to tire rotation, the sensor may no longer be at the original location. It is suggested that all the PIDs be recorded, the system retrained, and then the sensor identifier PIDs be used to pinpoint the actual location of each sensor.

#### **EVT1\_PRESS through EVT5\_PRESS**

This is the tire pressure associated with each TPMS warning indicator event. This can be used along with the function code to clearly identify the TPMS events that were strictly due to low pressure. It can also be used to determine when a sensor is transmitting inaccurate tire pressure.

#### **EVT1\_SNSR\_ST through EVT5\_SNSR\_ST**

Describes the warning status of each TPMS event by using the information received from the TPMS status (TPMS\_STAT) PID. If there is a communication issue, the status could be Normal.

- Unknown
- Normal (normal operation)
- Low (low pressure event)
- Fault (sensor fault or system fault)

#### **EVT1\_SNSR\_ID through EVT5\_SNSR\_ID**

This is the identifier of the sensor involved in each TPMS event. EVT1 is the most recent event that triggered the TPMS warning indicator. Default is \$ 00 00 00 00.

#### **Wheel Rotation and Sensor Training Techniques**

##### **Moving a Problem Sensor/Wheel to a Different Position**

If a sensor in a certain location has caused several events, yet the sensor trains and seems to operate normally, moving that particular wheel to a different location on the vehicle is a good way to isolate the issue to a certain sensor/wheel location. Rotate the wheels and road test the vehicle. This can be done in an attempt to replicate the issue. This determines if the issue followed the sensor or remained in the original sensor location.

### **Training Sensors in a Different Order**

This is a technique to get past a left front sensor that may not be responding to determine if the remaining sensors train to the module. This can help save time determining if other sensors are having issues or if the module is experiencing training difficulties with a certain location.

### **Training Known Good Sensors From Another Vehicle**

Training known good sensors from another vehicle cannot differentiate between a faulted module and Radio Frequency Interference (RFI), as some noise source could be preventing the TPM module from receiving the tire pressure status from the original sensors as well as the known good sensors. This technique can be used to differentiate between a sensor and module issue. If the TPM module cannot train any of the sensors on the same vehicle, and likewise cannot train known good sensors from another vehicle, then the issue is with the TPM module or RFI and not with the original sensors. The original sensors should not be replaced.

### **Items That Cause RFI**

#### **Non-OEM Equipment**

The following equipment has been found to sometimes cause RFI:

- Video equipment has been found to cause RFI especially when the video and power supply lines are near the TPMS.
- Car alarms (even those installed by dealerships) have been found to create enough RFI to cause the TPMS to malfunction or lose considerable range. These car alarms can sometimes be difficult to locate, as they are usually hidden somewhere out of the way for reduced accessibility.
- Many different in-vehicle cell phone chargers have been found to cause considerable RFI. The vehicles with the power point closest to the TPM module are the most affected. It must be noted that most cell phone chargers do not produce high levels of RFI all the time. This depends on the state of charge of the cell phone battery. The phone must be almost completely discharged in some cases.
- Power supplies and DC/AC inverters typically create a lot of RFI. Most consumer grade equipment has very little filtering or shielding.

#### **OEM Modules**

In some cases, the RFI may actually be caused by a module or ground on the vehicle. Depending on the severity of the issue, a dirty ground, improperly built ground shield or module can disable the system. Modules that have microcontrollers using clock circuits to create the timing pulses for the microprocessor may radiate RFI.

### **Using Customer's Electronics to Pinpoint the Radio Frequency Interference (RFI) Source**

This can be a way to determine the cause of an issue well before the sensors and module are replaced with little or no affect on the system performance. Since this takes more up-front work, it relies on working with the customer to determine what equipment was being used at the time of the event.

### **Options for Eliminating Intermittent TPMS Conditions Caused by RFI**

- If an OEM component or customer device is causing an RFI issue, replace the device.

- If a phone charger is causing an RFI issue, the customer should consult their cell phone provider to acquire a different phone charger.
- If a device such as a dealer-installed alarm is causing an RFI issue, move the device to another location on the vehicle. In the case of a portable device, move the power cord to another power point location.

In summary, if the RFI source is present and cannot be moved or replaced, the intermittent issue remains. The TPMS system must accept RFI and the unwanted system operation it can cause.

### **Inspection and Verification**

1. Verify the customer concern. Keep the following items in mind when diagnosing any TPMS related issue:
  - The tire pressure sensors are not designed to be used with aftermarket wheels. The use of run-flat tires (tires with steel body cord plies in the tire sidewall) that are not originally equipped, may block the TPMS signal and are not recommended.
  - Non-OEM modifications made to the vehicle may result in false TPMS warnings.
  - Swapping wheels on vehicles with the same TPMS sensors sets a fault if the sensors are not trained. Refer to [Tire Pressure Monitoring System \(TPMS\) Sensor Training](#) in this section.
  - The tire pressure calibrations in the TPM for the system cannot be changed to use lower tire pressures than those listed on the Vehicle Certification (VC) label.
  - Certain non-OEM electronic equipment may cause RFI and false TPMS warnings. To aid in diagnosis, obtain information from the owner regarding any equipment that has been added or was in use at the time the TPMS fault occurred.
  - It may be necessary to disconnect any electronic add-on equipment to verify its impact on TPMS operation. For intermittent cases, it may be necessary to ask the customer to provide portable electronic equipment to verify its impact on the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

### **Visual Inspection Chart**

<b>Mechanical</b>	<b>Electrical</b>
<ul style="list-style-type: none"> <li>• Low tire pressure</li> <li>• Spare tire installed as a road wheel</li> <li>• Sensors not trained after a tire rotation</li> <li>• Tire Pressure Monitoring System (TPMS) sensor damaged or missing</li> <li>• Incorrect <u>TPMS</u> sensor installed</li> <li>• <u>TPMS</u> sensor installed incorrectly</li> <li>• Non-OEM wheels installed (aftermarket rims)</li> <li>• Non-OEM equipped run-flat tires or rigid sidewall tires (19.5" steel carcass heavy-duty tires) installed</li> <li>• Other non-OEM modifications (roll cages, service barriers, part racks, ladder racks)</li> </ul>	<ul style="list-style-type: none"> <li>• Body Control Module (BCM) fuse 26 (5A)</li> <li>• Wiring, terminals or connectors</li> <li>• <u>TPM</u> missing or damaged</li> <li>• Aftermarket electronic accessories (in-car chargers or supplies, DC/AC inverters, video screens, car alarms)</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.  
If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).
5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.  
If the scan tool does not communicate with the VCM:
  - check the VCM connection to the vehicle.
  - check the scan tool connection to the VCM.
  - refer to [Section 418-00](#), No Power To The Scan Tool, to diagnose no power to the scan tool.
6. If the scan tool does not communicate with the vehicle:
  - verify the ignition key is in the ON position.
  - verify the scan tool operation with a known good vehicle.
  - refer to [Section 418-00](#), The PCM Does Not Respond To the Scan Tool, to diagnose no response from the PCM.
7. Carry out the network test.
  - If the scan tool responds with no communication for one or more modules, refer to [Section 418-00](#).
  - If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).
8. Clear the CMDTCs and carry out the self-test diagnostics for the BCM and the TPM module.
9. If the DTCs retrieved are related to the concern, go to the BCM DTC Chart or the TPM Module DTC Chart. For all other DTCs, refer to the Diagnostic Trouble Code (DTC) Chart in [Section 419-10](#).
10. If no DTCs related to the concern are retrieved, GO to [Symptom Chart](#).

## DTC Charts

### Body Control Module (BCM) DTC Chart

DTC	Description	Action
B1182:00	Tire Pressure Monitoring System (TPMS): No Sub Type Information	<a href="#">GO to Pinpoint Test F</a> .
B1182:55	Tire Pressure Monitoring System (TPMS): Not Configured	This DTC is only present when a new BCM is installed, the BCM is flashed or is reconfigured. TRAIN the tire pressure sensors. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.
B124D:02	Tire Pressure Sensor: General Signal Failure	<p><b>NOTE:</b> If the vehicle has been stationary for more than 30 minutes, the sensors go into sleep mode to conserve battery power. It may be necessary to wake them up so they transmit the latest tire pressure information to the <u>TPM</u> module.</p> <p>ACTIVATE the TPMS sensors. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Activation</a> in this section.</p>

		REPEAT the self-test. If DTC B124D:02 is retrieved again, <a href="#">GO to Pinpoint Test F</a> .
B1251:00	Tire Pressure Sensor Low Battery: No Sub Type Information	<a href="#">GO to Pinpoint Test H</a> .
B1254:51	Right Rear (Outside on Dual Wheel) Tire Pressure Sensor and Transmitter Assembly: Not Programmed	This DTC is only present when a new <u>BCM</u> is installed, the <u>BCM</u> is flashed or reconfigured. TRAIN the tire pressure sensors. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.
B1255:51	Left Rear (Outside on Dual Wheel) Tire Pressure Sensor and Transmitter Assembly: Not Programmed	This DTC is only present when a new <u>BCM</u> is installed, the <u>BCM</u> is flashed or reconfigured. TRAIN the tire pressure sensors. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.
C1A56:51	Left Front Tire Pressure Sensor and Transmitter Assembly: Not Programmed	This DTC is only present when a new <u>BCM</u> is installed, the <u>BCM</u> is flashed or reconfigured. TRAIN the tire pressure sensors. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.
C1A58:51	Right Front Tire Pressure Sensor and Transmitter Assembly: Not Programmed	This DTC is only present when a new <u>BCM</u> is installed, the <u>BCM</u> is flashed or reconfigured. TRAIN the tire pressure sensors. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.
All other DTCs	—	REFER to <a href="#">Section 419-10</a> .

#### Tire Pressure Monitor (TPM) Module DTC Chart

DTC	Description	Action
B1D55:01	Antenna #2: General Electrical Failure	REFER to <a href="#">Section 303-06</a> .
U0140:87	Lost Communication with Body Control Module: Missing Message	<a href="#">GO to Pinpoint Test I</a> .
U0422:68	Invalid Data Received from Body Control Module (BCM): Event Information	RETRIEVE and REPAIR all non-network DTCs in the <u>BCM</u> . REFER to <a href="#">Section 419-10</a> .

#### Symptom Chart

#### Symptom Chart

**NOTE:** For vehicles with different front and rear tire pressures, the tire pressures must be adjusted and the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors results in a false low tire pressure event, causing the Tire Pressure Monitoring System (TPMS) indicator to illuminate.

For vehicles with the same tire pressure for front and rear tires, training the sensors is not necessary after a tire rotation.

**Failure of a TPMS component may not cause the message center to display a fault message or store a DTC. The Symptom Chart is a starting point to begin diagnosis of these concerns.**

Condition	Possible Sources	Action
• The Tire Pressure Monitoring System (TPMS) warning indicator is on continuously and the message center displays LOW TIRE PRESSURE	<ul style="list-style-type: none"> <li>• Spare tire currently in use</li> <li>• Tire pressure not set to specifications listed on the Vehicle Certification (VC) label</li> <li>• <u>TPMS</u> sensors not trained following tire rotation</li> <li>• <u>TPMS</u> sensor(s)</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test D.</a></li> </ul>
• The Body Control Module (BCM) cannot enter sensor training mode when using the <u>TPMS</u> sensor training procedure	<ul style="list-style-type: none"> <li>• Stoplamp switch concern</li> <li>• Ignition switch concern</li> <li>• <u>BCM</u></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test E.</a></li> </ul>
• The <u>TPMS</u> warning indicator illuminates with DTCs present	<ul style="list-style-type: none"> <li>• Not all <u>TPMS</u> sensors are installed</li> <li>• <u>TPMS</u> sensors not trained</li> <li>• <u>TPMS</u> sensor(s)</li> <li>• Intermittent <u>TPMS</u> operation due to Radio Frequency Interference (RFI)</li> <li>• <u>TPM</u> module wiring</li> <li>• <u>TPM</u> module</li> <li>• <u>BCM</u> wiring</li> <li>• <u>BCM</u></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test F.</a></li> </ul>
• The <u>TPMS</u> warning indicator illuminates with no DTCs present	<ul style="list-style-type: none"> <li>• Communication network concern</li> <li>• Instrument Panel Cluster (IPC)</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to <a href="#">Section 413-01</a> to diagnose the <u>TPMS</u> warning indicator is always on.</li> </ul>
• One or more <u>TPMS</u> sensors do not train and DTCs are present	<ul style="list-style-type: none"> <li>• <u>TPMS</u> sensor(s)</li> <li>• Vehicle communication issue</li> <li>• Intermittent <u>TPMS</u> operation due to <u>RFI</u></li> <li>• <u>TPM</u> module wiring</li> <li>• <u>TPM</u> module</li> <li>• <u>BCM</u> wiring</li> <li>• <u>BCM</u></li> </ul>	<ul style="list-style-type: none"> <li>• FOLLOW the diagnostics for the DTC(s) retrieved. REFER to DTC Charts in this section.</li> </ul>
• One or more <u>TPMS</u> sensors do not train and no DTCs are present	<ul style="list-style-type: none"> <li>• <u>TPMS</u> sensor(s)</li> <li>• Radio Frequency Interference (RFI)</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test G.</a></li> </ul>

## Pinpoint Tests

## **Pinpoint Test D: The Tire Pressure Monitoring System (TPMS) Warning Indicator Is ON Continuously and The Message Center Displays LOW TIRE PRESSURE**

### **Normal Operation**

The Tire Pressure Monitor (TPM) module monitors the air pressure of all 4 road tires. The wheel-mounted tire pressure sensors transmit data via radio frequency signals to the TPM module. The TPM module is a radio receiver that collects the air pressure data from the Tire Pressure Monitoring System (TPMS) tire pressure sensors. The data is then sent to the Body Control Module (BCM) where a predetermined pass/fail criteria is applied. The TPMS sensor radio transmissions are sent approximately once every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The BCM compares each TPMS sensor transmission against a low-pressure limit. If it has been determined that the tire pressure has fallen below this limit, the BCM communicates this on the vehicle communication bus to the Instrument Panel Cluster (IPC). The IPC then illuminates the TPMS warning indicator and displays the appropriate message(s) in the message center.

This symptom can also be caused by a spare tire currently being used in place of a road tire. Make sure that the spare tire is not currently in use. On vehicles with different front and rear tire pressures, if the sensors are not trained following a tire rotation, this symptom may result. Advise the customer that on vehicles with different front and rear tire pressures, the sensors must be trained as directed in the Owner's Literature.

#### **This pinpoint test is intended to diagnose the following:**

- Spare tire currently in use
- Tire pressure not set to specifications listed on the Vehicle Certification (VC) label
- TPMS sensors not trained following tire rotation
- TPMS sensor(s)

## **PINPOINT TEST D: THE TPMS WARNING INDICATOR IS ON CONTINUOUSLY AND THE MESSAGE CENTER DISPLAYS LOW TIRE PRESSURE**

**NOTE:** Use only the Digital Tire Pressure Gauge any time tire pressures are measured to be sure that accurate values are obtained.

**NOTE:** If a warranty case is opened for an actual TPMS fault, document and include the actual tire pressure data in all warranty communications.

Test Step	Result / Action to Take
<b>D1 CHECK FOR LOW TIRE PRESSURE</b> <ul style="list-style-type: none"><li>● Using the Digital Tire Pressure Gauge, measure and record the air pressure in all 4 tires.</li><li>● Adjust the pressure for those found to be below the specification listed on the <u>VC</u> label.</li><li>● Activate each sensor at least twice with the training tool or customer activation tool to make sure the <u>TPM</u> module gets the latest air pressure data. Refer to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Activation</a> or drive the vehicle for at least 2 minutes above 32 km/h (20 mph) to clear the low pressure warning. Do not train the sensors at this time.</li><li>● Has the <u>TPMS</u> warning indicator gone out?</li></ul>	<b>Yes</b> The system is operating correctly at this time. The concern was caused by low tire pressure. <b>No</b> GO to <a href="#">D2</a> .
<b>D2 CHECK FOR SPARE TIRE IN USE</b>  <b>NOTE:</b> The spare tire is not programmable even if it is	<b>Yes</b> REPAIR and REMOUNT the

<p>equipped with a <u>TPMS</u> sensor. If a damaged road wheel is located in the cargo area, the sensor may still be recognized by the <u>TPMS</u> as low. Make sure the spare tire is not currently in use. To restore <u>TPMS</u> functionality, repair the damaged road wheel and re-mount it to the vehicle.</p> <ul style="list-style-type: none"> <li>• Check spare tire location.</li> <li>• <b>Is the spare tire in use?</b></li> </ul>	<p>wheel to the vehicle. REFER to <a href="#">Wheel and Tire</a> in this section. ADJUST tire pressures to the required pressure as defined on the <u>VC</u> label located in the driver door jam.</p> <p><b>No</b> GO to <a href="#">D3</a>.</p>
<p><b>D3 CHECK IF THE TIRES WERE ROTATED WITHOUT <u>TPMS</u> SENSOR TRAINING</b></p> <p><b>NOTE:</b> If the <u>TPMS</u> sensors at the front of the vehicle are still trained in the rear positions but inflated to the front air pressures, the <u>TPMS</u> warning indicator illuminates continuously.</p> <ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: DataLogger — <u>BCM</u>.</li> <li>• Monitor and record the following <u>BCM</u> PIDs: <ul style="list-style-type: none"> <li>■ Left Front Tire Pressure (TPM_PRES_LF)</li> <li>■ Right Front Tire Pressure (TPM_PRES_RF)</li> <li>■ Left Rear Tire Pressure (TPM_PRES_LRO)</li> <li>■ Right Rear Tire Pressure (TPM_PRES_RRO)</li> </ul> </li> <li>• <b>Do the rear PIDs show front air pressures and the front PIDs show rear air pressures?</b></li> </ul>	<p><b>Yes</b> The tires have been rotated without training the sensors. TRAIN the sensors. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.</p> <p><b>No</b> GO to <a href="#">D4</a>.</p>
<p><b>D4 CHECK FOR STUCK <u>TPMS</u> SENSOR</b></p> <ul style="list-style-type: none"> <li>• Monitor and record the following <u>BCM</u> PIDs: <ul style="list-style-type: none"> <li>■ Left Front Tire Pressure (TPM_PRES_LF)</li> <li>■ Right Front Tire Pressure (TPM_PRES_RF)</li> <li>■ Left Rear Tire Pressure (TPM_PRES_LRO)</li> <li>■ Right Rear Tire Pressure (TPM_PRES_RRO)</li> </ul> </li> <li>• Using the Digital Tire Pressure Gauge, measure the actual tire pressures.</li> <li>• Compare the air pressure PIDs with the actual air pressures.</li> <li>• <b>Do the compared tire pressure values match within ± 5 psi?</b></li> </ul>	<p><b>Yes</b> REFER to <a href="#">Section 413-01</a> to diagnose the <u>TPMS</u> warning indicator is always on.</p> <p><b>No</b> INSTALL a new <u>TPMS</u> sensor(s) for the sensor(s) in question. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor</a> in this section.</p>

#### Pinpoint Test E: The Body Control Module (BCM) Cannot Enter Sensor Training Mode When Using the Tire Pressure Monitoring System (TPMS) Sensor Training Procedure

##### Normal Operation

For the Body Control Module (BCM) to enter Tire Pressure Monitoring System (TPMS) sensor training mode, the BCM must receive valid inputs from the stoplamp switch (off) and ignition switch (run), and it must receive valid vehicle speed sensor input (0 km/h [0 mph]). Refer to [Tire Pressure Monitoring System \(TPMS\) Sensor Training](#) in this section for the complete sensor training procedure.

##### This pinpoint test is intended to diagnose the following:

- Stoplamp switch concern
- Ignition switch concern
- BCM

**PINPOINT TEST E: THE BCM CANNOT ENTER SENSOR TRAINING MODE WHEN USING THE TPM SENSOR TRAINING PROCEDURE**

Test Step	Result / Action to Take
<b>E1 CHECK THE STOPLAMP OPERATION</b>	<p><b>Yes</b> GO to <a href="#">E2</a>.</p> <p><b>No</b> REFER to <a href="#">Section 417-01</a> to continue diagnosis of the stoplamp switch.</p>
<b>E2 CHECK THE IGNITION SWITCH INPUT</b>	<p><b>Yes</b> GO to <a href="#">E3</a>.</p> <p><b>No</b> REFER to <a href="#">Section 211-05</a> to continue diagnosis of the ignition switch.</p>
<b>E3 CHECK FOR VEHICLE SPEED-RELATED DTCs IN THE <u>BCM</u></b>	<p><b>Yes</b> REFER to the <u>BCM</u> DTC Chart in <a href="#">Section 419-10</a>.</p> <p><b>No</b> GO to <a href="#">E4</a>.</p>
<b>E4 CHECK FOR CORRECT <u>BCM</u> OPERATION</b>	<p><b>Yes</b> INSTALL a new <u>BCM</u>. REFER to <a href="#">Section 419-10</a>. TEST the system for normal operation.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.</p>

**Pinpoint Test F: The Tire Pressure Monitoring System (TPMS) Warning Indicator Illuminates With DTCs Present**

**Normal Operation**

If there is a fault with 1, 2 or 3 of the Tire Pressure Monitoring System (TPMS) sensors, DTC B124D:02 sets. The TPMS warning indicator flashes for 70 seconds and then remains on continuously when the ignition switch is turned to the ON position and the message center displays TIRE PRESSURE SENSOR FAULT.

If the TPM module does not get a response from all 4 of the TPMS sensors and transfers that information to

the BCM, DTC B1182:00 sets and the message center displays TIRE PRESSURE MONITOR FAULT.

It should be noted that TPMS sensor communication to the TPM module can be interrupted by radio frequency noise, which can cause intermittent issues that are not vehicle concerns. Radio frequency noise is generated by electrical motors and appliance operation, cellular telephones, remote transmitters, power inverters and portable entertainment equipment. Anytime the TPMS sensor training procedure is performed successfully, the warning indicator is extinguished and the vehicle must be driven for 18-20 minutes before the TPM module sets a fault.

- DTC B1182:00 (Tire Pressure Monitoring System (TPMS): No Sub Type Information) — set by the BCM when **all 4** of the tire pressure sensors are faulted, not responding or not heard by the TPM module.
- DTC B124D:02 (Tire Pressure Sensor: General Signal Failure) — set by the BCM when 1, 2 or 3 of the tire pressure sensors are faulted, not responding or not heard by the TPM module.
- TPMS\_STAT PID = SENSOR FAULT — when the BCM does not receive the tire pressure status for 1 to 3 TPMS sensors from the TPM module for 20 minutes with vehicle speed above 32 km/h (20 mph).
- TP\_STAT PID = SYSTEM FAULT when the BCM does not receive a signal transmission from **all 4** TPMS sensors from the TPM module for 20 minutes with vehicle speed above 32 km/h (20 mph).

**This pinpoint test is intended to diagnose the following:**

- Not all TPMS sensors are installed
- TPMS sensors not trained
- TPMS sensor(s)
- TPM module wiring
- TPM module
- BCM wiring
- BCM

#### **PINPOINT TEST F: THE TPMS WARNING INDICATOR ILLUMINATES WITH DTCs PRESENT**

**NOTE:** If a warranty case is opened for an actual TPMS fault, document and include the actual tire pressure data in all warranty communications.

**NOTE:** If the vehicle has been stationary for more than 30 minutes, the sensors go into a "sleep mode" to conserve battery power. It is necessary to wake them up so that they transmit the latest tire pressure information to the TPM module.

Test Step	Result / Action to Take
<b>F1 VERIFY TPM MODULE COMMUNICATION</b> <ul style="list-style-type: none"><li>• Ignition ON.</li><li>• Using a scan tool, carry out the Network Test.</li><li>• <b>Does the <u>TPM</u> module pass the Network Test?</b></li></ul>	<p><b>Yes</b> GO to <a href="#">F2</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a> to diagnose the <u>TPM</u> module does not respond to the scan tool.</p>
<b>F2 CHECK THE SENSOR IDENTIFIER PIDs AND SYSTEM STATUS PID</b> <ul style="list-style-type: none"><li>• Enter the following diagnostic mode on the scan tool: DataLogger —</li></ul>	<p><b>Yes</b> GO to <a href="#">F3</a>.</p>

<p><u>BCM</u>.</p> <ul style="list-style-type: none"> <li>• Read and record the following PIDs:           <ul style="list-style-type: none"> <li>▪ Left Front Tire Transmitter Identifier (TPM_S_ID_LF)</li> <li>▪ Right Front Tire Transmitter Identifier (TPM_S_ID_RF)</li> <li>▪ Left Rear Tire Transmitter Identifier (TPM_S_ID_LRO)</li> <li>▪ Right Rear Tire Transmitter Identifier (TPM_S_ID_RRO)</li> </ul> </li> <li>• Monitor the <u>TPMS</u> system status (<u>TPMS_STAT</u>) <u>PID</u>.</li> <li>• Does the <u>TPMS_STAT PID</u> display <u>SENSOR FAULT</u>?</li> </ul>	<p><b>No</b></p> <p>If the <u>TPMS_STAT PID</u> displays <u>SYSTEM FAULT</u>, GO to <a href="#">F4</a>.</p>
<p><b>F3 CARRY OUT THE SENSOR TRAINING PROCEDURE (SENSOR FAULT)</b></p> <ul style="list-style-type: none"> <li>• Train all 4 tire pressure sensors. Refer to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.</li> <li>• <b>Did all of the tire pressure sensors transmit correctly and did the horn sound when each TPMS sensor transmitted to the TPM module?</b></li> </ul>	<p><b>Yes</b></p> <p>Using the scan tool, LOCATE the updated <u>TPMS</u> sensor identifiers trained to the <u>BCM</u> module. COMPARE these values to those recorded prior to the <u>TPMS</u> sensor training procedure. Disregarding sensor position, any sensor identifiers that do not match those retrieved from the module were changed, but not retrained. The sensors are now trained to the vehicle, diagnosis is complete. DOCUMENT all <u>TPMS</u> sensor identifiers on the applicable warranty claim.</p> <p>TEST the system for normal operation.</p> <p><b>No</b></p> <p><b>Before installing a new sensor(s)</b> : If a sensor does not respond to the Tire Pressure Monitor Activation Tool, MOVE the vehicle to rotate the wheels at least one-fourth of a turn and ATTEMPT to activate the same sensor again. If the sensor still fails to train, ATTEMPT to train the sensor with the vehicle doors open. If the sensor(s) fails to train a second time, INSTALL a new <u>TPMS</u> sensor(s) for the sensor(s) in question. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor</a> in this section.</p>
<p><b>F4 CARRY OUT THE SENSOR TRAINING PROCEDURE (SYSTEM FAULT)</b></p> <ul style="list-style-type: none"> <li>• Train all 4 tire pressure sensors. Refer to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.</li> <li>• <b>Did all of the tire pressure sensors transmit correctly and did the horn sound when each TPMS sensor transmitted to the TPM module?</b></li> </ul>	<p><b>Yes</b></p> <p>Using the scan tool, LOCATE the updated <u>TPMS</u> sensor identifiers trained to the <u>BCM</u> module. COMPARE these values to those recorded prior to the Tire Pressure Monitoring System (TPMS) Sensor Training procedure. Disregarding sensor position, any sensor identifiers that do not match those retrieved from the module were changed, but not retrained. The sensors are now trained to the vehicle, diagnosis is complete. DOCUMENT all <u>TPMS</u> sensor identifiers on the applicable warranty claim.</p> <p>TEST the system for normal operation.</p>

	<p><b>No</b></p> <p><b>Before installing a TPM module :</b> If sensors do not respond to the Tire Pressure Monitor Activation Tool, MOVE the vehicle to rotate the wheels at least one-fourth of a turn and ATTEMPT to activate the same sensors again. If the sensors still fail to train, ATTEMPT to train the sensors with the vehicle doors open. If the sensors still fail to train, INSTALL a new TPM module. REFER to <a href="#">Tire Pressure Monitor (TPM) Module</a> in this section. TEST the system for normal operation. If the concern is still present, GO to <a href="#">F5</a>.</p>
<b>F5 CHECK FOR CORRECT BCM OPERATION</b>	<p><b>Yes</b></p> <p><b>NOTE:</b> The TPMS sensors may not be present. DISMOUNT the tire. REFER to <a href="#">Wheel and Tire</a> in this section. VERIFY the TPMS sensors are present and mounted to the wheels. If missing, INSTALL new TPMS sensors.</p> <p>If the TPMS sensors are present, INSTALL a new BCM. REFER to <a href="#">Section 419-10</a>. CLEAR the DTCs. REPEAT the self-test.</p> <p><b>No</b></p> <p>The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

#### Pinpoint Test G: One Or More TPMS Sensors Do Not Train And No DTCs Are Present

**NOTE:** If the vehicle has been stationary for more than 30 minutes, the sensors go into a sleep mode to conserve battery power. It becomes necessary to wake them up so they transmit the latest tire pressure information to the TPM module. For additional information, refer to [Tire Pressure Monitoring System \(TPMS\) Sensor Activation](#) in this section.

##### Normal Operation

The TPM module monitors the tire pressure of all 4 road tires. The wheel-mounted tire pressure sensors transmit signals via radio frequency to the Tire Pressure Monitor (TPM) module. The TPM module is a radio receiver that collects the tire pressure data from the tire pressure sensors. The TPMS sensor radio transmissions are sent approximately once every 60 seconds when the vehicle speed exceeds 32 km/h (20 mph). The BCM learns the position on the vehicle of each TPMS sensor through the training process. Refer to [Tire Pressure Monitoring System \(TPMS\) Sensor Training](#) in this section for the complete sensor training procedure.

**This pinpoint test is intended to diagnose the following:**

- TPMS sensors
- Radio Frequency Interference (RFI)

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#### PINPOINT TEST G: ONE OR MORE TPMS SENSORS DO NOT TRAIN AND NO DTCs ARE PRESENT

Test Step	Result / Action to Take
<b>G1 ATTEMPT TO TRAIN THE TPMS SENSORS</b> <p><b>NOTE:</b> Banded TPMS sensors are not compatible with the valve mounted <u>TPMS</u> sensor system.</p> <p><b>NOTE:</b> The <u>BCM</u> has a 2-minute time limit between sensor responses. If the <u>BCM</u> does not recognize any 1 of the 4 tire pressure sensors during this time limit, the horn sounds twice, the message center displays TIRE NOT TRAINED REPEAT, and the entire procedure must be repeated.</p> <ul style="list-style-type: none"> <li>• Train all 4 <u>TPMS</u> sensors. Refer to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.</li> <li>• <b>Do all of the <u>TPMS</u> sensors train?</b></li> </ul>	<p><b>Yes</b> The system is operating correctly at this time. The concern may have been caused by <u>RFI</u>.</p> <p><b>No</b> If one or more <u>TPMS</u> sensors trained, GO to <a href="#">G2</a>. If none of the <u>TPMS</u> sensors trained, <a href="#">GO to Pinpoint Test E</a>.</p>
<b>G2 CHECK FOR RADIO FREQUENCY INTERFERENCE</b> <ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Move the vehicle to rotate the wheels at least one-fourth turn.</li> <li>• Train all 4 <u>TPMS</u> sensors. Refer to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.</li> <li>• <b>Did the <u>TPMS</u> sensor(s) train?</b></li> </ul>	<p><b>Yes</b> The system is operating correctly at this time. The concern may have been caused by <u>RFI</u>.</p> <p><b>No</b> ATTEMPT to train the <u>TPMS</u> sensor(s) with the doors open. If the <u>TPMS</u> sensor(s) still do not train INSTALL a new <u>TPMS</u> sensor(s) for the sensor(s) in question. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test H: DTC B1251:00

##### Normal Operation

- DTC B1251:00 (Tire Pressure Sensor Low Battery: No Sub Type Information) — This DTC sets in continuous memory in the Body Control Module (BCM) when there is a fault in the Tire Pressure Monitoring System (TPMS), such as a damaged or missing TPMS sensor(s), or when attempting to train a TPMS sensor(s) with a low battery. The TPMS warning indicator flashes for 70 seconds then illuminates continuously when the ignition switch is turned to the ON position. The message center also displays TIRE PRESSURE SENSOR FAULT.

This pinpoint test is intended to diagnose the following:

- TPMS sensor(s)

#### PINPOINT TEST H: DTC B1251:00

Test Step	Result / Action to Take
<b>H1 TRAIN THE TPMS SENSORS TO DETERMINE THE INOPERATIVE SENSOR</b>	

<ul style="list-style-type: none"> <li>Train all 4 <u>TPMS</u> sensors. Refer to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor Training</a> in this section.</li> <li><b>Did all of the <u>TPMS</u> sensors transmit correctly when each <u>TPMS</u> sensor transmitted to the <u>TPM</u> module?</b></li> </ul>	<p><b>Yes</b> CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p> <p><b>No</b> If the <u>TPMS</u> sensors fail to train, REFER to <b>Wheel Rotation And Sensor Training Techniques</b> in this section.</p> <p>If the <u>TPMS</u> sensor(s) fails to train a second time, INSTALL a new <u>TPMS</u> sensor(s) for the sensor(s) in question. REFER to <a href="#">Tire Pressure Monitoring System (TPMS) Sensor</a> in this section.</p>
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### Pinpoint Test I: DTC U0140:87

#### Normal Operation

- DTC U0140:87 (Lost Communication With Body Control Module: Missing Message) — This DTC is set by the Tire Pressure Monitor (TPM) module in continuous memory if data messages received from the BCM are missing.

This pinpoint test is intended to diagnose the following:

- Communication network concern
- TPM module
- BCM

### PINPOINT TEST I: DTC U0140:87

Test Step	Result / Action to Take
<b>I1 VERIFY THE CUSTOMER CONCERN</b> <ul style="list-style-type: none"> <li>Ignition ON.</li> <li>Verify there is an observable symptom present.</li> <li><b>Is an observable symptom present?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">I2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>I2 CHECK THE COMMUNICATION NETWORK</b> <ul style="list-style-type: none"> <li>Ignition ON.</li> <li>Using a scan tool, carry out the Network Test.</li> <li><b>Do both the <u>BCM</u> and the <u>TPM</u> module pass the Network Test?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">I3</a>.</p> <p><b>No</b> If either module does not pass the Network Test, REFER to <a href="#">Section 418-00</a> to diagnose the <u>BCM</u> does not respond to the scan tool or the <u>TPM</u> module does not respond to the scan tool.</p>
<b>I3 CHECK THE <u>TPM</u> MODULE</b>	

<p><b>CMDTCs</b></p> <ul style="list-style-type: none"> <li>• Using a scan tool, carry out the <u>TPM</u> module self-test.</li> <li>• Using a scan tool, clear the <u>TPM</u> module DTCs.</li> <li>• Ignition OFF.</li> <li>• Wait 10 seconds.</li> <li>• Ignition ON.</li> <li>• Using a scan tool, carry out the <u>TPM</u> module self-test.</li> <li>• <b>Is DTC U0140:87 retrieved again?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">I4</a>.</p> <p><b>No</b> The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<p><b>I4 CHECK FOR DTCs IN THE <u>BCM</u></b></p> <ul style="list-style-type: none"> <li>• Using a scan tool, carry out the <u>BCM</u> self-test.</li> <li>• <b>Is DTC U3003:16 or U3003:17 present?</b></li> </ul>	<p><b>Yes</b> <u>TPM</u> module DTC U0140:87 may have been set due to a voltage issue in the <u>BCM</u>. REFER to the <u>BCM</u> DTC Chart in <a href="#">Section 419-10</a>.</p> <p><b>No</b> GO to <a href="#">I5</a>.</p>
<p><b>I5 CHECK FOR DTC U0140, U0140:00, OR U0140:87 SET IN OTHER MODULES</b></p> <ul style="list-style-type: none"> <li>• Clear the <u>CMDTCs</u> from all modules.</li> <li>• Ignition OFF.</li> <li>• Ignition ON.</li> <li>• Wait 10 seconds.</li> <li>• Using a scan tool, retrieve the <u>CMDTCs</u> from all modules.</li> <li>• <b>Is DTC U0140, U0140:00, or U0140:87 set in more than one module?</b></li> </ul>	<p><b>Yes</b> INSTALL a new <u>BCM</u>. REFER to <a href="#">Section 419-10</a>. CLEAR all continuous DTCs. REPEAT the self-test.</p> <p><b>No</b> INSTALL a new <u>TPM</u> module. REFER to <a href="#">Tire Pressure Monitor (TPM) Module</a> in this section. TEST the system for normal operation.</p>



## Wheels And Tires

### Special Tool(s)

 ST2869-A	Digital Tire Pressure Gauge 204-354
 ST3058-A	Hunter Road Force® Wheel Balancer GSP9700 Series

### Inspection and Verification

 **WARNING:** Vehicle may have multiple drive wheels. Do not use engine to power the driveline unless all drive wheels are elevated off the ground. Drive wheels in contact with ground could cause unexpected vehicle movement. Failure to follow this instruction may result in serious personal injury.

Verify the customer concern by carrying out a road test on a smooth road. If any vibrations are apparent, GO to [Symptom Chart - NVH](#).

To maximize tire performance, inspect for signs of incorrect inflation and uneven wear, which may indicate a need for balancing, rotation or front suspension alignment.

Correct tire pressure and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration and unnecessary sharp braking increase tire wear.

Replacement tires must follow the recommended:

- tire sizes.
- speed rating.
- load range.
- tire construction type.

The use of any other tire/wheel size, load range or type can seriously affect:

- ride.
- handling.
- speedometer/odometer calibration.
- vehicle ground clearance.

- tire clearance between the body and chassis.
- wheel bearing life.
- braking performance.

New wheels need to be installed when the vehicle wheels:

- are bent.
- are cracked.
- are dented.
- are heavily corroded.
- are leaking.
- have elongated wheel hub bolt holes.
- have excessive lateral or radial runout.

Use only the tire sizes recommended on the tire label located on the driver door or door pillar attached to the vehicle. Larger or smaller tires can damage the vehicle, affect durability and require changing the speedometer calibration. Make sure wheel size and offsets match those recommended for the tire in use.

1. Inspect the tires for signs of uneven wear. Refer to the following descriptions to identify the type of wear and for the appropriate repair action to be carried out.
2. Check the tires for:
  - cuts.
  - stone bruises.
  - abrasions.
  - blisters.
  - embedded objects.
3. Check the valve stems for:
  - cracks.
  - cuts.

Install a new valve stem when damage is found or any time a new tire is installed.

4. Tread wear indicators are molded into the bottom of the tread grooves. Install a new tire when the indicator bands become less than 2/32 inch.

## Tire Wear

Tire wear is commonly defined as a loss of tread depth. Tire tread wear occurs due to friction with the contact surface (road/pavement). The tread should wear down uniformly all the way around the circumference of the tire and all the way across the tread face. When this does not occur, the tire may have abnormal/incorrect wear.

### Normal Tire Wear

Normal tire wear is identified as even wear around and across the tread. Because there are many factors (driving style, road surfaces, type of vehicle, type of tire) that can affect tire wear, there is no absolute mileage expectation for a normal wear condition. A tire is considered worn-out when the tread has worn to the level of the tread wear indicators.

## **Abnormal/Incorrect Tire Wear**

Abnormal/incorrect tire wear is identified as tire wear that is not even around or across the tread, creating performance-related issues.

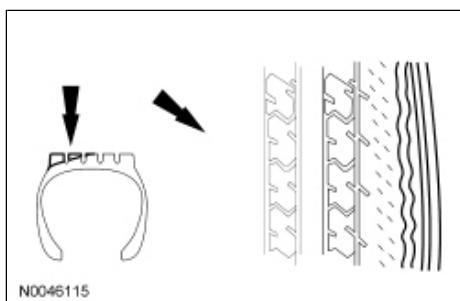
Abnormal/incorrect tire wear can be caused by numerous factors, some of which include driving style (aggressive, passive), climate (hot, cold), road conditions, vehicle loading and maintenance (correct tire pressure, rotation intervals and balance). It is important to determine the root cause of wear on a vehicle before carrying out repair. Tires exhibiting abnormal/incorrect tire wear may still be serviceable provided that the minimum tread depth is greater than 2/32 inch and the tire is not causing a vehicle performance (noise/vibration) concern.

Some abnormal/incorrect wear patterns look the same all the way around the tread of the tire, other wear patterns are not consistent and can occur in various spots on the tread area. The underlying causes of the 6 wear categories are different. Refer to the following descriptions to identify the type of wear and the appropriate repair action to be carried out.

### **Inner Edge/Shoulder Wear**

Inner edge (or shoulder) wear occurs on the inside edge of the tire and is usually caused by excessive toe out and/or excessive negative camber. If the tread depth of the outer shoulder is at least 50% greater than the tread depth of the inner shoulder, the tire is experiencing inner edge/shoulder wear. Visually inspect the tires to determine whether the tires have this type of wear. In some instances, the tread depth of each rib may need to be measured and compared it to that of the shoulder.

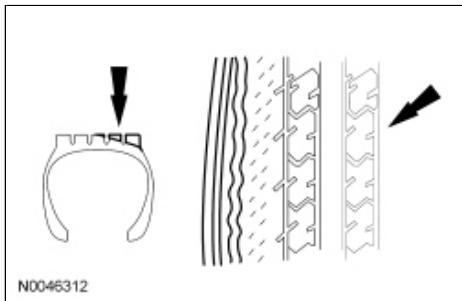
**NOTE:** RF tire shown, others similar.



### **Outer Edge/Shoulder Wear**

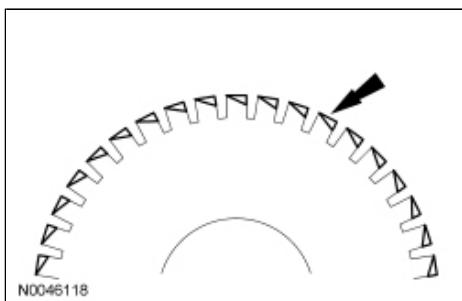
Outer edge (or shoulder) wear occurs on the outside edge of the tire and is usually caused by excessive toe in and/or excessive positive camber. If the tread depth of the inner shoulder is at least 50% greater than the tread depth of the outer shoulder, the tire is experiencing outer edge/shoulder wear. Visually inspect the tires to determine whether the tires have this type of wear. In some instances, the tread depth of each rib may need to be measured and compared to that of the shoulder.

**NOTE:** RF tire shown, others similar.



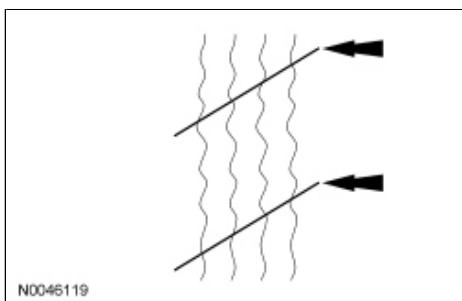
### Heel/Toe Wear

Heel/toe wear (also known as feathering) occurs along the outside or inside edge/shoulder of the tire. Visually inspect the tires in both the inside and outside shoulder ribs to determine whether the tires have this type of wear. In some instances, the difference in tread depth of leading versus trailing edge of each lug in the inside and outside shoulder rib may need to be measured.



### Diagonal Wear

Diagonal wear occurs diagonally across the tread area and around the circumference of the tire. To determine whether tires have this type of wear, visually inspect the tires to determine if the wear pattern runs diagonally across the tread and around the circumference of the tire. In some instances, the difference in tread depth along the diagonal wear pattern may need to be measured.



### Symptom Chart — Tire Wear

### Symptom Chart — Tire Wear

**NOTE:** For suspension system and additional alignment diagnosis, refer to [Section 204-00](#).

Condition	Possible Sources	Action
• Inner edge/shoulder wear	<ul style="list-style-type: none"> <li>Excessive toe out and/or negative camber</li> <li>Incorrect wheel and tire assembly rotation intervals</li> <li>High-speed cornering</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">GO to Pinpoint Test A</a>.</li> <li><a href="#">GO to Pinpoint Test A</a>.</li> <li><a href="#">GO to Pinpoint Test A</a>.</li> </ul>
• Outer edge/shoulder wear	<ul style="list-style-type: none"> <li>Excessive toe in and/or positive camber</li> <li>Incorrect wheel and tire assembly rotation intervals</li> <li>High-speed cornering</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">GO to Pinpoint Test B</a>.</li> <li><a href="#">GO to Pinpoint Test B</a>.</li> <li><a href="#">GO to Pinpoint Test B</a>.</li> </ul>
• Heel/toe wear	<ul style="list-style-type: none"> <li>Excessive toe in/out</li> <li>Incorrect wheel and tire assembly rotation intervals</li> </ul>	<ul style="list-style-type: none"> <li>ROTATE the wheel and tire assemblies. REFER to <a href="#">Wheel and Tire Rotation</a> in this section. CHECK the alignment, ADJUST as necessary.</li> </ul>
• Diagonal wear	<ul style="list-style-type: none"> <li>Excessive toe in/out</li> <li>Incorrect tire rotation intervals</li> <li>Loose, worn or damaged suspension components</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">GO to Pinpoint Test C</a>.</li> <li><a href="#">GO to Pinpoint Test C</a>.</li> <li>REFER to <a href="#">Section 204-00</a>.</li> </ul>

#### Symptom Chart — NVH

#### Symptom Chart — NVH

**NOTE:** NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to [Section 100-04](#). Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Wobble or shimmy	<ul style="list-style-type: none"> <li>Bent wheel</li> <li>Damaged tire</li> <li>Loose wheel nuts</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new wheel as necessary.</li> <li>INSTALL a new tire as necessary.</li> <li>TIGHTEN to specification.</li> </ul>

• High-speed shake	• Tires/wheels	• REFER to Wheel and Tire Runout Component Tests in this section.
• Vehicle vibration	• Tires/wheels	• REFER to Wheel and Tire Runout Component Tests in this section.

### Pinpoint Tests

For a description of the various tire wear patterns, refer to Inspection and Verification.

For vehicles with different front and rear tire pressures (such as E-Series and certain F-Series), adjust the tire pressures and train the tire pressure sensors following a tire rotation. Refer to [Tire Pressure Monitoring System \(TPMS\) Sensor Training](#) in this section. Failure to train the sensors results in a false low tire pressure event, causing the Tire Pressure Monitoring System (TPMS) indicator to illuminate.

For vehicles with the same tire pressure for front and rear tires, tire rotation does not affect the system.

#### Pinpoint Test A: Inner Edge/Shoulder Wear

**This pinpoint test is intended to diagnose the following:**

- Excessive toe out and/or negative camber
- Incorrect wheel and tire assembly rotation intervals
- High-speed cornering

#### PINPOINT TEST A: INNER EDGE/SHOULDER WEAR

Test Step	Result / Action to Take
<b>A1 MEASURE THE TREAD DEPTH</b>	<p><b>Yes</b> ROTATE the wheel and tire assemblies. REFER to <a href="#">Wheel and Tire Rotation</a> in this section.</p> <p>CHECK and ADJUST the toe to nominal +0.15 degrees (toe in). CHECK and ADJUST caster and camber to nominal. REFER to <a href="#">Section 204-00</a>.</p> <p><b>No</b> INSTALL a new tire(s). CHECK and ADJUST the toe to nominal. CHECK and ADJUST caster and camber to nominal. REFER to <a href="#">Section 204-00</a>.</p>

#### Pinpoint Test B: Outer Edge/Shoulder Wear

**This pinpoint test is intended to diagnose the following:**

- Excessive toe in and/or positive camber
- Incorrect wheel and tire assembly rotation intervals
- High-speed cornering

## PINPOINT TEST B: OUTER EDGE/SHOULDER WEAR

Test Step	Result / Action to Take
<b>B1 MEASURE THE TREAD DEPTH</b> <ul style="list-style-type: none"> <li>Using a tread depth gauge or similar tool, measure the outside edge/shoulder tread depth.</li> <li><b>Is the tread depth greater than 2/32 inch?</b></li> </ul>	<p><b>Yes</b> ROTATE the wheel and tire assemblies. REFER to <a href="#">Wheel and Tire Rotation</a> in this section.</p> <p>CHECK and ADJUST the toe to nominal -0.15 degrees (toe out). CHECK and ADJUST caster and camber to nominal. REFER to <a href="#">Section 204-00</a>.</p> <p><b>No</b> INSTALL a new tire(s). CHECK and ADJUST the toe to nominal. CHECK and ADJUST caster and camber to nominal. REFER to <a href="#">Section 204-00</a>.</p>

## Pinpoint Test C: Diagonal Wear

This pinpoint test is intended to diagnose the following:

- Incorrect tire rotation intervals
- Excessive toe in/out
- Loose, worn or damaged suspension components

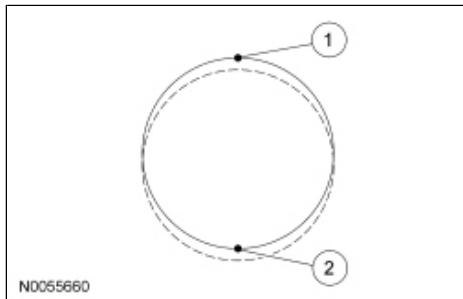
## PINPOINT TEST C: DIAGONAL WEAR

Test Step	Result / Action to Take
<b>C1 MEASURE THE TREAD DEPTH</b> <ul style="list-style-type: none"> <li>Using a tread depth gauge or similar tool, measure the tread depth of the wear pattern.</li> <li><b>Is the tread depth greater than 2/32 inch?</b></li> </ul>	<p><b>Yes</b> If no performance concerns (noise/vibration) are present, the tire can remain in service. CHECK the air pressure in the tires, ADJUST as necessary. ROTATE the wheel and tire assemblies. REFER to <a href="#">Wheel and Tire Rotation</a> in this section. INSPECT for loose, worn or damaged suspension components. INSTALL new components as necessary. CHECK the alignment and ADJUST as necessary. REFER to <a href="#">Section 204-00</a>.</p> <p><b>No</b> INSTALL a new tire(s). CHECK the air pressure in the tires, ADJUST as necessary. ROTATE the wheel and tire assemblies. REFER to <a href="#">Wheel and Tire Rotation</a> in this section. INSPECT for loose, worn or damaged suspension components. INSTALL new components as necessary. CHECK the alignment and ADJUST as necessary. REFER to <a href="#">Section 204-00</a>.</p>

## Component Tests

## Radial Runout

Radial runout is the egg-shaped deviation from a perfect circle and is measured perpendicular to the circumference. On a wheel and tire assembly, this means measuring the center tire tread rib. The center rib is indicative of the condition of the tire as a whole. Total runout is the difference between the maximum-to-minimum gauge reading. The high spot is the location of maximum runout.



Item	Description
1	High spot
2	Low spot

### Loaded Runout Measurement (Hunter Road Force® 9700 Series Wheel Balancer)

**NOTE:** Diagnosis of tire/wheel vibration should not be performed on tires with less than 320 km (200 mi). Some initial tire/wheel vibration issues (such as flat spotting) correct themselves after the tires have been in service for 320 km (200 mi).

This procedure is intended to assist with the diagnosis of wheel and tire assembly runout and/or force variation issues.

The Hunter Road Force® 9700 Series Wheel Balancer measures the wheel and tire assembly's loaded runout and the tire's radial spring rate. The balancer then converts the runout into pounds of force (termed as Road Force®). Measuring loaded runout (Road Force®) is more effective than measuring unloaded runout using a dial indicator.

1. Using a tire crayon, record the vehicle position on the inner sidewall of all 4 tires.
2. Remove the wheel and tire assemblies. For additional information, refer to [Wheel and Tire](#) in this section.
3. **NOTE:** Use only the Digital Tire Pressure Gauge any time tire pressures are measured to be sure that accurate values are obtained.

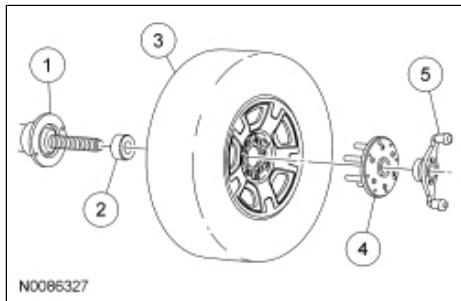
Make sure the tire pressures are set to the correct pressure as indicated on the Vehicle Certification (VC) label.

4. **NOTICE:** Make sure the correct wheel balancer adapters are used when mounting the assembly to the wheel balancer or damage to the wheel may occur.

**NOTE:** Make sure the wheel and tire assembly is clean and free of foreign material prior to installation on the balancer.

**NOTE:** The wheel balancer inflation station must be turned OFF for tires with inflation pressures of 414 kPa (60 psi) or above.

Mount the wheel and tire assembly on a suitable wheel balancer using the correct wheel balancer adapters as shown. [Refer to the list of recommended wheel balancer adapters on the PTS website.](#)



Item	Description
1	Wheel balancer
2	Cone
3	Wheel and tire assembly
4	Finger plate
5	Balancer wing nut

5. Measure the Road Force®.

- Temporarily mark the high spot and the Road Force® value on the sidewall of the tire. If the wheel and tire assembly Road Force® value is not within specification, carry out the Match Mounting procedure to optimize the wheel and tire assembly.
- If the wheel and tire assembly Road Force® value is within specification, permanently mark the high spot and the Road Force® value on the inward sidewall of the tire for reference during future wheel and tire service. Balance the assembly and install the wheel and tire on the vehicle using the Wheel-to-Hub Optimization procedure.

Vehicle	Maximum allowable Road Force® value
F-150 with P-metric tires	11 kg (25 lb)
F-150 with LT-metric tires	16 kg (35 lb)

**Runout Measurement (Dial Indicator)**

**NOTE:** Diagnosis of tire/wheel vibration should not be performed on tires with less than 320 km (200 mi). Some initial tire/wheel vibration issues (such as flat spotting) correct themselves after the tires have been in service for 320 km (200 mi).

**NOTE:** Loaded runout measurements are the preferred method for verifying tire serviceability. While a dial indicator can be used to optimize the position of the tire on the wheel, the unloaded runout measurement cannot accurately determine if the tire should be removed from service.

Use the following procedures if normal diagnostics leads to a potential runout issue.

Some vehicles may exhibit a wheel and tire vibration caused by excessive runout. Radial runout measurements can be taken using a dial indicator and should be measured with the wheel and tire assembly mounted on a suitable wheel balancer. Make sure the dial indicator is mounted securely to eliminate gauge movement when measuring runout.

1. **NOTE:** Use only the Digital Tire Pressure Gauge any time tire pressures are measured to be sure that accurate values are obtained.

Make sure the tire pressures are set to the correct pressure as indicated on the VC label.

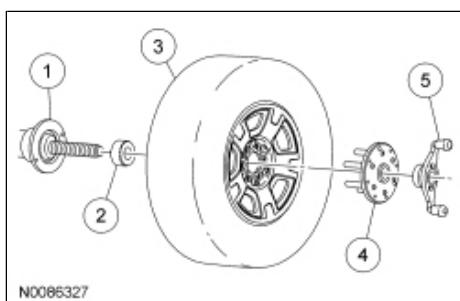
2. Using a tire crayon, record the vehicle position on the inner sidewall of all 4 tires.

3. Remove the wheel and tire assemblies. Refer to [Wheel and Tire](#) in this section.

4. **NOTICE:** Make sure the correct wheel balancer adapters are used when mounting the assembly to the wheel balancer or damage to the wheel may occur.

**NOTE:** Make sure the wheel and tire assembly is clean and free of foreign material prior to installation on the balancer.

Mount the wheel and tire assembly on a suitable wheel balancer using the correct wheel balancer adapters as shown. [Refer to the list of recommended wheel balancer adapters on the PTS website.](#)

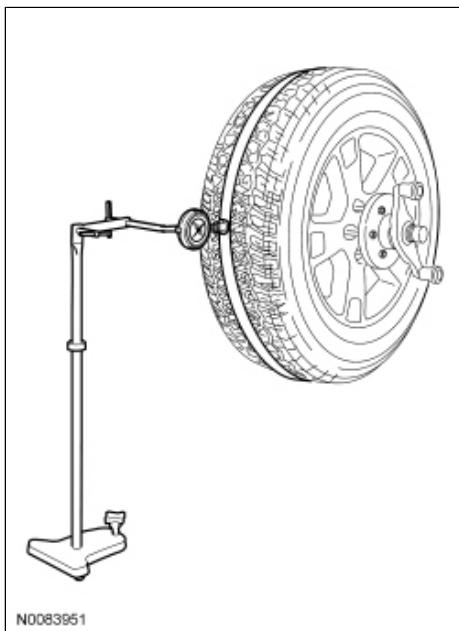


Item	Description
1	Wheel balancer
2	Cone
3	Wheel and tire assembly
4	Finger plate
5	Balancer wing nut

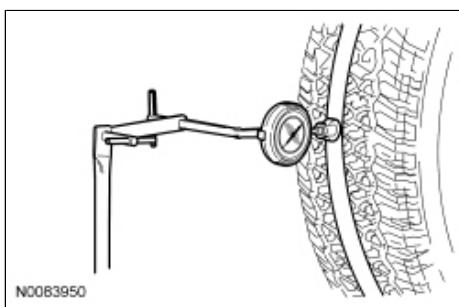
5. **NOTE:** Apply masking tape on the center tread rib to allow for a smoother measuring surface. Some fluctuation of the gauge reading is expected. Observe the overall sweep of the gauge from the highest to the lowest spot on the tire.

Position the dial indicator and stand with the dial indicator on the center tread rib.

- Rotate the wheel and tire assembly (or wheel) to locate the low spot.
- Adjust the runout gauge to read 0.
- Rotate the wheel and tire assembly one complete revolution to make sure the low spot has been found and the dial indicator returns to 0.



6. While slowly and constantly rotating the wheel and tire assembly (or wheel), measure the radial runout.
  - Note the variance (runout) from 0 on the dial of the gauge.
  - If the runout reading of a wheel and tire assembly is greater than 1.14 mm (0.045 in), locate and temporarily mark the high spot and runout reading on the sidewall of the tire and carry out the Match Mounting procedure to optimize the wheel and tire assembly.
  - If the runout reading of a wheel and tire assembly is 1.14 mm (0.045 in) or less, permanently mark the high spot and the runout reading on the inner sidewall of the tire for reference during future wheel and tire service. Balance the assembly and install the wheel and tire on the vehicle using the Wheel-to-Hub Optimization procedure.

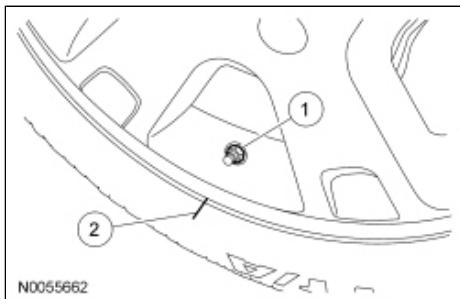


### **Match Mounting**

**NOTE:** Road Force® values in illustrations are shown in pounds.

Match mounting is a technique used to reduce radial runout or Road Force® on wheel and tire assemblies. Excessive runout is a source of ride quality complaints and match mounting can be used to minimize the runout. Match mounting can be accomplished by changing the position of the tire on the wheel.

1. Position the wheel and tire assembly on a tire machine and put a reference mark on the tire sidewall at the valve stem position.



Item	Description
1	Valve stem
2	Reference mark

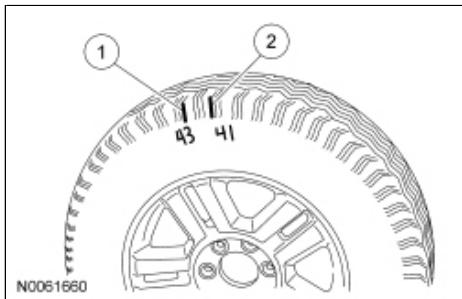
2. **NOTICE:** For tires equipped with a Tire Pressure Monitoring System (TPMS), the sensor may be damaged by incorrect tire mounting or dismounting. Dismount the tire from the wheel as instructed in the Disassembly and Assembly procedure. Failure to follow these instructions may result in component damage.

**NOTE:** Always make sure that the final high spot and measurement values are permanently marked on the inner sidewall of the tire for reference during future wheel and tire service.

Using a suitable tire machine, separate the tire beads from the wheel.

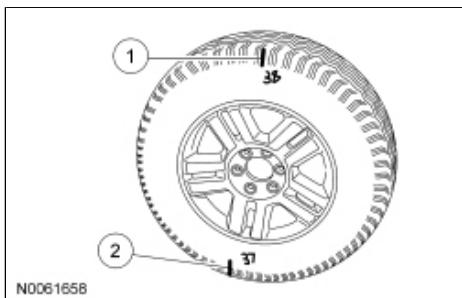
- Lubricate the tire beads using a suitable fast drying, corrosion inhibiting tire bead lubricant.
- Position the tire 180 degrees (halfway around) on the rim so the valve stem reference mark is opposite the valve stem.

3. Reinflate the wheel and tire assembly to the specified air pressure and measure the assembly again using the dial indicator or Hunter Road Force® 9700 Series Wheel Balancer. Mark the second high spot on the tire.
  - If the runout or Road Force® is reduced to within specifications, the concern has been resolved. Balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.
4. If the second runout or Road Force® measurement is still not within specification and both high spots are close to each other (within 101.6 mm [4 in]), the root cause is probably the tire (the high spot followed the tire).
  - To be sure the tire is causing the high runout, it is necessary to have 2 runout or Road Force® measurements that are not within specification and the high spots must be in approximately the same location on the tire's sidewall. If the tire is the cause, install a new tire, balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.
  - If the second high spot is not within 101.6 mm (4 in) of the first high spot, proceed to the next step.



Item	Description
1	First high spot on the tire
2	Second high spot on the tire

5. If the second high spot is still above specification and within 101.6 mm (4 in) of being opposite the first high spot on the wheel, the root cause is probably the wheel (the high spot followed the wheel). Dismount the tire from the wheel, mount the wheel on a balancer and check the wheel runout. If the wheel runout exceeds 1.14 mm (0.045 in), install a new wheel, balance the assembly and install on the vehicle using the Wheel-to-Hub Optimization procedure.

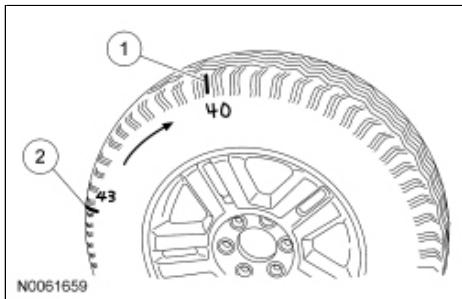


Item	Description
1	First high spot on the tire
2	Second high spot on the tire

6. **NOTE:** If the second high spot did not follow the wheel or the tire and the runout is still not within specification, improvements may be made by rotating the tire 90 degrees (one-fourth turn).

Draw an arrow on the tire sidewall from the second high spot towards the first high spot (in the shortest direction).

- Separate the tire beads from the wheel and rotate the tire 90 degrees (one-fourth turn) in the direction of the arrow.

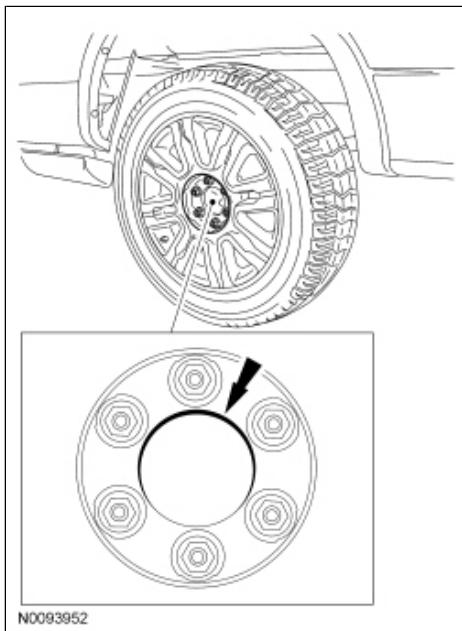


Item	Description
1	First high spot on the tire
2	Second high spot on the tire

### Wheel-to-Hub Optimization

Wheel-to-hub optimization is important. Use the clearance between the wheel and hub to offset or neutralize the Road Force® or runout of the wheel and tire assembly. For every 0.001 inch of wheel-to-hub clearance, the Road Force® can be affected between 1 and 3 pounds depending on the tire stiffness.

**NOTE:** The example below illustrates how the clearance between the wheel and the hub can be used to offset the high spot of radial runout or Road Force®. Following the procedure will make sure of the best optimization.



1. Position the wheel and tire assembly on the vehicle so the high spot location is at the 6 o'clock position and install the wheel nuts by hand until snug.
2. **NOTE:** Do not allow the full weight of the vehicle to rest on the tires while tightening the wheel nuts.

Lower the vehicle until the tires make contact with the ground, slightly loading the suspension.  
Tighten the wheel nuts as described in this section.

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## Tire Pressure Monitoring System (TPMS) Sensor Activation

### Special Tool(s)

 ST2941-A	Activation Tool, Tire Pressure Monitor 204-363, or Customer Activation Tool, Tire Pressure Monitor
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**NOTE:** The tire pressure sensors will go into a "sleep mode" when a vehicle is stationary to conserve battery power. The sensors do not transmit information while in sleep mode. It will be necessary to wake them up so they will transmit the latest tire pressure information.

1. Turn the ignition switch to the ON position.
2. Position the Tire Pressure Monitor Activation Tool against the LF tire sidewall at the tire valve stem.
3. **NOTE:** The Tire Pressure Monitor Activation Tool will provide feedback in the form of a flashing green light and a beep sound for each successful response from a tire pressure sensor. This feedback may not always be present, do not rely on it as a confirmation that the module heard a particular sensor.

**NOTE:** If a sensor does not respond to the Tire Pressure Monitor Activation Tool, move the vehicle to rotate the wheels at least one-fourth of a turn and attempt to activate the same sensor again. If the sensor still does not respond, attempt to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, attempt to train the sensor with the vehicle doors open.

Press the test button on the Tire Pressure Monitor Activation Tool to activate the sensor. Activate the sensor at least 2 times.

4. Repeat Steps 2 and 3 for the remaining tires.
5. If the Tire Pressure Monitoring System (TPMS) indicator remains illuminated after adjusting and activating each sensor, refer to the Symptom Chart in Diagnosis and Testing in this section.



## Tire Pressure Monitoring System (TPMS) Sensor Training

### Special Tool(s)

 ST2941-A	Activation Tool, Tire Pressure Monitor 204-363
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

**NOTE:** If the vehicle has been stationary for more than 30 minutes, the sensors will go into a "sleep mode" to conserve battery power. It will be necessary to wake them up so they will transmit the latest tire pressure information to the BCM. For additional information, refer to [Tire Pressure Monitoring System \(TPMS\) Sensor Activation](#) in this section.

**NOTE:** The Tire Pressure Monitoring System (TPMS) Training procedure must be done on a single vehicle, in an area without radio frequency noise and at least 1 m (3 ft) away from other vehicles equipped with a Tire Pressure Monitoring System (TPMS).

Radio frequency noise is generated by electrical motors and appliance operation, cellular telephones, remote transmitters, power inverters and portable entertainment equipment.

**NOTE:** If a sensor does not respond to the Tire Pressure Monitor Activation Tool, move the vehicle to rotate the wheels at least one-fourth of a turn and attempt to activate the same sensor again. If the sensor still does not respond, attempt to activate the same sensor again using the customer activation tool (if available). If the sensor still fails to train, attempt to train the sensor with the vehicle doors open.

**NOTE:** The BCM has a 2-minute time limit between sensor responses. If the BCM does not recognize any 1 of the 4 tire pressure sensors during this time limit, the horn will sound twice and the message center (if equipped) will display TIRE NOT TRAINED REPEAT and the entire procedure must be repeated.

**NOTE:** For vehicles with different front and rear tire pressures (such as the E-Series and certain F-Series), the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors will cause the TPMS indicator to illuminate. For vehicles with the same tire pressure for front and rear tires, tire rotation will not affect the system.

**NOTE:** Refer to Description and Operation, Push Button Start System Ignition Modules in [Section 211-05](#) to review the procedures for achieving the various ignition states on vehicles with this feature.

- NOTE:**  An animated version of this procedure is available on-line.

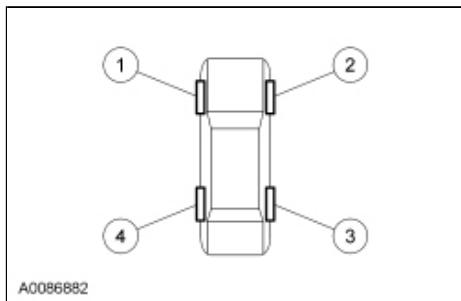
Turn the ignition switch to the OFF position, then press and release the brake pedal.

2. Cycle the ignition switch from the OFF position to the RUN position 3 times, ending in the RUN position.
3. Press and release the brake pedal.
4. Turn the ignition switch to the OFF position.
5. Turn the ignition switch from the OFF position to the RUN position 3 times, ending in the RUN position.
  - The horn will sound once and the TPMS indicator will flash if the training mode has been entered successfully. If equipped, the message center will display TRAIN LF TIRE.

6. **NOTE:** It may take up to 6 seconds to activate a tire pressure sensor. During this time, the Tire Pressure Monitor Activation Tool must remain in place at the valve stem.

Place the Tire Pressure Monitor Activation Tool on the LF tire sidewall at the valve stem. Press and release the test button on the Tire Pressure Monitor Activation Tool. The horn will sound briefly to indicate that the tire pressure sensor has been recognized by the BCM.

7. Within 2 minutes of the horn sounding, place the Tire Pressure Monitor Activation Tool on the RF tire sidewall at the valve stem and press and release the test button to train the RF tire pressure sensor.



8. **NOTE:** Do not wait more than 2 minutes between training each sensor or the BCM will time out and the entire procedure must be repeated.

Repeat Step 7 for the RR and LR tires.

The procedure is completed after the last tire has been trained. When the training procedure is complete, the message center (if equipped) will display TIRE TRAINING COMPLETE.

For vehicles not equipped with a message center, successful completion of the training procedure will be verified by turning the ignition switch to the OFF position without the horn sounding. If the horn sounds twice when the switch is turned to the OFF position, the training procedure was not successful.

9. Using the scan tool, locate the updated TPMS sensor identifiers trained to the BCM and document them on the applicable warranty claim.
10. **NOTE:** This step is required to clear DTC C2780, cause the BCM to exit the manufacturing mode and to make sure there are no other concerns with a newly programmed BCM.

If the sensors are being trained due to the installation of a new BCM, clear any DTCs and carry out the BCM On-Demand Self Test.



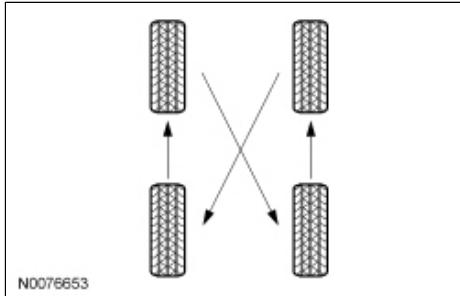
## Wheel and Tire Rotation

**NOTE:** This procedure is intended for vehicles equipped with Tire Pressure Monitoring System (TPMS) and different front and rear tire pressures.

1. Remove the wheel and tire assemblies. For additional information, refer to [Wheel and Tire](#) in this section.
2. **NOTE:** The front tires are shown at the top of the illustration.

Rotate the wheel and tire assemblies as shown.

- Cross the front tires and move them to the rear of the vehicle.
- Move the rear tires (without crossing) to the front of the vehicle.

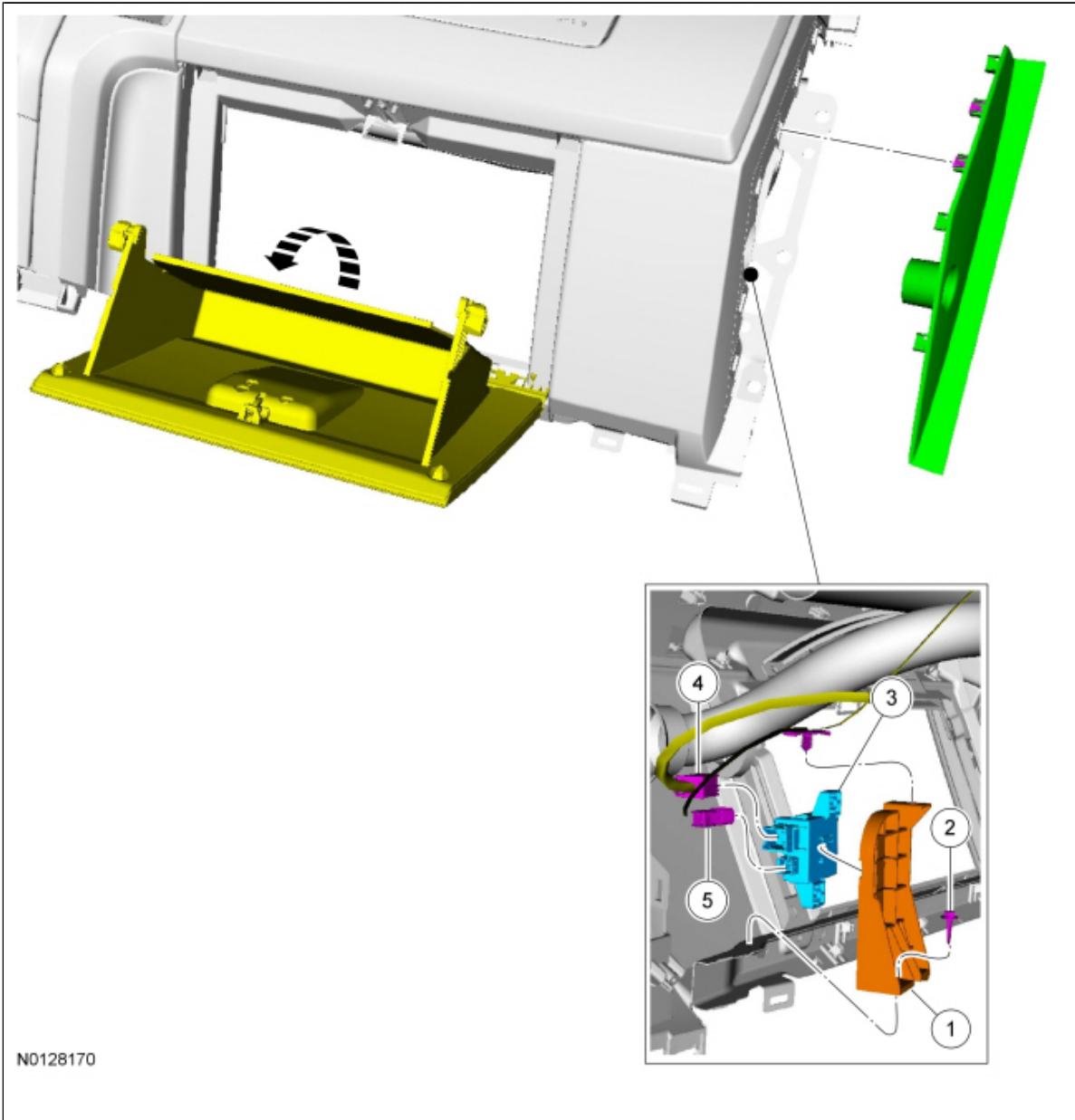


3. Install the wheel and tire assemblies. For additional information, refer to [Wheel and Tire](#) in this section.
4. Adjust the tire pressures. For additional information, refer to the Vehicle Certification (VC) label located on the driver door jamb.
5. **NOTE:** The tire pressures must be adjusted and the tire pressure sensors must be trained following a tire rotation. Failure to train the sensors will result in a false low tire pressure event, which will cause the TPMS indicator to illuminate.

Train the TPMS sensors. For additional information, refer to [Tire Pressure Monitoring System \(TPMS\) Sensor Training](#) in this section.



### Tire Pressure Monitor (TPM) Module



Item	Part Number	Description
1	19A435	TPMS module mounting bracket
2	W707628	<u>TPMS</u> screw (1 required)
3	15K602	Tire Pressure Monitoring System (TPMS) module

4	—	TPMS module electrical connector (part of 14401)
5	—	External antenna coax connector

### Removal

**NOTICE:** Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

1. Remove the RH instrument panel side finish panel.
2. Open the glove compartment door and while pushing in on the glove compartment tab, position the glove compartment downwards.
3. Remove the screw from the TPMS module mounting bracket.
4. Disconnect the TPMS module electrical connector and the external antenna connector.
5. Separate the TPMS module from the TPMS module mounting bracket.

### Installation

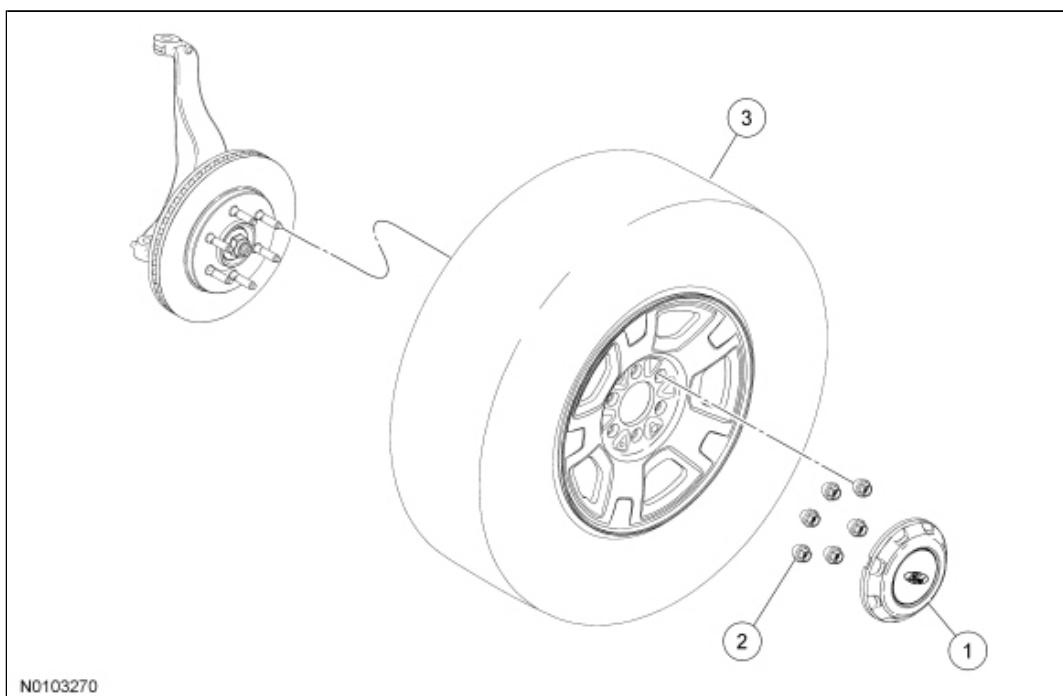
1. To install, reverse the removal procedure.
-

## Wheel and Tire

### Material

Item	Specification
High Temperature Nickel Anti-Seize Lubricant XL-2	—

**NOTE:** Typical 6 lug wheel shown, 7 lug similar.



N0103270

Item	Part Number	Description
1	1130	Center cap (if equipped)
2	1012	Wheel nut (6 or 7 required)
3	—	Wheel and tire assembly

### Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. **NOTICE:** Do not use heat to loosen a seized wheel nut or damage to the wheel and wheel bearing can occur.

Remove the 6 or 7 wheel nuts.

3. Remove the wheel and tire assembly.

## Installation

1.  **WARNING:** When a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surface of the wheel and the mounting surface of the wheel hub, brake drum or brake disc. Make sure that any fasteners that attach the rotor to the hub are secured so they do not interfere with the mounting surfaces of the wheel. Failure to follow these instructions when installing wheels may result in the wheel nuts loosening and the wheel coming off while the vehicle is in motion, which could result in loss of control, leading to serious injury or death to vehicle occupant(s).

**NOTICE:** Make sure to apply a thin coat of anti-seize lubrication only to the interface between the wheel pilot bore and the hub pilot. Do not allow the anti-seize to make contact with the wheel-to-brake disc/drum mounting surface, wheel studs, wheel nuts, brake pads or brake disc friction surfaces or damage to components may occur.

Clean the wheel mounting surfaces and apply a thin coat of anti-seize to the wheel hub pilot surface (wheel only).

2. Install the wheel and tire assembly.

3.  **WARNING:** Retighten wheel nuts within 160 km (100 mi) after a wheel is reinstalled. Wheels can loosen after initial tightening. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

**NOTICE:** Failure to tighten the wheel nuts in a star/cross pattern can result in high brake disc runout, which will speed up the development of brake roughness, shudder and vibration.

**NOTE:** The wheel nut torque specification is for clean, dry wheel stud and wheel nut threads.

Install the 6 or 7 wheel nuts by hand.

- Tighten the wheel nuts in a star/cross pattern.
- Tighten to 204 Nm (150 lb-ft).



**Material**

Item	Specification	Fill Capacity
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—	—
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

**General Specifications**

Item	Specification
Drive pinion flange runout	0.25 mm (0.010 in)
Maximum allowable driveshaft runout	0.50 mm (0.020 in)
Minimum Traction-Lok breakaway torque	27 Nm (20 lb-ft)
U-joint operating angle	0.5°-3.0°

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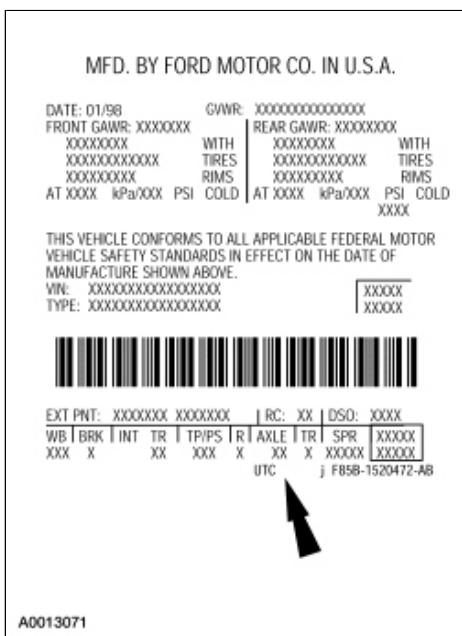
## Driveline System

The driveline consists of the following:

- Front drive axle
- Rear drive axle
- Front axle halfshafts
- Front driveshaft
- Rear driveshaft
- Center support bearings
- CV joints
- U-joints and flanges
- Flex couplers

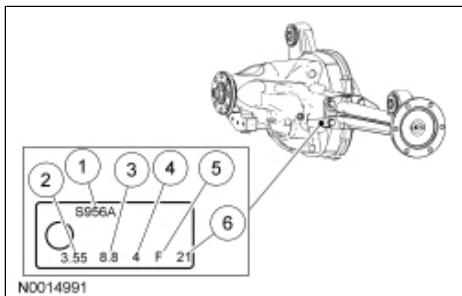
The source of the drivetrain power is generated by the engine and delivered to the transmission. The driveline transfers the engine torque through the driveshaft to the axle. The rear driveshaft is connected to the output shaft of the transmission or transfer case and to the rear axle. The front driveshaft is connected to the transfer case and to the front axle. Slip yokes are used to allow for any changes to the length of the driveshaft. Changes in length are self-adjusted up in the driveshaft slip mechanism. The engine torque enters the axle through the drive pinion, which rotates the ring gear. The ring gear is mounted to the differential case, which contains the gears that transmit power to the rear axle shafts or front halfshafts. These shafts and halfshafts rotate the drive wheels. The Electronic Locking Differential (ELD) rear axle assembly, except for the differential case and its internal components, is identical to the conventional rear axle. The ELD employs an electronically operated magnetic coil to engage the unit. The Traction-Lok rear axle assembly, except for the differential case and its internal components, is identical to the conventional rear axle. The Traction-Lok employs 2 multi-disc differential clutch packs to control differential action. The mounting distance of the differential side gear is controlled by plates on each side, friction and steel. Also included is a steel selective shim to control the position of the differential side gear, and a spring which provides initial preload to the clutch pack. The steel clutch plates are splined to the axle shafts. The friction plates are contained in the case by matching slots, thus providing continuous engagement of the differential clutch packs. The Torsen® front differential case houses the parallel axis planetary helical side gears to which the axle shafts are splined. The engine angle is built into the engine mounts. If the engine angle is out of specification, the engine mounts must be inspected for damage.

### Vehicle Certification (VC) Label Example



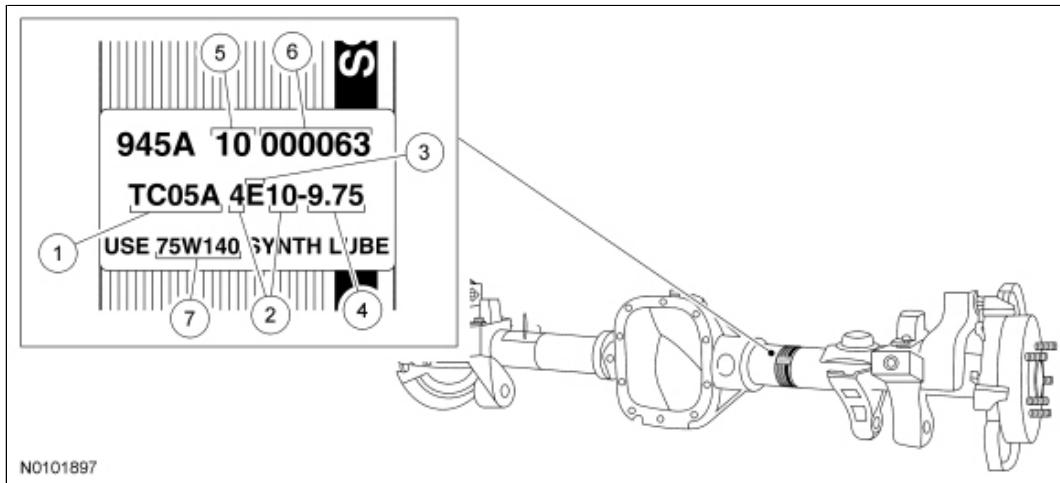
The Vehicle Certification (VC) label is located in the driver door jamb. The first 2 digits of the axle code indicate the rear axle and the third digit refers to the front axle, if equipped. For information on the VC label, refer to [Section 100-01](#).

#### Front Axle Identification Tag



Item	Description
1	Plant code
2	Axle ratio
3	Ring gear diameter (inch)
4	Build year
5	Build month
6	Build day

#### Rear Axle Identification Tag



Item	Description
1	Plant code
2	Axle ratio
3	Differential type C= Open/conventional L= Limited slip E= Electronic Locking Differential (ELD)
4	Ring gear diameter (inch)
5	Build year
6	Axle serial number
7	Lubricant type

**NOTE:** The axle identification tag is the official service identifier. Do not damage the tag.

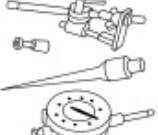
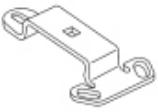
The axle identification tag identifies a particular axle design, a specific ratio, and if it is a conventional or limited slip type. In addition, the plant code will not change as long as that particular axle assembly never undergoes an external design change. If, however, an internal design change takes place during the production life of the axle and that internal change affects the interchangeability of the components, a dash and numerical suffix is added to the plant code. This means that, as an assembly, both axles are interchangeable; however, internally they are different. Therefore, each requires different internal components at the time of repair.

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## Driveline System

### Special Tool(s)

 ST1268-A	Clamp Plate, Driveshaft 205-320 (T92L-4851-C)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1266-A	Dial Indicator Gauge with Holding Fixture 100-D002 (D78P-4201-B) or equivalent
 ST1863-A	Gauge, Differential (Traction-Lok) 205-385 (T97T-4205-B)
 ST1267-A	Runout Gauge, Drive Pinion Flange 205-319 (T92L-4851-B)

### Material

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5

### Principles of Operation

The driveline system enables the power generated by the engine and transferred through the transmission and, if applicable, transfer case, to place the vehicle in motion. Rotational torque received from the transmission or transfer case is delivered to the front and rear drive axles by way of the driveshafts. The U-

joints or CV joints at the ends of the shafts allow the shafts to rotate smoothly in an allowable angle plane. The rotational torque is introduced into the axle drive pinion which drives the differential ring gear. The ring gear is bolted to the differential case flange on the differential. The differential divides the torque between the right and left halfshaft while permitting the halfshafts to turn at different speeds when required, such as when cornering.

### Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

### Visual Inspection Chart

Mechanical
<ul style="list-style-type: none"> <li>• U-joints</li> <li>• CV joints</li> <li>• Center bearings</li> <li>• Driveshaft tubes</li> <li>• Mounting brackets</li> <li>• Flanges</li> <li>• Housing and cover damage</li> <li>• Differential bearings</li> <li>• Differential gear sets</li> <li>• Pinion bearings</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and GO to [Symptom Chart - Driveline](#) or GO to [Symptom Chart - NVH](#).

### Symptom Chart — Driveline

#### Symptom Chart — Driveline

Condition	Possible Sources	Action
<ul style="list-style-type: none"> <li>• Traction-Lok does not work in snow, mud or on ice</li> </ul>	<ul style="list-style-type: none"> <li>• Differential</li> </ul>	<ul style="list-style-type: none"> <li>• CARRY OUT the Traction-Lok Differential Operation Check in this section. REPAIR as necessary. REFER to <a href="#">Section 205-02A</a> or <a href="#">Section 205-02B</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Torsen® differential does not work in snow, mud or on ice</li> </ul>	<ul style="list-style-type: none"> <li>• Differential</li> </ul>	<ul style="list-style-type: none"> <li>• CARRY OUT the Torsen Differential Operation Check in this section. REPAIR as necessary. REFER to <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Lubricant leaking</li> </ul>	<ul style="list-style-type: none"> <li>• Vent</li> </ul>	<ul style="list-style-type: none"> <li>• CLEAN the axle housing vent.</li> </ul>

	<ul style="list-style-type: none"> <li>from the pinion seal, axle shaft oil seals or support arm to the housing</li> </ul>	<ul style="list-style-type: none"> <li>Damage in the seal contact area or dust slinger on the pinion flange dust shield</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new pinion flange and the pinion seal if damage is found.</li> </ul>
	<ul style="list-style-type: none"> <li>The vehicle does not shift between the different modes correctly</li> </ul>	<ul style="list-style-type: none"> <li>Mode switch</li> <li>Wiring/relays</li> <li>Shift motor</li> <li>Transfer case</li> <li>Generic Electronic Module (GEM) or 4x4 control module</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 308-07A</a>.</li> </ul>
	<ul style="list-style-type: none"> <li>Front axle will not engage</li> </ul>	<ul style="list-style-type: none"> <li>Switches</li> <li>Wiring</li> <li>GEM or 4x4 control module</li> <li>Shift motor</li> <li>Integrated Wheel End (IWE)</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 308-07A</a>.</li> </ul>
	<ul style="list-style-type: none"> <li>Front axle will not disengage</li> </ul>	<ul style="list-style-type: none"> <li>Switches</li> <li>Wiring</li> <li>GEM or 4x4 control module</li> <li>Shift motor</li> <li>IWE</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 308-07A</a>.</li> </ul>
	<ul style="list-style-type: none"> <li>Electronic Locking Differential (ELD) does not engage in snow, mud or on ice</li> </ul>	<ul style="list-style-type: none"> <li>Mode switch</li> <li>Differential</li> <li>Transfer Case Control Module (TCCM)</li> <li>Wiring</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 308-07A</a>.</li> </ul>
	<ul style="list-style-type: none"> <li>Differential side gears/pinion gears are scored</li> </ul>	<ul style="list-style-type: none"> <li>Insufficient lubrication</li> <li>Incorrect or contaminated lubricant type</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL new gears. FILL the axle to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>INSTALL new gears. CLEAN and REFILL the axle to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
	<ul style="list-style-type: none"> <li>Axle overheating</li> </ul>	<ul style="list-style-type: none"> <li>Lubricant level too low</li> <li>Incorrect or contaminated lubrication type</li> <li>Bearing preload adjusted too tight</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the lubricant level. FILL the axle to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>INSPECT the axle for damage. REPAIR as necessary. CLEAN and REFILL the axle to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>CHECK the ring and pinion for damage. INSPECT the ring and pinion wear pattern. ADJUST the preload as</li> </ul>

	<ul style="list-style-type: none"> <li>Excessive gear wear</li> <li>Incorrect ring gear backlash</li> </ul>	<p>necessary.</p> <ul style="list-style-type: none"> <li>INSPECT all the axle gears for wear or damaged. INSTALL new components as necessary.</li> <li>INSPECT the ring gear for scoring. INSPECT the ring and pinion wear pattern. ADJUST the ring gear backlash as necessary.</li> </ul>
<ul style="list-style-type: none"> <li>Broken gear teeth on the ring gear or pinion</li> </ul>	<ul style="list-style-type: none"> <li>Overloading the vehicle</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new ring and pinion. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Halfshaft broken</li> </ul>	<ul style="list-style-type: none"> <li>Overloading the vehicle</li> <li>Misaligned axle halfshaft</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new axle halfshaft. REFER to <a href="#">Section 205-04</a>.</li> <li>INSPECT the axle for damage. CHECK axle halfshaft alignment. INSTALL a new axle halfshaft. REFER to <a href="#">Section 205-04</a>.</li> </ul>

#### Symptom Chart — NVH

#### Symptom Chart — NVH

**NOTE:** NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to [Section 100-04](#). Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to [Section 100-04](#) for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
<ul style="list-style-type: none"> <li>Axle howling or whine — front or rear axle</li> </ul>	<ul style="list-style-type: none"> <li>Axle lubricant low</li> <li>Axle housing damage</li> <li>Damaged or worn wheel hub bearings</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the lubricant level. FILL the axle to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>INSPECT the axle housing for damage. REPAIR or INSTALL a new axle as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>CHECK for abnormal wheel hub bearing play or roughness. REFER to <a href="#">Section 204-01A</a>, <a href="#">Section 204-01B</a> or <a href="#">Section 204-02</a>.</li> </ul>

	<ul style="list-style-type: none"> <li>• Damaged or worn differential ring and pinion</li> <li>• Damaged or worn differential side or pinion bearings</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT and INSTALL a new differential ring and pinion as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>• INSPECT and INSTALL new differential side or pinion bearings as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Driveline clunk — loud clunk when shifting from REVERSE to DRIVE</li> </ul>	<ul style="list-style-type: none"> <li>• Incorrect axle lubricant level</li> <li>• Excessive backlash in the axle</li> <li>• Damaged or worn pinion bearings</li> <li>• Damaged or worn U-joints</li> <li>• Loose or missing fasteners</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the lubricant level. FILL the axle to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>• CHECK the axle backlash. REPAIR as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>• REPAIR or INSTALL new pinion bearings as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>• INSPECT the U-joints for wear or damage. INSTALL new U-joints or driveshaft as necessary. REFER to <a href="#">Section 205-01</a>.</li> <li>• CHECK all driveline fasteners for proper torque. REFER to <a href="#">Section 205-01</a>, <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Driveline clunk — occurs as the vehicle starts to move forward following a stop</li> </ul>	<ul style="list-style-type: none"> <li>• Worn driveshaft CV joint or U-joints with excessive play</li> <li>• Loose axle mount</li> <li>• Loose or missing fasteners</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT the CV joint and U-joints for a worn condition. INSTALL a new driveshaft or U-joints as necessary. REFER to <a href="#">Section 205-01</a>.</li> <li>• CHECK the axle for loose bolts. TIGHTEN to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>• CHECK all driveline fasteners for proper</li> </ul>

		<p>torque. REFER to <a href="#">Section 205-01</a>, <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</p>
<ul style="list-style-type: none"> <li>• Driveline clunk — occurs during acceleration or from cruise to coast/deceleration</li> </ul>	<ul style="list-style-type: none"> <li>• Damaged or worn CV joint</li> <li>• Loose or missing fasteners</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT the CV joint and boot. INSTALL a new CV joint as necessary. REFER to <a href="#">Section 205-04</a>.</li> <li>• CHECK all driveline fasteners for proper torque. REFER to <a href="#">Section 205-01</a>, <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Clicking, popping or grinding — occurs while the vehicle is turning</li> </ul>	<ul style="list-style-type: none"> <li>• Inadequate or contaminated lubrication in the CV joints</li> <li>• Another component contacting the halfshaft</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the CV boots and joints for wear or damage. INSTALL new components as necessary. REFER to <a href="#">Section 205-04</a>.</li> <li>• CHECK the halfshafts and the area around the halfshafts. REPAIR as necessary.</li> </ul>
<ul style="list-style-type: none"> <li>• High pitched chattering — noise from the axle when the vehicle is turning</li> </ul>	<ul style="list-style-type: none"> <li>• Incorrect or contaminated lubricant</li> <li>• Damaged or worn differential (differential side gears and pinion gears)</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the vehicle by driving in tight circles (5 clockwise, 5 counterclockwise). CLEAN and REFILL the axle to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>• REPAIR or INSTALL new differential side gears or pinion gears as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Buzz — buzzing noise is the same at cruise or coast/deceleration</li> </ul>	<ul style="list-style-type: none"> <li>• Incorrect driveline angles</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK for correct driveline angles. REPAIR as necessary. REFER to <a href="#">Driveline Angle Measurement</a> in this section.</li> </ul>
<ul style="list-style-type: none"> <li>• Rumble or boom — noise occurs at coast/deceleration, usually driveshaft speed-related and noticeable over a wide range of speeds</li> </ul>	<ul style="list-style-type: none"> <li>• Driveshaft is out-of-balance</li> <li>• U-joints are binding or seized</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the driveshaft for damage, missing balance weights or undercoating. REFER to <a href="#">Driveshaft Runout and Balancing</a> in this section.</li> <li>• ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints or driveshaft as</li> </ul>

	<ul style="list-style-type: none"> <li>Misalignment of yellow dot on driveshaft-to-yellow dot on pinion flange plus or minus 1 bolt hole</li> <li>Worn or damaged driveshaft center bearing support</li> </ul>	<p>necessary. REFER to <a href="#">Section 205-01</a>.</p> <ul style="list-style-type: none"> <li>REINSTALL driveshaft with yellow dots aligned plus or minus 1 bolt hole. REFER to <a href="#">Section 205-01</a>.</li> <li>CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new driveshaft as necessary. REFER to <a href="#">Section 205-01</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Grunting — normally associated with a shudder experienced during acceleration from a complete stop</li> </ul>	<ul style="list-style-type: none"> <li>Driveshaft CV joint binding</li> <li>Loose axle mount bolts or suspension fasteners</li> </ul>	<ul style="list-style-type: none"> <li>CLEAN the CV joint and INSTALL a new driveshaft as necessary. REFER to <a href="#">Section 205-01</a>.</li> <li>INSPECT the rear suspension and axle. TIGHTEN the fasteners to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Howl — can occur at various speeds and driving conditions. Affected by acceleration and deceleration</li> </ul>	<ul style="list-style-type: none"> <li>Incorrect ring and pinion contact, incorrect bearing preload or gear damage</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT and REPAIR as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Chuckle — heard at coast/deceleration. Also described as a knock</li> </ul>	<ul style="list-style-type: none"> <li>Incorrect ring and pinion contact or damaged teeth on the coast side of the ring and pinion</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT and REPAIR as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Knock — noise occurs at various speeds. Not affected by acceleration or deceleration</li> </ul>	<ul style="list-style-type: none"> <li>Gear tooth damage to the drive side of the ring and pinion</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new ring and pinion. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Scraping noise — a continuous low pitched noise starting at low speeds</li> </ul>	<ul style="list-style-type: none"> <li>Worn or damaged pinion bearings</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT and REPAIR or INSTALL new pinion bearings. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Driveline shudder — occurs during acceleration from a slow speed or stop (vehicle unloaded)</li> </ul>	<ul style="list-style-type: none"> <li>Drive axle assembly mispositioned</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or</li> </ul>

	<ul style="list-style-type: none"> <li>• Loose axle bolts</li> <li>• Loose or missing fasteners</li> <li>• Driveline angles out of specification</li> <li>• U-joints binding or seized</li> <li>• Binding or damaged driveshaft CV joint</li> <li>• Transfer case</li> </ul>	<p><a href="#">Section 205-03</a>.</p> <ul style="list-style-type: none"> <li>• CHECK the axle for loose bolts. TIGHTEN the bolts to specification. REFER to <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>• CHECK all driveline fasteners for proper torque. REFER to <a href="#">Section 205-01</a>, <a href="#">Section 205-02A</a>, <a href="#">Section 205-02B</a> or <a href="#">Section 205-03</a>.</li> <li>• MEASURE and ADJUST the driveline angles as necessary. REFER to <a href="#">Driveline Angle Measurement</a>, <a href="#">Driveline Angle Adjustment</a>.</li> <li>• ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints or driveshaft as necessary. REFER to <a href="#">Section 205-01</a>.</li> <li>• INSPECT the driveshaft CV joint and coupling shaft for wear or damage. INSTALL a new driveshaft as necessary. REPAIR as necessary. REFER to <a href="#">Section 205-01</a>.</li> <li>• REFER to <a href="#">Section 308-07A</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Driveline shudder — occurs during acceleration from a slow speed or stop (vehicle loaded)</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification due to loaded condition</li> </ul>	<ul style="list-style-type: none"> <li>• MEASURE and ADJUST the driveline angles as necessary. REFER to <a href="#">Driveline Angle Measurement</a>, <a href="#">Driveline Angle Adjustment</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Take-off shudder — with 1-piece driveshaft (loaded or unloaded)</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• MEASURE and ADJUST the driveline angles as necessary. REFER to <a href="#">Driveline Angle Measurement</a>, <a href="#">Driveline Angle Adjustment</a>.</li> <li>• If concern is still present lower axle pinion using 1 degree shim with thick end forward. REFER to, <a href="#">Driveline Angle Adjustment</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Take-off shudder — with 1-piece driveshaft (loaded or</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of</li> </ul>	<ul style="list-style-type: none"> <li>• Lower axle pinion replacing 1 degree shim</li> </ul>

unloaded) after driveline angle adjustment using 1 degree shim	specification	with a 2 degree shim with thick end forward. REFER to, <a href="#">Driveline Angle Adjustment</a> .
<ul style="list-style-type: none"> <li>• Driveline vibration or moan — occurs on deceleration (coast down) above 45 mph with 1-piece driveshaft (loaded or unloaded)</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• MEASURE and ADJUST the driveline angles as necessary. REFER to <a href="#">Driveline Angle Measurement</a>, <a href="#">Driveline Angle Adjustment</a>.</li> <li>• If concern is still present raise axle pinion using 1 degree shim with thick end rearward. REFER to, <a href="#">Driveline Angle Adjustment</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Driveline vibration or moan — occurs on deceleration (coast down) above 45 mph with 1-piece driveshaft (loaded or unloaded) after driveline angle adjustment using 1 degree shim</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• Raise axle pinion replacing 1 degree shim with a 2 degree shim with thick end rearward. REFER to, <a href="#">Driveline Angle Adjustment</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Shudder on acceleration from 10-25 mph under medium to heavy throttle — with 2-piece driveshaft (loaded or unloaded)</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• MEASURE and ADJUST the driveline angles as necessary. REFER to <a href="#">Driveline Angle Measurement</a>, <a href="#">Driveline Angle Adjustment</a>.</li> <li>• If concern is still present lower axle pinion using 1 degree shim with thick end forward. REFER to, <a href="#">Driveline Angle Adjustment</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Shudder on acceleration from 10-25 mph under medium to heavy throttle — with 2-piece driveshaft (loaded or unloaded) after driveline angle adjustment using 1 degree shim</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• Lower axle pinion replacing 1 degree shim with a 2 degree shim with thick end forward. REFER to, <a href="#">Driveline Angle Adjustment</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Driveline vibration or moan — occurs on deceleration above 45 mph with 2-piece driveshaft (loaded or unloaded), after driveline angle adjustment using 1 degree shim is installed with the thick end forward</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• Lower the center bearing. <a href="#">Driveline Angle Adjustment</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Driveline vibration or moan — occurs on deceleration above 45 mph with 2-piece driveshaft (loaded or unloaded)</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• MEASURE and ADJUST the driveline angles as necessary. REFER to <a href="#">Driveline Angle Measurement</a>, <a href="#">Driveline Angle Adjustment</a>.</li> </ul>

		<p><a href="#"><u>Angle Adjustment</u></a>.</p> <ul style="list-style-type: none"> <li>If concern is still present raise axle pinion using 1 degree shim with thick end rearward. REFER to, <a href="#"><u>Driveline Angle Adjustment</u></a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Driveline vibration or moan — occurs on deceleration above 45 mph with 2-piece driveshaft (unloaded), after driveline angle adjustment using 1 degree shim is installed with the thick end rearward</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• Raise axle pinion replacing 1 degree shim with a 2 degree shim with thick end rearward. REFER to, <a href="#"><u>Driveline Angle Adjustment</u></a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Shudder on acceleration from 10-25 mph under medium to heavy throttle — after driveline angle adjustment using 1 degree shim is installed with the thick end rearward — with 2-piece driveshaft (unloaded)</li> </ul>	<ul style="list-style-type: none"> <li>• Driveline angle out of specification</li> </ul>	<ul style="list-style-type: none"> <li>• Lower the center bearing. <a href="#"><u>Driveline Angle Adjustment</u></a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Driveline vibration — occurs at cruising speeds</li> </ul>	<ul style="list-style-type: none"> <li>• Worn U-joints</li> <li>• Misalignment of yellow dot on driveshaft-to-yellow dot on pinion flange plus or minus 1 bolt hole</li> <li>• Worn or damaged driveshaft center bearing support</li> <li>• Loose driveshaft-to-axle pinion or transmission flange bolts</li> <li>• Excessive axle pinion flange runout</li> <li>• Driveshaft is out-of-balance</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK for wear or incorrect seating. INSTALL new U-joints or driveshaft as necessary. REFER to <a href="#"><u>Section 205-01</u></a>.</li> <li>• REINSTALL driveshaft with yellow dots aligned plus or minus 1 bolt hole. REFER to <a href="#"><u>Section 205-01</u></a>.</li> <li>• CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new driveshaft as necessary. REFER to <a href="#"><u>Section 205-01</u></a>.</li> <li>• INSPECT the axle pinion flange. TIGHTEN the pinion flange bolts to specification. REFER to <a href="#"><u>Section 205-01</u></a>.</li> <li>• CARRY OUT a runout check. REPAIR as necessary. REFER to Component Test in this section.</li> <li>• CHECK the driveshaft for damage, missing balance</li> </ul>

	<ul style="list-style-type: none"> <li>• Binding or damaged driveshaft CV joint</li> <li>• Excessive driveshaft runout</li> <li>• Driveline angles out of specification</li> <li>• Incorrectly seated CV joint in the wheel hub</li> <li>• Damage or missing driveshaft slip yoke damper (163 in wheelbase and 133 in wheelbase 4.6L 4x2 do not get dampers)</li> </ul>	<p>weights or undercoating. CHECK the driveshaft balance. CARRY OUT a driveline vibration test. REFER to <a href="#">Driveshaft Runout and Balancing</a> in this section.</p> <ul style="list-style-type: none"> <li>• INSPECT the driveshaft CV joint for wear or damage. INSTALL a new driveshaft as necessary. REFER to <a href="#">Section 205-01</a>.</li> <li>• CARRY OUT a runout check. REFER to <a href="#">Driveshaft Runout and Balancing</a> in this section.</li> <li>• CHECK for correct driveline angles. REPAIR as necessary. REFER to <a href="#">Driveline Angle Measurement</a> in this section.</li> <li>• CHECK the outer CV joint for correct seating into the hub. REPAIR as necessary. REFER to <a href="#">Section 205-04</a>.</li> <li>• INSTALL a new driveshaft as necessary. REFER to <a href="#">Section 205-01</a>.</li> </ul>
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### Analysis of Leakage

Clean the leaking area enough to identify the exact source.

A plugged axle housing vent can cause excessive pinion seal lip wear due to internal pressure buildup.

Verify the lubricant level is at least 3-5 mm (1/8-3/16 in) below the bottom of the fill hole.

### Axle Vent

A plugged vent will cause excessive seal lip wear due to internal pressure buildup. If a leak occurs, check the vent. If the vent cannot be cleared, install a new vent.

### Drive Pinion Seal

Leaks at the drive pinion seal originate from the following causes:

- Damaged seal
- Worn seal journal surface

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

The drive pinion seal can be torn, cut or gouged if it is not installed correctly. The spring that holds the drive pinion seal against the pinion flange may be knocked out and allow fluid to pass the lip.

Metal chips trapped at the sealing lip can cause oil leaks. These can cause a wear groove on the drive pinion flange and result in pinion seal wear.

When a seal leak occurs, install a new drive pinion seal and check the vent to make sure it is clean and free of foreign material.

A new drive pinion flange must be installed if any of these conditions exist.

#### Drive Pinion Nut

**NOTICE:** Install the drive pinion nut to the correct torque specifications or damage to the differential components may occur.

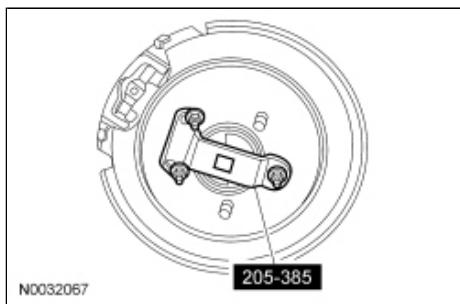
On some high-mileage vehicles, oil may leak through the threads of the drive pinion nut. This condition can be corrected by installing a new nut and applying threadlock and sealer on the threads and nut face.

#### Component Tests

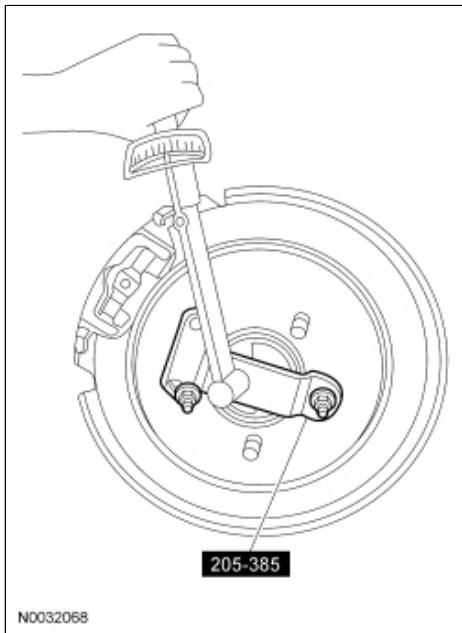
##### Traction-Lok Differential Operation Check

A Traction-Lok differential can be checked for correct operation without removing it from the rear axle housing.

Raise and remove only one rear wheel. Install the Differential Gauge (Traction-Lok) on the wheel bolts.



Use a torque wrench with the capacity of at least 271 Nm (200 lb-ft) to rotate the axle shaft. Make sure that the transmission is in NEUTRAL, and that one rear wheel is on the floor while the other rear wheel is raised off the floor. The breakaway torque required to start rotation must be at least 27 Nm (20 lb-ft). The initial breakaway torque may be higher than the continuous turning torque.



The axle shaft must turn with even pressure throughout the check without slipping or binding. If the torque reading is less than specified, check the differential case for incorrect assembly.

#### Traction-Lok Differential Check Road Test

1. Place one wheel on a dry surface and the other wheel on ice, mud or snow.
2. Gradually open the throttle to obtain maximum traction prior to break away. The ability to move the vehicle demonstrates correct performance of a Traction-Lok rear axle assembly.
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the Traction-Lok feature of the differential. Release the brake when traction is established. Use light throttle on starting to provide maximum traction.
4. If, with unequal traction, both wheels slip, the limited slip rear axle has done all it can possibly do.
5. In extreme cases of differences in traction, the wheel with the least traction may spin after the Traction-Lok has transferred as much torque as possible to the non-slipping wheel.

#### Torsen® Differential Check Road Test

1. Place one wheel on a dry surface and the other wheel on ice, mud or snow.
2. Gradually open the throttle to obtain maximum traction prior to break away. The ability to move the vehicle demonstrates correct performance of a Torsen® front axle assembly.
3. When starting with one wheel on an excessively slippery surface, a slight application of the parking brake may be necessary to help energize the Torsen® feature of the differential. Release the brake

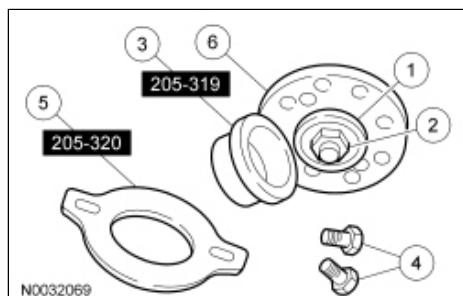
when traction is established. Use light throttle on starting to provide maximum traction.

4. If, with unequal traction, both wheels slip, the limited slip front axle has done all it can possibly do.
5. In extreme cases of differences in traction, the wheel with the least traction may spin after the Torsen® has transferred as much torque as possible to the non-slipping wheel.

#### Pinion Flange Runout Check — Circular

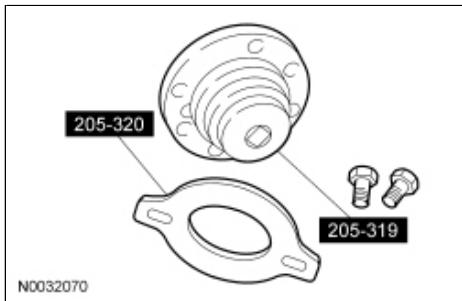
**NOTICE:** Pinion bearing preload must be reset if the pinion nut has been loosened or removed for pinion flange reindexing or replacement or damage to the component may occur.

1. Raise the vehicle on a twin-post hoist that supports the rear axle.
2. Remove the driveshaft. Refer to [Section 205-01](#).
3. Check the pinion flange for damage.
4. Position the Driveshaft Clamp Plate and Drive Pinion Flange Runout Gauge on the pinion flange.

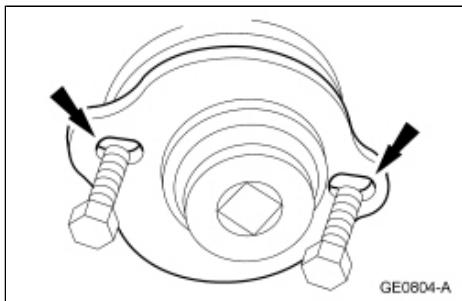


Item	Part Number	Description
1	—	Pilot (part of 205-319) (T92L-4851-B)
2	354845	Pinion nut
3	205-319	Gauge, Drive Pinion Flange Runout (T92L-4851-B)
4	—	Bolts (2 required) (part of 205-320) (T92L-4851-C)
5	205-320	Plate, Driveshaft Clamp (T92L-4851-C)
6	4851	Pinion flange

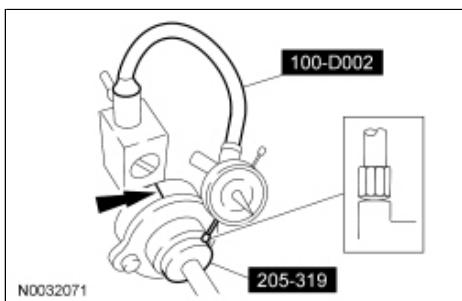
5. Position the Driveshaft Clamp Plate and Drive Pinion Flange Runout Gauge onto the pinion flange.



6. Align the holes on the clamp plate with the holes in the pinion flange and install the bolts. Snug the bolts evenly.

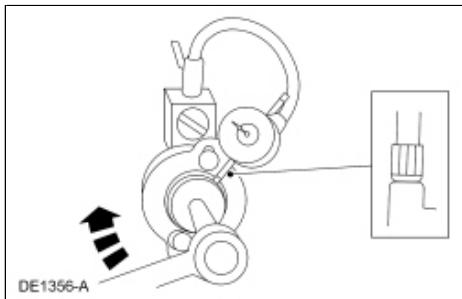


7. Position the Dial Indicator Gauge with Holding Fixture as shown. Turn the Dial Indicator Gauge, and locate and mark the high spot on the pinion flange with yellow paint.



If the flange runout exceeds 0.25 mm (0.010 in), remove the pinion flange, reindex the flange one-half turn on the pinion, and reinstall it. Refer to [Section 205-02A](#), [Section 205-02B](#) or [Section 205-03](#) for the flange removal and installation procedures.

8. Check the runout again. If necessary, rotate the flange until an acceptable runout is obtained. If the flange runout is still more than 0.25 mm (0.010 in), install a new pinion flange.



9. If excessive runout is still evident after replacement of the pinion flange, install a new ring and pinion. Repeat the above checks until the runout is within specifications.
10. Install the driveshaft. Refer to [Section 205-01](#).

#### **Tooth Contact Pattern Check — Gearset**

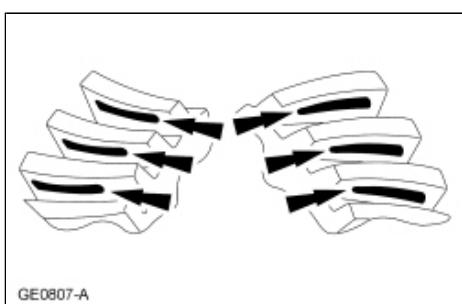
1. To check the gear tooth contact, paint the gear teeth with a suitable marking compound. A mixture that is too wet will run and smear; a mixture that is too dry cannot be pressed out from between the teeth.
2. Use a box wrench on the ring gear bolts as a lever to rotate the ring gear several complete revolutions in both directions or until a clear tooth contact pattern is obtained.
3. Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. Incorrect adjustment can be corrected by readjusting the ring gear or the pinion.

#### **Contact Pattern Location**

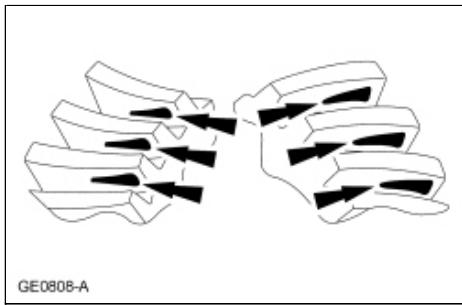
In general, desirable ring gear tooth patterns must have the following characteristics:

- Drive pattern on the drive side ring gear well centered on the tooth.
- Coast pattern on the coast side ring gear well centered on the tooth.
- Clearance between the pattern and the top of the tooth.
- No hard lines where the pressure is high.

Acceptable ring gear tooth patterns for all axles.

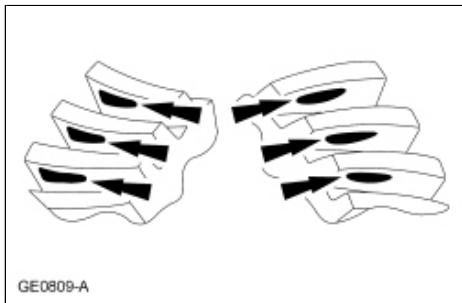


Correct backlash with a thinner pinion position shim required.



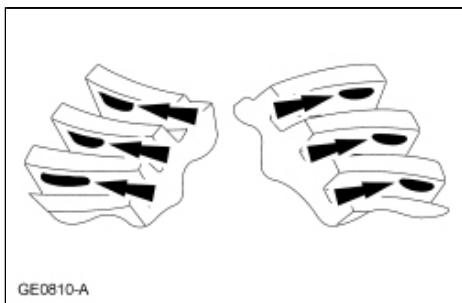
GE0808-A

Correct backlash with a thicker pinion position shim required.



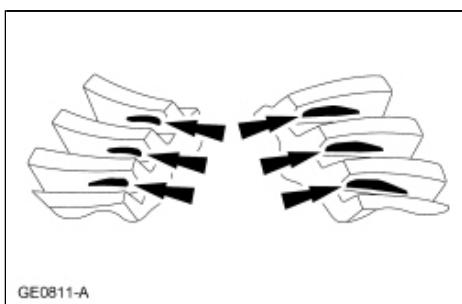
GE0809-A

Correct pinion position shim that requires a decrease in backlash.



GE0810-A

Correct pinion position shim that requires an increase in backlash.



GE0811-A



## Driveline Angle Adjustment

**NOTE:** Some vehicles may exhibit a drive-away shudder or vibration under moderate to heavy acceleration from a stop, especially when heavily loaded or when towing a trailer. It is important to confirm how the vehicle is driven the majority of the time (loaded or unloaded), as adjusting the driveline angle in one condition (loaded or unloaded) may result in a shudder or vibration with the vehicle in the opposite condition (loaded or unloaded).

**NOTE:** Verify suspension is not modified from the original configuration. Aftermarket leveling kits and rear leaf spring shackle kits change ride height, which affects pinion angle and other critical driveline related operating angles. Vehicle must be at Original Equipment Manufacturer (OEM) specifications before accurate evaluation and diagnosis can be performed.

**NOTE:** The driveline angle must be measured with the vehicle in the same condition as the concern (loaded or unloaded) to determine the amount of adjustment necessary to correct the condition.

1. Measure the driveline angle. For additional information, refer to [Driveline Angle Measurement](#) in this section.
  - If the driveline does not have an optimum 3.5 degree operating range, proceed to the following adjustment steps using the parts listed in the table below.

Part Number	Part Name
5A313	1 degree pinion angle shim
5A313	2 degree pinion angle shim
00812	Upper u-bolt center plate bolt (4 required)
5705	U-bolt (4 required)
W520215	U-bolt nut (8 required)
W713078	Center bearing support bolt
W713649	Center bearing support nut
4A209	Center bearing support shim
506545	Shock absorber lower bolt
W520214	Shock absorber lower nut

**NOTE:** The driveline angle on these vehicles can be changed by adding 1 degree or 2 degree pinion angle shims.

2. Remove and discard the shock absorber lower nut and bolt.
3. **NOTE:** To change the pinion angle.

Using a suitable jack to support the rear axle, remove and discard the 8 u-bolt nuts and the 4 u-bolts. For additional information, refer to [Section 204-02](#).

4. **NOTE:** Replace one bolt at time.

Replace the upper u-bolt center plate bolts. For additional information, refer to [Section 204-02](#).

- Install the new bolts and tighten to 102 Nm (75 lb-ft).
5. **NOTE:** Never use more than 1 shim on a side at a time.
- Install desired shim on the axle spring seat, or on top of the 4x4 spacer block.
- Lower the axle pinion using the thick edge of the shim forward, to decrease pinion angle.
  - Raise the axle pinion using the thick edge of the shim rearward, to increase pinion angle.
6. Install 4 new u-bolts and 8 new u-bolt nuts. With the suspension at curb height, tighten the new u-bolt nuts evenly in a cross-type pattern in 4 stages. For additional information, refer to [Section 204-02](#).
- Stage 1: Tighten in a cross pattern to 35 Nm (26 lb-ft).
  - Stage 2: Tighten in a cross pattern to 70 Nm (52 lb-ft).
  - Stage 3: Tighten in a cross pattern to 100 Nm (74 lb-ft).
  - Stage 4: Tighten in a cross pattern to 133 Nm (98 lb-ft).
7. Install a new shock absorber lower nut and bolt. For additional information, refer to [Section 204-02](#).
- Tighten the new nut and bolt to 90 Nm (66 lb-ft).
8. **NOTE:** If adjusting axle pinion angle to reduce/eliminate driveline vibration or moan causes an issue with shudder on acceleration, then the pinion angle must be adjusted to optimize the balance between perceived vibration/moan and perceived shudder.

**NOTE:** Shims can be used to lower the center bearing support and minimize this condition. Up to 3 shims may be installed. The center bearing support bolts must be replaced using the part listed in the table or new grade 10.9 bolts. The bolts should be long enough to extend at least 3 threads past the nuts.

Measure the driveline angle again. For additional information, refer to [Driveline Angle Measurement](#) in this section.

- If necessary, remove and discard the 2 center bearing support bolts and install shims in 1/4 inch increments to lower the center bearing support.
  - Install 2 new bolts and tighten to 48 Nm (35 lb-ft).
-



## Driveline Angle Measurement

### Special Tool(s)

 ST1622-A	Anglemaster II Driveline Inclinometer/Protractor 164-R2402 or equivalent
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**NOTE:** This procedure does not apply to CV joints, flex couplers or double cardan joints that are used in some driveshafts. This check is for single-cross and roller-style joints found in the driveshafts.

**NOTE:** Prior to checking driveline angularity, inspect the U-joints for correct operation.

**NOTE:** An incorrect driveline angle can cause a vibration or shudder. For additional information, refer to [Section 100-04](#).

**NOTE:** 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.

### All vehicles

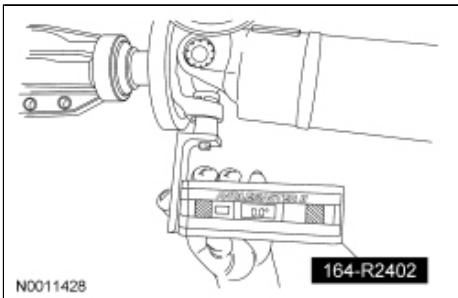
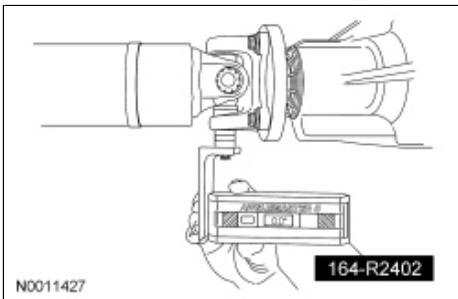
1. Carry out the following preliminary setup steps:
  - Inspect the U-joints for correct operation.
  - Park the vehicle on a level surface such as a drive-on hoist, or back onto a front end alignment rack.
  - Verify the curb position ride height is within specifications with the vehicle unloaded and all of the tires are inflated to their normal operating pressures.
  - Calibrate the Anglemaster II Driveline Inclinometer/Protractor by placing it on a clean, flat level section of the frame rail and press the ALT-ZERO button.

### Vehicles with flat-flanged, split-pin or slip-flanged U-joints

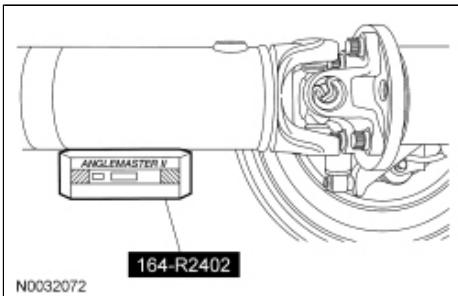
2. **NOTE:** If equipped, remove the snap ring to allow access to the base of the U-joint cup. Make sure the Anglemaster II Driveline Inclinometer/Protractor is seated against the U-joint cup.

**NOTE:** Rotate the driveshaft until the flange U-joint cup is parallel with the floor. This will simplify taking measurements.

To check the U-joint operating angle, install the Anglemaster II Driveline Inclinometer/Protractor. Check and record the flange angle as angle A.



3. Using the Anglemaster II Driveline Inclinometer/Protractor, measure the slope of the connecting component. Record the measurement of the component angle as angle B.

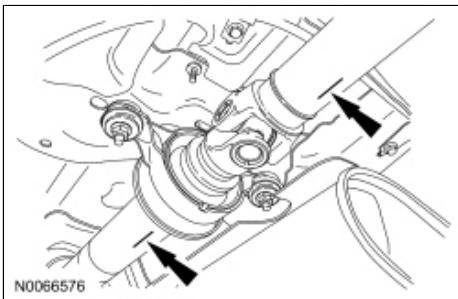


#### Multiple piece driveshafts

4. **NOTE:** Repeat this step for each center support bearing on the driveshaft.

**NOTE:** It is not necessary to remove the U-joint snap ring, if equipped, for these measurements.

Using the Anglemaster II Driveline Inclinometer/Protractor, measure the slope of the components in front and behind the center support bearing U-joint in the area indicated. Record the front component as angle A and the rear component as angle B.



#### All vehicles

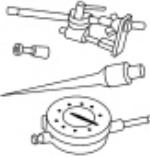
5. **NOTE:** When 2 connected components slope in the same direction, subtract the smallest number from the larger number to find the U-joint operating angle. When 2 connected components slope in the opposite direction, add the measurements to find the U-joint operating angle.

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

- The U-joint operating angle is the angle formed by 2 yokes connected by a cross and bearing kit. Ideally, the operating angles on each connection of the driveshaft must:
    - be equal or within one degree of each other.
    - have a 3 degree maximum operating angle.
    - have at least one-half of one degree continuous operating angle.
6. If the angle is not within specifications, repair or adjust to obtain the correct angle. Inspect the engine mounts, transmission mounts, center support bearing mounting, rear suspension, rear axle, rear axle mounting or the frame for wear or damage.

## Driveshaft Runout and Balancing

### Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST3025-A	Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) 257-00018 or equivalent

### Driveshaft Inspection

**NOTE:** Driveline vibration exhibits a higher frequency and lower amplitude than high-speed shake. Driveline vibration is directly related to the speed of the vehicle and is noticed at various speeds. Driveline vibration can be perceived as a tremor in the floorpan or heard as a rumble, hum or boom.

**NOTE:** Refer to Specifications in this section for all runout specifications.

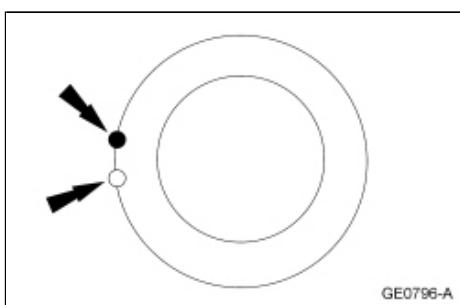
1. **NOTE:** Do not make any adjustments before carrying out a road test. Do not change the tire pressure or the vehicle load.  
  
Carry out a visual inspection of the vehicle. Operate the vehicle and verify the condition by reproducing it during the road test.
  - The concern should be directly related to vehicle road speed, not affected by acceleration or deceleration or could not be reduced by coasting in NEUTRAL.
2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
  - The driveshaft should be kept at an angle equal to or close to the curb-weighted position. Use a twin-post hoist or a frame hoist with jackstands.
3. Inspect the driveshaft for damage, undercoating or incorrectly seated U-joints. Rotate the driveshaft slowly by hand and feel for binding or end play in the U-joint trunnions. Remove the driveshaft. For additional information, refer to [Section 205-01](#). Inspect the slip yoke splines for any galling, dirt, rust or incorrect lubrication. Clean the driveshaft or install new U-joints as necessary. Install a new driveshaft if damaged. After any corrections or new components are installed, recheck for the vibration at the road test speed.
  - If the vibration is gone, test drive the vehicle.
  - If the vibration persists or the driveshaft passes visual inspection, measure the driveshaft runout.

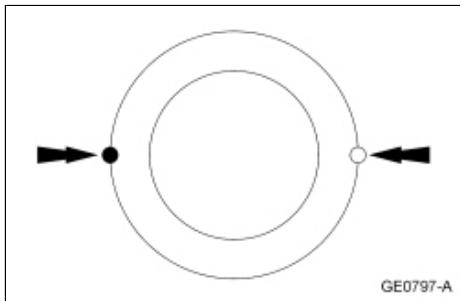
## Driveshaft Runout

1. Install the Dial Indicator Gauge with Holding Fixture. Rotate the driveshaft by turning the axle and measure the runout at the front, the center and the rear of the driveshaft.
  - If the runout exceeds 1 mm (0.040 in) at the front or center, install a new driveshaft.
  - If the front and center is within 1 mm (0.040 in), but the rear runout is not, index-mark the rear runout high point and proceed to Step 2.
  - If the runout is within 1 mm (0.040 in) at all points, recheck for vibration at road test speed. If the vibration persists, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.
2. **NOTE:** Circular pinion flanges can be turned in 90 degree or one-fourth increments. Half-round pinion flanges are limited to 2 positions.

Index-mark the driveshaft to the pinion flange. Disconnect the driveshaft and rotate it 180 degrees. Reconnect the driveshaft. Recheck the runout at the rear of the driveshaft.

- If the runout is still over specification, mark the high point and proceed to Step 3.
  - If the runout is within specification, check for the vibration at the road test speed. If the vibration is still present, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.
3. Excessive driveshaft runout can originate in the driveshaft itself or from the pinion flange. To find the source, compare the 2 high points previously determined.
    - If the index marks are close together, within 25 mm (1 in), the driveshaft is eccentric. Install a new driveshaft.
    - If the marks are on opposite sides of the driveshaft, 180 degrees apart, the slip yoke or pinion flange is responsible. Check the pinion flange runout. If the pinion flange runout exceeds specifications, a bent pinion is indicated.
    - If the pinion flange and pinion runouts are within specifications, road test and check for the vibration at the road test speed. If the vibration persists, balance the driveshaft. For additional information, refer to Driveshaft Balancing in this procedure.

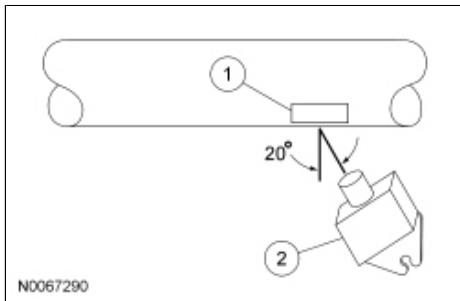




### Driveshaft Balancing — Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix)

#### All vehicles

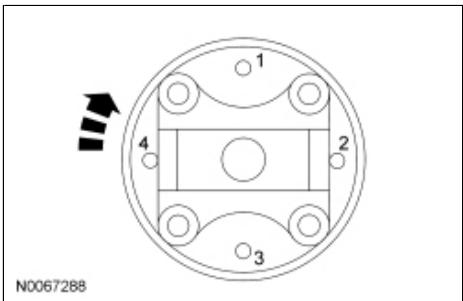
1. Install the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) to the vehicle.
2. Working under the vehicle, install an accelerometer. The accelerometer can be attached and mounted near either the transmission or differential end of the driveshaft.
3. Clean an area of the driveshaft and install the reflective tape, then install the photo-tachometer sensor. The sensor should be placed at approximately a 20-degree angle from perpendicular to the surface of the reflective tape. Make sure the sensor does not get moved during the balance procedure.
  1. Reflective tape.
  2. Photo-tachometer sensor.



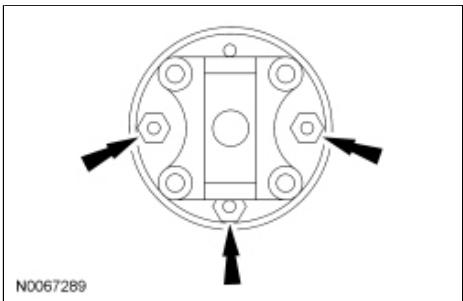
4. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a driveshaft balance test with the driveshaft unmodified.

#### Vehicles with tapped pinion flanges

5. Label the tapped holes in the pinion flange numerically, starting at the top hole as 1. Mark the remaining holes 2, 3 and 4. Label in the direction of rotation.

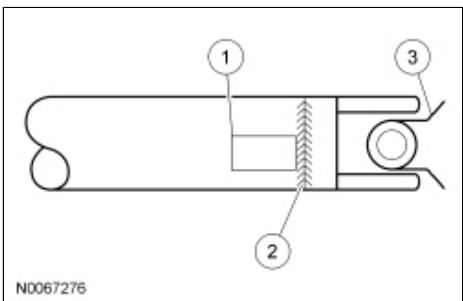


6. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a second test with the 12 mm (0.47 in) test weight set screw in the No. 1 hole, previously marked on the pinion flange.
7. Remove the test weight, then install the weight combination directed by the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix).



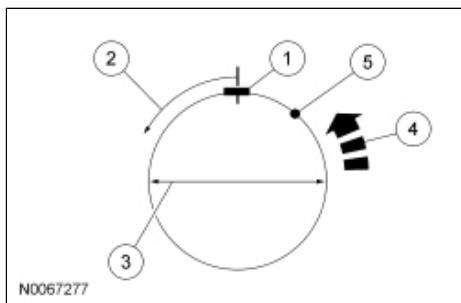
#### Vehicles without tapped pinion flanges

8. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a second test with a test weight. Using a metal band, secure the test weight to the end of the driveshaft. The weight should be placed at the end of the driveshaft tube, as close to the tube-to-yoke weld seam as possible. Mark the location of the test weight on the driveshaft, as shown in the figure below.
  1. Test weight.
  2. Tube-to-yoke weld seam.
  3. Driveshaft pinion flange.
  - Select the test weight based on driveshaft size. Larger driveshafts use 10 g (0.353 oz). Smaller driveshafts use 5 g (0.176 oz).



9. Remove the test weight, then install the recommended weight at the position directed by the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix). Using a metal band and epoxy, secure the test weight to the driveshaft, as shown in the figure below.

1. Test weight.
  2. Measure in this direction.
  3. Driveshaft diameter.
  4. Directional rotation.
  5. Balance weight relative to test weight centerline.
- The results are displayed with respect to the location to where the test weight was placed.

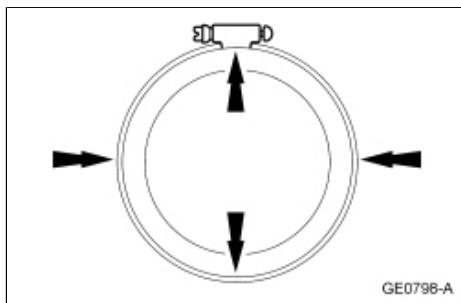


#### All vehicles

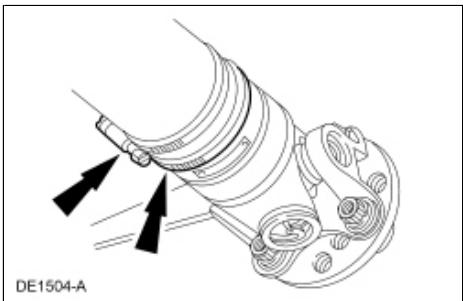
10. Using the Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix), run a third test to verify the repair.

#### Driveshaft Balancing — Hose Clamp Method

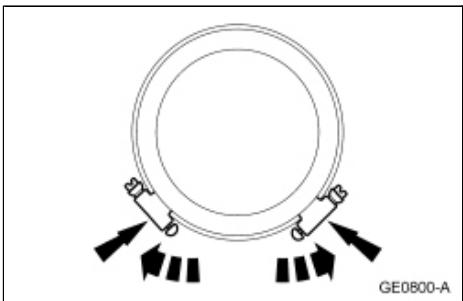
1. Install 1 or 2 hose clamps on the driveshaft, near the rear. Position of the hose clamp head(s) can be determined through trial and error.
2. Mark the rear of the driveshaft into 4 approximately equal sectors and number the marks 1 through 4. Install a hose clamp on the driveshaft with its head at position No. 1, as shown in the figure below. Check for vibration at road speed. Recheck with the clamp at each of the other positions to find the position that shows minimum vibration. If 2 adjacent positions show equal improvement, position the clamp head between them.



3. If the vibration persists, add a second clamp at the same position and recheck for vibration.



4. If no improvement is noted, rotate the clamps in opposite directions, equal distances from the best position determined in Step 2. Separate the clamp heads about 13 mm (1/2 in) and recheck for vibration at the road speed.



5. Repeat the process with increasing separation until the best combination is found or the vibration is reduced to an acceptable level.
-

**Material**

Item	Specification	Fill Capacity
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

**Torque Specifications**

Description	Nm	lb-ft
Rear driveshaft center bearing bolts	48	35
Rear driveshaft flange bolts	103	76
Front driveshaft flange-to-pinion flange bolts	55	41
Front driveshaft flange-to-transfer case flange bolts	55	41
Skid plate bolts (SVT Raptor vehicles)	48	35
Stabilizer bar bracket nuts	55	41

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## **Driveshaft**

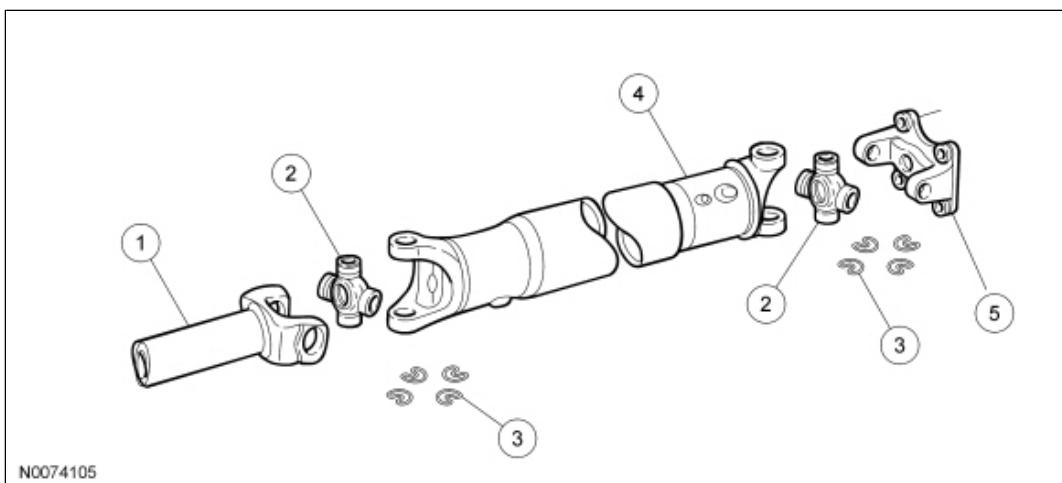
Refer to [Section 205-00](#).

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## Driveshaft Universal Joint — Snap Ring Type

### Special Tool(s)

	Installer/Remover, C-Frame and Screw 205-086 (T74P-4635-C)
ST1172-A	



Item	Part Number	Description
1	4841	Driveshaft slip yoke
2	4635	U-joint assembly
3	—	Snap rings (part of 4635)
4	4602	Driveshaft assembly
5	4782	Driveshaft flange

### Disassembly

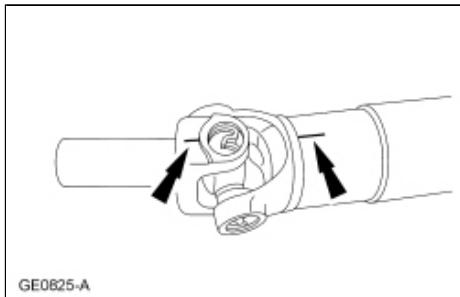
1. Remove the driveshaft. Refer to [Driveshaft — Front](#), [Driveshaft — Rear, One-Piece](#) or [Driveshaft — Rear, Two-Piece](#) in this section.
2. **NOTICE:** Do not, under any circumstance, clamp the driveshaft assembly in the jaws of a vise or similar holding fixture. Denting or localized fracturing may result, causing driveshaft failure during vehicle operation.

Place the driveshaft on a suitable workbench. Do not damage the tube.

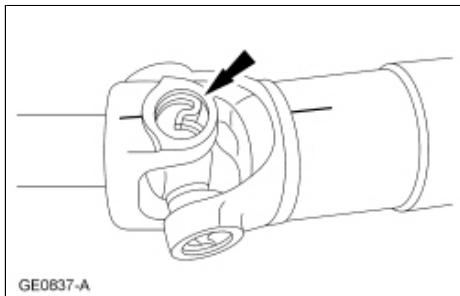
3. **NOTE:** If the components are not marked and therefore installed incorrectly, driveshaft imbalance can

occur.

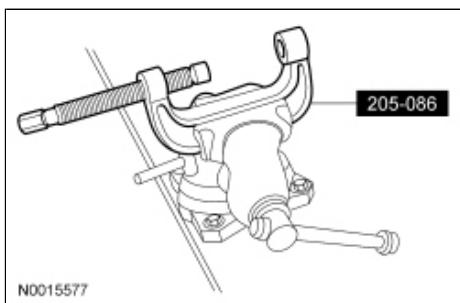
Index-mark the driveshaft components.



4. Remove and discard all 4 of the snap rings.



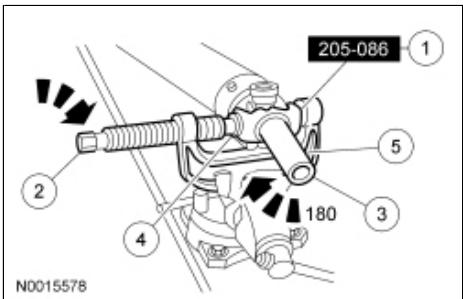
5. Place the C-Frame and Screw Remover/Installer in a vise.



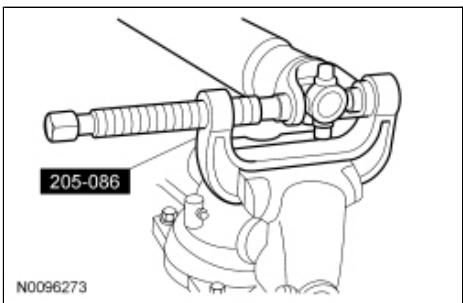
6. **NOTE:** If necessary, use a pair of pliers to remove a bearing cup that fails to press out all the way.

Remove the bearing cups and the driveshaft slip yoke.

1. Position the driveshaft slip yoke in the C-Frame and Screw Remover/Installer.
2. Press out a bearing cup.
3. Rotate the driveshaft slip yoke 180 degrees.
4. Press on the U-joint spider to remove the remaining bearing cup.
5. Remove the driveshaft slip yoke.

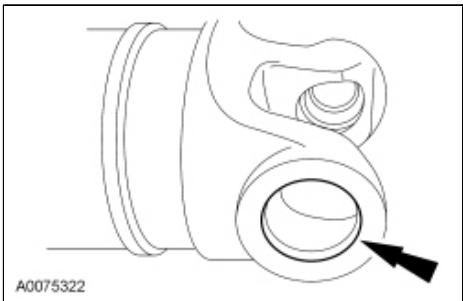


7. Repeat steps to remove the remaining bearing cups and the U-joint spider from the driveshaft yoke.



8. **NOTE:** Inspect the bearing cup bores and retaining ring grooves. Remove any rust or other surface irregularities.

Inspect the bearing cup bores of the driveshaft slip yoke and driveshaft yoke. Make sure that the bearing cup bores are clean and smooth.



## Assembly

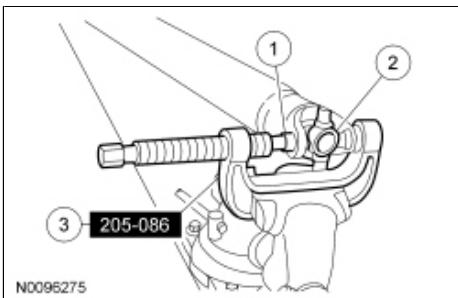
1. **NOTE:** Install the U-Joint Kits as complete assemblies only. Do not mix components from other U-Joint Kits.

**NOTE:** Lubricate the driveshaft slip yoke and driveshaft yoke bearing cup bores with grease from part kit # KT9L3P-M1C111-AA before installing the bearing cups.

Install a new U-joint spider and bearing cup.

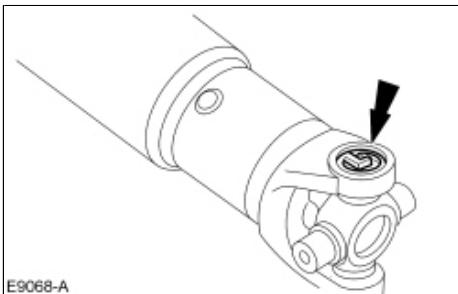
1. Start a new bearing cup in the driveshaft yoke.
  - Check the needle bearings for correct positioning.
2. Position the new U-joint spider in the driveshaft yoke.
3. Press the bearing cup to just below the snap ring groove using the C-Frame and Screw

Remover/Installer.

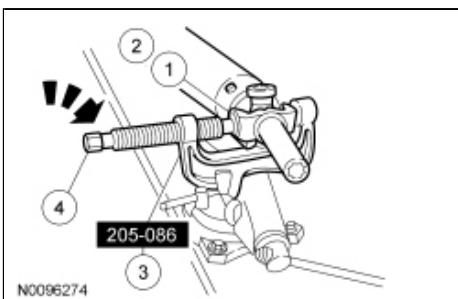


2. **NOTE:** Never mix yellow and black snap rings on opposing sides.

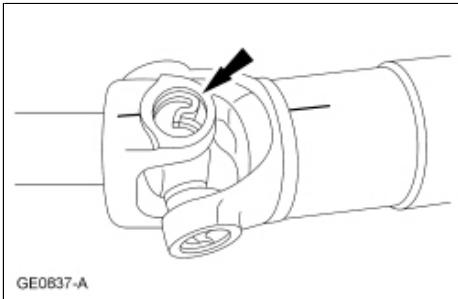
Remove the shaft from the C-Frame and Screw Remover/Installer and install a new yellow snap ring.



3. Repeat steps to install the new bearing cup and snap ring on the opposite side of the driveshaft yoke.
  - If the yellow snap ring will not seat in the snap ring groove, install the black snap rings.
4. Install the driveshaft slip yoke and new bearing cup.
  1. Align the index marks made during disassembly and install the driveshaft slip yoke on the U-joint spider.
  2. Start a new bearing cup in the driveshaft slip yoke.
    - Check the needle bearings for correct positioning.
  3. Position the assembly in the C-Frame and Screw Remover/Installer.
  4. Press the bearing cup to just below the snap ring groove using the C-Frame and Screw Remover/Installer.



5. Remove the driveshaft from the C-Frame and Screw Remover/Installer and install a new yellow snap ring.

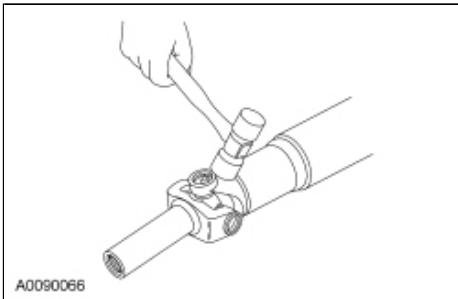


6. **NOTE:** Never mix yellow and black snap rings on opposing sides.

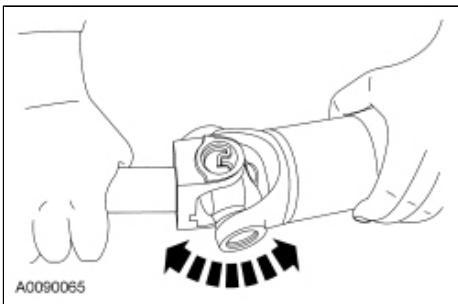
Repeat steps to install the new bearing cup and snap ring on the opposite side of the driveshaft slip yoke.

- If the yellow snap ring will not seat in the snap ring groove, install the black snap rings.

7. A sharp rap on the driveshaft yoke with a brass or plastic hammer will seat the bearing cups.



8. Rotate the driveshaft yoke to make sure the U-joints are free to rotate easily, without binding, before installing the driveshaft.



9. Install the driveshaft. Refer to [Driveshaft — Front](#), [Driveshaft — Rear, One-Piece](#) or [Driveshaft — Rear, Two-Piece](#) in this section.



## **Driveshaft**

**NOTE:** All driveshafts are balanced. If undercoating the vehicle, protect the driveshaft and U-joints to prevent overspray of any undercoating material.

Vehicles have the following types of driveshafts:

- Front driveshaft with CV joints at the front and rear ends of the driveshaft. The only serviceable part of the front driveshaft is the mounting hardware. The front driveshaft can be balanced by methods described in the General Driveline section. Refer to [Section 205-00](#).
- One-piece rear driveshafts with a rear U-joint flange and a slip yoke
- Two-piece rear driveshafts with a front flanged U-joint or slip yoke, center bearing with a slip joint and a flanged U-joint at the rear

Driveshafts are used to transfer movement from the transmission or transfer case to the front or rear axle. The driveshaft is composed of the U-joints, CV joints, connecting shafts and the attaching yokes. Some vehicles are equipped with a center support bearing. The center support bearing is prelubricated and sealed for the life of the bearing.

Driveshafts differ in length, diameter and type of yoke to accommodate various wheelbase and powertrain combinations.

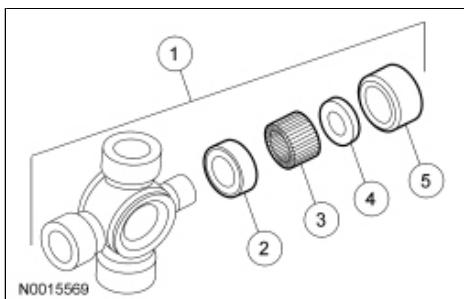
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## Universal Joints

U-joints have the following features:

- Lubed-for-life design and require no lubrication
- Equipped with nylon thrust washers (located at each base of the bearing cup) which control end play, position the needle bearing and improve grease movement
- Held in place by snap rings

The U-joints allow the speeding up and slowing down of the driveshafts as the angularity of the driveshaft changes.



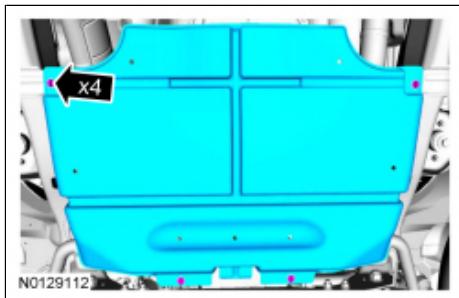
Item	Part Number	Description
1	4635	U-joint
2	—	Grease seal (part of 4635)
3	—	Needle rollers (part of 4635)
4	—	Thrust washer (part of 4635)
5	—	Bearing cup (part of 4635)



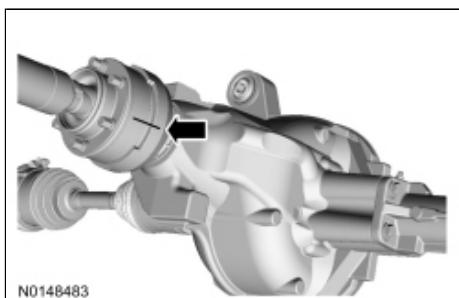
## Driveshaft — Front

### Removal

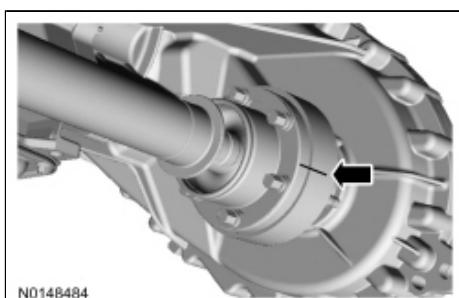
1. With the vehicle in NEUTRAL, position the vehicle on a hoist. Refer to [Section 100-02](#).
2. If equipped.



3.

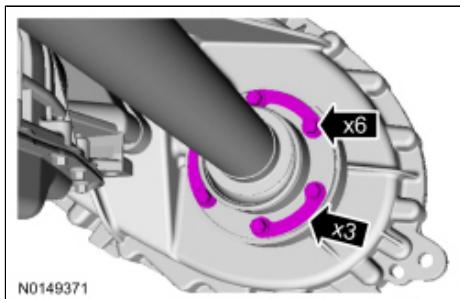


4.



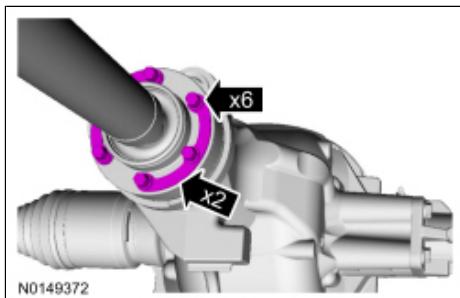
5. **NOTE:** If new bolts are not available, the old bolts and washers can be reused if they are not damaged. When reusing old bolts, the threads need to be cleaned and loctite has to be used on the threads of each bolt.

- To install, tighten to 55 Nm (41 lb-ft).

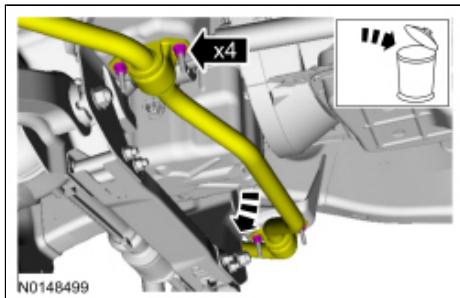


6. **NOTE:** If new bolts are not available, the old bolts and washers can be reused if they are not damaged. When reusing old bolts, the threads need to be cleaned and loctite has to be used on the threads of each bolt.

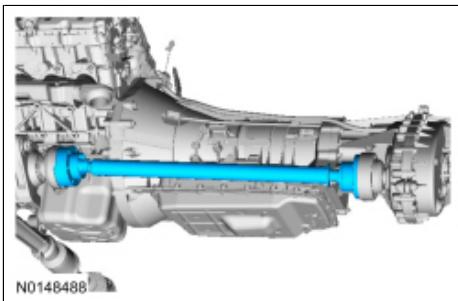
- To install, tighten to 55 Nm (41 lb-ft).



7.
  - To install, tighten to 55 Nm (41 lb-ft).



- 8.



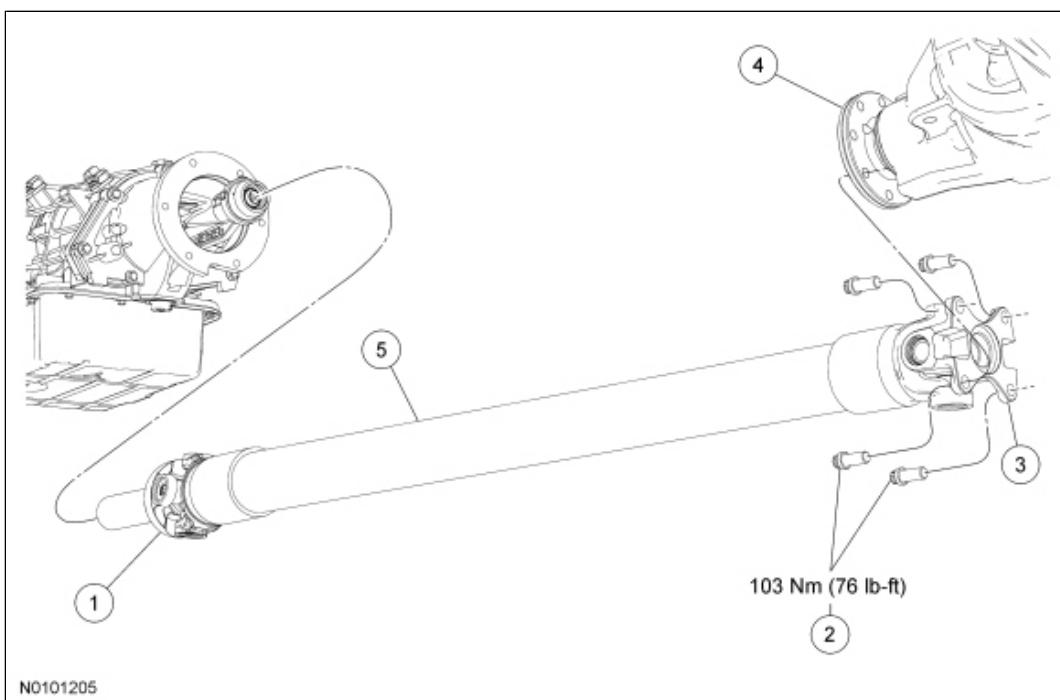
### Installation

1. To install, reverse the removal procedure.
-

## Driveshaft — Rear, One-Piece

### Material

Item	Specification
Threadlock and Sealer TA-25	WSK-M2G351-A5



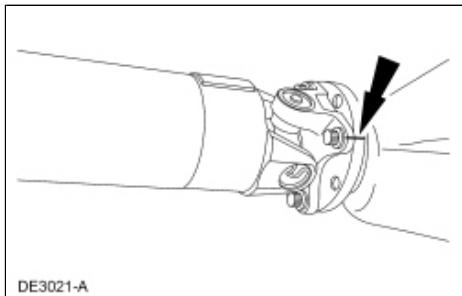
Item	Part Number	Description
1	4841	Driveshaft slip yoke
2	N800594	Driveshaft flange-to-pinion bolts (4 required)
3	4782	Rear driveshaft flange
4	4851	Pinion flange
5	4602	Driveshaft assembly

### Removal and Installation

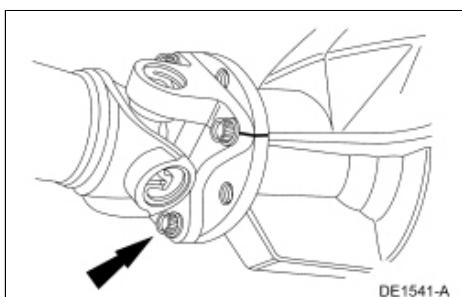
**NOTE:** For automatic transmissions, when installing a new driveshaft, match the yellow dots on the driveshaft to the yellow dots on the pinion flange and the output shaft to maintain balance during installation.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).

2. Index-mark the driveshaft flange to the pinion flange and the driveshaft flange to the transmission flange to maintain alignment during installation.

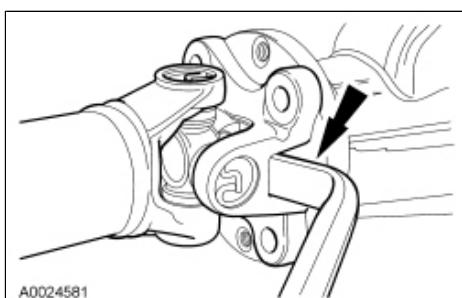


3. Remove and discard the 4 driveshaft flange bolts.
  - To install, tighten the 4 new bolts to 103 Nm (76 lb-ft).



4. **NOTICE:** The driveshaft flange fits tightly on the flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft flange from the flange pilot. Pry only in the area shown with a suitable tool to disconnect the driveshaft flange from the flange pilot or damage to the driveshaft flange can occur.

Using a suitable tool as shown, disconnect the driveshaft flange from the flange pilot and remove the driveshaft.



5. **NOTICE:** The driveshaft flange fits tightly on the pinion flange pilots. To make sure that the driveshaft flanges seat squarely on the pinion flange pilots, tighten the driveshaft flange bolts evenly in a cross pattern or damage to the flanges can occur.

**NOTE:** If new bolts are not available, coat the threads of the original driveshaft flange bolts with threadlock and sealer.

**NOTE:** Align the index marks made during removal.

To install, reverse the removal procedure.

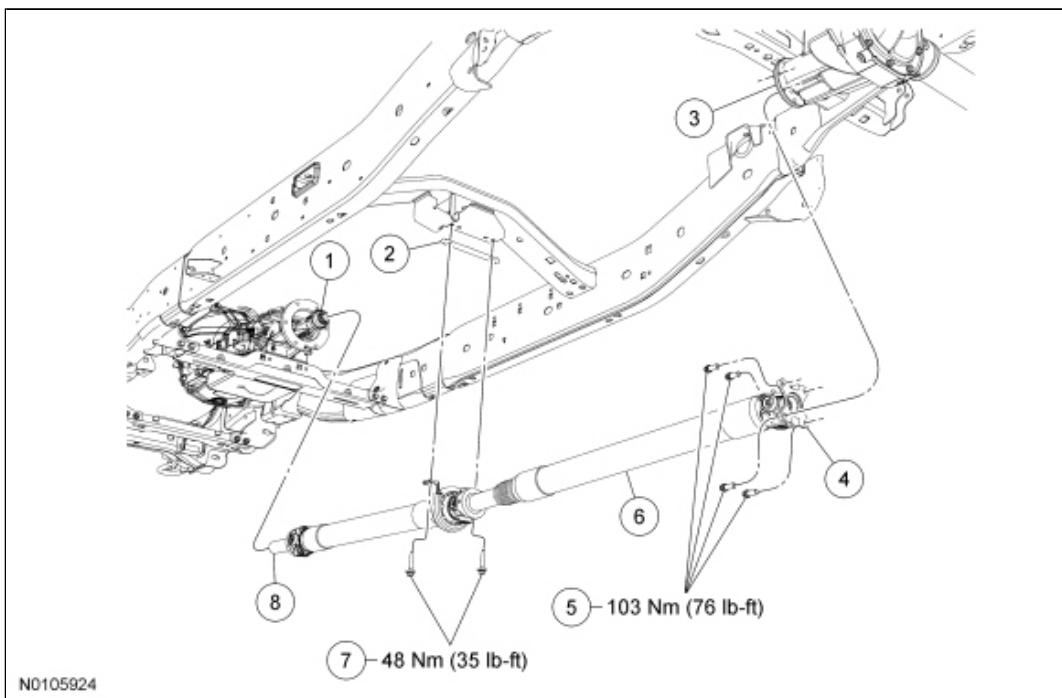
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## Driveshaft — Rear, Two-Piece

### Material

Item	Specification
Motorcraft® Threadlock and Sealer TA-25	WSK-M2G351-A5

**NOTE:** Front slip yoke shown, front fixed flange similar.

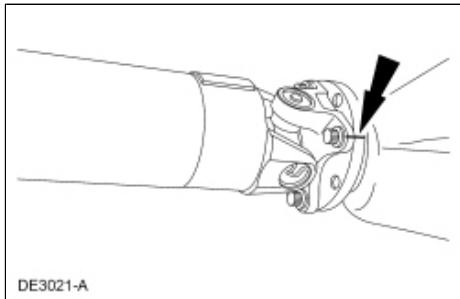


Item	Part Number	Description
1	7A309	Transmission extension housing
2	4A209	Center bearing shim (if equipped)
3	4858	Pinion flange
4	4782	Driveshaft flange
5	N800594	Driveshaft flange-to-pinion bolts (4 required) (front fixed flange [8 required])
6	4R602	Driveshaft assembly
7	W713078	Driveshaft center bearing bolts (2 required)
8	4841	Driveshaft slip yoke

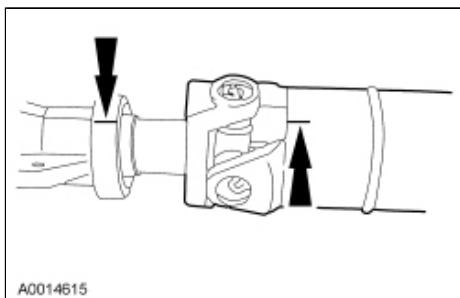
## Removal and Installation

**NOTE:** For automatic transmissions, when installing a new driveshaft, match the yellow dots on the driveshaft to the yellow dots on the pinion flange and the output shaft to maintain balance during installation.

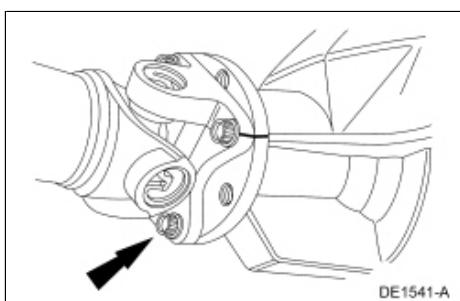
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Index-mark the driveshaft flange to the pinion flange to maintain alignment during installation.



3. Index-mark the driveshaft to the extension housing to maintain alignment during installation.

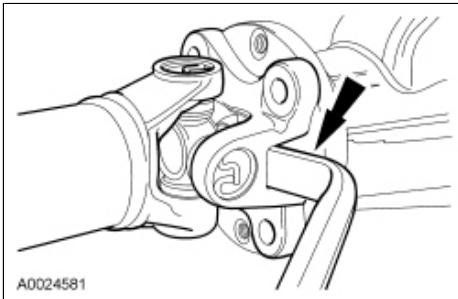


4. Remove and discard the 4 driveshaft flange bolts.
  - To install, tighten the 4 new bolts to 103 Nm (76 lb-ft).



5. **NOTICE:** The driveshaft flange fits tightly on the flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft flange from the flange pilot. Pry only in the area shown with a suitable tool, to disconnect the driveshaft flange from the flange pilot or damage to the driveshaft flange can occur.

Using a suitable tool as shown, disconnect the driveshaft flange from the flange pilot.



6. Remove the driveshaft in the following sequence.
  1. Remove the 2 driveshaft center bearing bolts.
  2. Lower the driveshaft and slide the driveshaft slip yoke rearward off of the output shaft.
    - To install, tighten to 48 Nm (35 lb-ft).
7. Plug the extension housing to prevent fluid loss.
8. **NOTICE:** The driveshaft flange fits tightly on the pinion flange pilots. To make sure that the driveshaft flanges seat squarely on the pinion flange pilots, tighten the driveshaft flange bolts evenly in a cross pattern or damage to the driveshaft flange can occur.

**NOTE:** If new bolts are not available, coat the threads of the original driveshaft flange bolts with threadlock and sealer.

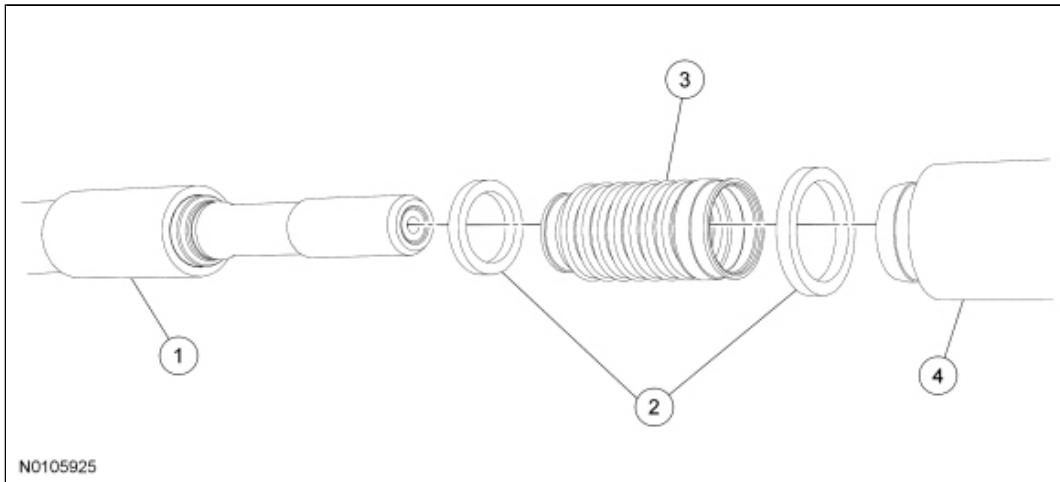
**NOTE:** Align the index marks made during removal.

**NOTE:** Clean any residual lubricant from the component.

To install, reverse the removal procedure.

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## Driveshaft Slip Yoke Boot

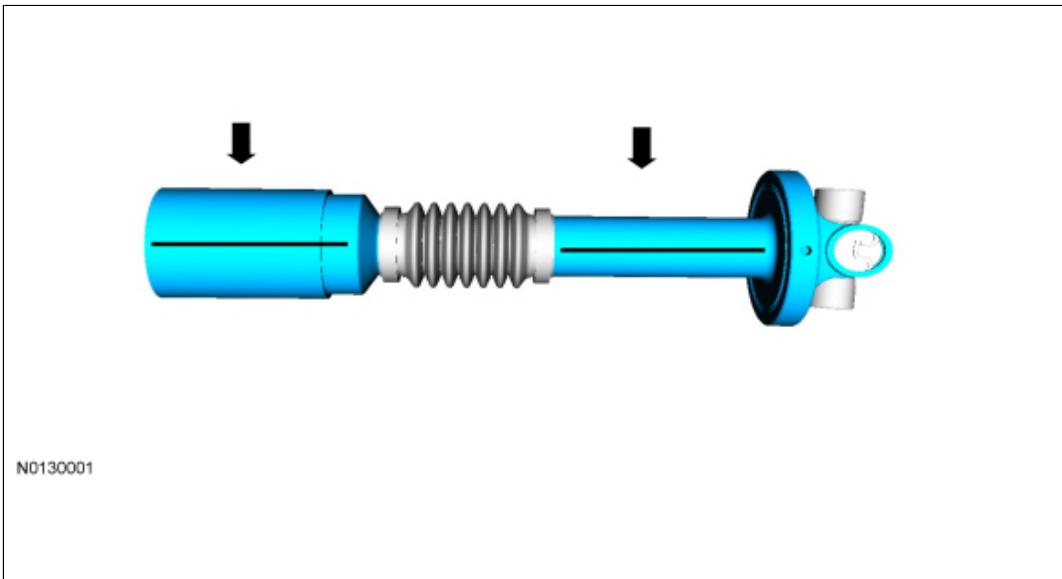


Item	Part Number	Description
1	4R602	Driveshaft assembly
2	3B478	Driveshaft slip-yoke boot clamps (2 required)( large clamp also part of kit M1C111)
3	4421	Driveshaft slip-yoke boot
4	4A335	Slip yoke

### Removal

- NOTICE:** The driveshaft and slip yoke have to be reassembled in the same phase as it was before disassembly. If the driveshaft and slip yoke isn't assembled in the same phase, a vibration can result.

Mark a straight line down the slip yoke and driveshaft, to help align for reassembly.



2. Remove the driveshaft. Refer to [Driveshaft — Front](#) or [Driveshaft — Rear, Two-Piece](#) in this section.
3. **NOTICE:** Do not, under any circumstance, clamp the driveshaft in the jaws of a vise or similar holding fixture. Denting or localizing fracture can result, causing driveshaft failure during vehicle operation.

Place the driveshaft on a suitable workbench. Do not damage the tubes.

4. Remove the driveshaft slip yoke from the driveshaft in the following sequence.
  1. Remove and discard the front driveshaft slip-yoke boot clamp.
  2. Remove the driveshaft slip yoke from the driveshaft.
5. Remove the slip-yoke boot from the driveshaft.
  - Inspect the boot for damage. Replace the boot as necessary.
6. Inspect the lubricant on the driveshaft splines and in the driveshaft slip yoke for contamination. If contaminated, inspect the driveshaft splines and the driveshaft slip yoke for wear. Install new components as necessary.

## Installation

1. Using a clean, dry lint free shop towel, thoroughly clean old grease from slip yoke splines.
2. Position the new small driveshaft slip-yoke boot clamp on the driveshaft stub shaft.
3. Slide the small opening end of the slip-yoke boot on the driveshaft stub shaft, as far as it will travel.
4. Using boot clamp pliers, crimp the driveshaft slip-yoke boot clamp.
5. **NOTICE:** The driveshaft and slip yoke have to be reassembled in the same phase as before disassembly. If the driveshaft and slip yoke aren't assembled in the same phase, a vibration can result.

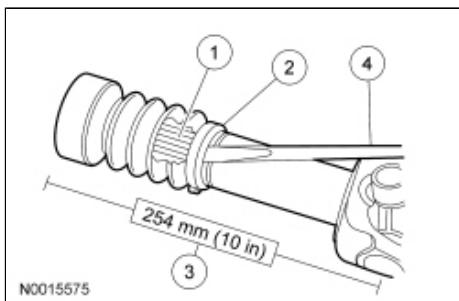
Install the driveshaft slip-yoke on the driveshaft.

1. Lubricate the driveshaft splines with long-life grease supplied in part # KT9L3P-M1C111-AA.
2. Pull the slip-yoke boot toward the driveshaft.
3. Position the new large slip-yoke boot clamp supplied in part # KT9L3P-M1C111-AA.
4. Align the marks from disassembly, and install the driveshaft slip yoke on the driveshaft.



N0129982

6. Set the driveshaft assembled length to specification.
  1. Remove any excess grease from the slip-yoke boot and driveshaft slip-yoke surfaces.
  2. Position the slip-yoke boot in the slip-yoke boot groove.
  3. Set the driveshaft assembled length to specification.
    - Measure from the stub shaft weld to the U-joint centerline.
  4. Bleed the air from the slip-yoke boot.



7. Using boot clamp pliers, crimp the large driveshaft slip-yoke boot clamp.
8. Install the driveshaft. Refer to [Driveshaft — Front](#) or [Driveshaft — Rear, Two-Piece](#) in this section.



**Material**

Item	Specification	Fill Capacity
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A	—
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—	—
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5	2.84L (6.0 pt) (to the bottom of the filler hole)
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

**General Specifications**

Item	Specification
Available drive pinion bearing adjustment shim in steps of 0.25 mm (0.010 in)	0.254-0.965 mm (0.010-0.038 in)
Backlash between ring gear teeth and pinion teeth	0.203-0.304 mm (0.008-0.012 in)
Differential case maximum runout	0.076 mm (0.003 in)
Pinion bearing rotational preload	1.5-3.0 Nm (13-26 lb-in)
Ring gear maximum variation between teeth backlash	0.102 mm (0.004 in)
Maximum axle shaft flange runout	0.279 mm (0.011 in)

**Rear Axle Backlash Shim Adjustment Table**

Backlash Change Required		Thickness Change Required	
mm	in	mm	in

0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

#### Torque Specifications

Description	Nm	lb-ft	lb-in
Axle vent	18	—	159
Brake hose bracket bolts	30	22	—
Brake tube/parking brake cable bracket bolt	25	18	—
RH parking brake cable bracket bolt	30	22	—
Differential bearing cap bolt	112	83	—
Differential housing cover bolts	45	33	—
Differential pinion shaft lock bolt	30	22	—
Differential ring gear bolts <sup>a</sup>	—	—	—
Filler plug	52	38	—
Handle Adapter	2.2	—	20
Lower shock absorber nuts	90	66	—
Tool 205-135 nut	7	—	62
U-bolt nut <sup>a</sup>	—	—	—
Wheel speed sensor bolts	15	—	133

<sup>a</sup> Refer to the procedure in this section.



## Rear Drive Axle and Differential

The rear axle assembly consists of the following:

- Integral-type housing hypoid gear design (center of the pinion set below the centerline of the ring gear)
- Hypoid differential ring gear and pinion consists of an 8.8-inch ring gear and an overhung drive pinion that is supported by 2 opposed tapered roller bearings
- Axle housing assembly that consists of a cast center section with 2 steel tube assemblies and a stamped differential housing cover
- Differential pinion shaft is retained by a threaded differential pinion shaft lock bolt attached to the differential case
- Differential case is mounted in the rear axle housing between 2 opposing differential bearings that are retained in the rear axle housing by 2 removable bearing caps

The rear drive axle receives rotational torque from the driveshaft. The direction of the rotation determines movement of the vehicle. The rotation enters the rear drive axle through the drive pinion flange, turning the drive pinion and rotating the ring gear. The ring gear is bolted to the differential case. The differential case houses the pinion shaft upon which the differential pinion gears ride. The pinion gears are in mesh with the differential side gears to which the axle shafts are splined. It is the unique arrangement of the differential that allows the axle shafts to be driven at different speed when needed, such as when driving around corners. A Traction-Lok differential is also available that introduces a series of clutch plates and discs behind the differential side gears to deliver as much torque as possible to each axle shaft when the traction at the rear wheels is not equal. The Traction-Lok differential requires a friction modifier that must be installed with the axle lubricant for the plates and discs to be functional.

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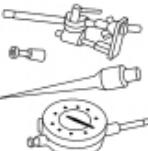
## Rear Drive Axle and Differential

Refer to [Section 205-00](#).

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## Ring Gear Backlash Adjustment

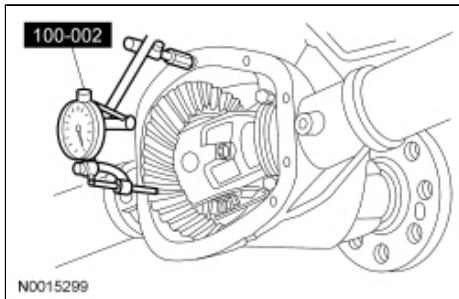
### Special Tool(s)

 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1485-A	Installer, Differential Shim 205-220 (T85L-4067-AH)

### Material

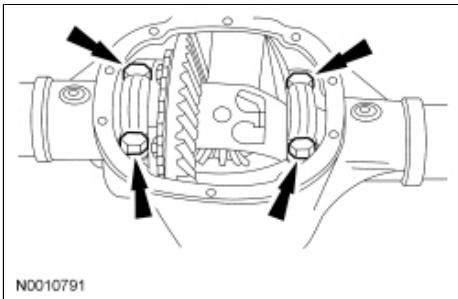
Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—

1. Remove the differential housing cover. For additional information, refer to [Differential Housing Cover](#) in this section.
2. Install the Dial Indicator Gauge with Holding Fixture and measure the ring gear backlash.
  - If a zero backlash condition occurs or the backlash is not within specification, proceed to Step 3.
  - If the backlash is within specification, proceed to Step 14.



3. Remove the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.
4. **NOTE:** Index-mark the position of the differential bearing caps, as arrows may not be visible. The differential bearing caps must be installed in their original locations and positions.

Remove the 4 bearing cap bolts and 2 caps.



5. If a zero backlash condition has occurred, add 0.50 mm (0.020 in) to the RH side shim and subtract 0.50 mm (0.020 in) from the LH side shim to allow a backlash indication. Install the 2 bearing caps and 4 bolts.
  - Tighten to 112 Nm (83 lb-ft).
  - Go back to Step 2.
6. To correct for high or low backlash, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

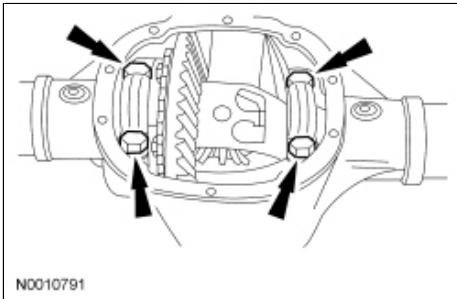
Differential Shim Size Chart 4067

Stripes and Color Code	Dimension A	
	mm	Inch

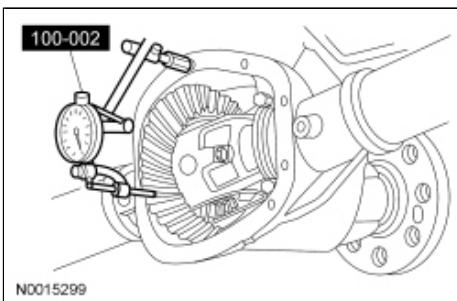
2 — C-COAL	7.7978-7.8105	0.3070-0.3075
1 — C-COAL	7.7470-7.7597	0.3050-0.3055
5 — BLU	7.6962-7.7089	0.3030-0.3035
4 — BLU	7.6454-7.6581	0.3010-0.3015
3 — BLU	7.5946-7.6073	0.2990-0.2995
2 — BLU	7.5458-7.5565	0.2970-0.2975
5 — PINK	7.4422-7.4549	0.2930-0.2935
4 — PINK	7.3914-7.4041	0.2910-0.2915
3 — PINK	7.3406-7.3533	0.2890-0.2895
2 — PINK	7.2898-7.3025	0.2870-0.2875
1 — PINK	7.2390-7.2517	0.2850-0.2855
5 — GRN	7.1882-7.2009	0.2830-0.2835
4 — GRN	7.1374-7.1501	0.2810-0.2815
3 — GRN	7.0866-7.0993	0.2790-0.2795
2 — GRN	7.0358-7.0485	0.2770-0.2775
1 — GRN	6.9850-7.0485	0.2750-0.2755
5 — WH	6.9342-6.9469	0.2730-0.2735
4 — WH	6.8834-6.8961	0.2710-0.2715
3 — WH	6.8326-6.8453	0.2690-0.2695
2 — WH	6.7818-6.7945	0.2670-0.2675
1 — WH	6.7310-6.7437	0.2650-0.2655
5 — YEL	6.6802-6.6929	0.2630-0.2635
4 — YEL	6.6294-6.6421	0.2610-0.2615
3 — YEL	6.5786-6.5913	0.2590-0.2595
2 — YEL	6.5278-6.5405	0.2570-0.2575
1 — YEL	6.4770-6.4897	0.2550-0.2555
5 — ORNG	6.4262-6.4389	0.2530-0.2535
4 — ORNG	6.3754-6.3881	0.2510-0.2515
3 — ORNG	6.3246-6.3373	0.2490-0.2495
2 — ORNG	6.2738-6.2865	0.2470-0.2475
1 — ORNG	6.2223-6.2357	0.2450-0.2455
2 — RED	6.1722-6.1849	0.2430-0.2435
1 — RED	6.1214-6.1341	0.2410-0.2415

7. Install the 2 bearing caps and 4 bolts.

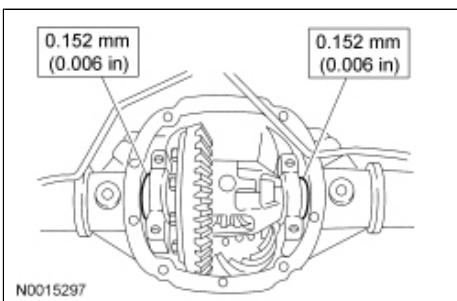
- Tighten to 112 Nm (83 lb·ft).



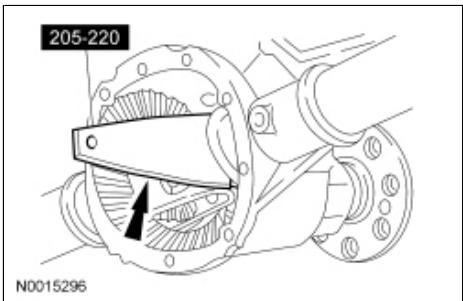
8. Using the Dial Indicator Gauge with Holding Fixture, recheck the ring gear backlash.
  - If backlash is now within specification, proceed to Step 9.
  - If backlash is not within specification, go back to Step 4.



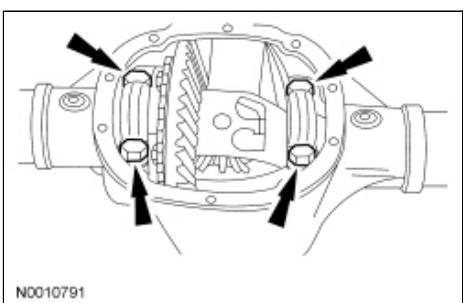
9. Remove the 4 bearing cap bolts and 2 bearing caps.
10. To establish differential bearing preload, increase both LH and RH differential bearing shim size by the thickness shown.



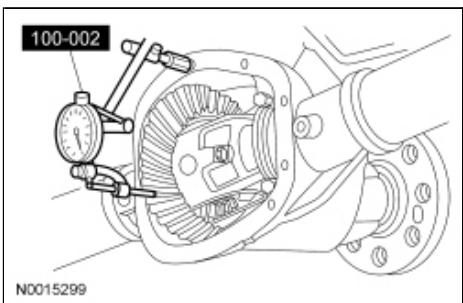
11. Using the Differential Shim Installer, fully seat the differential bearing shims. Make sure the assembly rotates freely.



12. Install the 2 bearing caps and 4 bolts.
  - Tighten to 112 Nm (83 lb-ft).



13. Using the Dial Indicator Gauge with Holding Fixture, do a final check of the ring gear backlash.

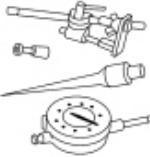


14. Apply marking compound and rotate the differential assembly 5 complete revolutions.
15. Verify an acceptable pattern check. For additional information, refer to Tooth Contact Pattern Check in [Section 205-00](#).
16. Install the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.
17. Install the differential housing cover. For additional information, refer to [Differential Housing Cover](#) in this section.



## Differential Case and Ring Gear — Conventional

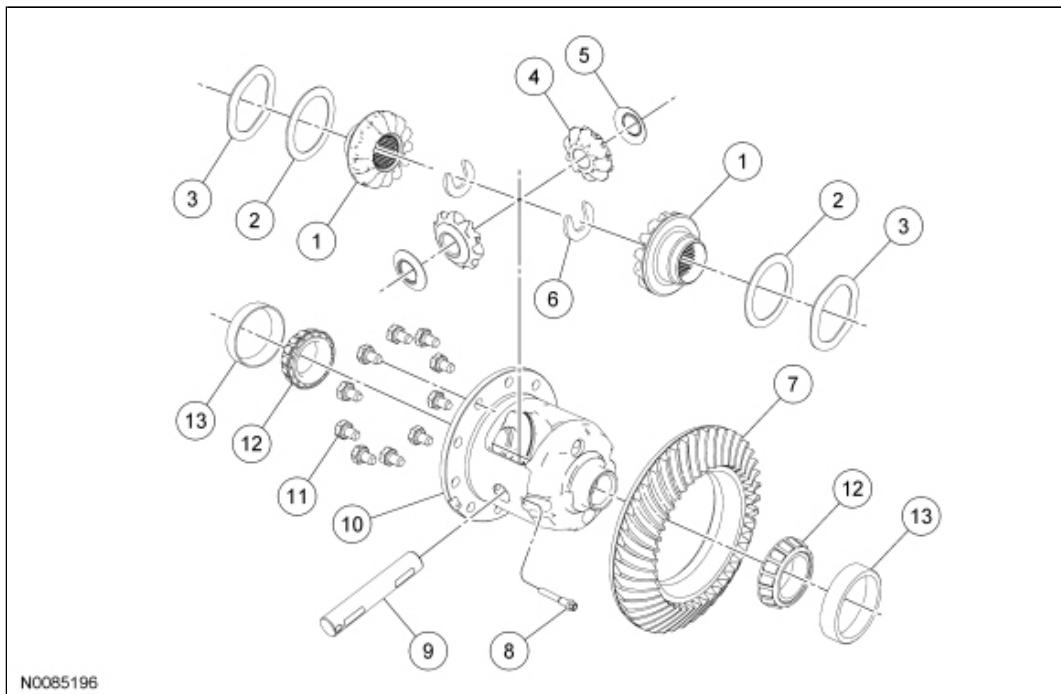
### Special Tool(s)

 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1265-A	Gauge, Differential Clutch 205-022 (T66L-4204-A)
 ST1749-A	Gauge, Differential (Traction Lock) 205-386 (T97T-4205-D)
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1220-A	Remover, Differential Bearing 205-116 (T77F-4220-B1)
 ST1543-A	Step Plate 205-D016 (D80L-630-5) or equivalent

### Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant	WSL-M2C192-A and GL-5

XY-75W140-QL (US); CXY-75W140-1L (Canada)	
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5



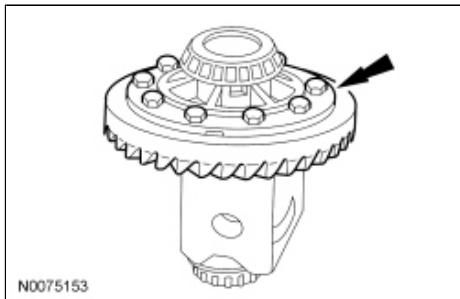
N0085196

Item	Part Number	Description
1	4236	Differential side gears
2	4228	Differential side gear thrust washers
3	—	Differential side gear wave washers
4	4215	Differential pinion gear (2 required)
5	4230	Differential pinion thrust washer (2 required)
6	4N237	Axle shaft U-washer (2 required)
7	4209	Differential ring gear
8	4241	Differential pinion shaft lock bolt
9	4211	Differential pinion shaft
10	4204	Differential case
11	4216	Differential ring gear bolt (10 required)
12	4221	Differential bearings
13	4222	Differential bearing cups

#### Initial disassembly

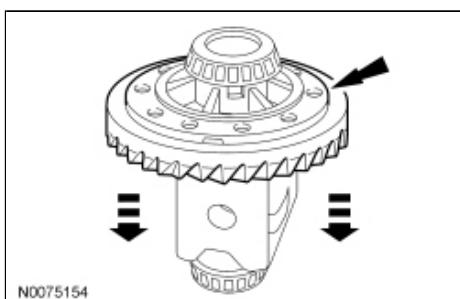
**NOTE:** If the differential ring gear backlash between teeth is greater than specification, remove the ring gear to check the differential case flange runout. Do not disassemble the differential carrier assembly.

1. Remove the differential carrier. Tag the differential shims and bearing cups for location. For additional information, refer to [Differential Carrier](#) in this section.
2. Remove and discard the 10 differential ring gear bolts.

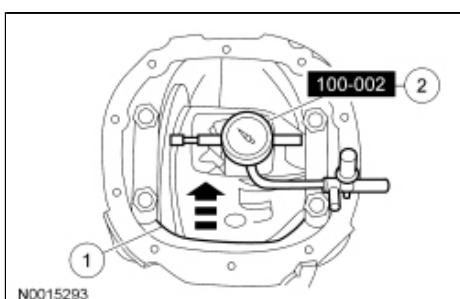


3. **NOTICE:** Care should be taken not to damage the differential ring gear bolt hole threads.

Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.

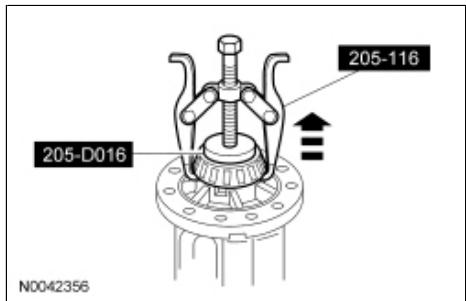


4. If checking differential case flange runout, install the bearing cups in their original location and install the differential assembly.
  1. Install the bearing caps and differential shims.
    - Rotate the differential assembly to verify the bearings have seated.
  2. Install the Dial Indicator Gauge With Holding Fixture and record the differential case runout.

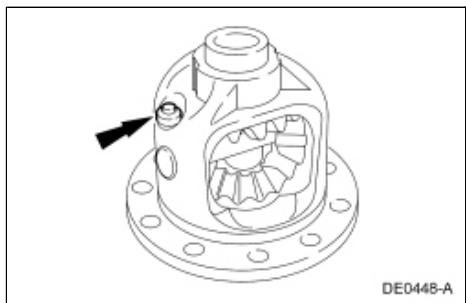


### Final disassembly

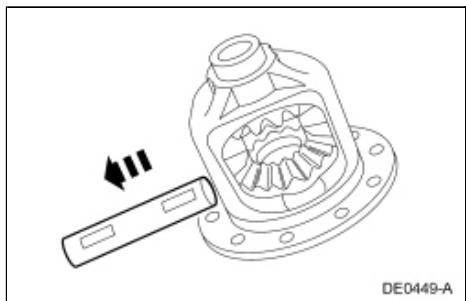
5. Using the Differential Bearing Remover and Step Plate, remove the differential bearings.



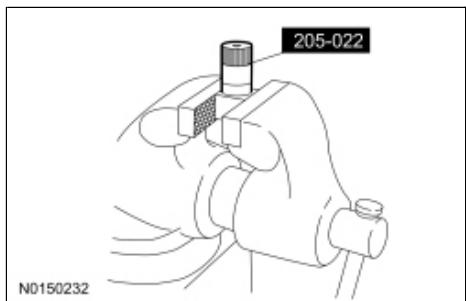
6. Remove the differential pinion shaft lock bolt.



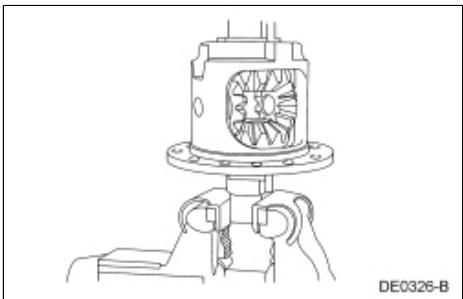
7. Remove the differential pinion shaft.



8. Install the Differential Gauge in a suitable vise.

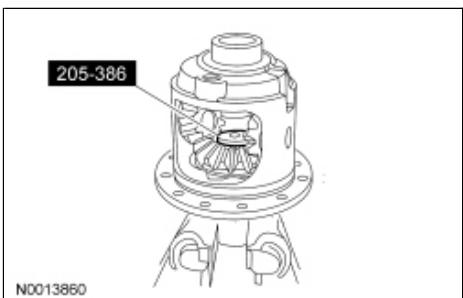


9. Install the differential case on the Differential Gauge.

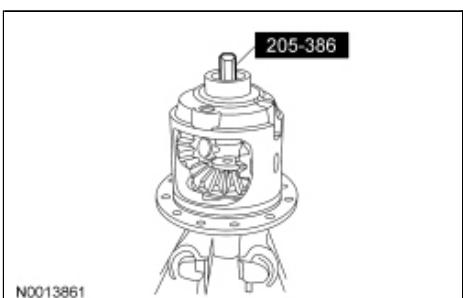


10. **NOTE:** Apply a small amount of grease to the centering hole of the Differential Gauge.

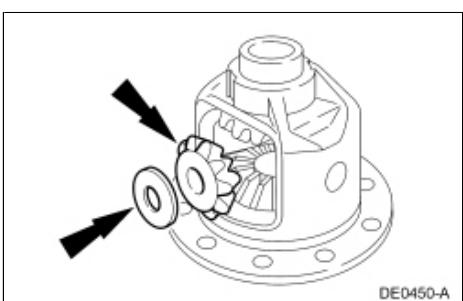
Install the Differential Gauge step plate in the bottom differential side gear.



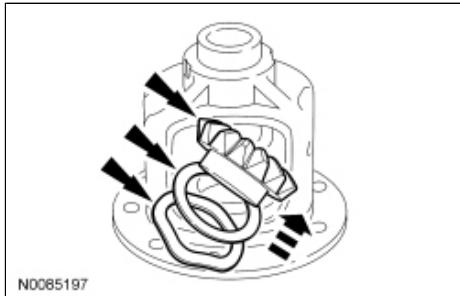
11. Install the Differential Gauge nut in the upper differential side gear. Hold the nut in position while installing the Differential Gauge hex screw. Tighten the hex-head screw until contact is made with the Step Plate.



12. Rotate and remove the differential pinion gears and differential pinion gear thrust washers.



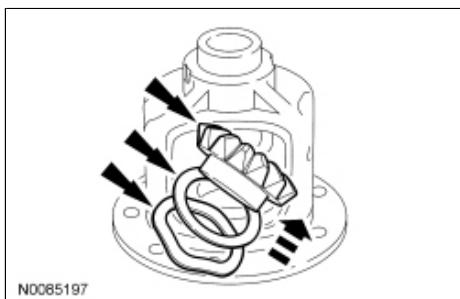
13. Remove the differential side gears, the differential side gear washers and the differential side gear wave washers.



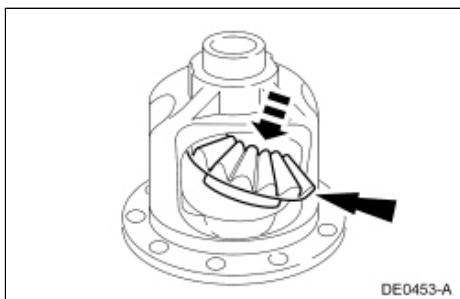
## Assembly

1. **NOTE:** Lubricate the differential side gear thrust washers, wave washers and the side gear journals with axle lubricant.

Position the differential side gear thrust washers and wave washers on the differential side gears.



2. Install the differential side gears.



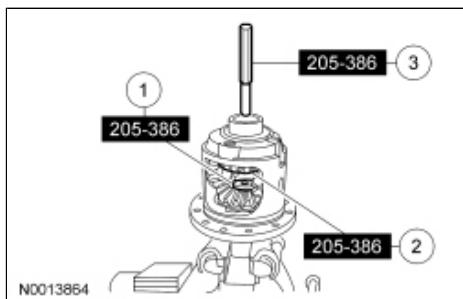
3. **NOTE:** Apply a small amount of grease to the Step Plate bore.

**NOTE:** If necessary, insert the Differential Gauge dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

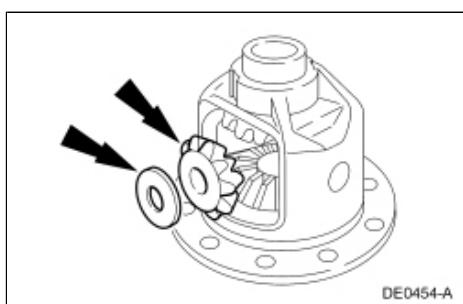
Assemble the Differential Gauge to the differential case.

1. Position the Differential Gauge step plate in the bottom differential side gear.
2. Position the Differential Gauge hex screw plate in the top differential side gear and hold it in place.

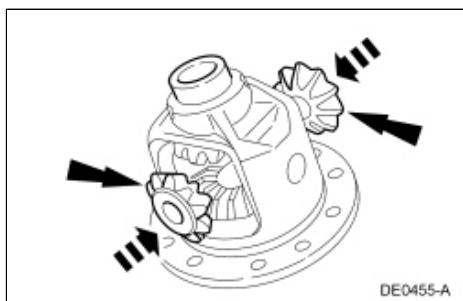
3. Install the Differential Gauge hex screw and tighten it 2 turns after it contacts the bottom Step Plate.



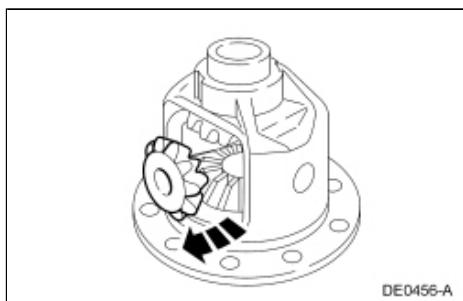
4. Use axle lubricant to lubricate the differential pinion gear thrust washers and the differential pinion gears.



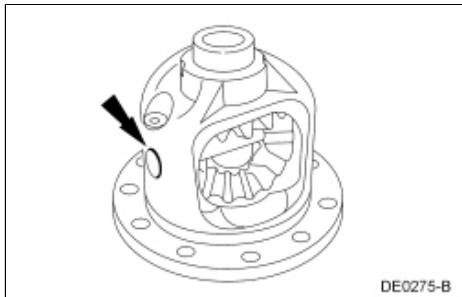
5. Install the differential pinion gears and differential pinion gear thrust washers opposite the differential side gears.



6. Rotate the differential pinion gears to align with the differential pinion shaft bore.

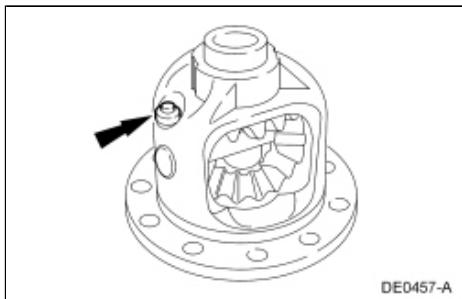


7. Install the differential pinion shaft.
  - Align the hole in the differential pinion shaft with the hole in the differential case.

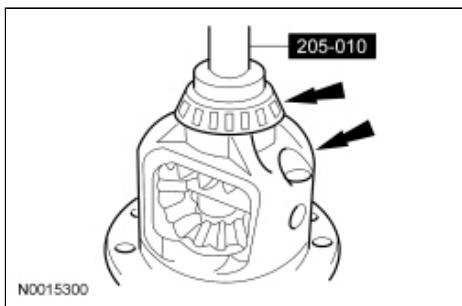


8. **NOTE:** If a new pinion shaft lock bolt is unavailable, coat the threads with threadlock and sealer prior to installation.

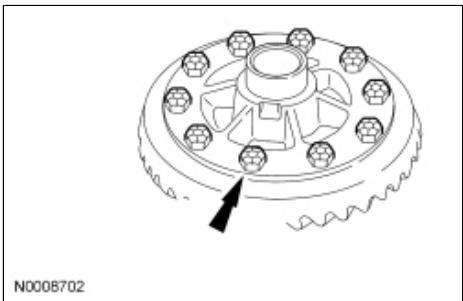
Install a new differential pinion shaft lock bolt and tighten finger-tight.



9. Using the Differential Side Bearing Installer, install the new differential bearings on the differential case.



10. Position the differential ring gear on the differential case. Align the bolt holes by starting 2 bolts through the holes in the differential case and into the differential ring gear.
11. Using a shop press, press the ring gear on the differential case.
12. Install the 10 new differential ring gear bolts. Tighten in 2 stages.
  - Stage 1: Tighten to 60 Nm (44 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.

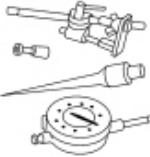
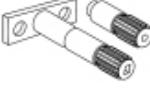
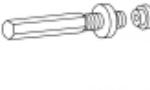


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13. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
-

## Differential Case and Ring Gear — Traction-Lok

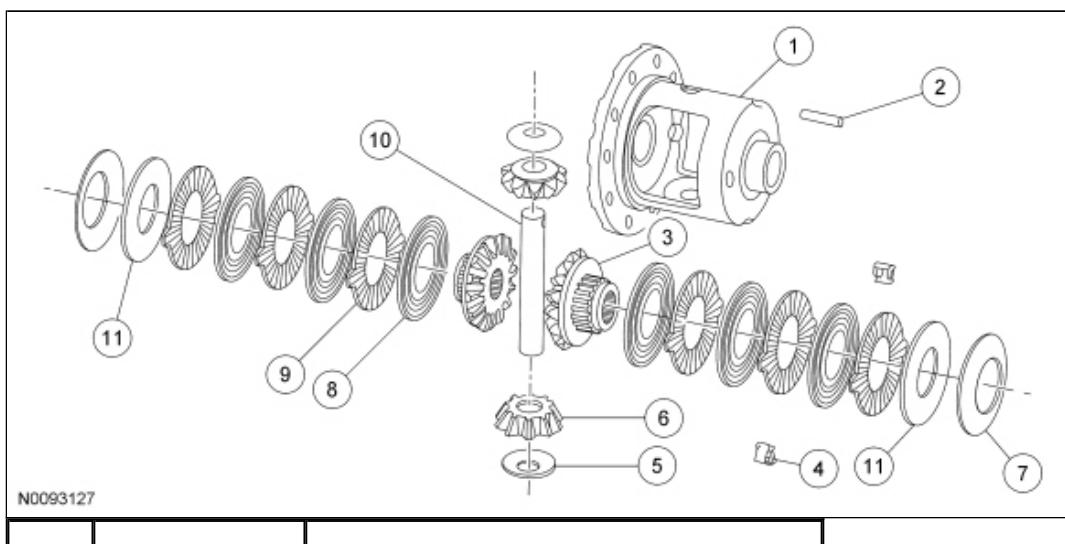
### Special Tool(s)

 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1374-A	Gauge, Differential Clutch 205-135 (T80P-4946-A)
 ST1265-A	Gauge, Differential Clutch 205-022 (T66L-4204-A)
 ST1372-A	Gauge, Differential Clutch (Mandrel for 205-135 [T80P-4946-A]) 205-270 (T87T-4946A)
 ST1749-A	Gauge, Differential (Traction-Lock) 205-386 (T97T-4205-D)
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Remover, Differential Bearing 205-116 (T77F-4220-B1)

	Rotator, Differential 205-378 (T97T-4205-C)
	Step Plate 205-D016 (D80L-630-5) or equivalent

#### Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY- 75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG- 1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5



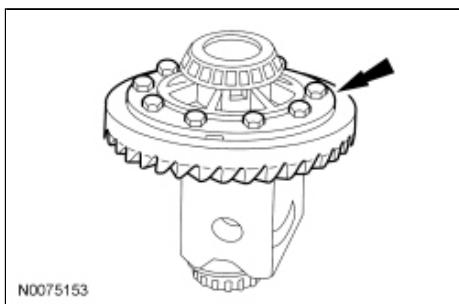
Item	Part Number	Description
1	4204	Differential case
2	4241	Differential pinion shaft lock bolt
3	4236	Differential side gear
4	—	Retainer clip (part of 4880)
5	4230	Differential pinion thrust washer
6	4215	Differential pinion gear
7	—	Plate preload spacer (part of 4880)
8	—	Clutch disc (part of 4880)
9	—	Clutch plate (part of 4880)
10	4211	Differential pinion shaft
11	—	Selective shim (part of 4880)

#### Initial disassembly

**NOTE:** If the Diagnostic Chart directed the servicing of the Traction-Lok clutch packs, it is not necessary to remove the differential carrier assembly from the axle housing. Proceed to Step 7.

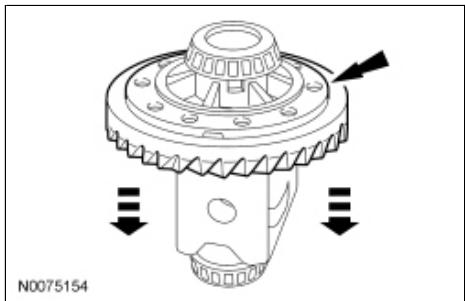
**NOTE:** If the differential ring gear backlash between teeth is greater than specification, remove the ring gear to check the differential case flange runout. Do not disassemble the differential carrier assembly.

1. Remove the differential carrier. Tag the differential shims and bearing cups for location. For additional information, refer to [Differential Carrier](#) in this section.
2. Remove and discard the 10 differential ring gear bolts.

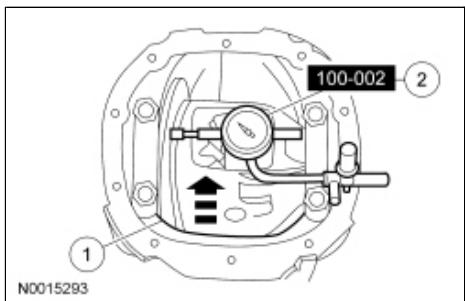


3. **NOTICE:** Care should be taken not to damage the differential ring gear bolt hole threads.

Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.

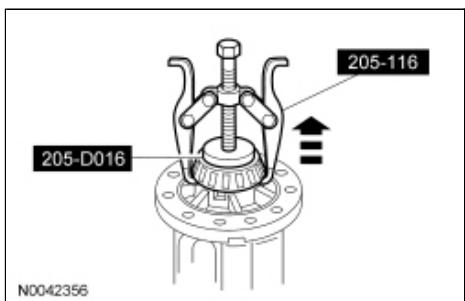


4. If checking differential case flange runout, install the bearing cups in their original location and install the differential assembly.
  1. Install the bearing caps and differential shims.
    - Rotate the differential assembly to verify the bearings have seated.
  2. Install the Dial Indicator Gauge With Holding Fixture and record the differential case runout.

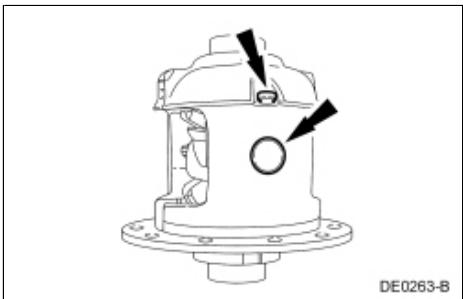


#### Final disassembly

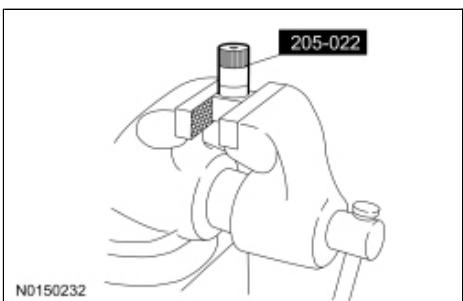
5. Using the Differential Bearing Remover and Step Plate, remove the differential bearings.



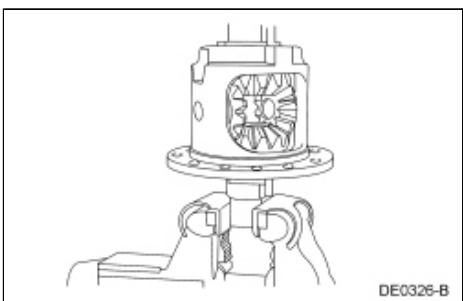
6. Remove the differential pinion shaft lock bolt and remove the differential pinion shaft.



7. Install the Differential Gauge in a suitable vise.

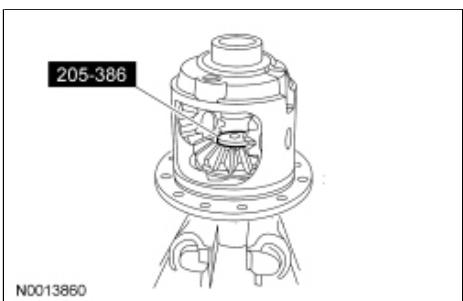


8. Install the differential case on the Differential Gauge.

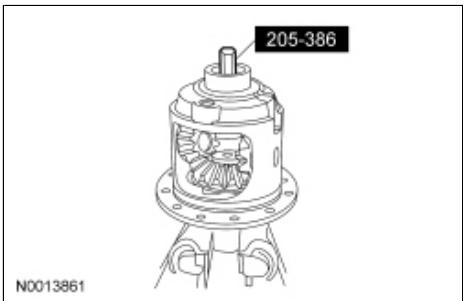


9. **NOTE:** Apply a small amount of grease to the centering hole of the Differential Gauge.

Install the Differential Gauge step plate in the bottom differential side gear.

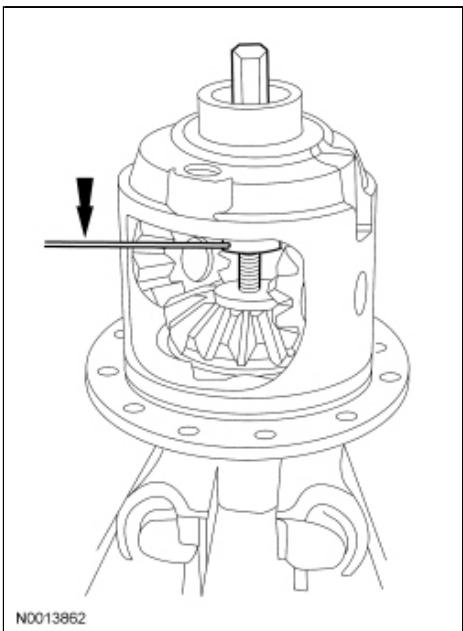


10. Install the nut in the upper differential side gear. Hold the nut in position while installing the hex screw. Tighten the hex-head screw until contact is made with the Differential Gauge step plate.



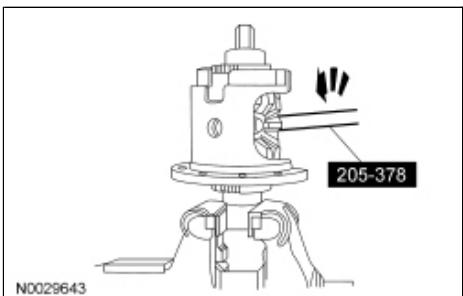
11. **NOTE:** The dowel bar is used to keep the nut from turning when the forcing screw is tightened.

Insert a suitable dowel bar in the hole of the nut. Tighten the forcing screw to force the differential side gears away from the differential pinion gears.

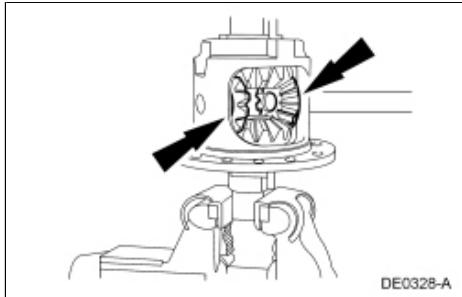


12. **NOTE:** Differential pinion gear thrust washers cannot be removed independently of the differential pinion gears.

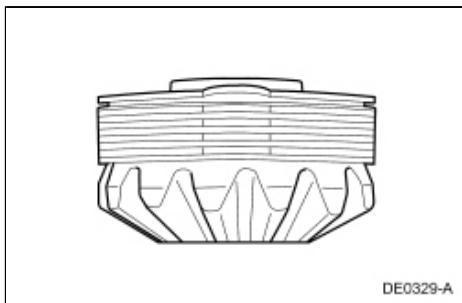
Insert the Differential Rotator in the pinion shaft bore, and turn the differential case to "walk" the differential pinion gears and differential case windows.



13. Remove the differential pinion gears and differential pinion gear thrust washers.



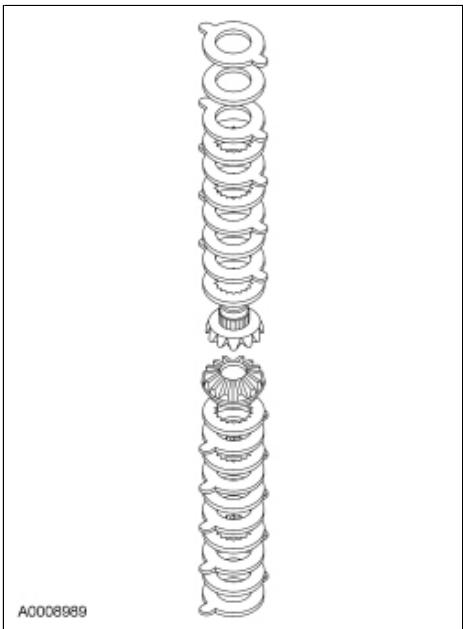
14. Remove the differential side gears and differential clutch packs with the selective shim and Belleville spring, tag them RH and LH.



15. **NOTICE:** Do not use acids or solvents when cleaning the differential clutch pack or damage to the components can result. Wipe components with a clean, lint-free cloth only.

**NOTE:** When separating the clutch plates and clutch disc, note the sequence in which they are disassembled. They must be reassembled in the same sequence.

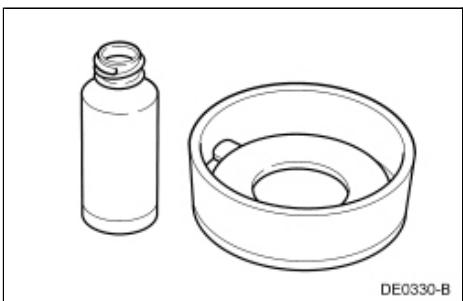
Separate the differential clutch disc and clutch plates for cleaning and inspection.



## Assembly

1. **NOTE:** Use 118 ml (4 oz) of the specified friction modifier in the axle.

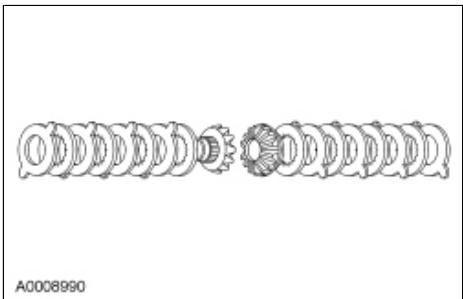
Pre-lubricate each steel clutch plate and soak all friction plates with friction modifier for at least 15 minutes.



2. **NOTE:** Do not mix the differential clutch packs or selective shims from one side with the other.

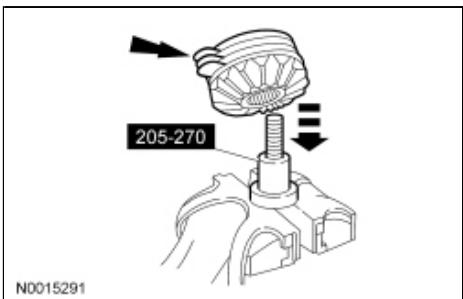
**NOTE:** The Belleville spring is a dished plate.

Assemble the differential clutch packs (without the selective shims and Belleville spring) on the respective differential side gears.

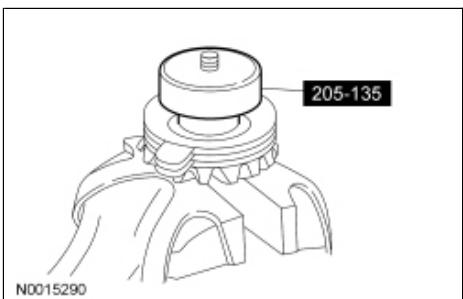


3. **NOTE:** Make sure the correct mandrel is used with the Differential Clutch Gauge.

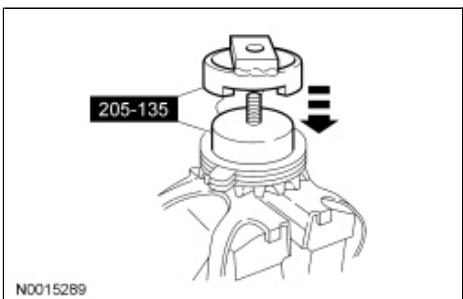
Place the base portion of the Differential Clutch Gauge in a vise. Install the differential clutch pack and differential side gear (without the selective shim or Belleville spring) on the gauge.



4. Position the Differential Clutch Gauge hand-tight on top of the differential clutch pack.

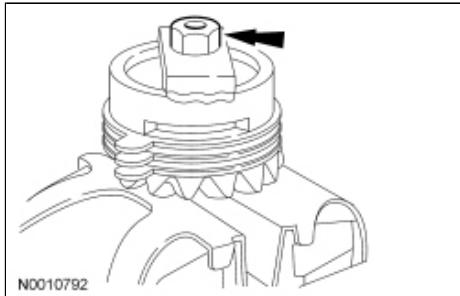


5. Install the Differential Clutch Gauge over the disc and differential clutch pack.



6. Install the nut of the gauge over the top and base stud.

- Tighten to 7 Nm (62 lb-in).

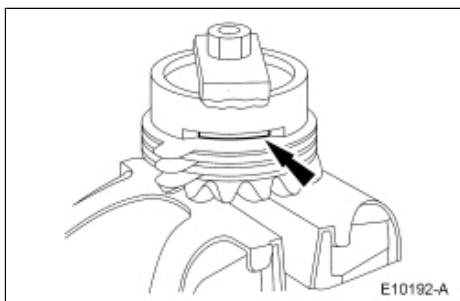


**7. NOTE:** Selective shims shown are available as part of the Clutch Pack Replacement Kit.

Use the feeler gauge and select the thickest blade that will enter between the tool and the differential clutch pack. Refer to the chart to determine which shim to use.

**Selective Shims**

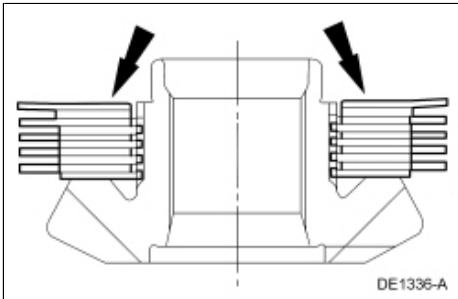
Feeler Gauge	Part Number	Description
0.096-0.104	E0AZ-4A324-G	0.025 in
0.105-0.109	E0AZ-4A324-H	0.030 in
0.110-0.114	E0AZ-4A324-C	0.035 in
0.115-0.190	E0AZ-4A324-D	0.040 in
0.120-0.125	E0AZ-4A324-F	0.045 in



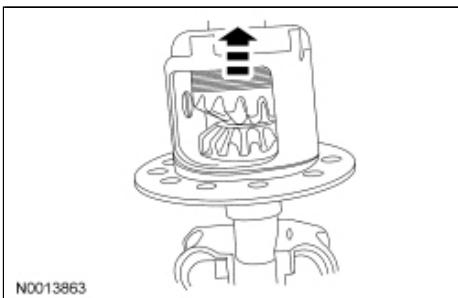
**8. Remove the Differential Clutch Gauge from the clutch pack and differential side gear assembly.**

**9. Place the selective shim and Belleville spring on the differential clutch pack.**

- The dished or concave side of the Belleville spring must face up against the thrust face of the differential case.



10. Install the differential side gears with the differential clutch packs, selective shims and Belleville spring into the differential case.
  - Hold the differential side gear assembly in place to prevent it from falling out of the differential case.

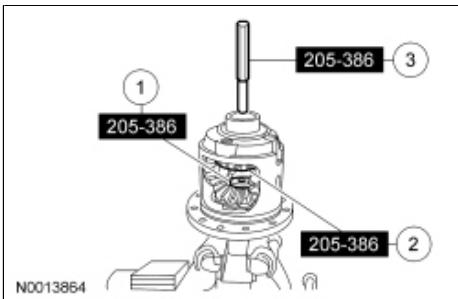


11. **NOTE:** Apply a small amount of grease to the step plate bore.

**NOTE:** If necessary, insert the dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

Assemble the Differential Gauge to the differential case.

1. Position the Differential Gauge step plate in the bottom differential side gear.
2. Position the Differential Gauge in the top differential side gear and hold it in place.
3. Install the Differential Gauge and tighten it 2 turns after it contacts the bottom step plate.

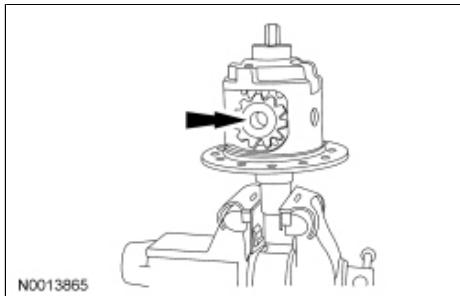


12. **NOTE:** Lubricate both sides of the differential pinion gear thrust washers with axle lubricant.

**NOTE:** Make sure the differential pinion gears are 180 degrees apart so they will align correctly with the pinion shaft bore.

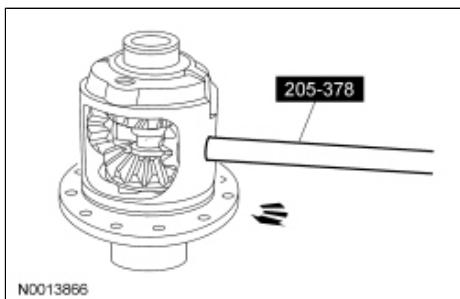
Position the differential pinion gears and differential pinion gear thrust washers in the window of the

differential case so they mesh with the differential side gear teeth.



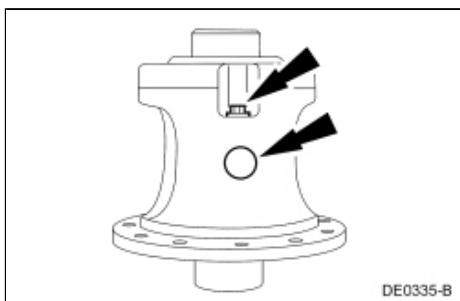
13. **NOTE:** It will probably be necessary to loosen or tighten the forcing screw to allow the differential pinion gears and differential side gears to rotate.

Inspect the Differential Rotator into the pinion shaft bore, and turn the differential case. This will cause the differential pinion gears to engage the differential side gear and "walk" into the differential case. Rotate the differential case until the pinion shaft mating holes are lined up exactly with the holes in the differential pinion gears.



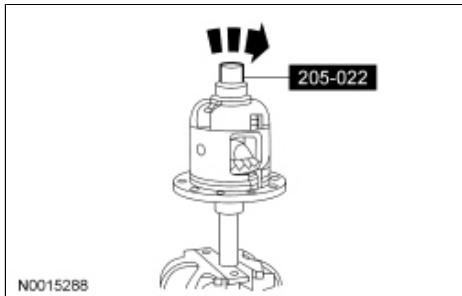
14. Remove the special tools.
15. **NOTE:** If a new differential pinion shaft lock bolt is unavailable, coat the threads of the original differential pinion shaft lock bolt with threadlock prior to installation.

Install the differential pinion shaft, then a new differential pinion shaft lock bolt finger-tight.

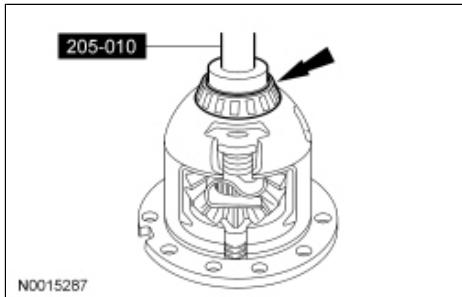


16. Check the torque required to rotate one differential side gear.
  - Mount the differential assembly and Differential Clutch Gauge in a vise.
  - The initial minimum break-away torque, if original clutch plates are used, must be within specification. The minimum rotating torque required to keep the differential side gear turning

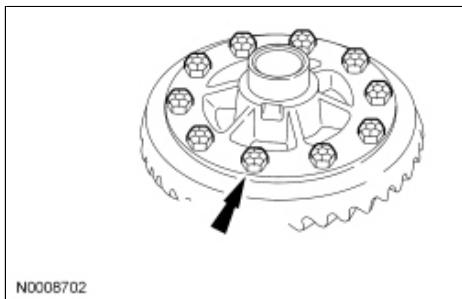
with new clutch plates may vary.



17. Using the Differential Side Bearing Installer, install the 2 differential bearings on the differential case.



18. Position the differential ring gear and the differential case. Align the bolt holes by hand-starting 2 new bolts through the holes in the differential case and into the differential ring gear.
19. Hand-start the 8 remaining new differential ring gear bolts. Tighten the 10 bolts in 2 stages.
  - Stage 1: Tighten to 60 Nm (44 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.



20. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
-



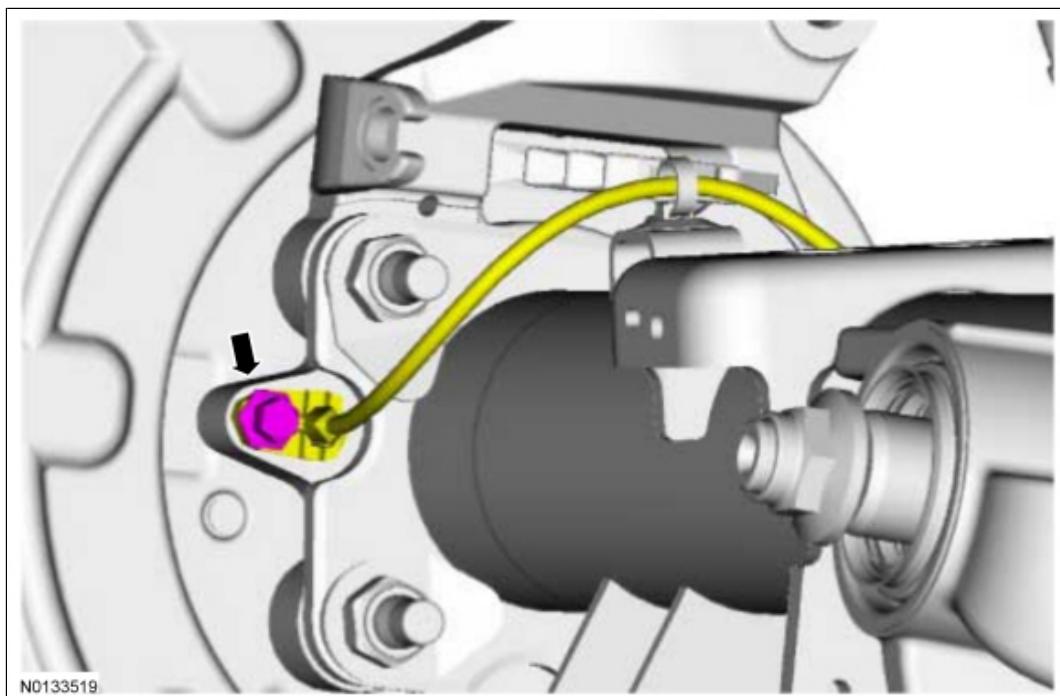
## Axle Shaft

### Material

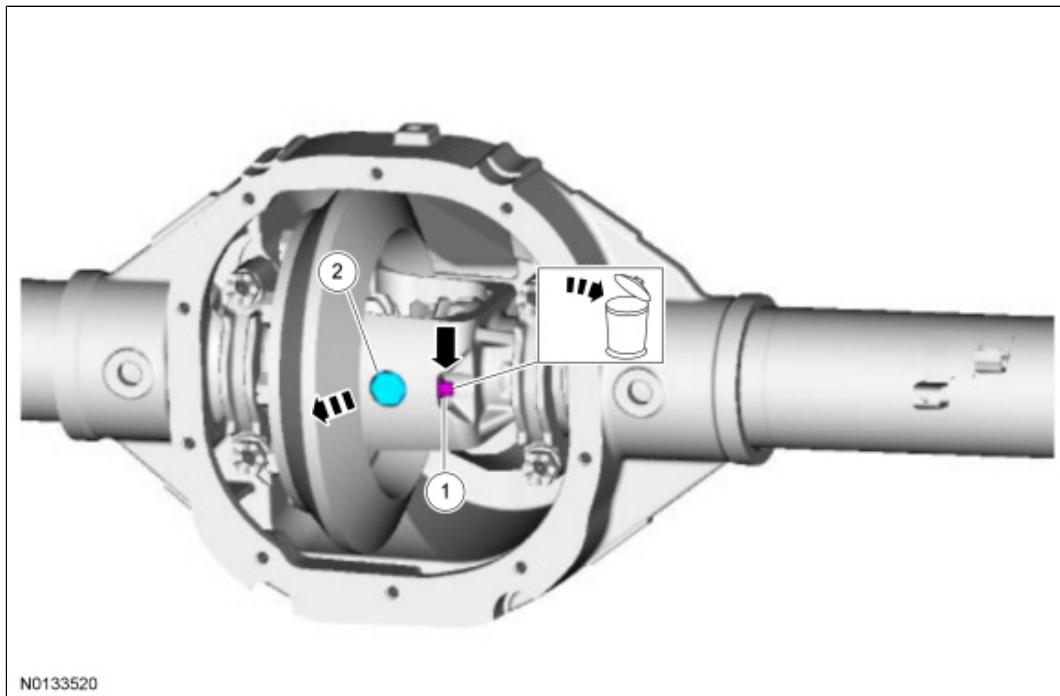
Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5

### Removal and Installation

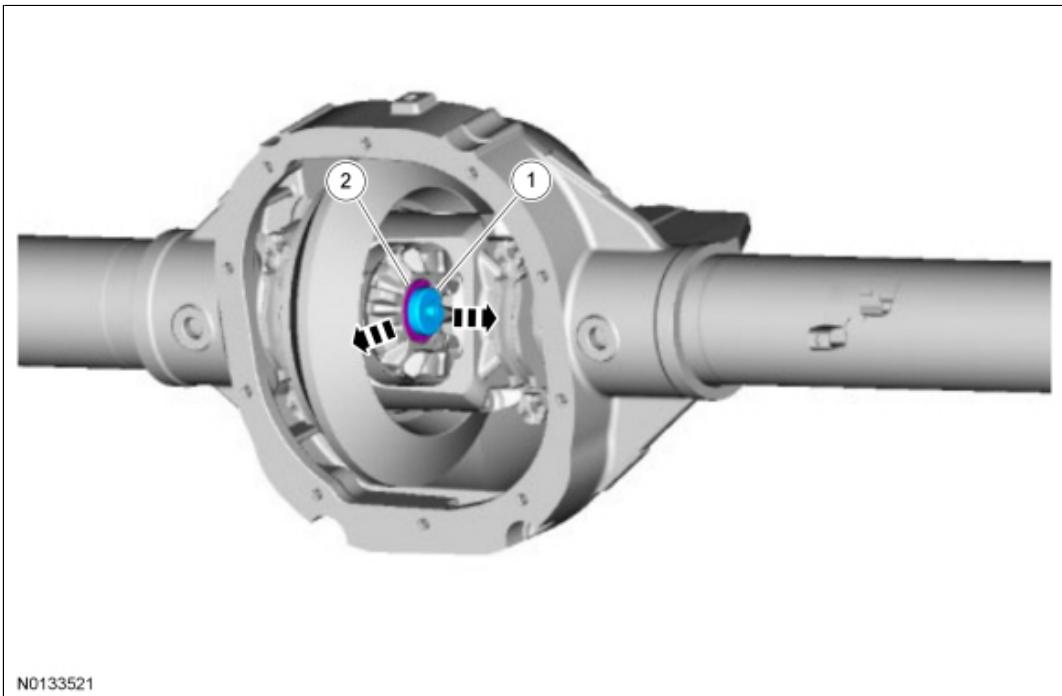
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the rear wheel and tire. For additional information, refer to [Section 204-04](#).
3. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
4.
  - To install, tighten to 15 Nm (133 lb-in).



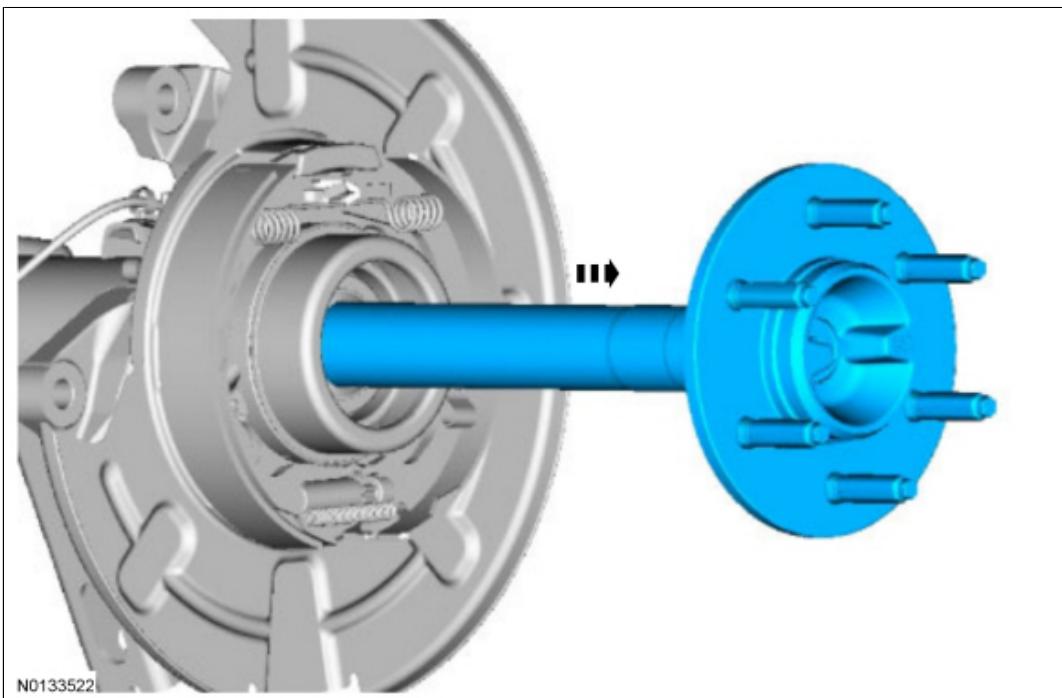
5. Remove the differential housing cover and drain the lubricant. For additional information, refer to [Differential Housing Cover](#) in this section.
6. Discard the specified component. Follow local disposal regulations.
  - To install, tighten to 30 Nm (22 lb-ft).



7.



8.



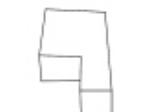
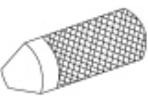
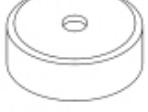
9. To install, reverse the removal procedure.

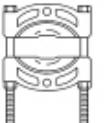
- Inspect and lubricate the lip of the wheel bearing oil seal with grease.

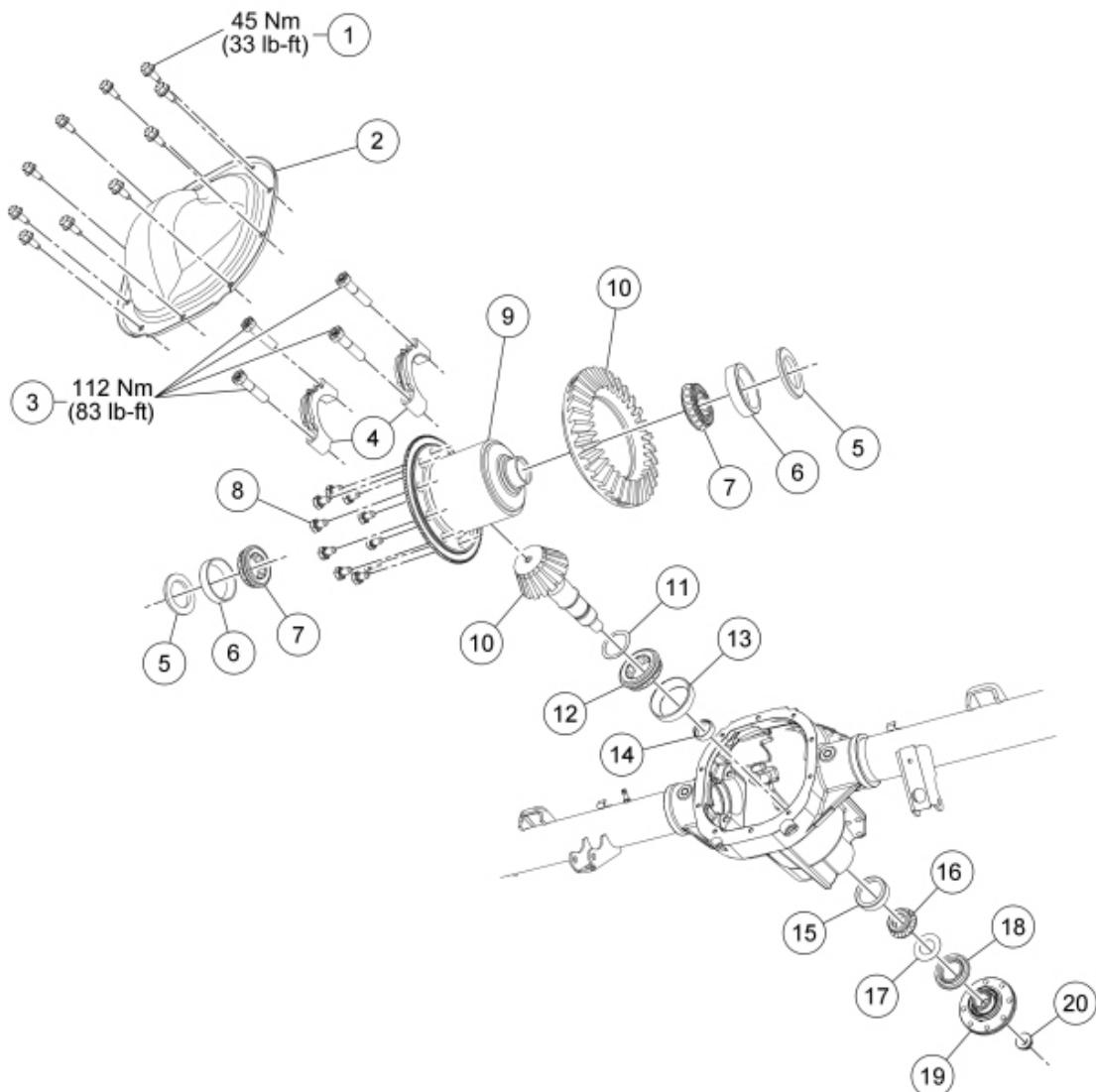


## Differential Bearings

### Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D79L-4221-A1) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1743-A	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for 205-S127 205-130 (T79P-4020-A19)

	
	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
	Installer, Shaft Bearing Cone 308-169 (T88T-7025-B)
	Plate, Bearing Oil Seal 205-090 (T75L-1165-B)
	Protector, Drive Pinion Thread 205-460 or equivalent
	Puller, Bearing 205-D064 (D84L-1123-A) or equivalent
	Step Plate 205-D016 (D80L-630-5) or equivalent



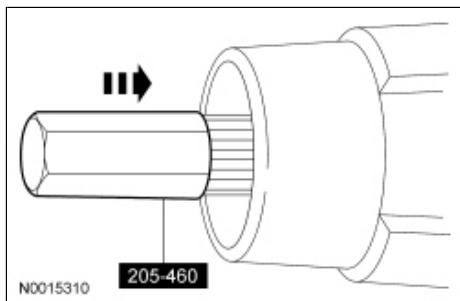
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Item	Part Number	Description
1	4346	Differential housing cover bolt (10 required)
2	4033	Differential housing cover
3	46108	Differential bearing cap bolts (part of 4010) (4 required)
4	—	Differential bearing caps (part of 4010) (2 required)
5	4067	Differential bearing shims (2 required)
6	4222	Differential bearing cups (2 required)
7	4221	Differential bearings (2 required)
8	4216	Ring gear bolt (10 required)

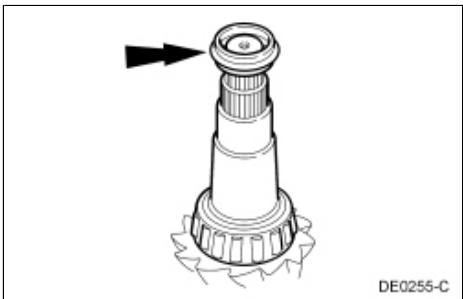
9	4204	Differential assembly
10	4209	Ring gear
10	4209	Drive pinion
11	4663	Pinion bearing alignment shim
12	—	Inner pinion bearing cup (part of 4625)
13	4625	Inner pinion bearing
14	4662	Collapsible spacer (part of 4320)
15	—	Outer pinion bearing cup (part of 4621)
16	4621	Outer pinion bearing
17	4670	Oil slinger
18	4676	Drive pinion oil seal
19	4851	Drive pinion flange
20	4C121	Drive pinion nut (part of 4320)

## Removal

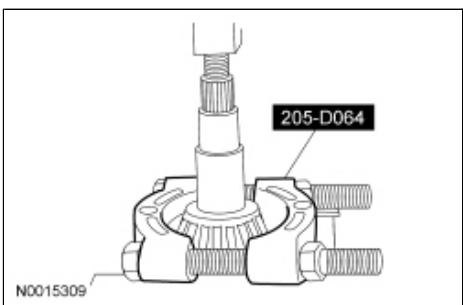
1. Remove the drive pinion seal. For additional information, refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.
2. Remove the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
3. Remove the axle drive pinion shaft oil slinger.
4. Using the Drive Pinion Thread Protector and a soft-faced hammer, drive the pinion assembly out of the outer pinion bearing and remove it through the rear of the differential housing.



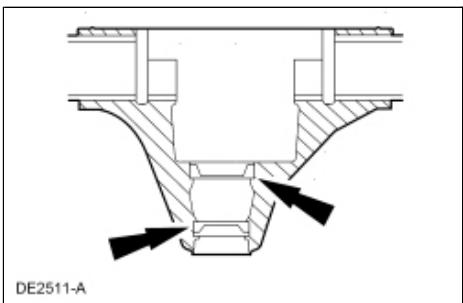
5. Remove the outer pinion bearing.
6. Remove the drive pinion collapsible spacer and discard it.



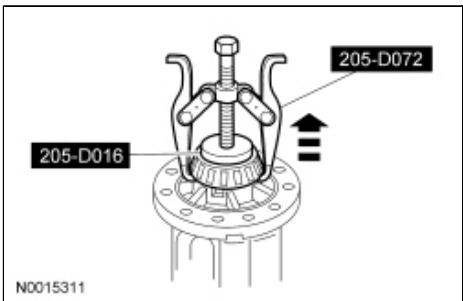
7. Using the Bearing Puller and a suitable press, remove the inner pinion bearing.



8. Using a brass drift, remove the pinion bearing cups by tapping alternately on opposite sides of the bearing cups.



9. Using the 2 Jaw Puller and Step Plate, remove the 2 differential bearings.

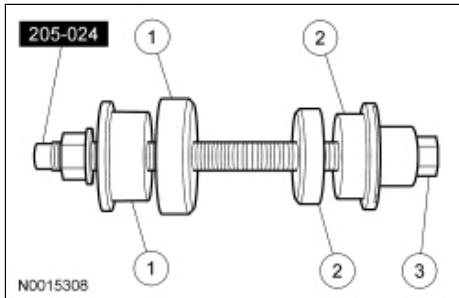


## Installation

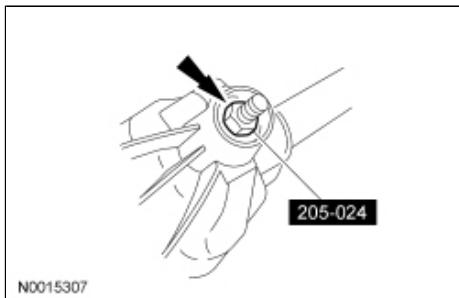
1. Position the Drive Pinion Bearing Cup Installer and the inner and outer bearing cups in their

respective bores.

1. After placing the inner and outer bearing cups in their respective bores, place the Drive Pinion Bearing Cup Installer on the inner bearing cup.
2. Place the Drive Pinion Bearing Cup Installer on the outer bearing cup.
3. Install the Drive Pinion Bearing Cup Installer.

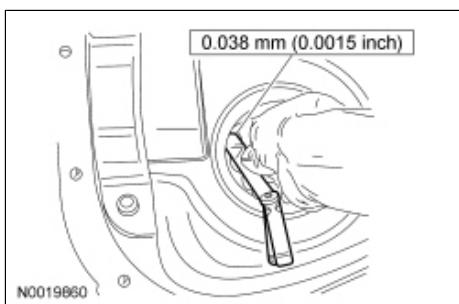


2. Tighten the Drive Pinion Bearing Cup Installer to seat the pinion bearing cups in their bores.



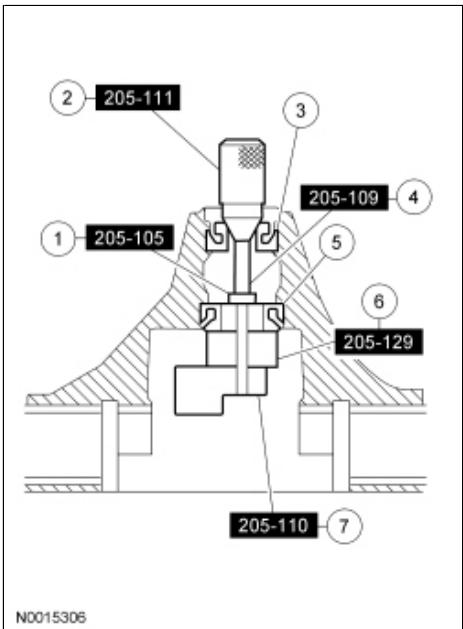
3. **NOTE:** If a feeler gauge of the specification shown can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not correctly seated.

Make sure the differential pinion bearing cups are correctly seated.



4. **NOTE:** Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

Assemble and position the Adapters.



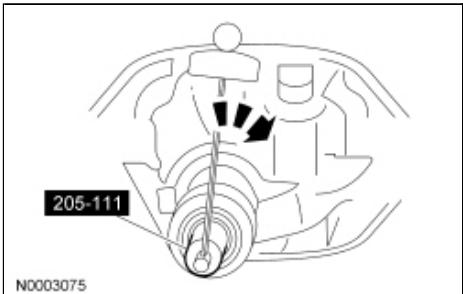
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Item	Part Number	Description
1	205-105	Adapter for 205-S127 (1.612 in OD) (T76P-4020-A3)
2	205-111	Adapter for 205-S127 (T76P-4020-A11)
3	4621	Drive pinion bearing (outer)
4	205-109	Adapter for 205-S127 (T76P-4020-A9)
5	4630	Drive pinion bearing (inner)
6	205-129	Adapter for 105-S127 (1.1884 in thick) (T79P-4020-A18)
7	205-110	Adapter for 205-S127 (1.7 in thick) (T76P-4020-A10)

5. **NOTE:** This step duplicates final drive pinion bearing preload.

Tighten the Adapter.

- Tighten to 2.2 Nm (20 lb-in) rotational torque.

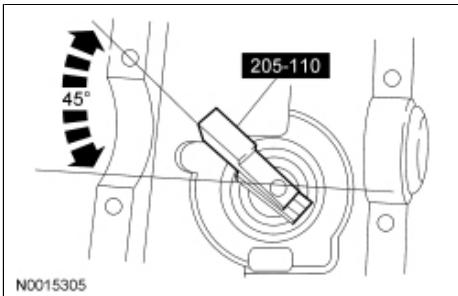


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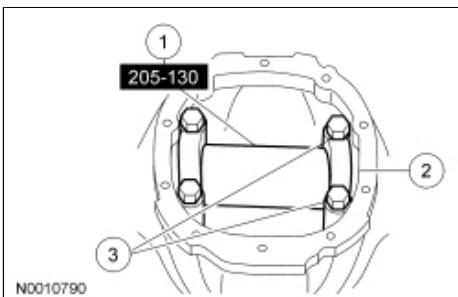
6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

Rotate the Adapter several half turns to make sure of correct seating of the drive pinion bearings and

position the Adapter.



7. Install the Adapter.
  1. Position the gauge tube.
  2. Install the 2 differential bearing caps.
  3. Install the 4 differential bearing cap bolts.
    - Tighten to 112 Nm (83 lb-ft).

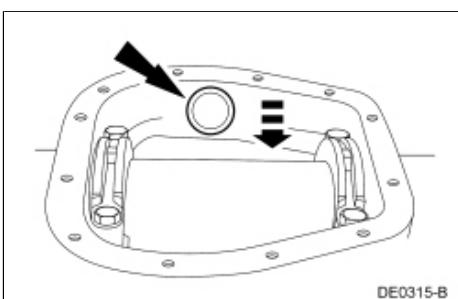


8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

**NOTE:** A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between Adapter and gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required, which results in a deep tooth contact in final assembly of integral axle assemblies.

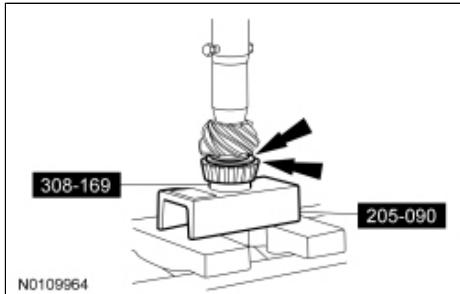
Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.

- After the correct drive pinion bearing adjustment shim thickness has been determined, remove all of the Adapters.

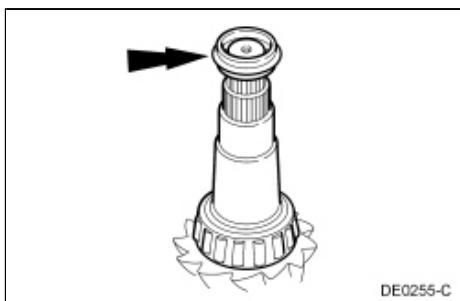


9. Using the Shaft Bearing Cone Installer and Bearing Oil Seal Plate and a shop press, drive the inner

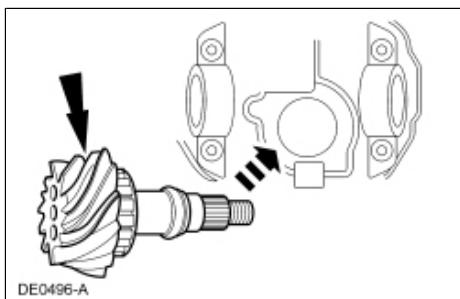
drive pinion bearing and drive pinion bearing adjustment shim until they are firmly seated on the pinion shaft.



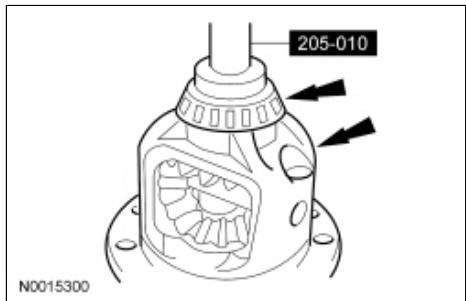
10. Install a new drive pinion collapsible spacer on the pinion shaft against the pinion shaft shoulder.



11. Install the drive pinion assembly into the axle housing.



12. Install the outer drive pinion bearing and the drive pinion shaft oil slinger.
13. Install the drive pinion seal and flange. For additional information, refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.
14. Using the Differential Side Bearing Installer, install the 2 new differential bearings.

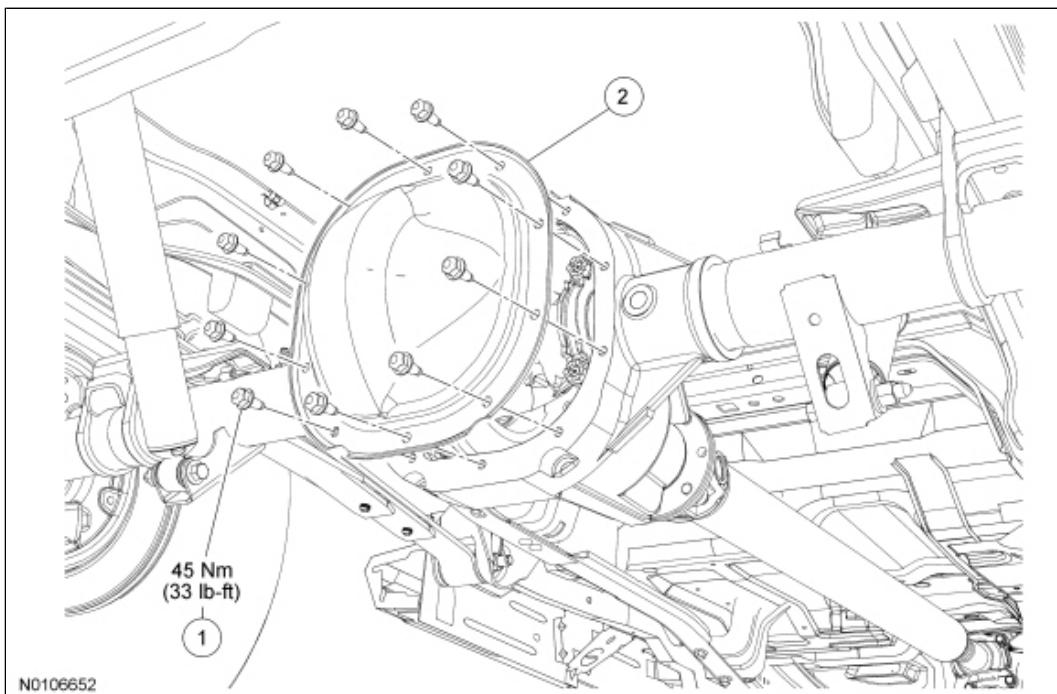


15. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
-

## Differential Housing Cover

### Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

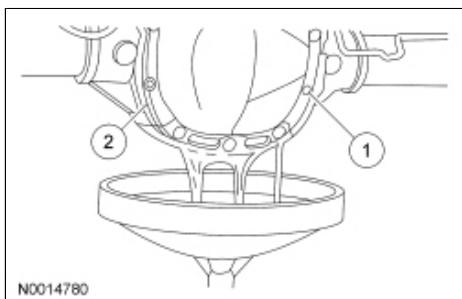


Item	Part Number	Description
1	4346	Differential housing cover bolt (10 required)
2	4033	Differential housing cover

### Removal

- With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).

2. Remove the differential housing cover.
  1. Remove the 10 differential housing cover bolts and drain the lubricant from the axle housing.
  2. Remove the differential housing cover.

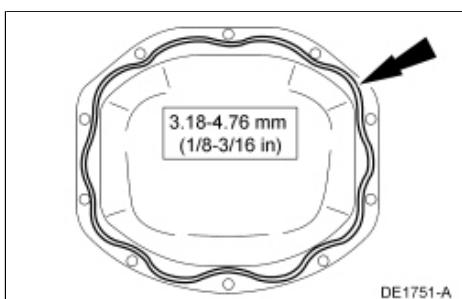


## Installation

1. **NOTE:** The machined surfaces on the differential housing and the differential housing cover must be clean and free of oil before applying the silicone sealant. Cover the inside of the rear axle prior to cleaning the machined surface to prevent contamination.

Clean the gasket mating surfaces.

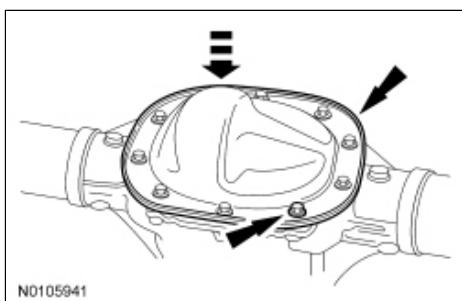
2. Apply a new continuous bead of sealant to the differential housing cover.



3. **NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone sealant, or new sealant must be applied. If possible, allow one hour before filling the axle housing with axle lubricant to make sure the silicone sealant has correctly cured.

Install the differential housing cover and the 10 differential housing cover bolts.

- Tighten to 45 Nm (33 lb-ft).



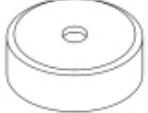
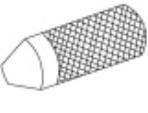
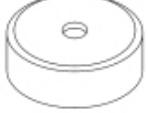
4. **NOTE:** When filling a Traction-Lok axle with new lubricant, first fill the axle with 118 ml (4 oz) of friction modifier.

Remove the filler plug, fill the axle with 2.8L (6.0 pt) of axle lubricant and install the filler plug.

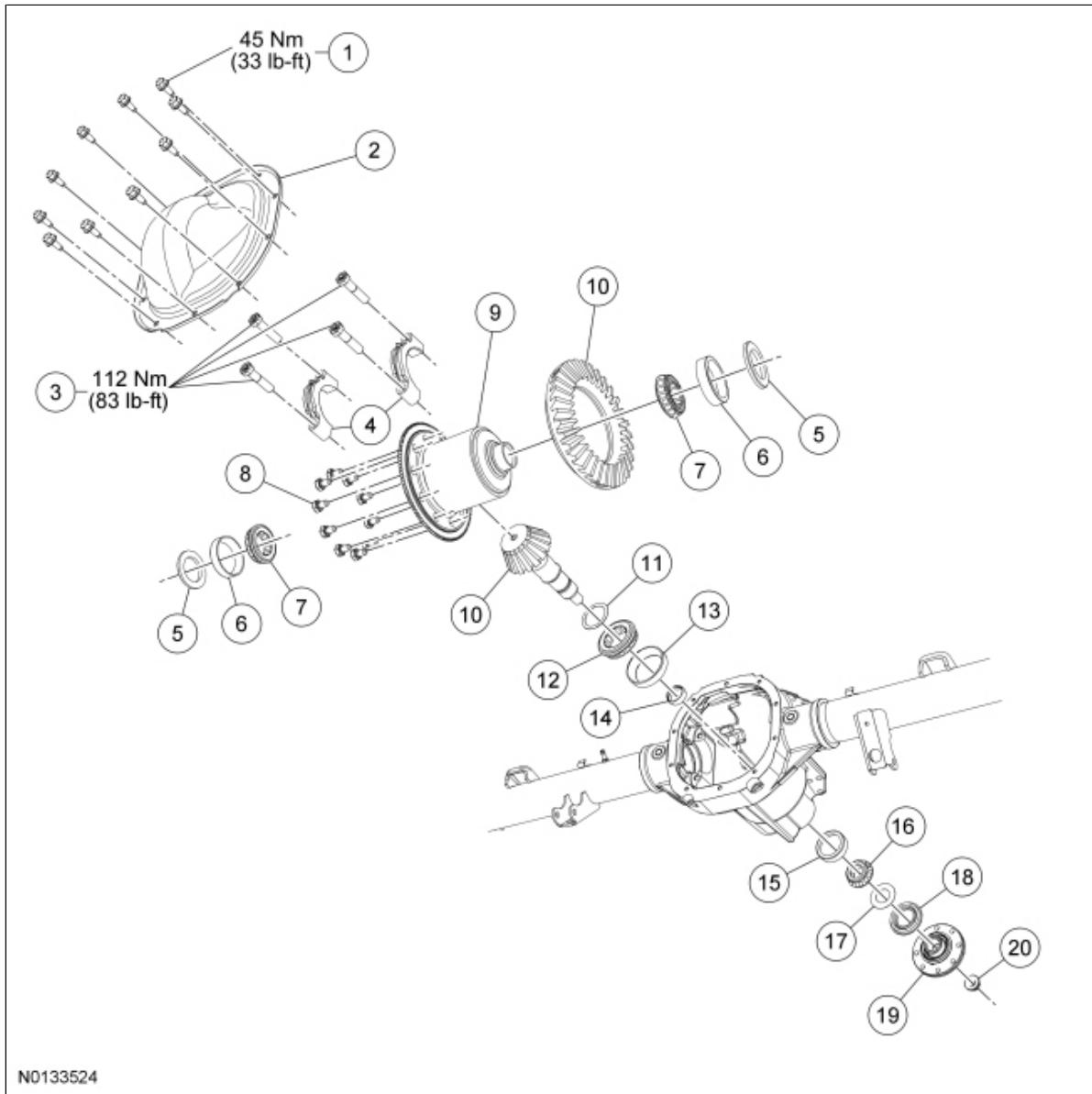
- Tighten to 52 Nm (38 lb-ft).
-

## Differential Ring And Pinion

### Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D79L-4221-A1) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1743-A	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for 205-S127 205-130 (T79P-4020-A19)

	
	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
	Installer, Shaft Bearing Cone 308-169 (T88T-7025-B)
	Plate, Bearing Oil Seal 205-090 (T75L-1165-B)
	Protector, Drive Pinion Thread 205-460 or equivalent
	Step Plate 205-D016 (D80L-630-5) or equivalent



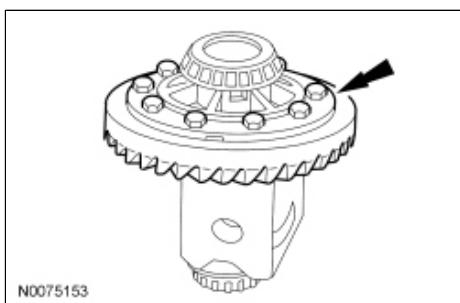
N0133524

Item	Part Number	Description
1	4346	Differential housing cover bolt (10 required)
2	4033	Differential housing cover
3	46108	Differential bearing cap bolts (part of 4010) (4 required)
4	—	Differential bearing caps (part of 4010) (2 required)
5	4067	Differential bearing shims (2 required)
6	4222	Differential bearing cups (2 required)
7	4221	Differential bearings (2 required)
8	4216	Ring gear bolt (10 required)

9	4204	Differential assembly
10	4209	Ring gear
10	4209	Drive pinion
11	4663	Pinion bearing alignment shim
12	—	Inner pinion bearing cup (part of 4625)
13	4625	Inner pinion bearing
14	4662	Collapsible spacer (part of 4320)
15	—	Outer pinion bearing cup (part of 4621)
16	4621	Outer pinion bearing
17	4670	Oil slinger
18	4676	Drive pinion oil seal
19	4851	Drive pinion flange
20	4C121	Drive pinion nut (part of 4320)

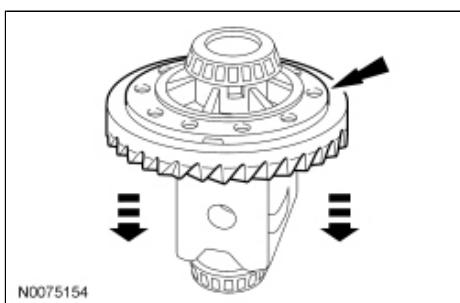
### Removal

1. Remove the drive pinion flange seal. For additional information, refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.
2. Remove the differential carrier assembly. For additional information, refer to [Differential Carrier](#) in this section.
3. Remove and discard the 10 differential ring gear bolts.

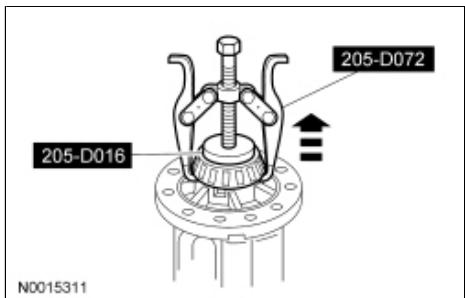


4. **NOTE:** Care should be taken not to damage the differential ring gear bolt hole threads.

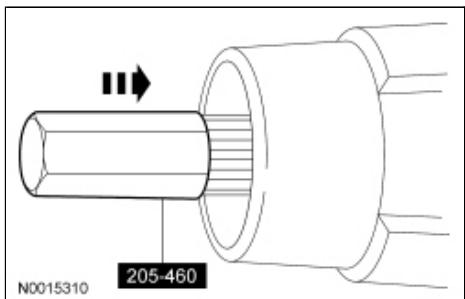
Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.



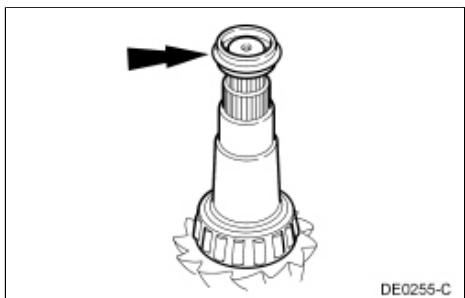
- Using the 2 Jaw Puller and Step Plate, remove the differential bearings.



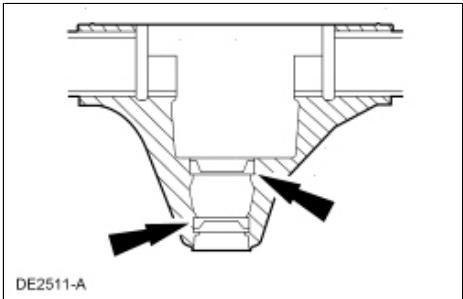
- Remove the drive pinion shaft oil slinger and the outer drive pinion bearing.
- Install the Drive Pinion Thread Protector. Using a soft-faced hammer, drive the pinion assembly out of the axle housing.



- Remove and discard the drive pinion collapsible spacer.

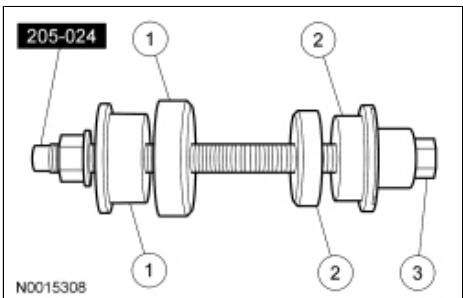


- Using a brass drift, remove the drive pinion bearing cups by tapping alternately on opposite sides of the drive pinion bearing cups.

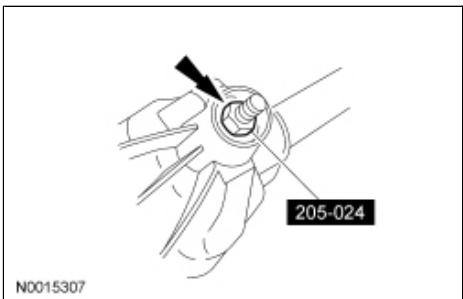


## Installation

1. Position the Drive Pinion Bearing Cup Installer and the inner and outer drive pinion bearing cups in their respective bores.
  1. After placing the inner and outer drive pinion bearing cups in their bores, place the Drive Pinion Bearing Cup Installer (inner) on the inner drive pinion bearing cup.
  2. Place the Drive Pinion Bearing Cup Installer (outer) on the outer drive pinion bearing cup.
  3. Install the Drive Pinion Bearing Cup Installer.

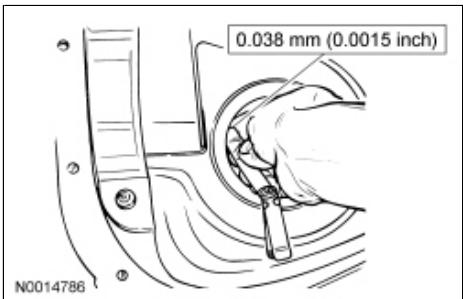


2. Tighten the Drive Pinion Bearing Cup Installer to seat the drive pinion bearing cups into their bores.



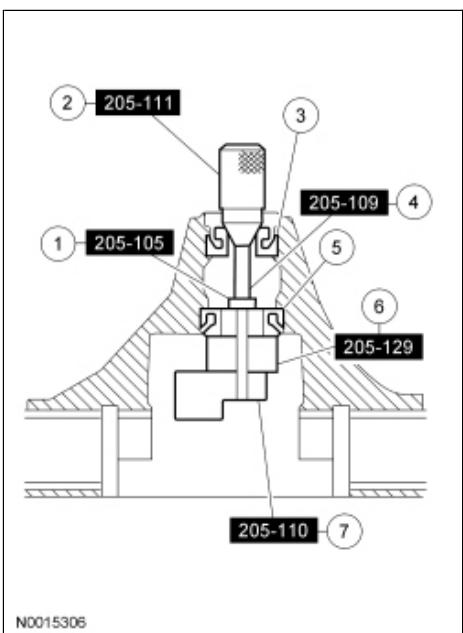
3. **NOTE:** If a feeler gauge can be inserted between a drive pinion bearing cup and the bottom of its bore at any point around the drive pinion bearing cup, the drive pinion bearing cup is not correctly seated.

Make sure the drive pinion bearing cups are correctly seated in their bores.



4. **NOTE:** Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

Assemble and position the Adapters.

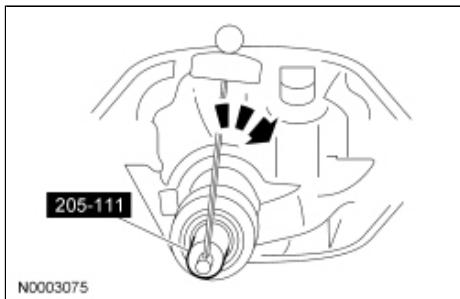


Item	Part Number	Description
1	205-105	Adapter for 205-S127 (1.612 in OD) (T76P-4020-A3)
2	205-111	Adapter for 205-S127 (T76P-4020-A11)
3	4621	Drive pinion bearing (outer)
4	205-109	Adapter for 205-S127 (T76P-4020-A9)
5	4630	Drive pinion bearing (inner)
6	205-129	Adapter for 105-S127 (1.1884 in thick) (T79P-4020-A18)
7	205-110	Adapter for 205-S127 (1.7 in thick) (T76P-4020-A10)

5. **NOTE:** This step duplicates final drive pinion bearing preload.

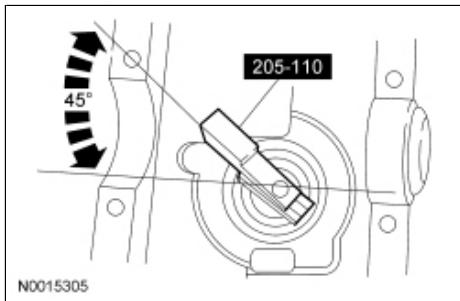
Tighten the Adapter.

- Tighten to 2.2 Nm (20 lb-in) rotational torque.



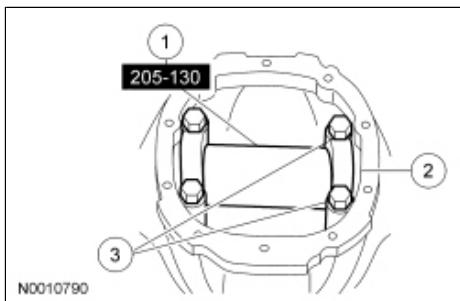
6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings and position the Adapter.



7. Install the Adapter.

1. Position the Adapter.
2. Install the 2 differential bearing caps.
3. Install the 4 differential bearing cap bolts.
  - Tighten to 112 Nm (83 lb-ft).



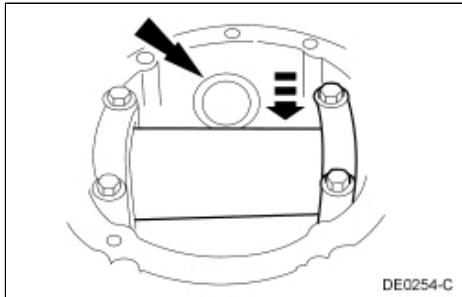
8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

**NOTE:** A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the Adapter and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required, which results in a deep tooth contact in final assembly of integral axle assemblies.

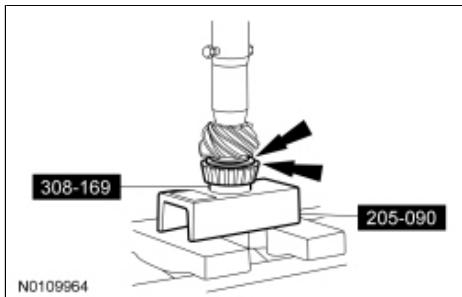
Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim

selection.

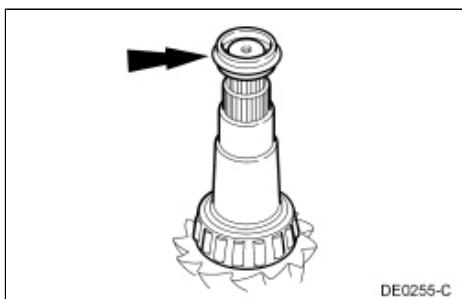
- After the correct drive pinion bearing adjustment shim thickness has been determined, remove all of the special tools.



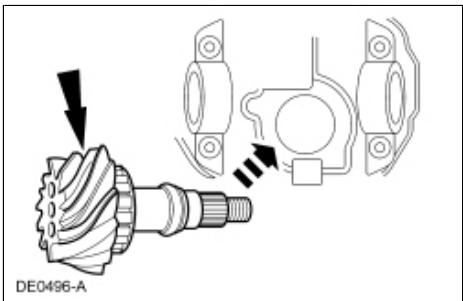
9. Using the Shaft Bearing Cone Installer and Bearing Oil Seal Plate and a shop press, drive the inner drive pinion bearing and the selected drive pinion bearing adjustment shim until they are firmly seated on the pinion shaft.



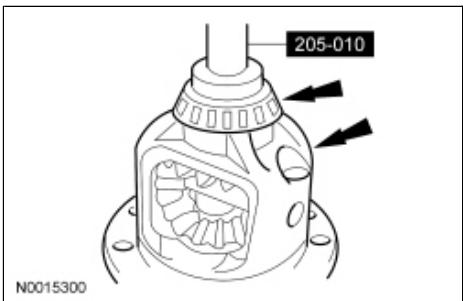
10. Install a new drive pinion collapsible spacer on the pinion shaft against the pinion shaft shoulder.



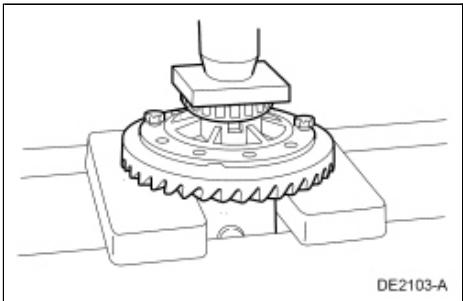
11. Install the drive pinion assembly into the axle housing.



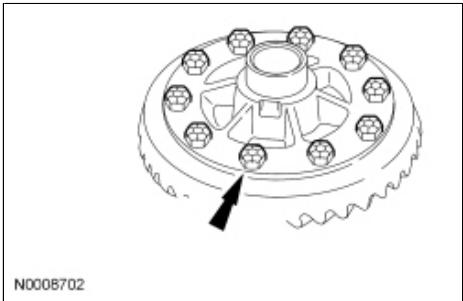
12. Install the outer drive pinion bearing and the drive pinion shaft oil slinger.
13. Using the Differential Side Bearing Installer, install the 2 new differential bearings.



14. Using 2 ring gear bolts as a guide, press the ring gear on the differential assembly.



15. Install the 10 new differential ring gear bolts. Tighten in 2 stages.
  - Stage 1: Tighten to 60 Nm (44 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.



16. Install the drive pinion seal and flange. For additional information, refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.
  17. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
-

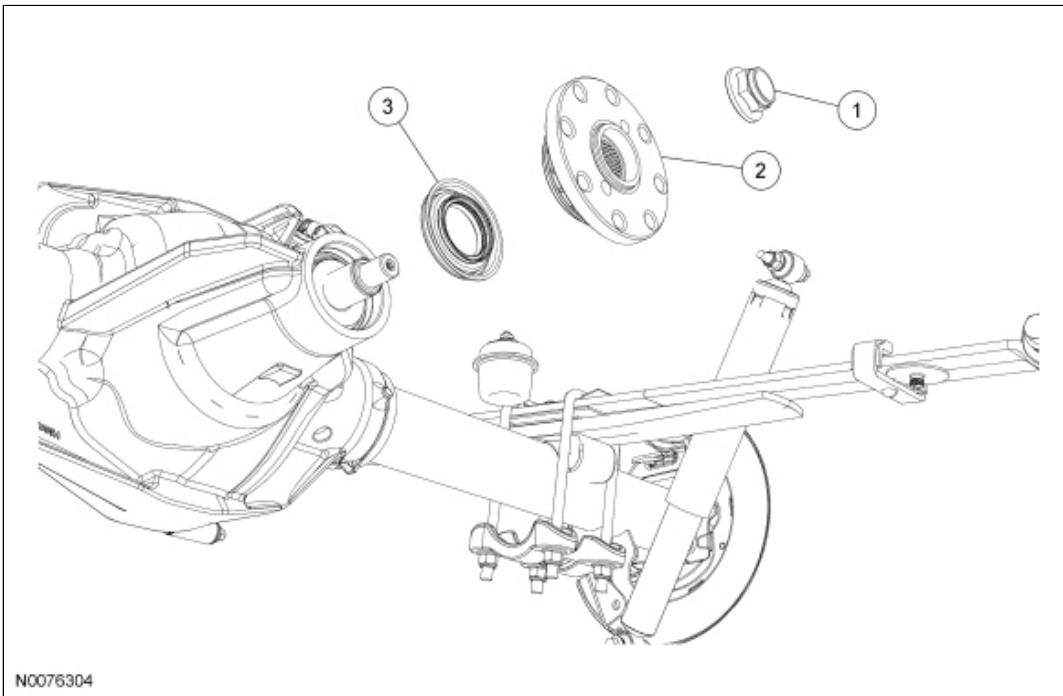
## Drive Pinion Flange and Drive Pinion Seal

### Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1325-A	Installer, Drive Pinion Oil Seal 205-208 (T83T-4676-A)

### Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



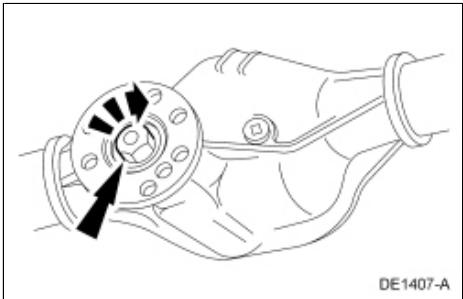
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Item	Part Number	Description
1	389546	Drive pinion nut
2	4851	Drive pinion flange
3	4676	Drive pinion oil seal

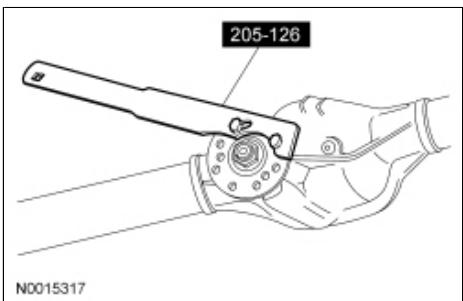
### Removal

**NOTICE:** The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.

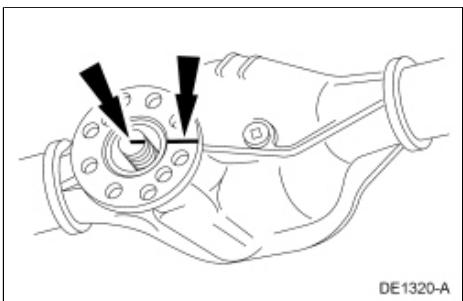
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the brake disc. For additional information, refer to [Section 206-04](#).
3. Remove the driveshaft. For additional information, refer to [Section 205-01](#).
4. Using a Nm (lb-in) torque wrench on the pinion nut, record the torque required to maintain rotation of the pinion gear through several revolutions.



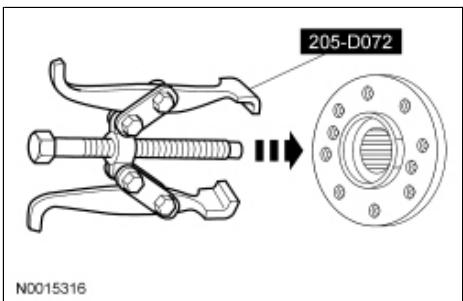
- Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, remove and discard the pinion nut.



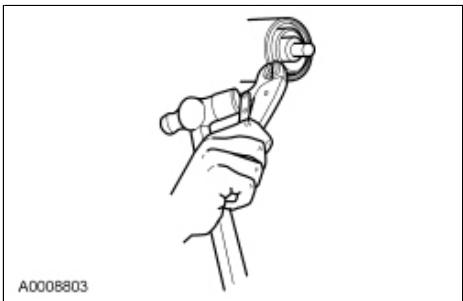
- Index-mark the pinion flange in relation to the drive pinion stem to make sure of correct alignment during installation.



- Using the 2 Jaw Puller, remove the pinion flange.



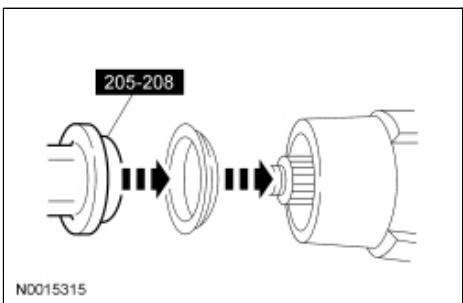
- Force up on the metal flange of the drive pinion seal. Install gripping pliers and strike with a hammer until the drive pinion seal is removed.



## Installation

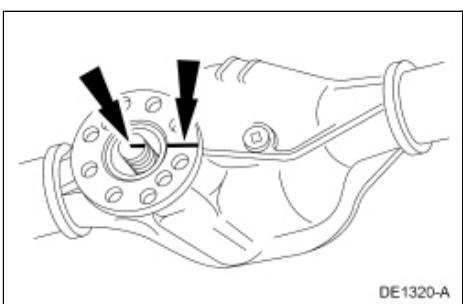
1. Lubricate the new drive pinion seal with grease.
2. **NOTE:** If the new drive pinion seal becomes misaligned during installation, remove the drive pinion seal and install a new drive pinion seal.

Using the Drive Pinion Oil Seal Installer, install a new drive pinion seal.

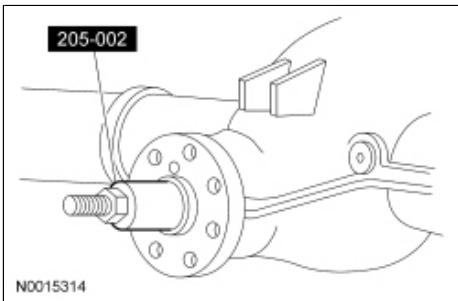


3. Lubricate the pinion flange splines with axle lubricant.
4. **NOTE:** Disregard the scribe marks if a new pinion flange is being installed.

Align the pinion flange with the drive pinion shaft.



5. Using the Drive Pinion Flange Installer, install the pinion flange.

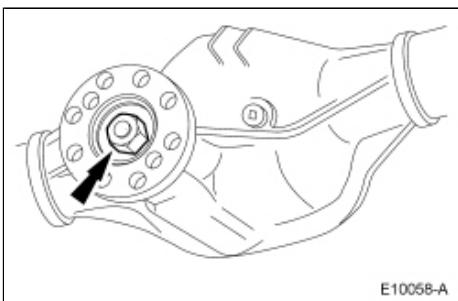


6. **NOTICE:** Install a new pinion nut with the same color as the original if not replacing the collapsible spacer. If a new collapsible spacer is installed, install the nut in the kit or damage to the component may occur.

Position the new pinion nut.

#### 8.8-In Drive Pinion Nut

Part Number	Color Description	Application
389546-S100	Orange	Axles built before 7/16/07
4320	Purple	Axles built after 7/16/07
4C121	Purple	Kit with spacer for all 223.52 mm (8.8 in) axles



7. **NOTICE:** Under no circumstances is the pinion nut to be backed off to reduce drive pinion bearing preload. If reduced drive pinion bearing preload is required, a new drive pinion collapsible spacer and pinion nut must be installed or damage to the component may occur.

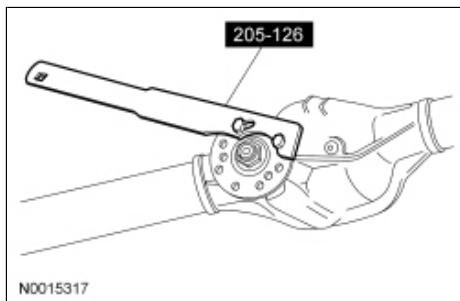
**NOTICE:** The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.

**NOTE:** Remove the Drive Pinion Flange Holding Fixture while taking drive pinion bearing preload readings with the Nm (lb-in) torque wrench.

Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, tighten the pinion nut.

- Rotate the drive pinion occasionally to make sure the drive pinion bearings are seating correctly.
- Install a Nm (lb-in) torque wrench on the pinion nut.
- Rotating the drive pinion through several revolutions, take frequent drive pinion bearing preload readings until the original recorded drive pinion bearing preload reading is obtained.

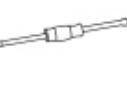
- If the original recorded drive pinion bearing preload is lower than specifications, tighten to the appropriate specifications for used drive pinion bearings. If the drive pinion bearing preload is higher than specification, tighten the pinion nut to the original reading as recorded. For additional information, refer to Specifications in this section.



8. Install the driveshaft. For additional information, refer to [Section 205-01](#).
  9. Install the brake disc. For additional information, refer to [Section 206-04](#).
-

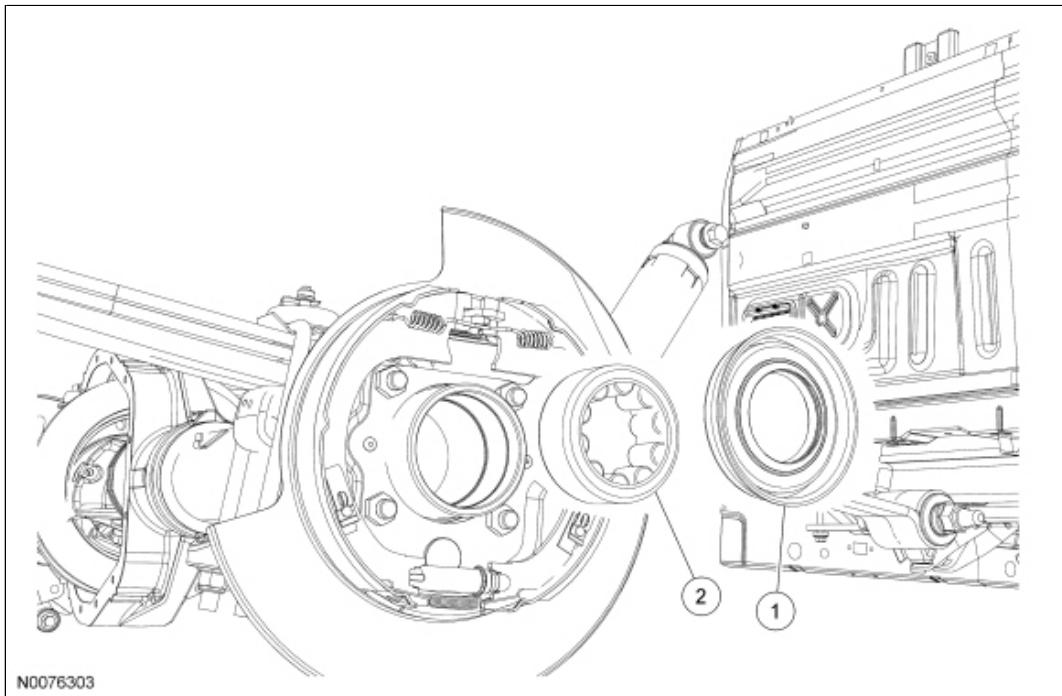
## Rear Wheel Bearing and Axle Shaft Seal

### Special Tool(s)

 ST1326-A	Adapter For 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1322-A	Installer, Axle Bearing 205-194 (T83T-1225-B)
 ST1736-A	Installer, Axle Oil Seal 205-381 (T97T-1177-A)
 ST1283-A	Remover, Axle Bearing 205-193 (T83T-1225-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

### Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



Item	Part Number	Description
1	1177	Axle shaft oil seal
2	1225	Axle shaft bearing

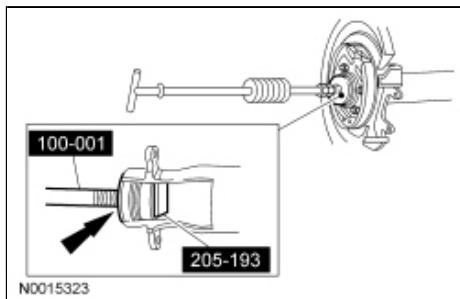
### Removal

1. Remove the axle shaft. For additional information, refer to [Axe Shaft](#) in this section.
2. **NOTE:** If the axle shaft oil seal is leaking, the axle housing vent may be plugged with foreign material.

**NOTE:** Use care to avoid damaging the axle shaft oil seal bore.

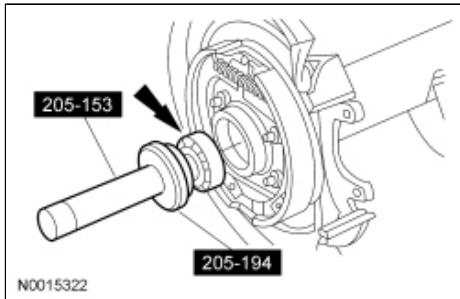
Using a suitable seal remover, remove and discard the axle shaft oil seal.

3. Inspect the rear wheel bearing and axle shaft for wear or damage.
4. If necessary, using the Axle Bearing Remover and Slide Hammer, remove the rear wheel bearing.

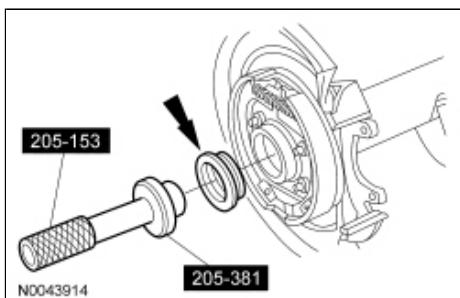


## Installation

1. If removed, lubricate the new rear wheel bearing with axle lubricant.
2. If removed, use the Axle Bearing Installer and Handle to install the rear wheel bearing.



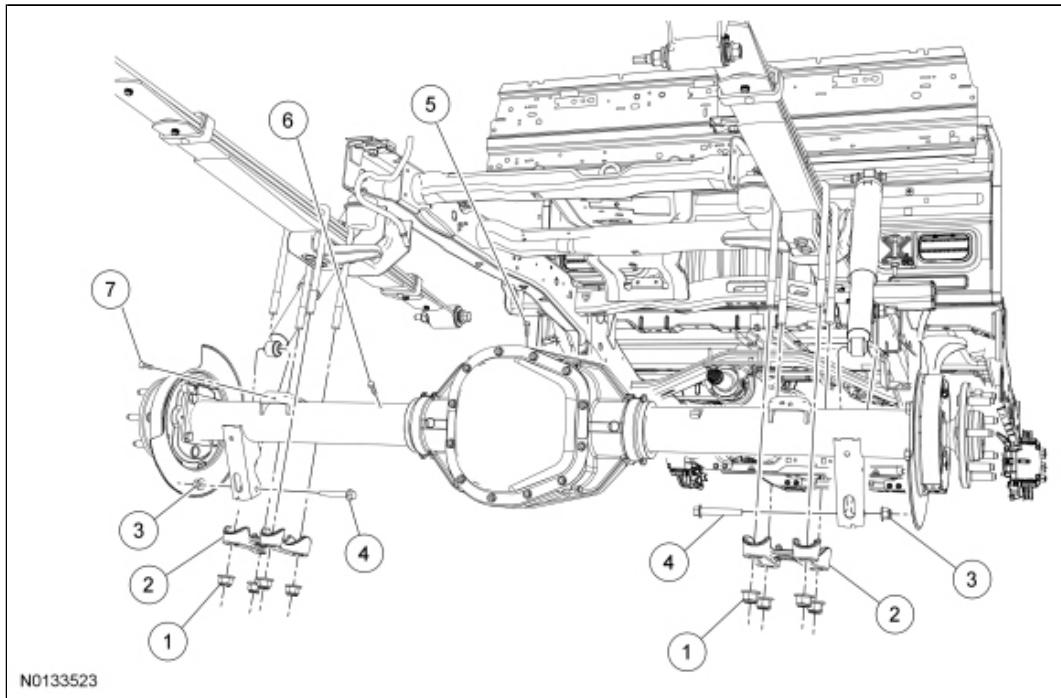
3. Lubricate the lip of the new axle shaft oil seal with grease.
4. Using the Axle Oil Seal Installer and Handle, install the new axle shaft oil seal.



5. Install the axle shaft. For additional information, refer to [Axle Shaft](#) in this section.
-



## Axle Assembly



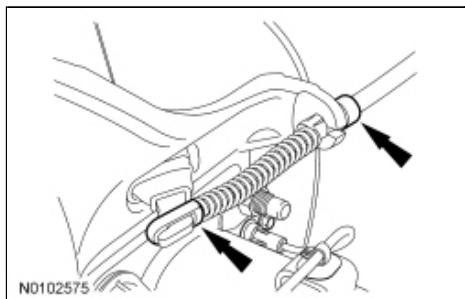
Item	Part Number	Description
1	W705518	U-bolt nuts (8 required)
2	5798	U-bolt plates (2 required)
3	W520214	Lower shock absorber nuts (2 required)
4	W506545	Lower shock absorber bolts (2 required)
5	57632	Brake tube/parking brake cable bracket bolt
6	4022	Axle vent
7	W712215	Brake hose bracket bolt

### Removal and Installation

**NOTICE:** Suspension fasteners are critical components because they affect performance of vital components and systems and their failure can result in major service expense. Install new components with the same component number or an equivalent component if installation is necessary. Do not use an installation component of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these components.

1. Remove the driveshaft. For additional information, refer to [Section 205-01](#).
2. Remove the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.

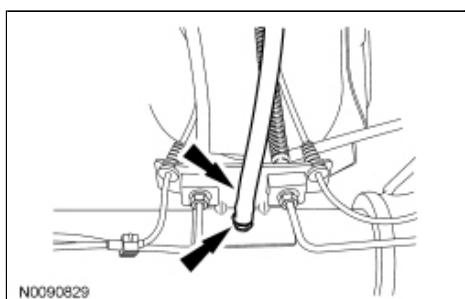
3. Release the parking brake cable tension. For additional information, refer to [Section 206-05](#).
4. Disconnect the parking brake cables.



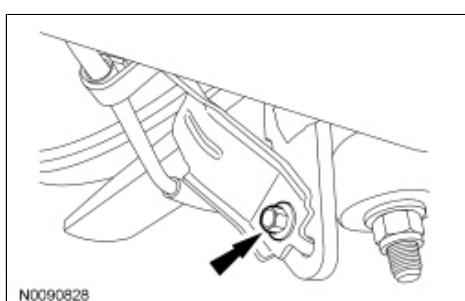
5. Disconnect the wheel speed sensor harness retainers from the axle.

**NOTE:** If the vent hose is disconnected from the vehicle body, a new retainer must be installed.

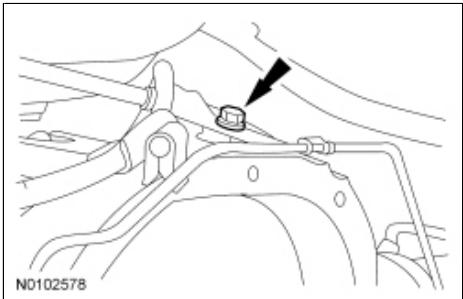
6. Disconnect the vent hose and remove the axle vent.
  - To install, tighten to 18 Nm (159 lb-in).



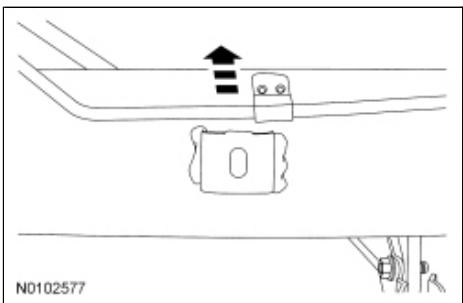
7. Remove the RH parking brake cable bracket bolt.
  - To install, tighten to 30 Nm (22 lb-ft).



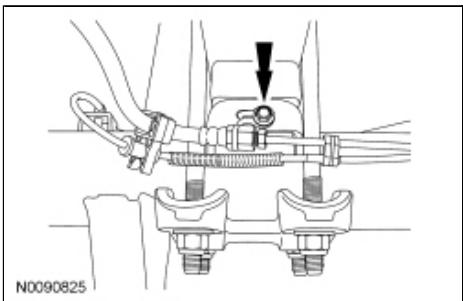
8. Remove the brake tube/parking brake cable bracket bolt.
  - To install, tighten to 25 Nm (18 lb-ft).



9. Disconnect the brake tube from the brake tube retaining clip.



10. Remove the 2 brake hose bracket bolts.
  - To install, tighten to 30 Nm (22 lb-ft).

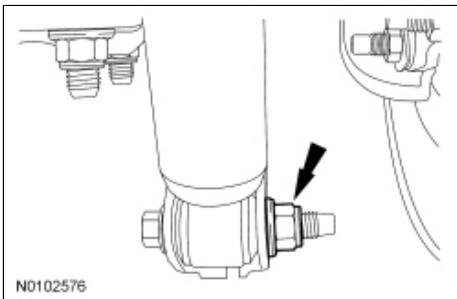


11. Support the axle with a suitable transmission jack.

12. **⚠ WARNING: Do not apply heat or flame to the shock absorber or strut tube. The shock absorber and strut tube are gas pressurized and could explode if heated. Failure to follow this instruction may result in serious personal injury.**

Remove and discard the 2 lower shock absorber nuts and 2 bolts.

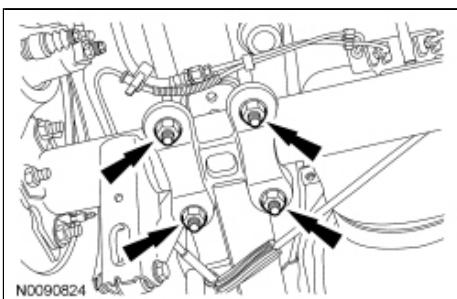
- To install, tighten the new nuts to 90 Nm (66 lb-ft).



13. **NOTICE:** Final tightening of the U-bolt nuts must be done with the suspension at curb height or incorrect clamp load may occur.

Remove and discard the 8 U-bolt nuts and the 4 U-bolts.

- To install, with the suspension at curb height, tighten the new nuts evenly in a cross-type pattern in 4 stages.
  - Stage 1: Tighten to 35 Nm (26 lb-ft).
  - Stage 2: Tighten to 70 Nm (52 lb-ft).
  - Stage 3: Tighten to 100 Nm (74 lb-ft).
  - Stage 4: Tighten to 133Nm (98 lb-ft).



14. **⚠️ WARNING:** Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.

Lower and remove the axle assembly.

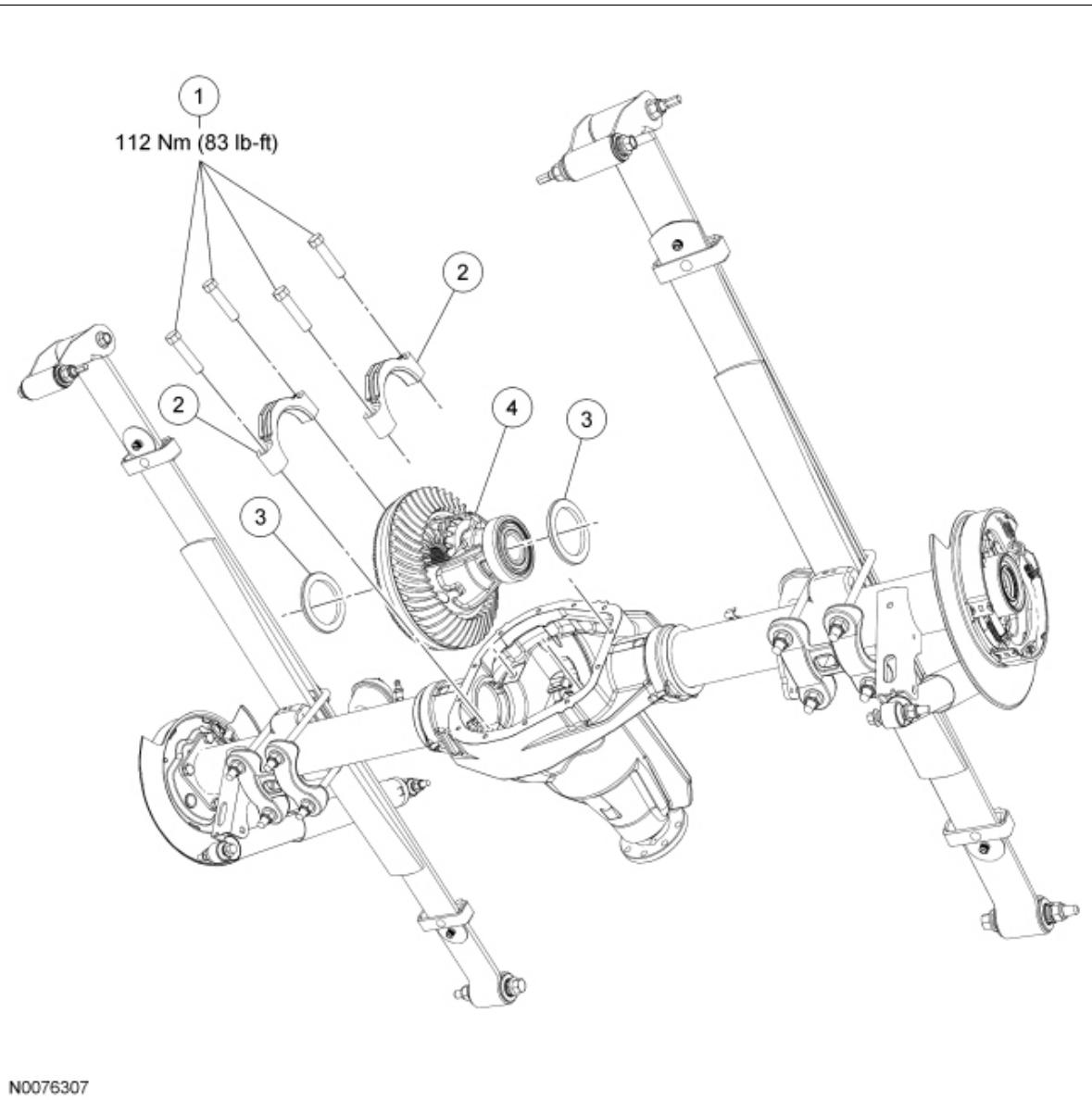
15. To install the original assembly, reverse the removal procedure.
16. Check the rear axle fluid level after installation.
-



## Differential Carrier

### Special Tool(s)

 ST1485-A	Shim Driver 205-220 (T85L-4067-AH)
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N0076307

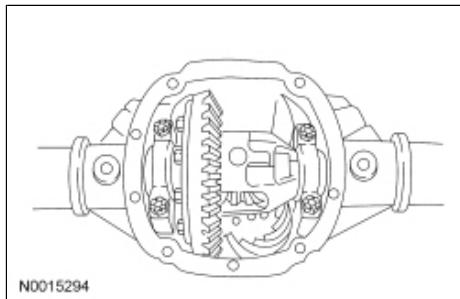
Item	Part Number	Description
1	—	Differential bearing cap bolts (part of 4010) (4 required)
2	—	Differential bearing caps (part of 4010) (2 required)
3	4067	Differential carrier bearing shims (2 required)
4	4204	Differential assembly

#### Removal

1. Remove the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.

2. **NOTE:** Index-mark the position of the differential bearing caps, as arrows may not be visible. The differential bearing caps must be installed in their original locations and positions.

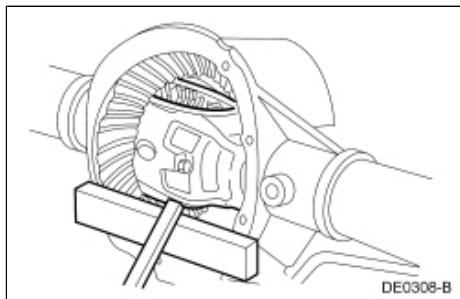
Remove the 4 differential bearing cap bolts and the 2 differential bearing caps.



3. **NOTICE:** Place a wood block between the pry bar and the axle housing to protect the machined surface from damage.

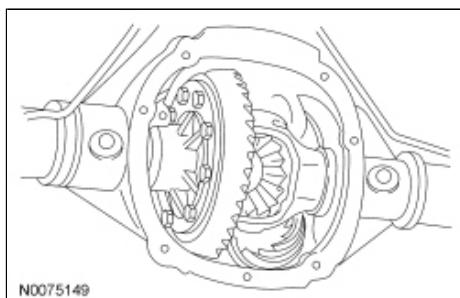
**NOTE:** Index-mark the position of the differential bearing shims. The differential bearing shims must be installed in their original locations and positions.

Using pry bars and wood blocks, remove the differential carrier assembly from the axle housing.



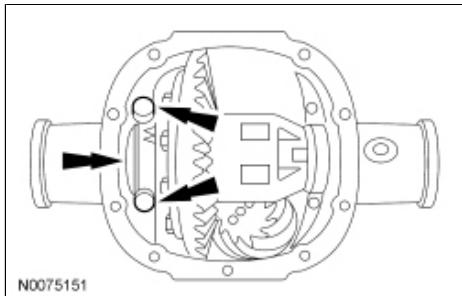
## Installation

1. Position the differential assembly in the axle housing.

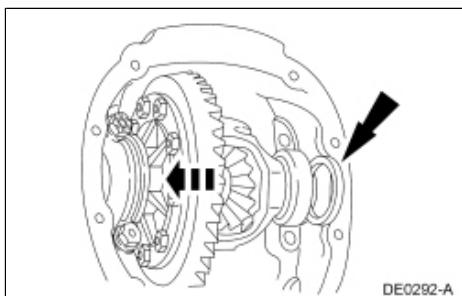


2. Install the originally removed differential bearing shim on the LH side.
3. **NOTE:** Apply pressure toward the LH side to make sure the LH differential bearing cap is seated.

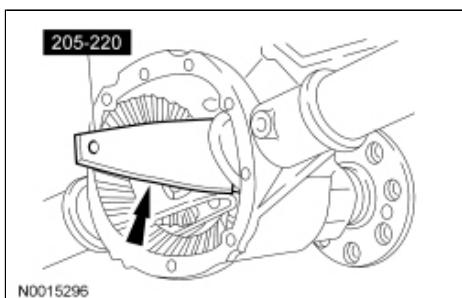
Install the LH differential bearing cap and loosely install the 2 differential bearing cap bolts.



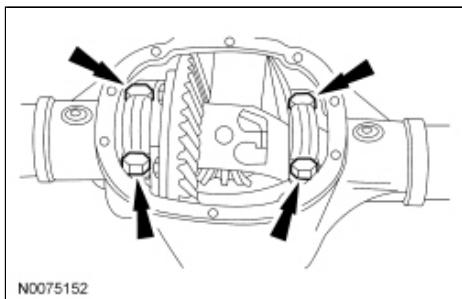
4. Install the original differential bearing shim on the RH side.



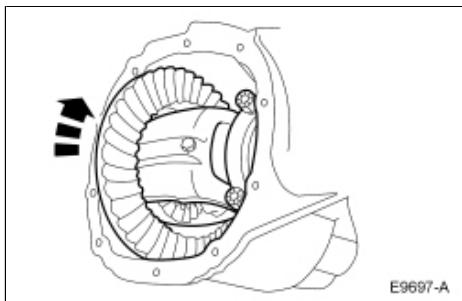
5. Using the Shim Driver, fully seat the differential bearing shims.



6. Install the RH side differential bearing cap and tighten the 4 LH side and RH side differential bearing cap bolts.
  - Tighten to 112 Nm (83 lb-ft).



7. Rotate the differential assembly to make sure it rotates freely.



8. Adjust the ring and pinion backlash. For additional information, refer to [Ring Gear Backlash Adjustment](#) in this section.
  9. Install the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.
-

**Material**

Item	Specification	Fill Capacity
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A	118 ml (4 oz) to be installed before axle lubricant — Not to be used with Electronic Locking Differentials (ELD)
Maximum Strength Retaining Compound Loctite® 638™	—	—
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—	—
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5	2.84L (6.0 pt) — ELD only 2.60L (5.5 pt) — Non Traction-Lok equipped 2.48L (5.25 pt) — Traction-Lok equipped
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

**Rear Axle Backlash Shim Adjustment Table**

Backlash Change Required		Thickness Change Required	
mm	In	mm	In
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006

0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

#### General Specifications

Item	Specification
Available drive pinion shims in steps of 0.25 mm (0.010 in)	0.254 mm (0.010 in) — 0.965 mm (0.038 in)
Electronic Locking Differential (ELD) side gear backlash	0.100-1.000 mm (0.004-0.040 in)
Maximum differential case flange ring gear runout	0.076 mm (0.003 in)
Maximum variation between ring gear teeth	0.102 mm (0.004 in)
Pinion bearing preload	1.8-3.3 Nm (16-29 lb-in)
Ring gear backlash	0.203-0.304 mm (0.008-0.012 in)
Maximum axle shaft flange runout	0.279 mm (0.011 in)

#### Torque Specifications

Description	Nm	lb-ft	lb-in
Axle vent	18	—	159
Brake hose bracket bolts	30	22	—
Brake tube/parking brake cable bracket bolt	25	18	—
RH parking brake cable bracket bolt	30	22	—
Differential bearing cap bolts	105	77	—
Differential housing cover bolts	45	33	—
Differential pinion shaft lock bolt	30	22	—
Differential ring gear bolts <sup>a</sup>	—	—	—
Driveshaft flange bolts	103	76	—
Electronic Locking Differential (ELD) coil screws	5	—	44
<u>ELD</u> electrical connector bolt	7	—	62

Fill plug	30	22	—
Handle Adapter	2.2	—	20
Lower shock absorber nuts	90	66	—
Tool 205-135 nut	7	—	62
U-bolt nut <sup>a</sup>	—	—	—
Wheel speed sensor bolts	15	—	133

<sup>a</sup> Refer to the procedure in this section.

---

## Rear Drive Axle and Differential

The rear axle assembly consists of the following:

- Integral-type housing hypoid gear design (center of the pinion set below the centerline of the ring gear)
- Hypoid differential ring gear and pinion consisting of a 9.75-inch ring gear and an overhung drive pinion that is supported by 2 opposed tapered roller bearings
- Pinion bearing preload that is maintained by a drive pinion collapsible spacer on the differential pinion shaft and adjusted by the pinion nut
- Cast center section with 2 steel tube assemblies and a stamped differential housing cover
- Differential housing cover using silicone sealant as a gasket
- Differential pinion shaft that is retained by a threaded differential pinion shaft lock bolt attached to the differential case
- Differential case that is mounted in the rear axle housing between 2 opposing differential bearings that are retained in the rear axle housing by 2 removable bearing caps
- Differential bearing preload and ring gear backlash which are adjusted by differential bearing shims that are located between the differential bearing cups and the rear axle housing

The rear drive axle receives rotational torque from the driveshaft. The direction of the rotation determines movement of the vehicle. The rotation enters the rear drive axle through the drive pinion flange, turning the drive pinion and rotating the ring gear. The ring gear is bolted to the differential case. The differential case houses the pinion shaft upon which the differential pinion gears ride. The pinion gears are in mesh with the differential side gears to which the axle shafts are splined. It is the unique arrangement of the differential that allows the axle shafts to be driven at different speed when needed, such as when driving around corners. A Traction-Lok differential is available that introduces a series of clutch plates and discs behind the differential side gears to deliver as much torque as possible to each axle shaft when the traction at the rear wheels is not equal. The Traction-Lok differential requires a friction modifier that must be installed with the axle lubricant for the plates and discs to be functional. An Electronic Locking Differential (ELD) is also available which electronically locks the differential side gears to the differential case which will allow maximum torque to both rear wheels. The operator controls the differential with a dash mounted switch.

The ELD system consists of the following components:

- ELD coil, located at the rear differential
- Rear differential
- Mode Select Switch (MSS) (unique for ELD equipped vehicles), located on instrument panel

The ELD system, which is optional on Electronic Shift-On-The-Fly (ESOF) equipped vehicles, allows the operator to lock the rear differential side gears when in 4H or 4L mode. ELD operation is requested by pulling out on the MSS when in 4H or 4L mode.

The operator can switch between 4H mode without ELD or 4H mode with ELD at speeds up to 30 km/h (19 mph). In 4H, the ELD will disengage at speeds above 40 km/h (25 mph) and will automatically reengage at speeds below 30 km/h (19 mph).

To engage or disengage the ELD while in 4L range, the vehicle speed must be less than 90 km/h (56 mph).



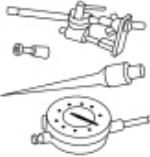
## Rear Drive Axle and Differential

Refer to [Section 205-00](#).

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## Ring Gear Backlash Adjustment

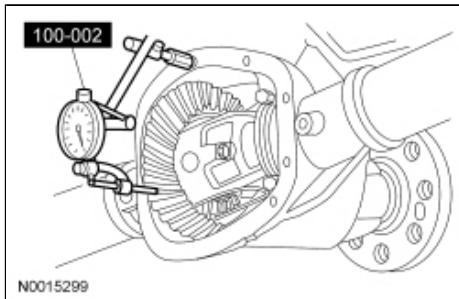
### Special Tool(s)

 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1485-A	Installer, Differential Shim 205-220 (T85L-4067-AH)

### Material

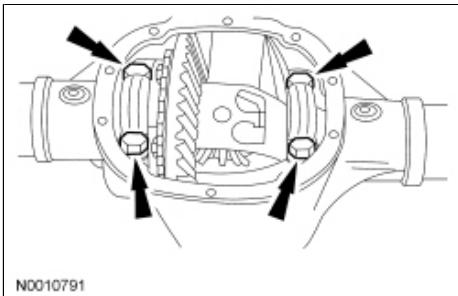
Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—

1. Remove the differential housing cover. For additional information, refer to [Differential Housing Cover](#) in this section.
2. Install the Dial Indicator Gauge with Holding Fixture and measure the ring gear backlash.
  - If a zero backlash condition occurs or the backlash is not within specification, proceed to Step 3.
  - If the backlash is within specification, proceed to Step 14.



3. Remove the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.
4. **NOTE:** Index-mark the position of the differential bearing caps, as arrows may not be visible. The differential bearing caps must be installed in their original locations and positions.

Remove the 4 bearing cap bolts and 2 caps.



5. If a zero backlash condition had occurred, add 0.50 mm (0.020 in) to the RH side shim and subtract 0.50 mm (0.020 in) from the LH side shim to allow a backlash indication. Install the 2 bearing caps and 4 bolts.
  - Tighten to 105 Nm (77 lb-ft).
  - Go back to Step 2.
6. To correct for high or low backlash, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

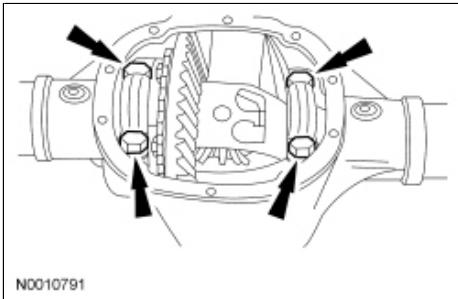
Differential Shim Size Chart 4067

Stripes and Color Code	Dimension A	
	mm	Inch

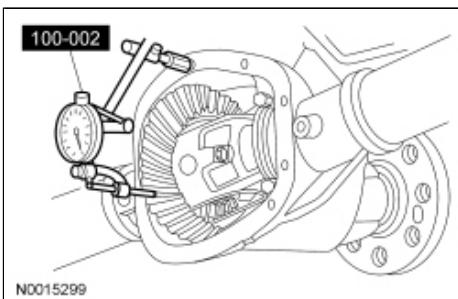
2 — C-COAL	7.7978-7.8105	0.3070-0.3075
1 — C-COAL	7.7470-7.7597	0.3050-0.3055
5 — BLU	7.6962-7.7089	0.3030-0.3035
4 — BLU	7.6454-7.6581	0.3010-0.3015
3 — BLU	7.5946-7.6073	0.2990-0.2995
2 — BLU	7.5458-7.5565	0.2970-0.2975
5 — PINK	7.4422-7.4549	0.2930-0.2935
4 — PINK	7.3914-7.4041	0.2910-0.2915
3 — PINK	7.3406-7.3533	0.2890-0.2895
2 — PINK	7.2898-7.3025	0.2870-0.2875
1 — PINK	7.2390-7.2517	0.2850-0.2855
5 — GRN	7.1882-7.2009	0.2830-0.2835
4 — GRN	7.1374-7.1501	0.2810-0.2815
3 — GRN	7.0866-7.0993	0.2790-0.2795
2 — GRN	7.0358-7.0485	0.2770-0.2775
1 — GRN	6.9850-7.0485	0.2750-0.2755
5 — WH	6.9342-6.9469	0.2730-0.2735
4 — WH	6.8834-6.8961	0.2710-0.2715
3 — WH	6.8326-6.8453	0.2690-0.2695
2 — WH	6.7818-6.7945	0.2670-0.2675
1 — WH	6.7310-6.7437	0.2650-0.2655
5 — YEL	6.6802-6.6929	0.2630-0.2635
4 — YEL	6.6294-6.6421	0.2610-0.2615
3 — YEL	6.5786-6.5913	0.2590-0.2595
2 — YEL	6.5278-6.5405	0.2570-0.2575
1 — YEL	6.4770-6.4897	0.2550-0.2555
5 — ORNG	6.4262-6.4389	0.2530-0.2535
4 — ORNG	6.3754-6.3881	0.2510-0.2515
3 — ORNG	6.3246-6.3373	0.2490-0.2495
2 — ORNG	6.2738-6.2865	0.2470-0.2475
1 — ORNG	6.2223-6.2357	0.2450-0.2455
2 — RED	6.1722-6.1849	0.2430-0.2435
1 — RED	6.1214-6.1341	0.2410-0.2415

7. Install the 2 bearing caps and 4 bolts.

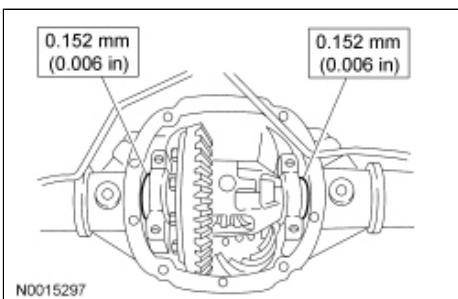
- Tighten to 105 Nm (77 lb-ft).



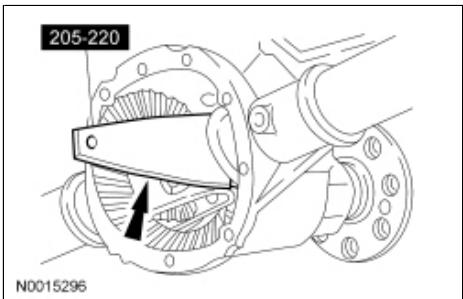
8. Using the Dial Indicator Gauge with Holding Fixture, recheck the ring gear backlash.
  - If backlash is now within specification, proceed to Step 9.
  - If backlash is not within specification, go back to Step 4.



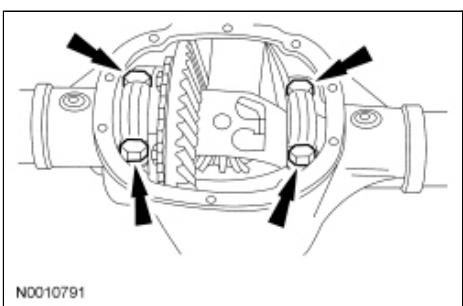
9. Remove the 4 bearing cap bolts and 2 bearing caps.
10. To establish differential bearing preload, increase both LH and RH differential bearing shim size by the thickness shown.



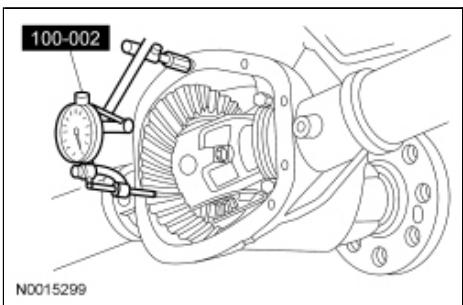
11. Using the Differential Shim Installer, fully seat the differential bearing shims. Make sure the assembly rotates freely.



12. Install the 2 bearing caps and 4 bolts.
  - Tighten to 105 Nm (77 lb-ft).



13. Using the Dial Indicator Gauge with Holding Fixture, do a final check of the ring gear backlash.

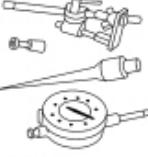
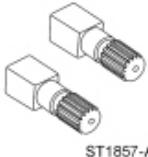
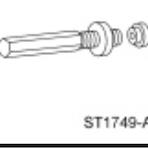


14. Apply marking compound and rotate the differential assembly 5 complete revolutions.
15. Verify an acceptable pattern check. For additional information, refer to Tooth Contact Pattern Check in [Section 205-00](#).
16. Install the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.
17. Install the differential housing cover. For additional information, refer to [Differential Housing Cover](#) in this section.



## Differential Case and Ring Gear — Conventional

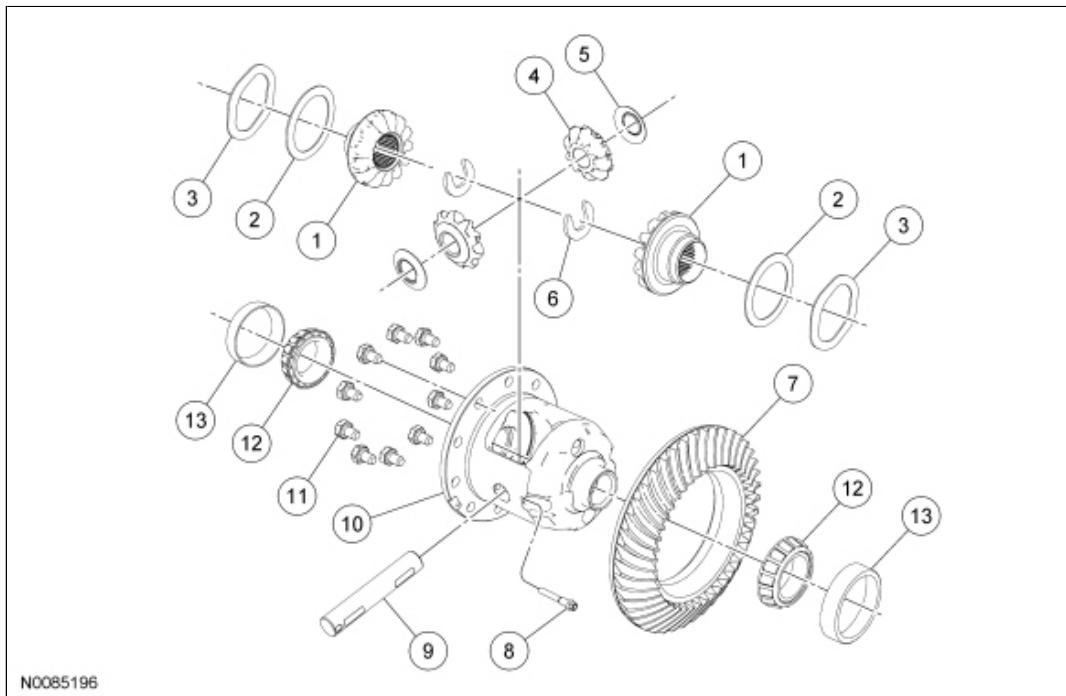
### Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1857-A	Gauge, Differential (Traction-Lock) 205-384 (T97T-4205-A)
 ST1749-A	Gauge, Differential (Traction-Lock) 205-386 (T97T-4205-D)
 ST2473-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
 ST1543-A	Step Plate 205-D061 (D80L-630-8) or equivalent

### Material

Item	Specification
Maximum Strength Retaining Compound	—

Loctite® 638™	
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5

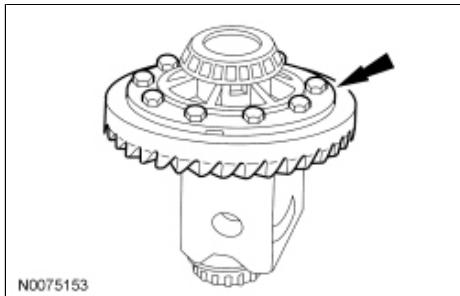


Item	Part Number	Description
1	—	Differential side gears (part of 4215)
2	4228	Differential side gear thrust washers
3	4214	Differential side gear wave washers
4	4215	Differential pinion gear
5	4230	Differential pinion thrust washer (also part of 4215)
6	4N237	Axle shaft U-washer
7	4209	Differential ring gear
8	4241	Differential pinion shaft lock bolt (also part of 4215)
9	4211	Differential pinion shaft
10	4204	Differential case
11	4216	Differential ring gear bolts (12 required)
12	4220	Differential bearings
13	—	Differential bearing cups (part of 4220)

### Disassembly

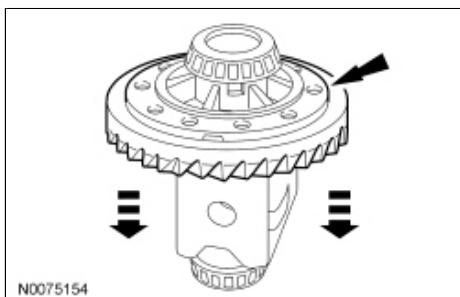
1. Remove the differential carrier. Tag the differential shims and bearing cups for location. For additional information, refer to [Differential Carrier](#) in this section.

2. Remove and discard the 12 differential ring gear bolts.



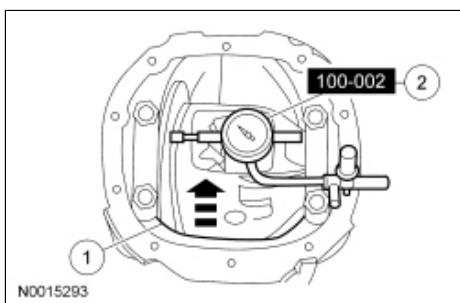
3. **NOTICE:** Care should be taken not to damage the differential ring gear bolt hole threads.

Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.

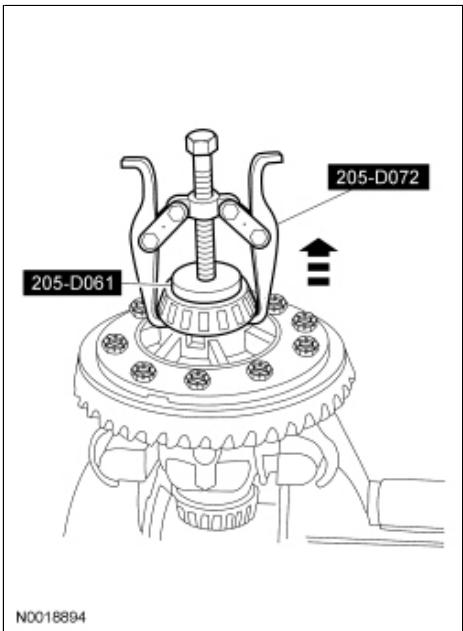


4. If checking differential case flange runout, install the bearing cups in their original location and install the differential assembly.

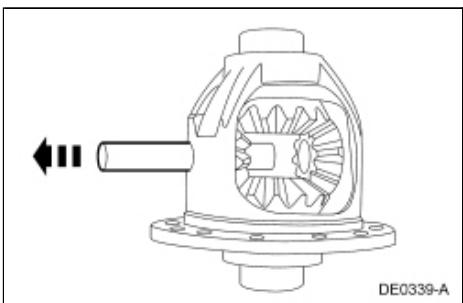
1. Install the bearing caps and differential shims.
  - Rotate the differential assembly to verify the bearings have seated.
2. Install the Dial Indicator Gauge With Holding Fixture and record the differential case runout.



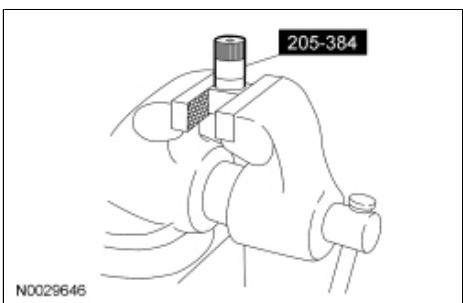
5. If necessary, remove the differential bearings with the 2 Jaw Puller and Step Plate.



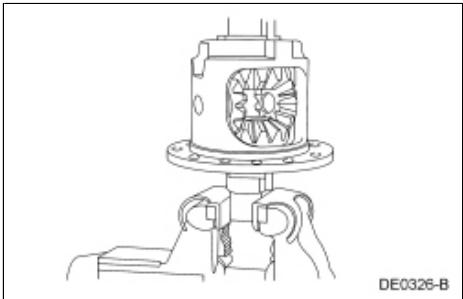
6. Remove the differential pinion shaft lock bolt and the differential pinion shaft.



7. Install the Differential Gauge in a suitable vise.

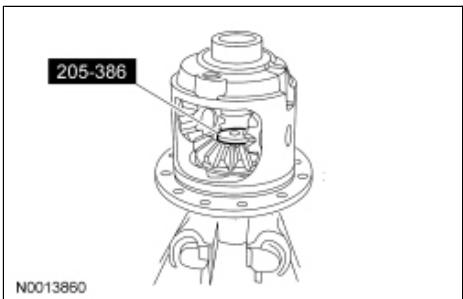


8. Install the differential case on the Differential Gauge.

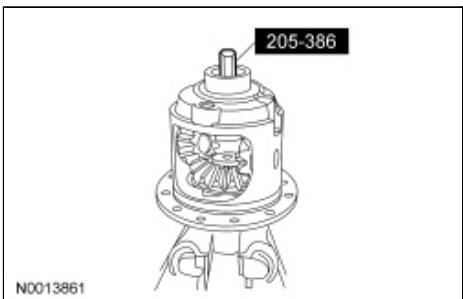


9. **NOTE:** Apply a small amount of grease to the centering hole of the Differential Gauge step plate.

Install the Differential Gauge step plate in the bottom differential side gear.

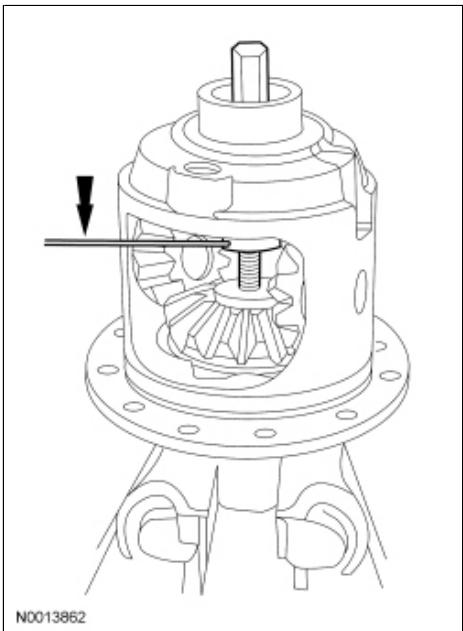


10. Install the Differential Gauge nut in the upper differential side gear. Hold the nut in position while installing the Differential Gauge hex screw. Tighten the hex-head screw until contact is made with the Step Plate.

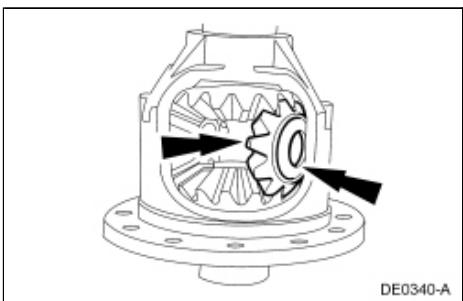


11. **NOTE:** The dowel bar is used to keep the nut from turning when the forcing screw is tightened.

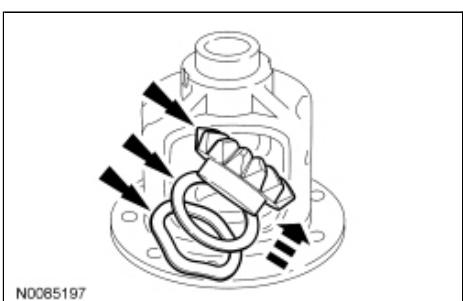
Insert a suitable dowel bar in the hole of the nut. Tighten the forcing screw to force the differential side gears away from the differential pinion gears.



12. Rotate and remove the differential pinion gears and differential pinion gear thrust washers.



13. Remove the differential side gears, the differential side gear thrust washers and the differential side gear wave washers.



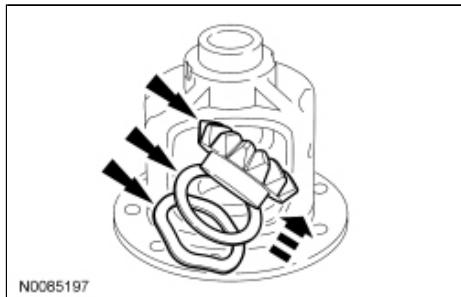
## Assembly

### All vehicles

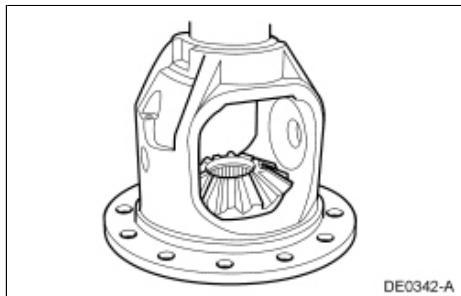
1. **NOTE:** Lubricate the differential side gear thrust washers, wave washers and the side gear journals

with axle lubricant.

Position the differential side gear thrust washers and wave washers on the differential side gears.



2. Position the differential side gears.

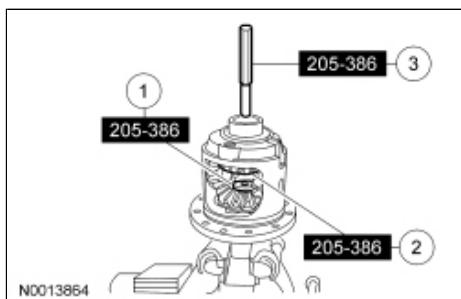


3. **NOTE:** Apply a small amount of grease to the step plate bore.

**NOTE:** If necessary, insert the dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

Assemble the Differential Gauge to the differential case.

1. Position the Differential Gauge step plate in the bottom differential side gear.
2. Position the Differential Gauge hex screw plate in the top differential side gear and hold it in place.
3. Install the Differential Gauge hex screw and tighten it 2 turns after it contacts the bottom step plate.

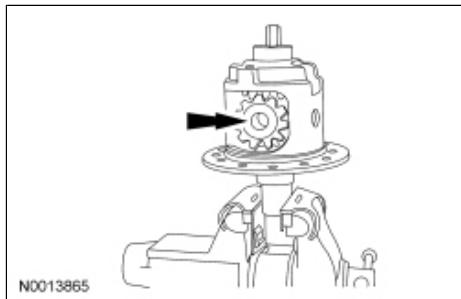


4. **NOTE:** Lubricate both sides of the differential pinion gear thrust washers with axle lubricant.

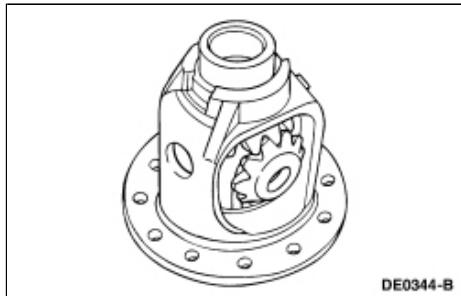
**NOTE:** Make sure the differential pinion gears are 180 degrees apart so they will align correctly with

the pinion shaft bore.

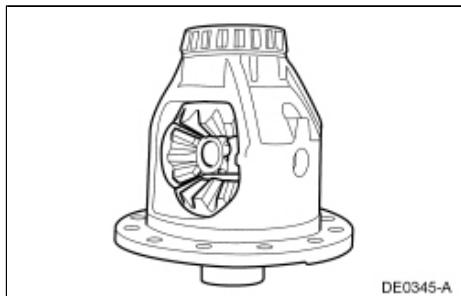
Position the differential pinion gears and differential pinion gear thrust washers in the window of the differential case so they mesh with the differential side gear teeth.



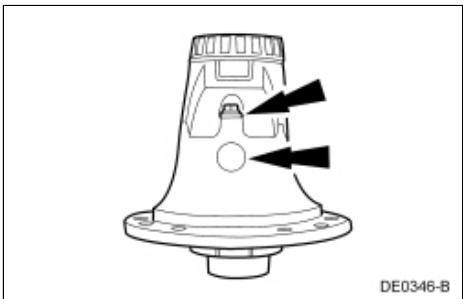
- Engage the differential pinion gears opposite the differential side gears.



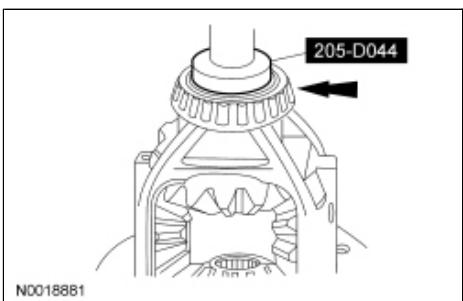
- Rotate the differential pinion gears to align the differential pinion shaft bore.



- Remove the Differential Gauges after verifying the differential pinion shaft bore alignment.
- Insert the differential pinion shaft, and install a new differential pinion shaft lock bolt finger-tight.



9. If removed, use the Differential Carrier Bearing Installer to install the differential bearings.



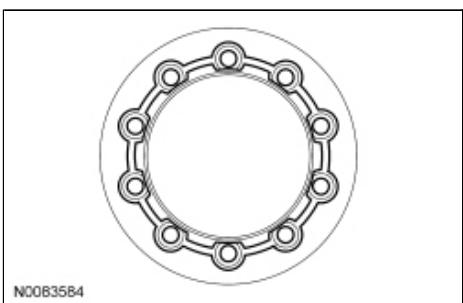
**Electronic Locking Differential (ELD) equipped vehicles and all vehicles equipped with 3.55, 3.73, and 4.10 ratio gear sets**

10. **NOTE:** The differential flange and ring gear flange must be free of any old retaining compound material. Make sure both surfaces are clean and free of oil, dust and debris. Failure to clean the surfaces can result in ring gear runout concerns.

Clean all traces of the old retaining compound material from the differential flange.

- Use solvent and Scotch-Brite® pads to remove.

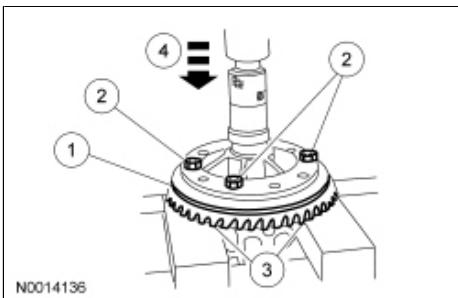
11. Apply a one-eighth inch bead of maximum strength retaining compound on the rear face of the ring gear in the pattern shown.



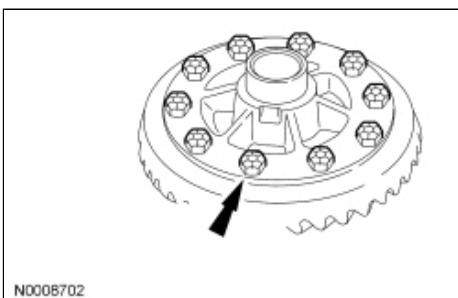
**All vehicles**

12. Install the ring gear.
  1. Place the ring gear on the differential assembly.
  2. Hand-start 3 new ring gear bolts to align the holes in the ring gear and the differential case.
  3. Using a suitable press, position the ring gear.

4. Press the ring gear into place.



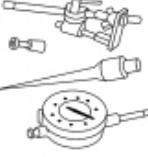
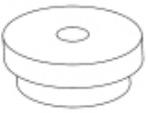
13. Hand-start the remaining 9 new differential ring gear bolts. Tighten the 12 bolts in 2 stages.
- Stage 1: Tighten to 60 Nm (44 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.



14. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
-

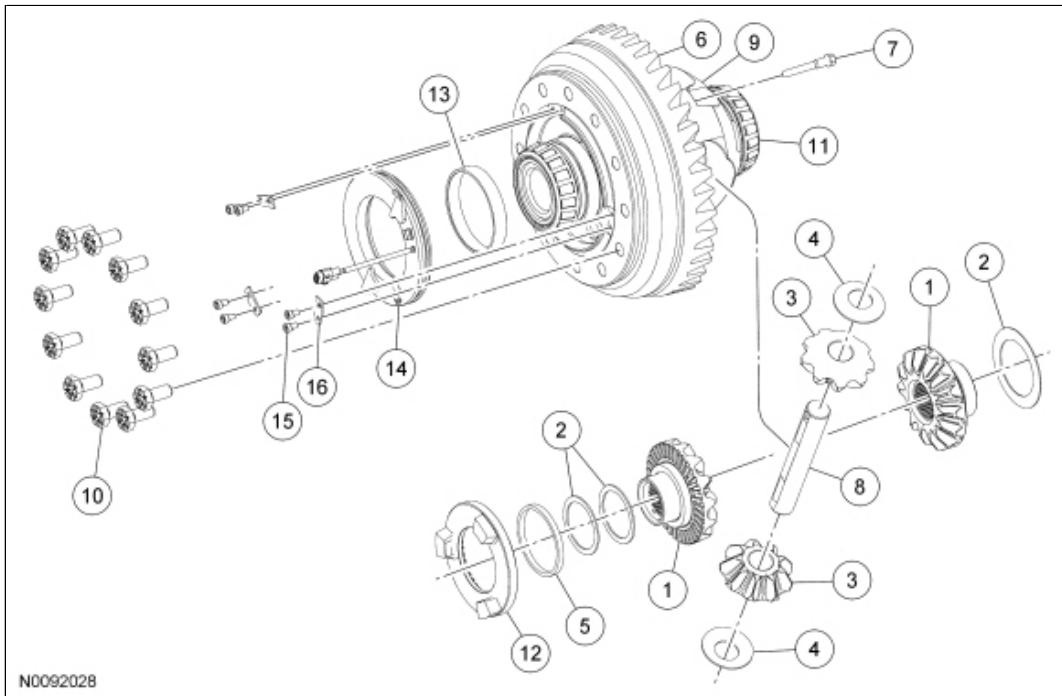
## Differential Case and Ring Gear — Electronic Locking Differential (ELD)

### Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST2473-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A)
 ST1543-A	Step Plate 205-D061 (D80L-630-8) or equivalent

### Material

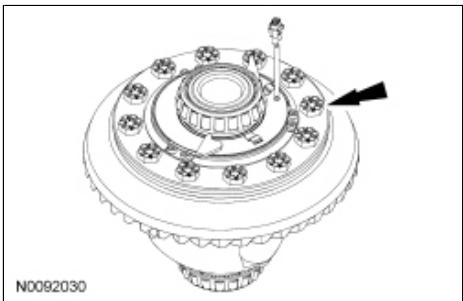
Item	Specification
Maximum Strength Retaining Compound Loctite® 638™	—
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5



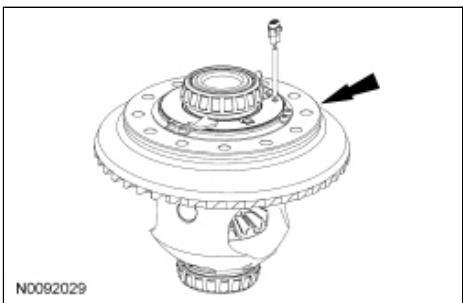
Item	Part Number	Description
1	—	Differential side gears (part of kit 4215)
2	—	Differential side gear thrust washers (part of kit 4215)
3	—	Differential pinion gears (part of kit 4215)
4	—	Differential pinion thrust washers (part of kit 4215)
5	—	Differential pinion spring (part of kit 4215)
6	4209	Differential ring gear
7	4241	Differential pinion shaft lock bolt
8	4211	Differential pinion shaft
9	4204	Differential case
10	4216	Differential ring gear bolt (12 required)
11	4220	Differential bearing
12	—	Cam-ring (part of kit 4880)
13	—	Plunger (part of kit 4880)
14	—	Coil (part of kit 4880)
15	—	Coil bolt (part of kit 4880) (6 required)
16	—	Stopper (part of kit 4880) (3 required)

### Disassembly

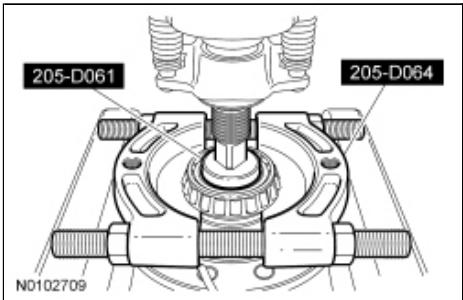
1. Remove the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
2. Remove and discard the 12 differential ring gear bolts.



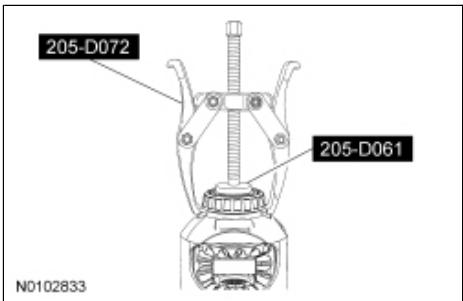
3. Insert a punch in the differential ring gear bolt holes and drive the differential ring gear off.



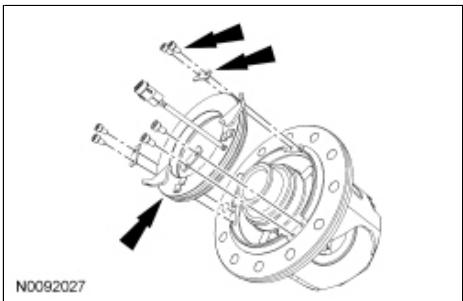
4. Using the Bearing Puller plate, Step Plate and a suitable press, remove the LH differential bearing.



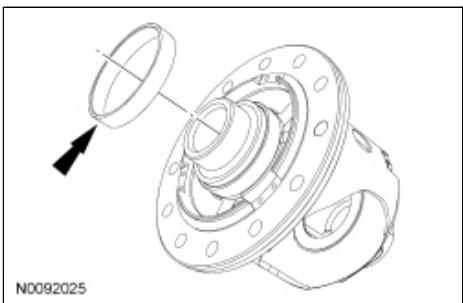
5. Using the 2 Jaw Puller and Step Plate, remove the RH differential bearing.



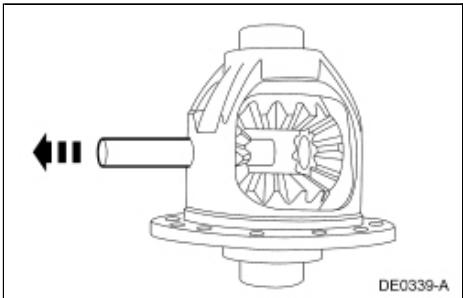
6. Remove and discard the 6 screws and 3 stoppers that hold the Electronic Locking Differential (ELD) coil in place and remove the coil.



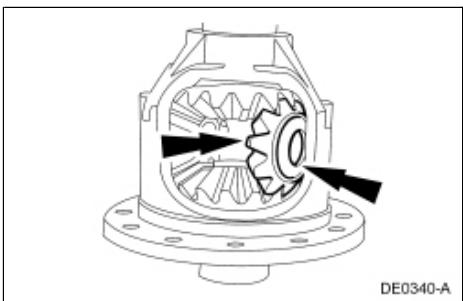
7. Remove the plunger assembly.



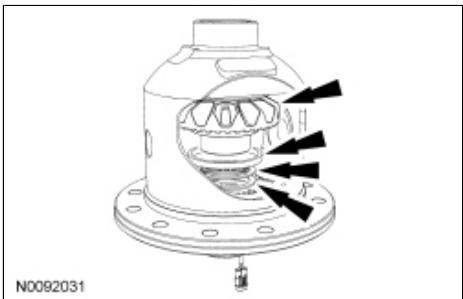
8. Remove the differential pinion shaft lock bolt and the differential pinion shaft.



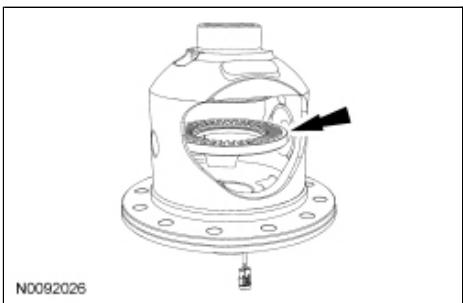
9. Rotate and remove the differential pinion gears and differential pinion gear thrust washers.



10. Remove the differential side gears, the differential side gear thrust washers and spring.



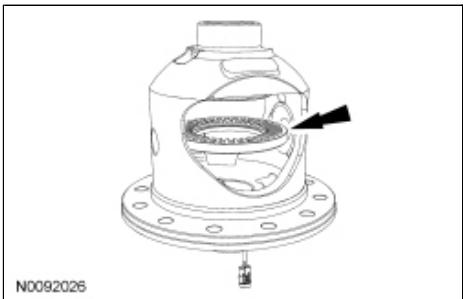
11. Remove the cam-ring.



## Assembly

### All vehicles

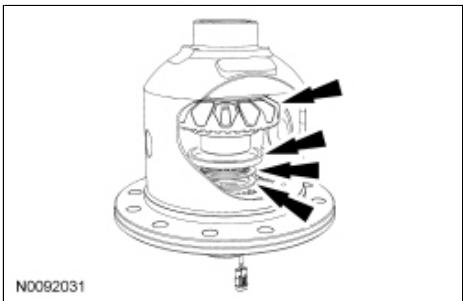
1. Install the cam-ring.



2. **NOTE:** Start by using the thickest thrust washers. If the gears do not assemble using the thickest thrust washers, back down in thickness until the gears will assemble.

Position the 2 LH differential side gear thrust washers and spring on the lower differential side gear and install the gear.

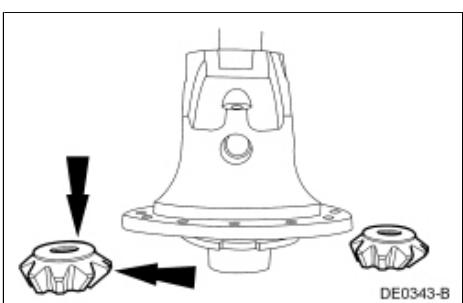
- Lubricate the differential side gear thrust washers and the differential side gear journals with axle lubricant.



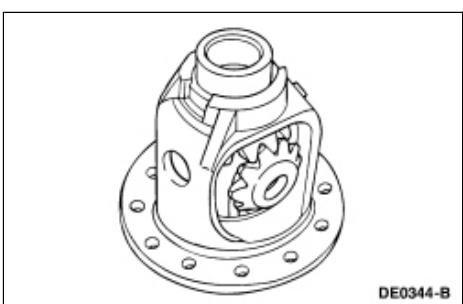
3. **NOTE:** Start by using the thickest thrust washer. If the gears do not assemble using the thickest thrust washers, back down in thickness until the gears will assemble.

Position the differential side gear thickest thrust washer on the RH differential side gear and install the gear.

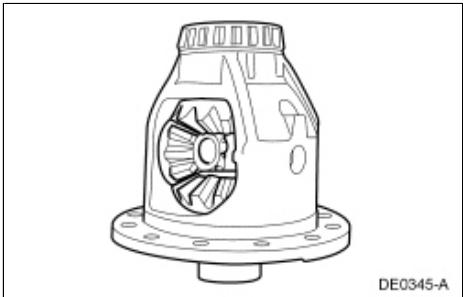
- Lubricate the differential side gear thrust washers and the differential side gear journals with axle lubricant.
4. Assemble the differential pinion gear thrust washers and the differential pinion gears.
    - Lubricate the washers and gears with rear axle lubricant.



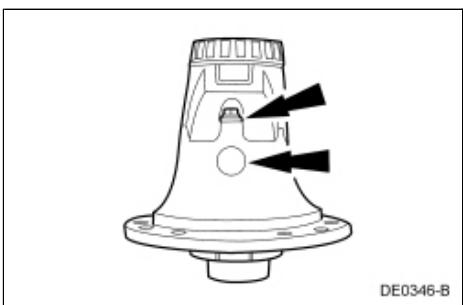
5. Engage the differential pinion gears opposite the differential side gears.



6. Rotate the differential pinion gears to align the differential pinion shaft bore.



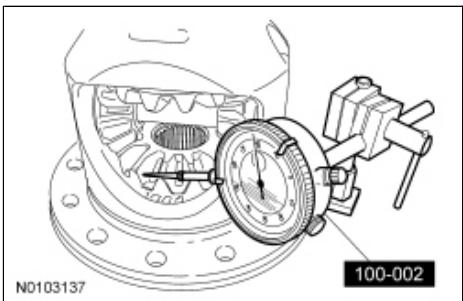
7. Insert the differential pinion shaft, and install a new differential pinion shaft lock bolt finger-tight.



8. Install the Dial Indicator Gauge With Holding Fixture.

- While pulling up on the RH differential gear, measure the backlash of the LH differential gear.
- Backlash should be 0.001-1.000 mm (0.004-0.040 in).
- If backlash is incorrect, install a thicker LH thrust washer to reduce backlash, or a thinner washer to increase backlash.

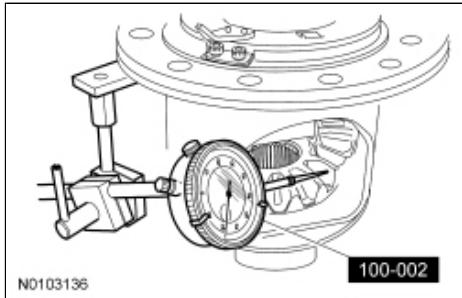
Part Number	Thickness (mm)	Thickness (in)	Quantity
Part of kit 4880	1.4	0.05	2
Part of kit 4880	1.6	0.06	2
Part of kit 4880	1.8	0.07	2



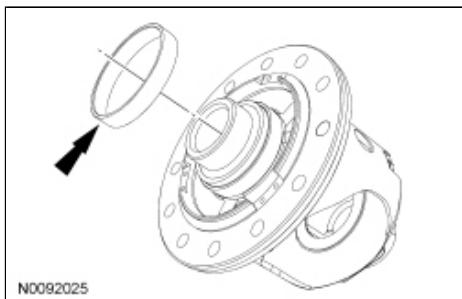
9. Turn the differential over and reposition the Dial Indicator Gauge With Holding Fixture.

- While pulling up on the LH differential gear, measure the backlash of the RH differential gear.
- Backlash should be 0.001-1.000 mm (0.004-0.040 in).
- If backlash is incorrect, install a thicker RH thrust washer to reduce backlash, or a thinner washer to increase backlash.

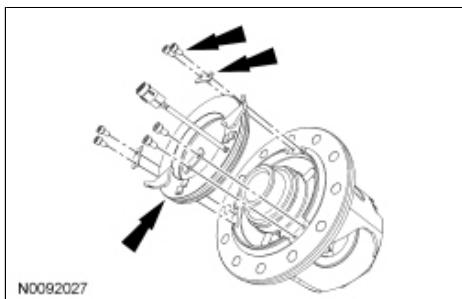
Part Number	Thickness (mm)	Thickness (in)	Quantity
Part of kit 4880	1.1	0.04	1
Part of kit 4880	1.3	0.05	1
Part of kit 4880	1.5	0.06	1



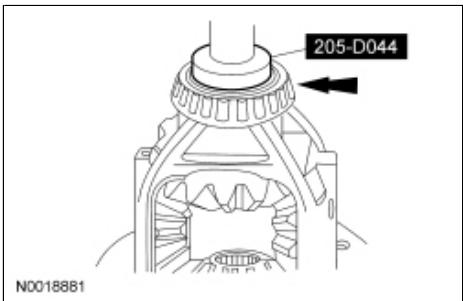
10. Tighten the differential pinion shaft lock bolt to 30 Nm (22 lb-ft).
11. Install the plunger assembly.



12. Install the ELD coil, 3 new stoppers and 6 new screws that hold the coil in place.
  - Tighten to 5 Nm (44 lb-in).



13. Use the Differential Carrier Bearing Installer to install the 2 differential bearings.



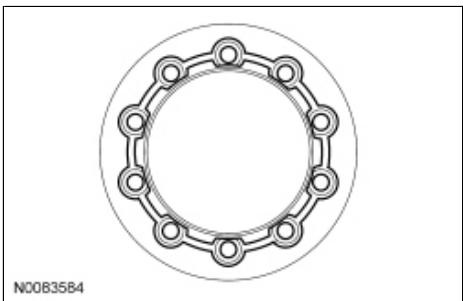
**Electronic Locking Differential (ELD) equipped vehicles and all vehicles equipped with 3.55, 3.73, and 4.10 ratio gear sets**

14. **NOTE:** The differential flange and ring gear flange must be free of any old retaining compound material. Make sure both surfaces are clean and free of oil, dust and debris. Failure to clean the surfaces can result in ring gear runout concerns.

Clean all traces of the old retaining compound material from the differential flange.

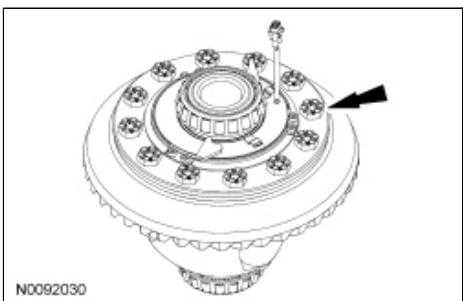
- Use solvent and Scotch-Brite® pads to remove.

15. Apply a one-eighth inch bead of maximum strength retaining compound on the rear face of the ring gear in the pattern shown.



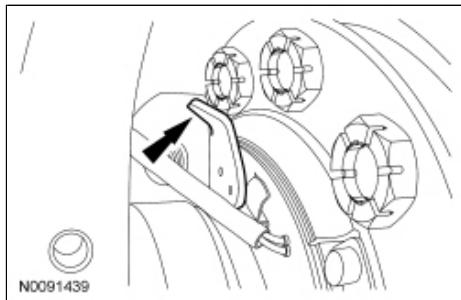
**All vehicles**

16. Install the ring gear and the 12 new differential ring gear bolts. Tighten in 2 stages.
  - Stage 1: Tighten to 60 Nm (44 lb-ft).
  - Stage 2: Tighten an additional 90 degrees.



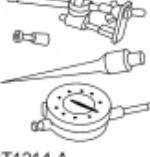
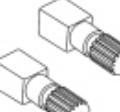
17. **NOTE:** Install the differential with the tabs on the ELD coil up against the differential bearing cap mounting surface.

Install the differential carrier in the axle housing. For additional information, refer to [Differential Carrier](#) in this section.



## Differential Case and Ring Gear — Traction-Lok

### Special Tool(s)

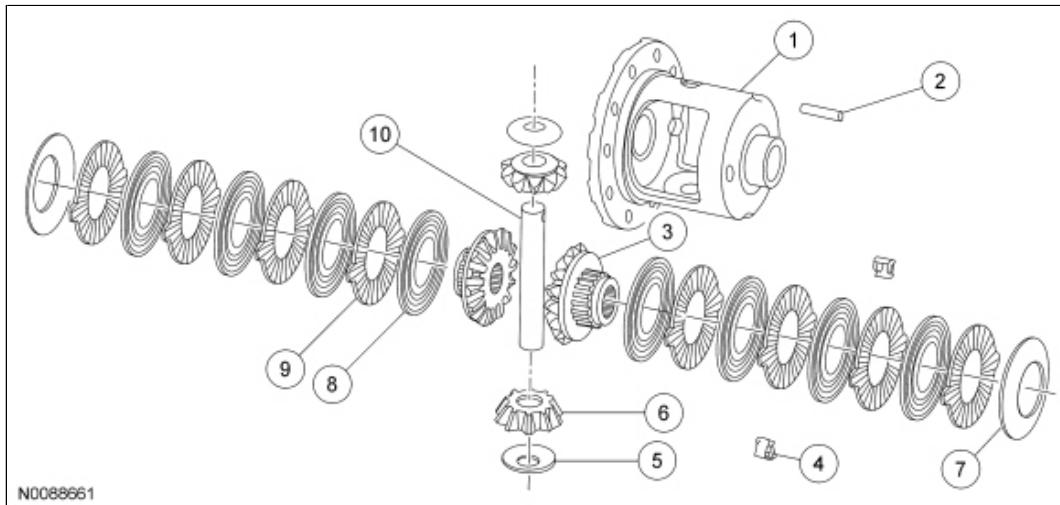
	15-101 Gauge, Differential Clutch (Excluding Mandrel) 205-135 (T80P-4946-A)
	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
	Gauge, Differential (Traction-Lok) 205-384 (T97T-4205-A)
	Gauge, Differential (Traction Lock) 205-386 (T97T-4205-D)
	Gauge, Differential (Traction-Lok) (Mandrel for 205-135 [T80P-4946-A]) 205-389 (T97T-4946-A)
	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent

	Rotator, Differential 205-378 (T97T-4205-C)
	Step Plate 205-D061 (D80L-630-8) or equivalent

#### Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Maximum Strength Retaining Compound Loctite® 638™	—
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY- 75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG- 1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5

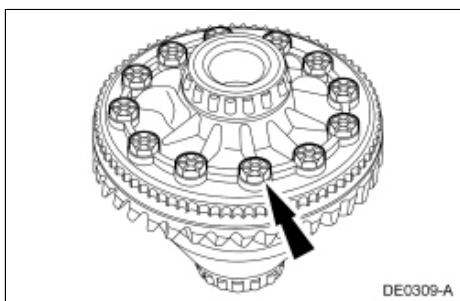
#### Traction-Lok Differential Assembly



Item	Part Number	Description
1	4204	Differential case
2	4241	Differential pinion shaft lock bolt (part of 4215)
3	—	Differential side gear (part of 4215)
4	—	Retainer clip (part of 4947)
5	4230	Differential pinion thrust washer (part of 4215)
6	—	Differential pinion gear (part of 4215)
7	—	Plate preload spacer (part of 4947)
8	—	Clutch disc (part of 4947)
9	—	Clutch plate (part of 4947)
10	4211	Differential pinion shaft

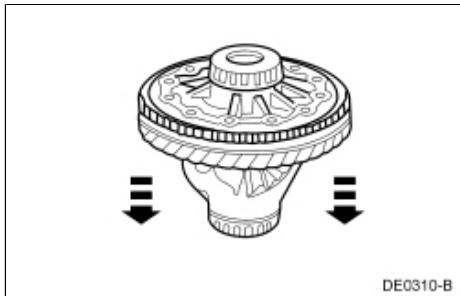
### Disassembly

1. Remove the differential carrier. Tag the differential shims and bearing cups for location. For additional information, refer to [Differential Carrier](#) in this section.
2. Remove and discard the 12 differential ring gear bolts.

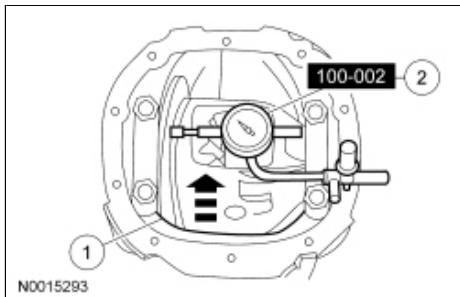


3. **NOTICE:** Care should be taken not to damage the differential ring gear bolt hole threads.

Insert a punch in the differential ring gear bolt holes. Drive off the differential ring gear.

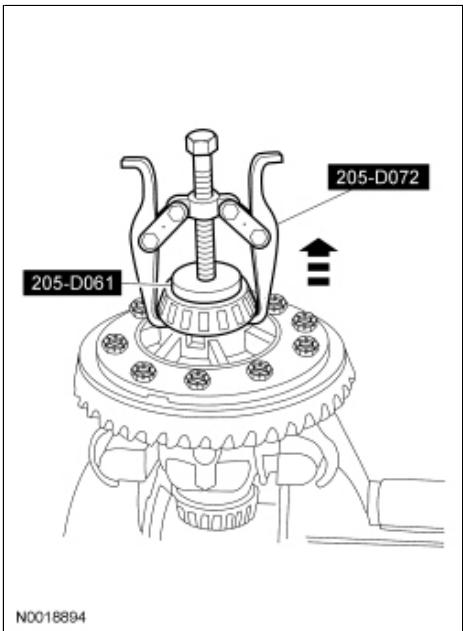


4. If checking differential case flange runout, install the bearing cups in their original location and install the differential assembly.
  1. Install the bearing caps and differential shims.
    - Rotate the differential assembly to verify the bearings have seated.
  2. Install the Dial Indicator Gauge With Holding Fixture and record the differential case runout.

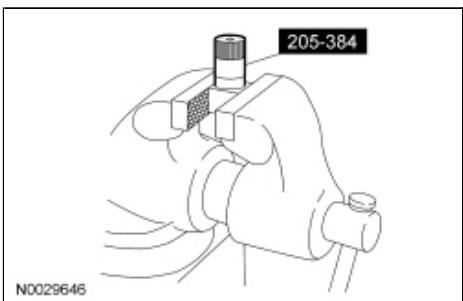


5. **NOTE:** The differential bearings need not be removed to overhaul the Ford limited slip differential.

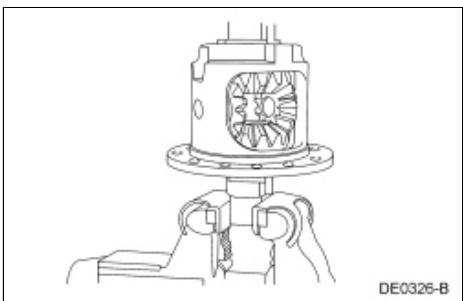
If necessary, use the 2 Jaw Puller and Step Plate to remove the differential bearings.



6. Install the Differential Gauge in a suitable vise.

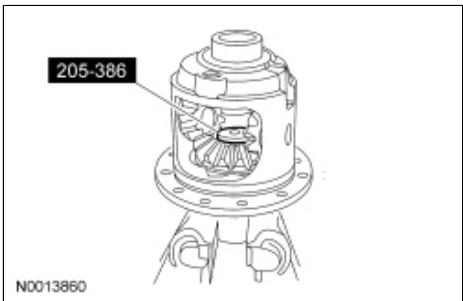


7. Install the differential case on the Differential Gauge.

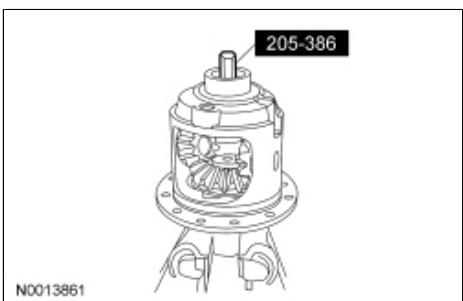


8. **NOTE:** Apply a small amount of grease to the centering hole of the Differential Gauge.

Install the Differential Gauge in the bottom differential side gear.

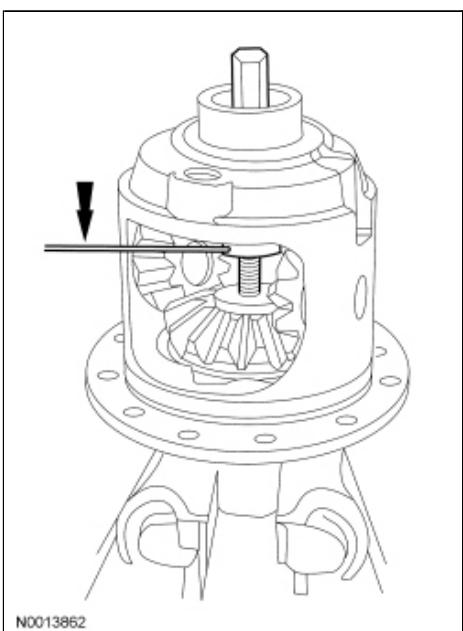


9. Install the nut in the upper differential side gear. Hold the nut in position while installing the hex screw. Tighten the hex-head screw until contact is made with the Step Plate.



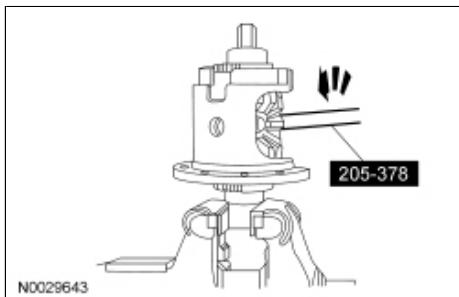
10. **NOTE:** The dowel bar is used to keep the nut from turning when the forcing screw is tightened.

Insert a suitable dowel bar in the hole of the nut. Tighten the forcing screw to force the differential side gears away from the differential pinion gears.

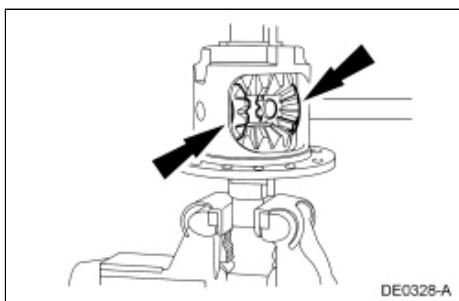


11. **NOTE:** Differential pinion gear thrust washers cannot be removed independently of the differential pinion gears.

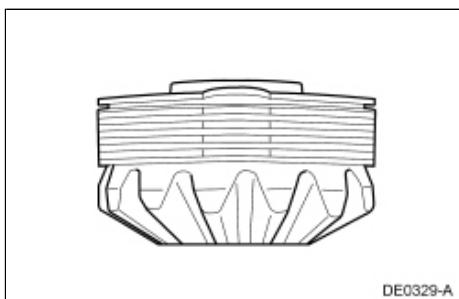
Insert the Differential Rotator in the pinion shaft bore, and turn the differential case to "walk" the differential pinion gears and differential pinion gear thrust washers out to the differential case windows.



12. Remove the differential pinion gears and differential pinion gear thrust washers.



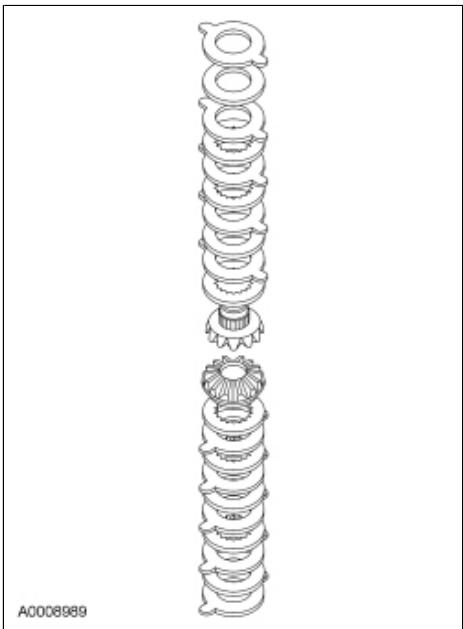
13. Remove the differential side gears and differential clutch packs with the selective shim and Belleville spring, tag them RH and LH.



14. **NOTE:** When separating the clutch plates and clutch discs, note the sequence in which they are disassembled. They must be reassembled in the same sequence.

**NOTE:** Do not use acids or solvents when cleaning the differential clutch pack. Wipe components with a clean, lint-free cloth only.

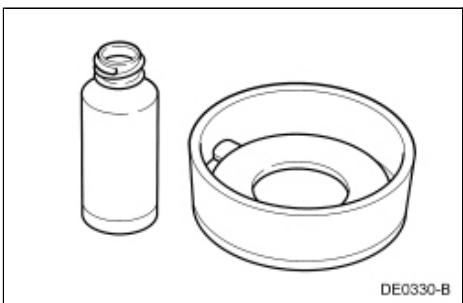
Separate the differential clutch discs and clutch plates for cleaning and inspection.



## Assembly

### All vehicles

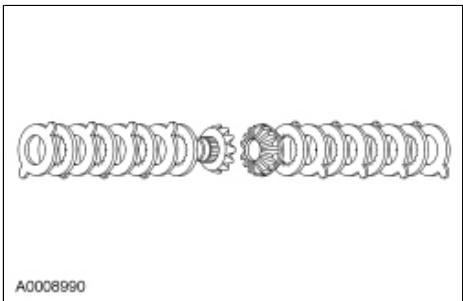
1. Lubricate each steel clutch plate and soak all friction plates with friction modifier for at least 15 minutes.



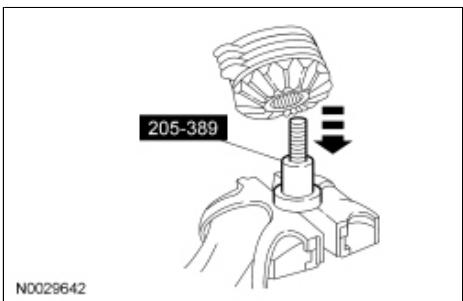
2. **NOTE:** Do not mix the differential clutch packs or selective shims from one side with the other.

**NOTE:** The Belleville spring is a dished plate.

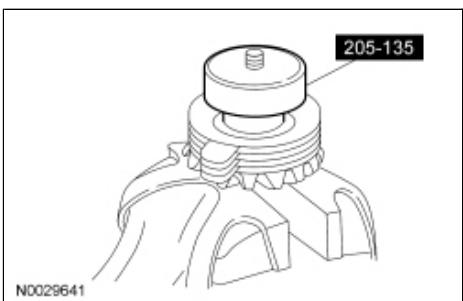
Assemble the differential clutch packs (without the selective shims and Belleville springs) on their respective differential side gears.



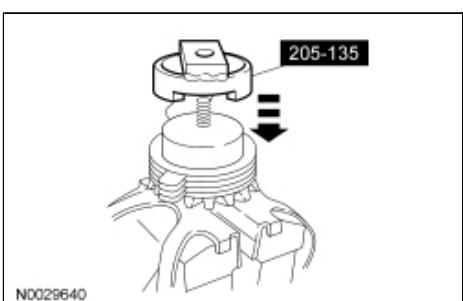
3. Clamp the bolt head of the Differential Gauge in a vise. Install the differential clutch pack and the differential side gear (without the selective shim or the Belleville spring) on the Differential Gauge.



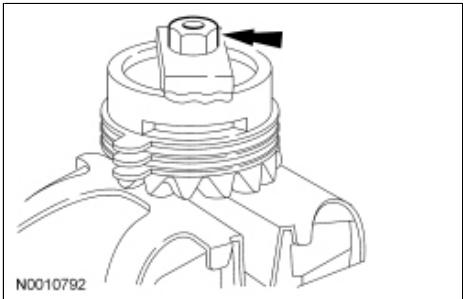
4. Position the Differential Clutch Gauge on top of the differential clutch pack.



5. Install the Differential Gauge over the disc and differential clutch pack.

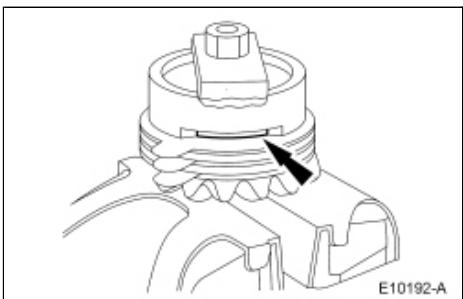


6. Install the nut over the top and base stud.
  - Tighten to 7 Nm (62 lb-in).



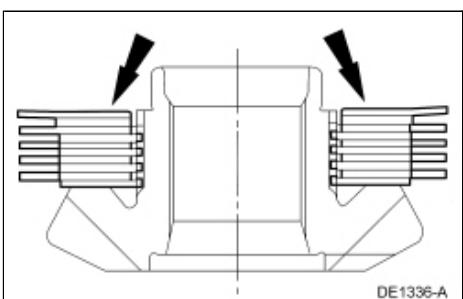
7. **NOTE:** Selective shims shown are available as part of the Clutch Pack Replacement Kit.

Use the feeler gauge and select the thickest blade that will enter between the tool and the differential clutch pack. Subtract 0.0075" from the reading. Then select the closest thinner thickness selective shim, that will be the new selective shim that should be used.



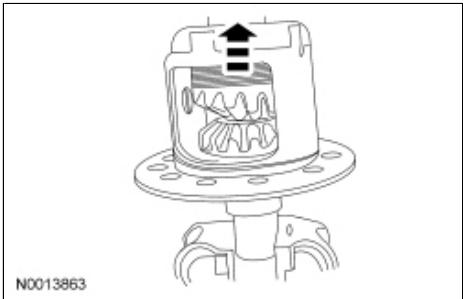
8. Place the selective shim and Belleville spring on the differential clutch pack.

- The dished or concave side of the Belleville spring must face up against the thrust face of the differential case.



9. Install the differential side gears with the differential clutch packs, selective shims and Belleville spring into the differential case.

- Hold the differential side gear assembly in place to prevent it from falling out of the differential case.

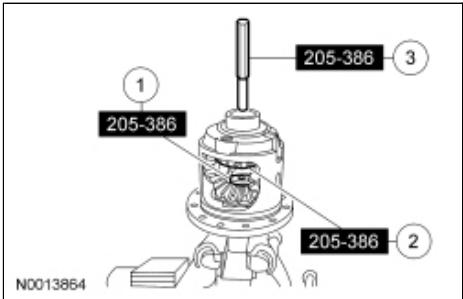


10. **NOTE:** Apply a small amount of grease to the step plate bore.

**NOTE:** If necessary, insert the dowel bar in the nut bore to keep the nut from turning as the hex screw is tightened.

Assemble the Differential Gauge to the differential case.

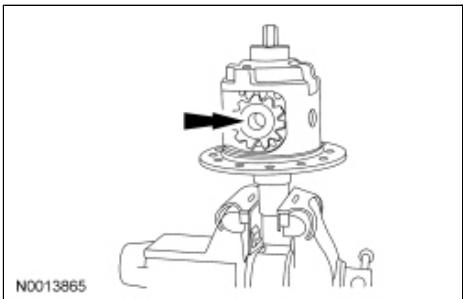
1. Position the Differential Gauge in the bottom differential side gear.
2. Position the Differential Gauge in the top differential side gear and hold it in place.
3. Install the Differential Gauge and tighten it 2 turns after it contacts the bottom step plate.



11. **NOTE:** Lubricate both sides of the differential pinion gear thrust washers with axle lubricant.

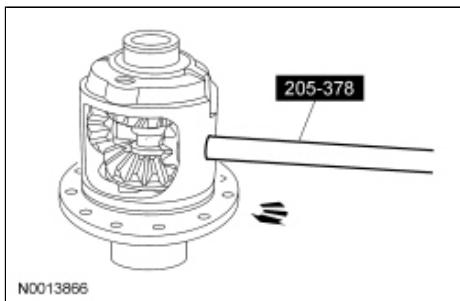
**NOTE:** Make sure the differential pinion gears are 180 degrees apart so they will align correctly with the pinion shaft bore.

Position the differential pinion gears and differential pinion gear thrust washers in the window of the differential case so they mesh with the differential side gear teeth.

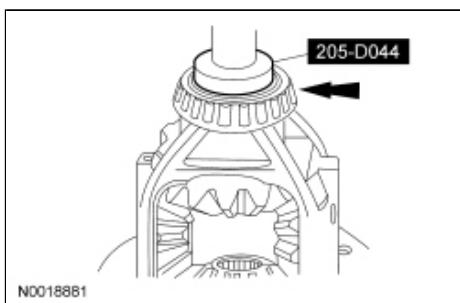


12. **NOTE:** It will probably be necessary to loosen or tighten the forcing screw to allow the differential pinion gears and differential side gears to rotate.

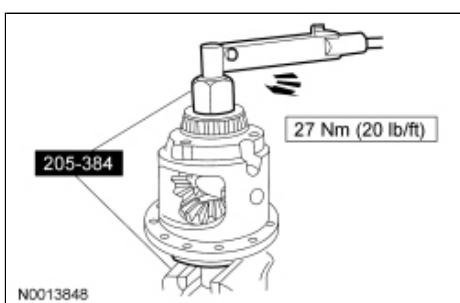
Insert the Differential Rotator into the pinion shaft bore, and turn the differential case. This will cause the differential pinion gears to engage the differential side gears and "walk" into the differential case. Rotate the differential case until the pinion shaft mating holes are lined up exactly with the holes in the differential pinion gears.



13. Remove the Differential Gauge.
14. Install the 2 new differential bearings using the Differential Carrier Bearing Installer.



15. Check the torque required to rotate one differential side gear.
  - Install the Differential Gauge with the 1/2-inch drive hole as shown.
  - The initial break-away torque, if original clutch plates are used, must be at least the minimum specification. The rotating torque required to keep the differential side gear turning with new clutch plates may vary.



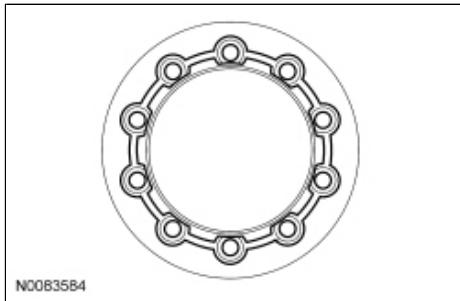
**Electronic Locking Differential (ELD) equipped vehicles and all vehicles equipped with 3.55, 3.73, and 4.10 ratio gear sets**

16. **NOTE:** The differential flange and ring gear flange must be free of any old retaining compound material. Make sure both surfaces are clean and free of oil, dust and debris. Failure to clean the surfaces can result in ring gear runout concerns.

Clean all traces of the old retaining compound material from the differential flange.

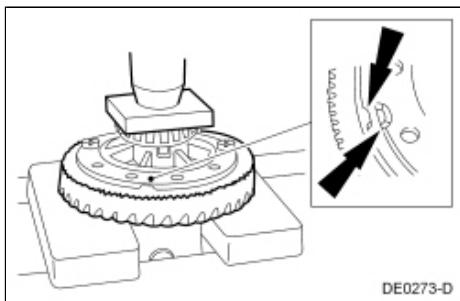
- Use solvent and Scotch-Brite® pads to remove.

17. Apply a one-eighth inch bead of maximum strength retaining compound on the rear face of the ring gear in the pattern shown.



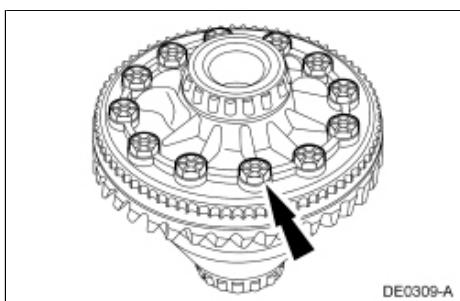
#### All vehicles

18. Using a suitable press, install the differential ring gear.



19. Install the new 12 differential ring gear bolts.

- Tighten to 150 Nm (111 lb-ft).



20. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.

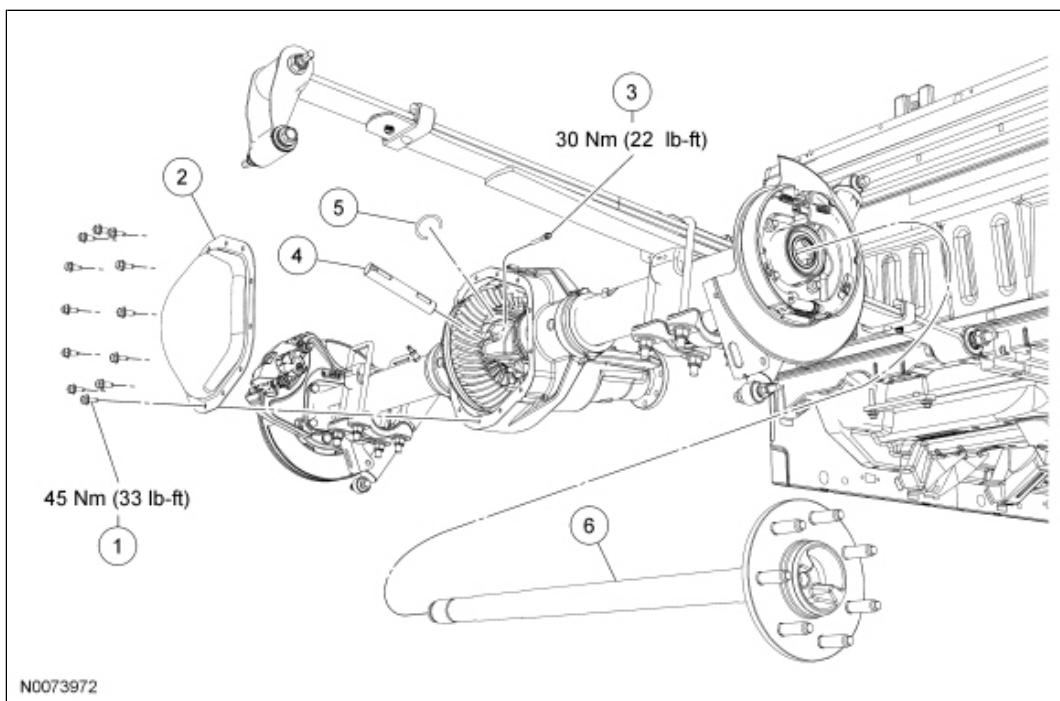
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## Axle Shaft

### Material

Item	Specification
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Threadlock and Sealer TA-25	WSK-M2G351-A5



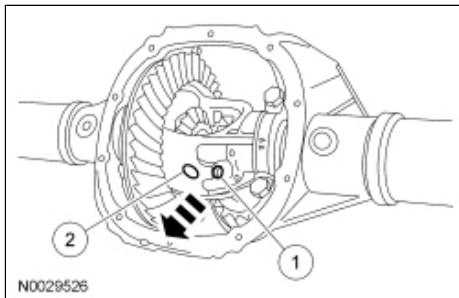
Item	Part Number	Description
1	4346	Differential housing cover bolt (12 required)
2	4033	Differential housing cover
3	4241	Differential pinion shaft locking bolt
4	4211	Differential pinion shaft
5	4N237	Axle shaft C-washer
6	4234	Axle shaft

### Removal

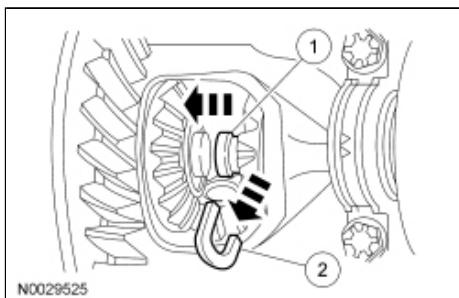
- With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-](#)

02.

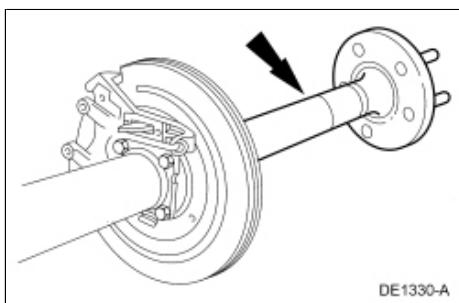
2. Remove the differential housing cover. For additional information, refer to [Differential Housing Cover](#).
3. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
4. Remove the bolt and position aside the wheel speed sensor.
5. Remove the differential pinion shaft.
  1. Remove and discard the differential pinion shaft lock bolt.
  2. Remove the differential pinion shaft.



6. Remove the U-washer.
  1. Push in on the axle shaft.
  2. Remove the U-washer.



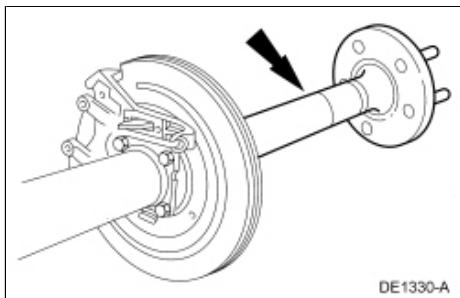
7. Remove the axle shaft.



## Installation

1. Lubricate the lip of the axle shaft oil seal with grease.

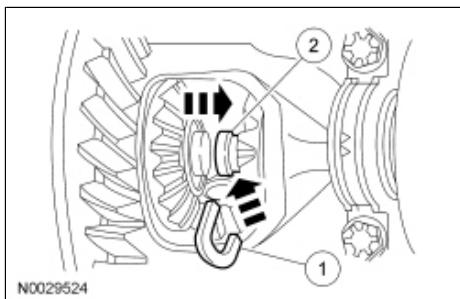
2. Install the axle shaft.



3. **NOTE:** Do not damage the rubber O-rings in the U-washer grooves.

Install the U-washer.

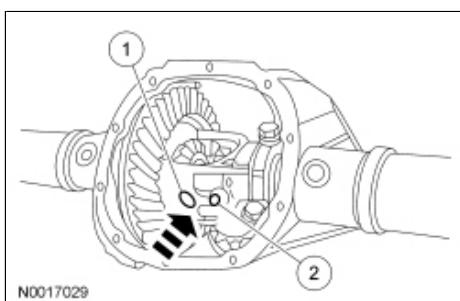
1. Position the U-washer on the button end of the axle shaft.
2. Pull the axle shaft outward.



4. **NOTE:** If a new differential pinion shaft lock bolt is unavailable coat the threads of the original differential pinion shaft lock bolt with threadlock prior to installation.

Install the differential pinion shaft.

1. Align the hole in the differential pinion shaft with the differential case lock bolt hole.
2. Install a new differential pinion shaft lock bolt.
  - Tighten to 30 Nm (22 lb-ft).



5. Install the wheel speed sensor and the bolt.
  - Tighten to 15 Nm (133 lb-in).

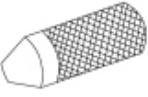
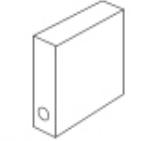
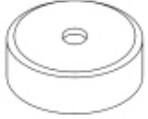
6. Install the rear brake disc. For additional information, refer to [Section 206-04](#).

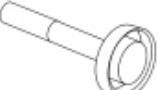
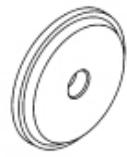
7. Install the differential housing cover. For additional information, refer to [Differential Housing Cover](#).

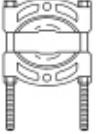
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## Differential Bearings

### Special Tool(s)

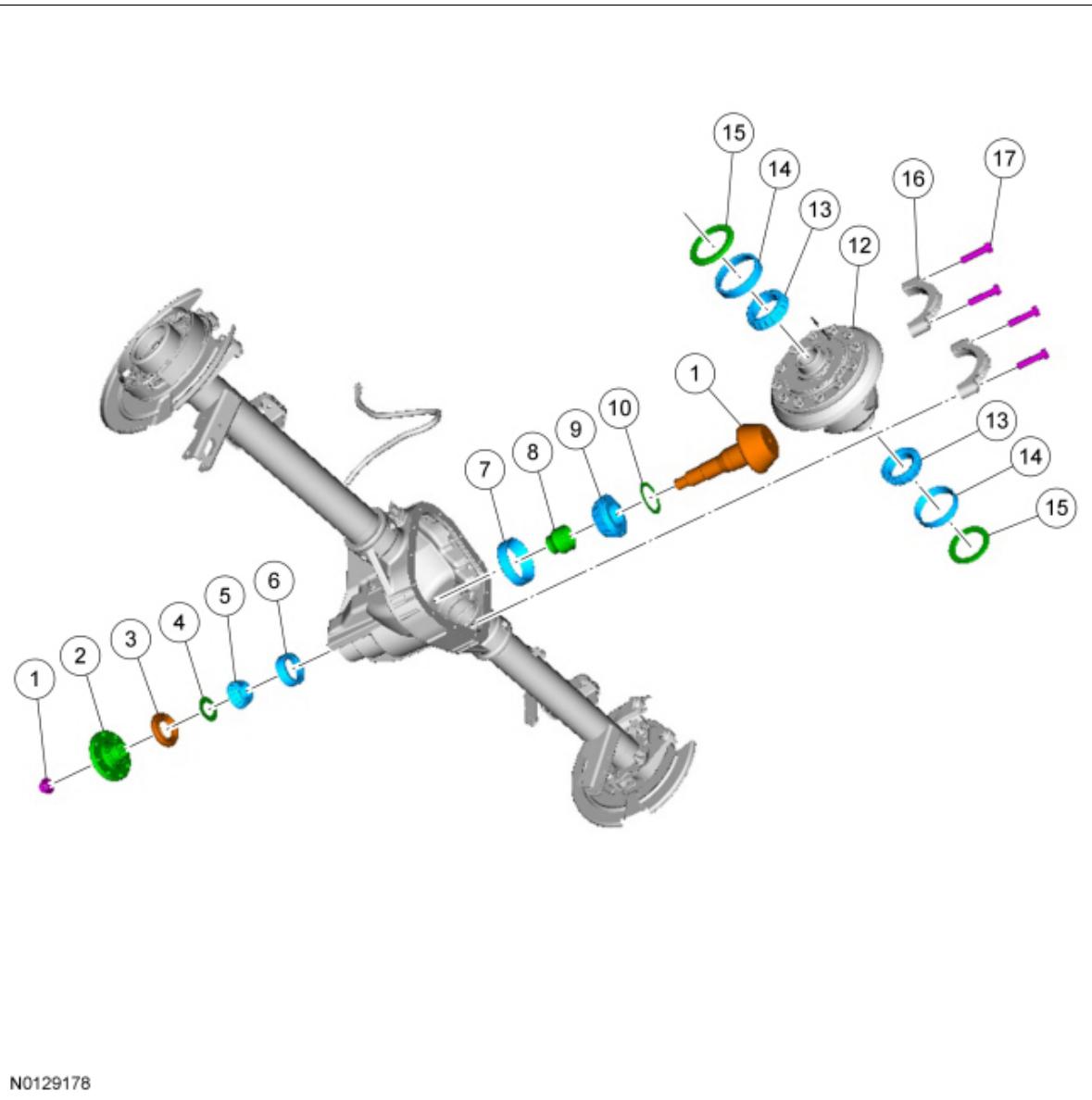
 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST2468-A	Adapter for 205-S156 205-159 (T80T-4020-F42)
 ST1429-A	Adapter for 205-S156 205-160 (T80T-4020-F43)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-226 (T85T-4020-AH1)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-383 (T97T-4020-B)
	Gauge Tube, Drive Pinion 205-377 (T97T-4020-A)

	ST1434-A
	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent ST2473-A
	Installer, Drive Pinion Bearing Cone 205-488 ST1367-A
	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A) ST1678-A
	Installer, Input Shaft Bearing Cup 308-391 ST2368-A
	Installer, Rear Axle Pinion Bearing Cup 205-852 ST1741-A
	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B) ST1254-A
	Protector, Drive Pinion Thread 205-229 (T85T-4209-AH) ST1744-A
	Puller, Bearing 205-D064 (D84L-1123-A)

 ST1368-A	
 ST1725-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent

#### Material

Item	Specification
Motorcraft® Premium Long-Life Grease XG-1-C (US); CXG-1-C (Canada)	ESA-M1C75- B



N0129178

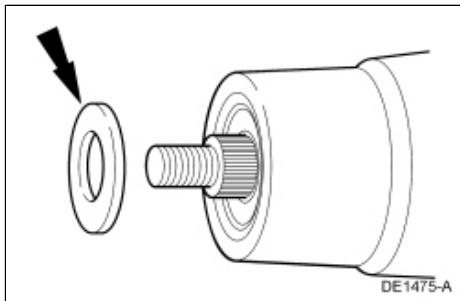
Item	Part Number	Description
1	389546	Drive pinion nut
2	4851	Drive pinion flange
3	4676	Drive pinion oil seal
4	4670	Pinion oil slinger
5	4621	Outer pinion bearing
6	—	Outer pinion bearing cup (part of 4621)
7	—	Inner pinion bearing cup (part of 4630)
8	4662	Collapsible spacer

9	4630	Inner pinion bearing
10	4663	Pinion bearing adjustment shim
11	4209	Drive pinion
12	4204	Differential assembly
13	4220	Differential carrier bearings (2 required)
14	—	Differential carrier bearing cups (Part of 4220) (2 required)
15	4067	Differential carrier bearing shims (2 required)
16	—	Differential bearing cap (part of 4010) (2 required)
17	—	Differential bearing cap bolts (part of 4010) (4 required)

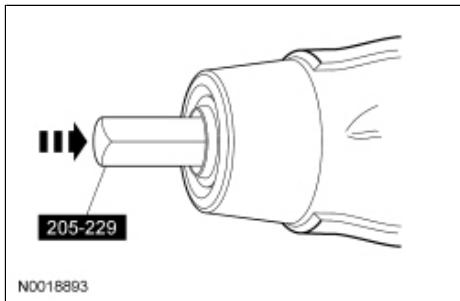
## Removal

### All vehicles

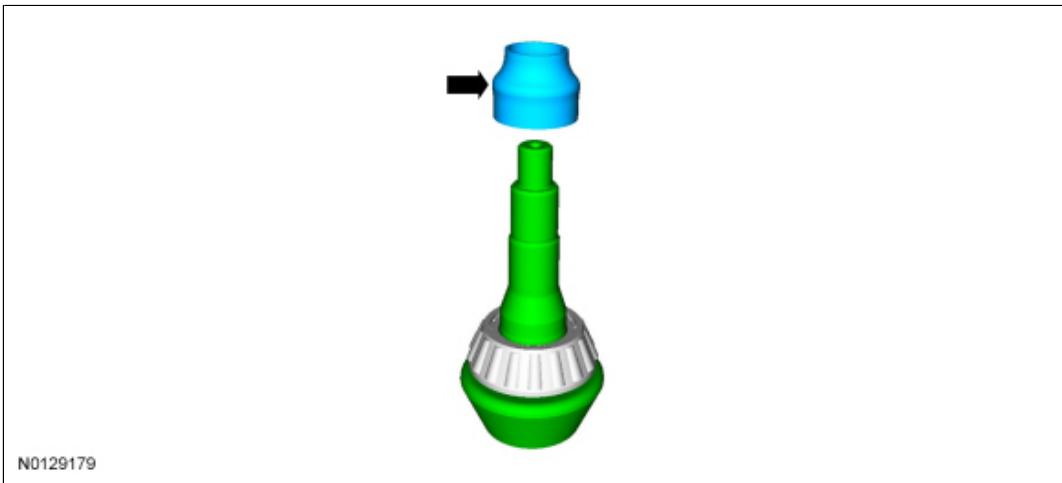
1. Remove the drive pinion seal. Refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.
2. Remove the differential carrier assembly. Refer to [Differential Carrier](#) in this section.
3. Remove the drive pinion shaft oil slinger.



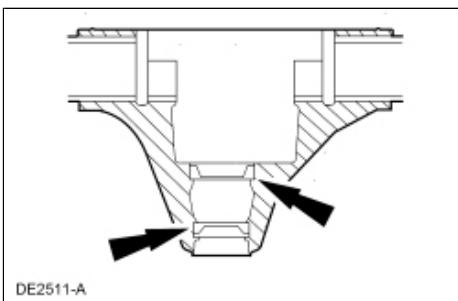
4. Install the Drive Pinion Thread Protector, then use a soft-faced hammer to drive the pinion gear out of the outer drive pinion bearing and remove the pinion gear.



5. Remove and discard the drive pinion collapsible spacer.

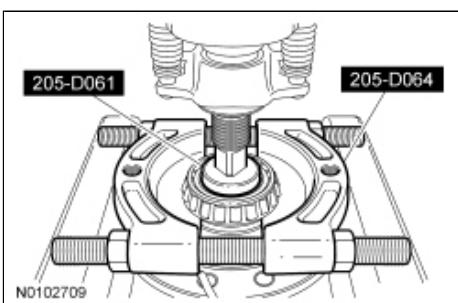


- Using a brass drift, remove the 2 drive pinion bearing cups by tapping alternately on opposite sides of the 2 drive pinion bearing cups.



#### **Electronic Locking Differential (ELD) equipped vehicles**

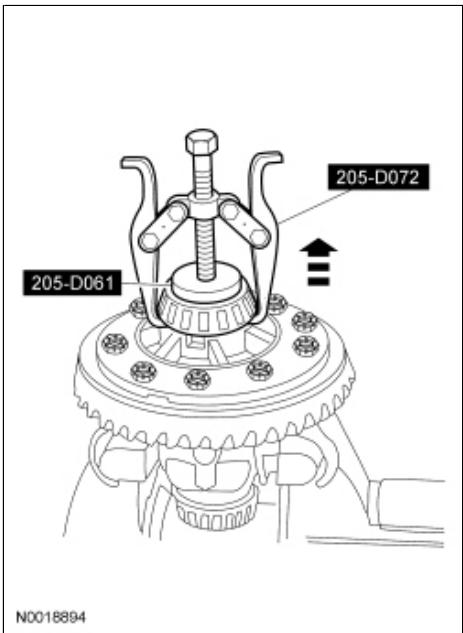
- Using the Bearing Puller plate, Step Plate and a suitable press, remove the LH differential bearing.



- Using the 2 Jaw Puller and Step Plate, remove the RH differential bearing.

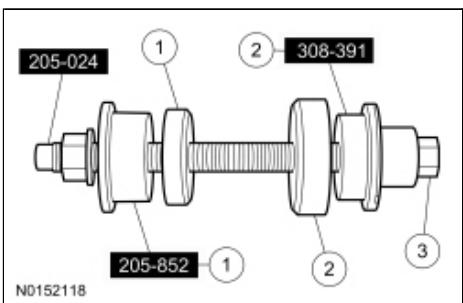
#### **Non-ELD equipped vehicles**

- Remove the 2 differential bearings with the 2 Jaw Puller and Step Plate.

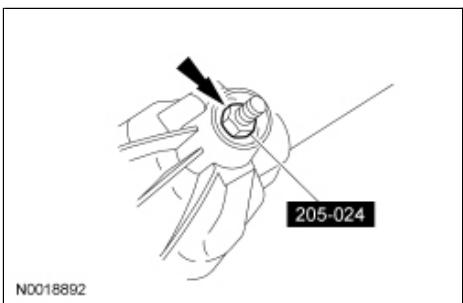


## Installation

1. Position the Drive Pinion Bearing Cup Installer and the inner and outer drive pinion bearing cups in their respective bores.
  1. Place the Rear Axle Pinion Bearing Cup Installer on the outer drive pinion bearing cup.
  2. Place the Rear Axle Pinion Bearing Cup Installer on the inner drive pinion bearing cup.
  3. Install the Drive Pinion Bearing Cup Installer.

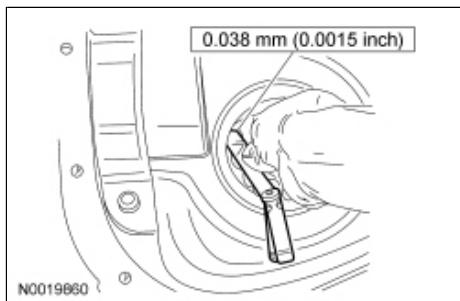


2. Tighten the Drive Pinion Bearing Cup Installer to fully seat the 2 differential drive pinion bearing cups.



3. **NOTE:** If a feeler gauge of the specification shown can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not correctly seated.

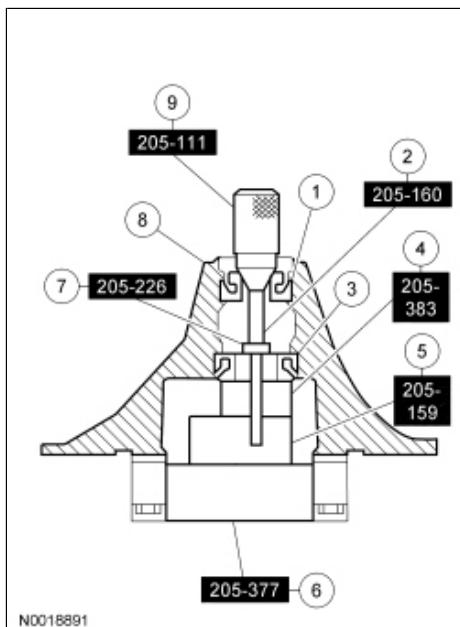
Make sure the differential pinion bearing cups are correctly seated.



4. **NOTICE:** Use the same drive pinion bearings and the drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly or damage to the component may occur.

**NOTE:** Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

Install the new drive pinion bearings and Adapters as shown.



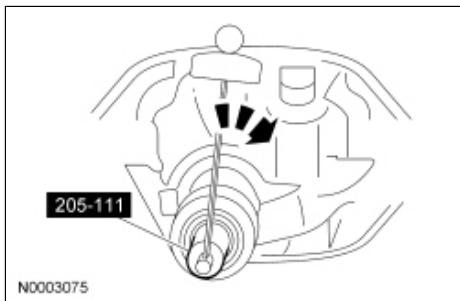
Item	Part Number	Description
1	4621	Outer pinion bearing
2	205-160	Adapter for 205-S127
3	4630	Inner pinion bearing
4	205-383	Depth Gauge/Aligner, Drive Pinion
5	205-159	Adapter for 205-S127

6	205-377	Drive Pinion Gauge Tube
7	205-226	Depth Gauge/Aligner, Drive Pinion
8	4010	Rear axle housing outer (front) pinion bearing
9	205-111	Adapter for 205-S127

5. **NOTE:** This step duplicates final drive pinion bearing preload.

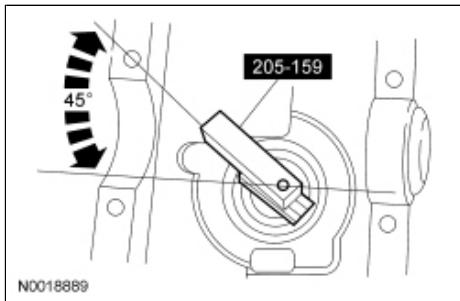
Tighten the Adapter.

- Tighten to 2.2 Nm (20 lb-in).



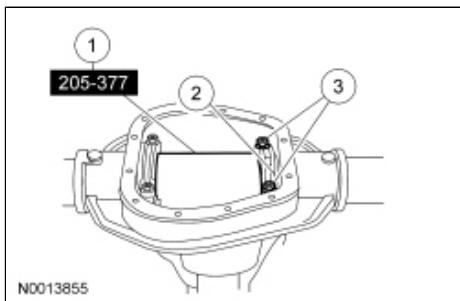
6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings.



7. Install the Drive Pinion Gauge Tube.

1. Position the Drive Pinion Gauge Tube.
2. Install the 2 differential bearing caps.
3. Install the 4 differential bearing cap bolts.
  - Tighten to 105 Nm (77 lb-ft).

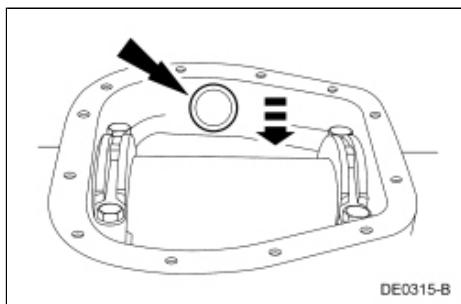


8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

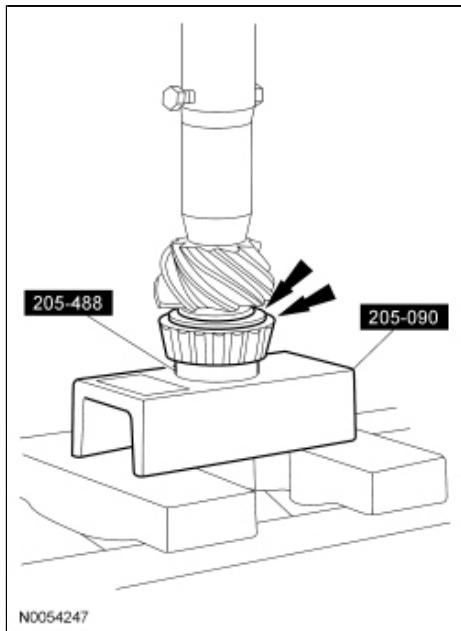
**NOTE:** A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the gauge block and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required, which results in a deep tooth contact in the final assembly of integral axle assemblies.

Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.

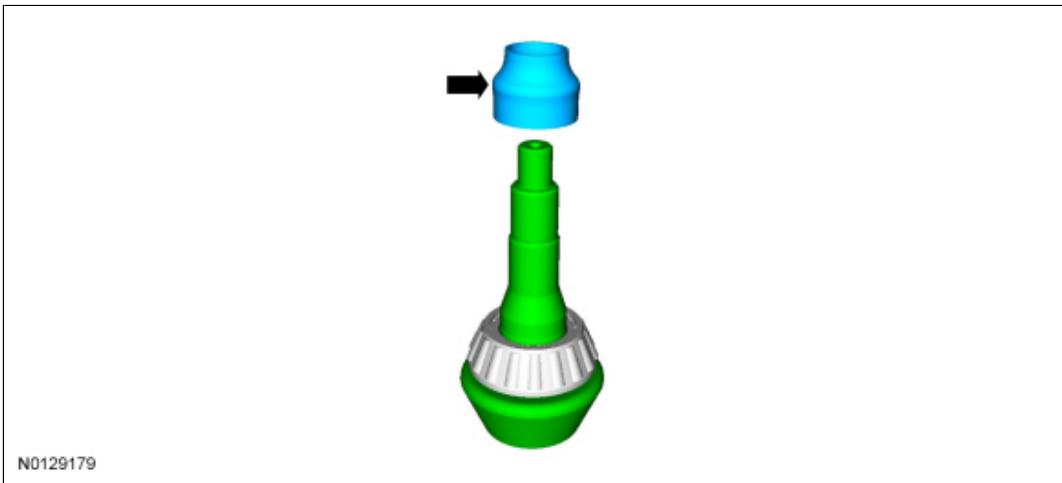
- After the correct drive pinion bearing adjustment shim thickness has been determined, remove the Adapters.



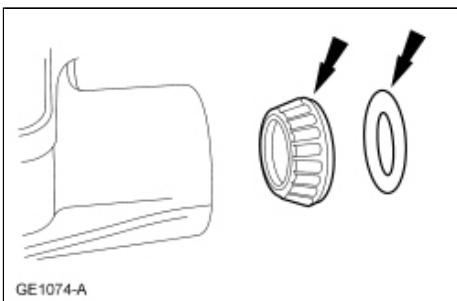
9. Using the Bearing/Oil Seal Plate and Drive Pinion Bearing Cone Installer, press the drive pinion bearing and selected drive pinion bearing adjustment shim until they are firmly seated on the pinion gear.



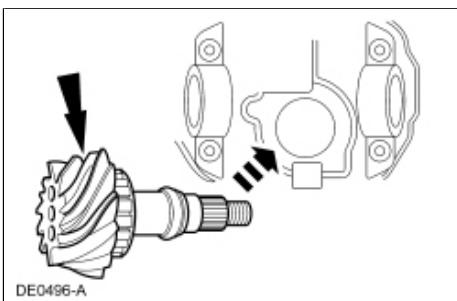
10. Place a new drive pinion collapsible spacer on the pinion gear against the pinion gear shoulder.



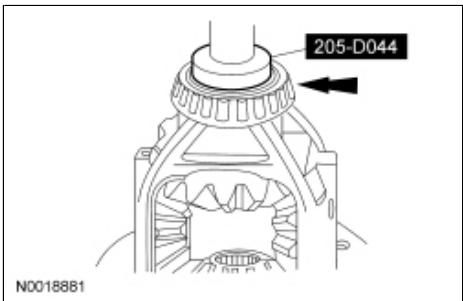
11. Install the outer drive pinion bearing and drive pinion shaft oil slinger.



12. Lubricate the pinion flange splines with grease.
13. Install the pinion gear in the pinion gear bore from inside the axle housing.



14. Using the Differential Carrier Bearing Installer, press the LH and RH differential bearing on the differential assembly.



15. Install the differential carrier. Refer to [Differential Carrier](#) in this section.
  16. Install the drive pinion seal and flange. Refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.
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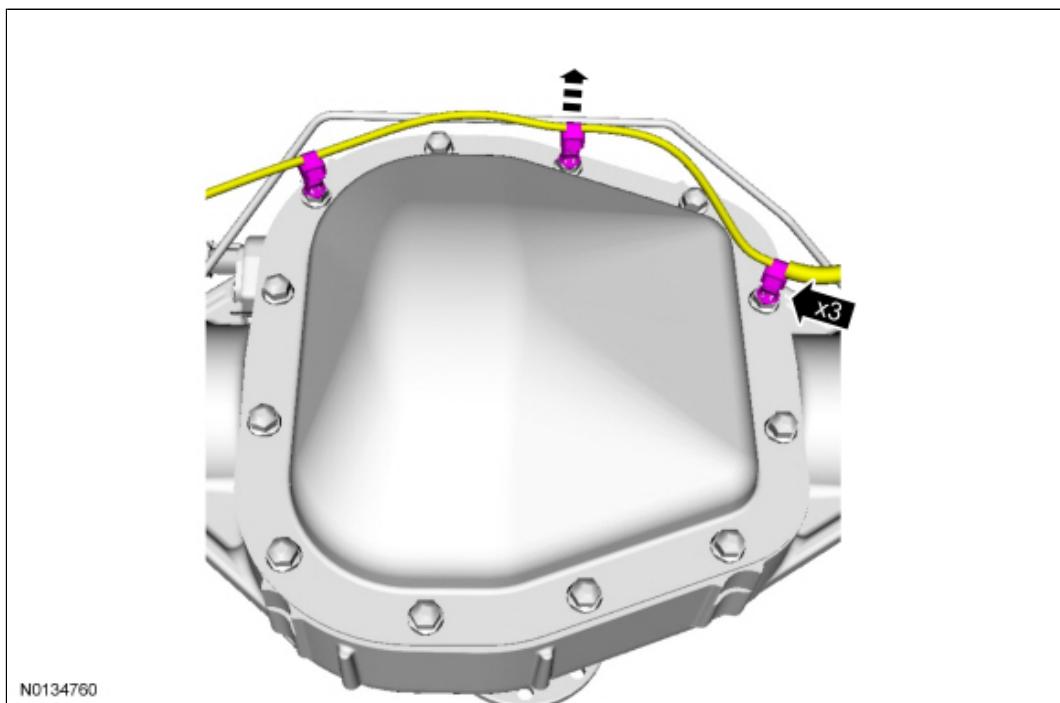
## Differential Housing Cover

### Material

Item	Specification
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY- 75W140-1L (Canada)	WSL-M2C192-A and GL-5
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

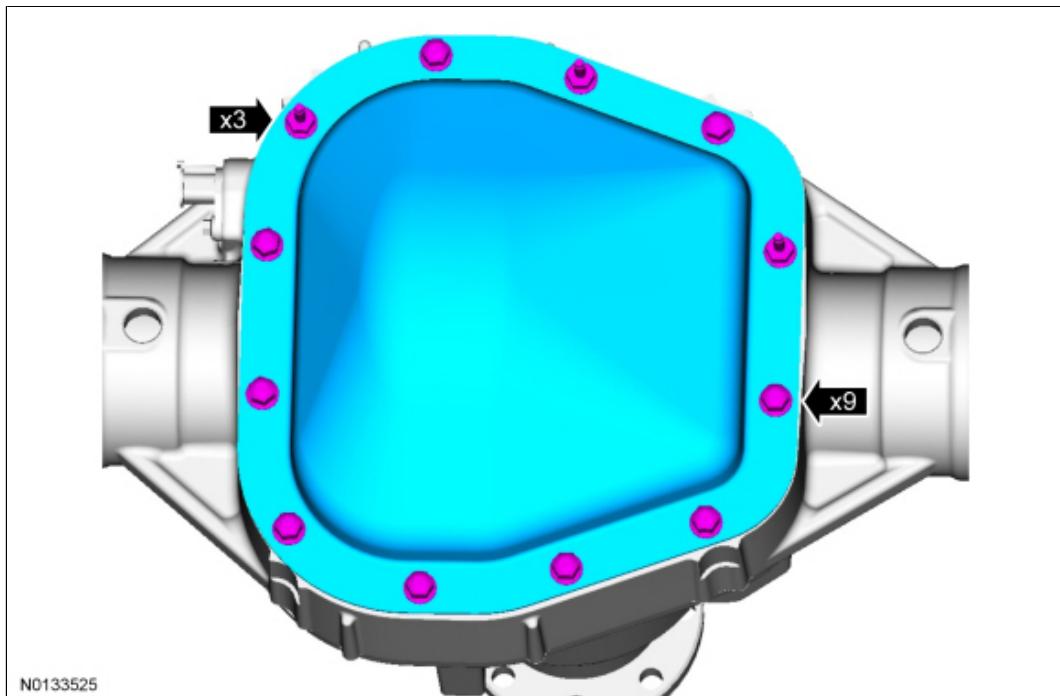
### Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Separate the 3 brake tube fasteners from the differential housing cover stud bolts.



3. Remove the differential housing cover.
  1. Remove the 9 differential housing cover bolts and the 3 differential housing cover stud bolts, and drain the lubricant from the axle housing.

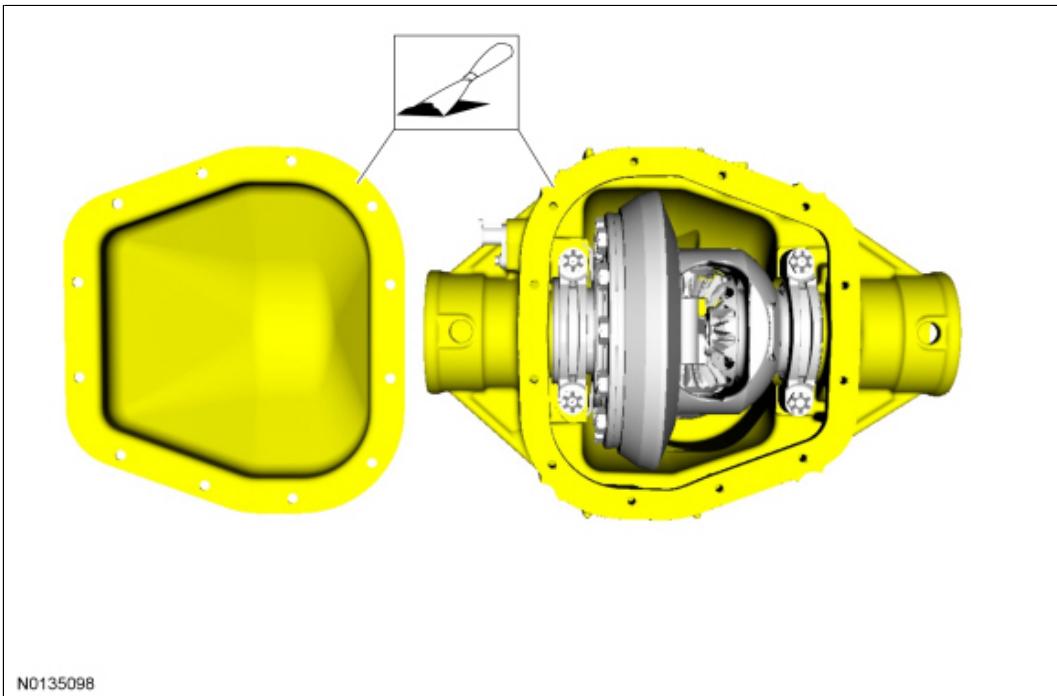
2. Remove the differential housing cover.



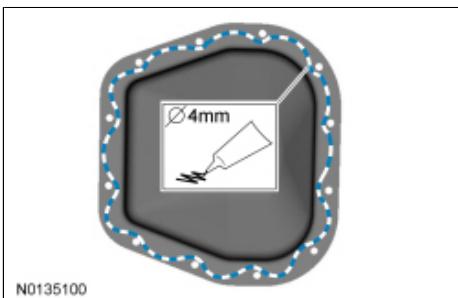
## Installation

1. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

Clean the gasket mating surface of the axle and the differential housing cover.



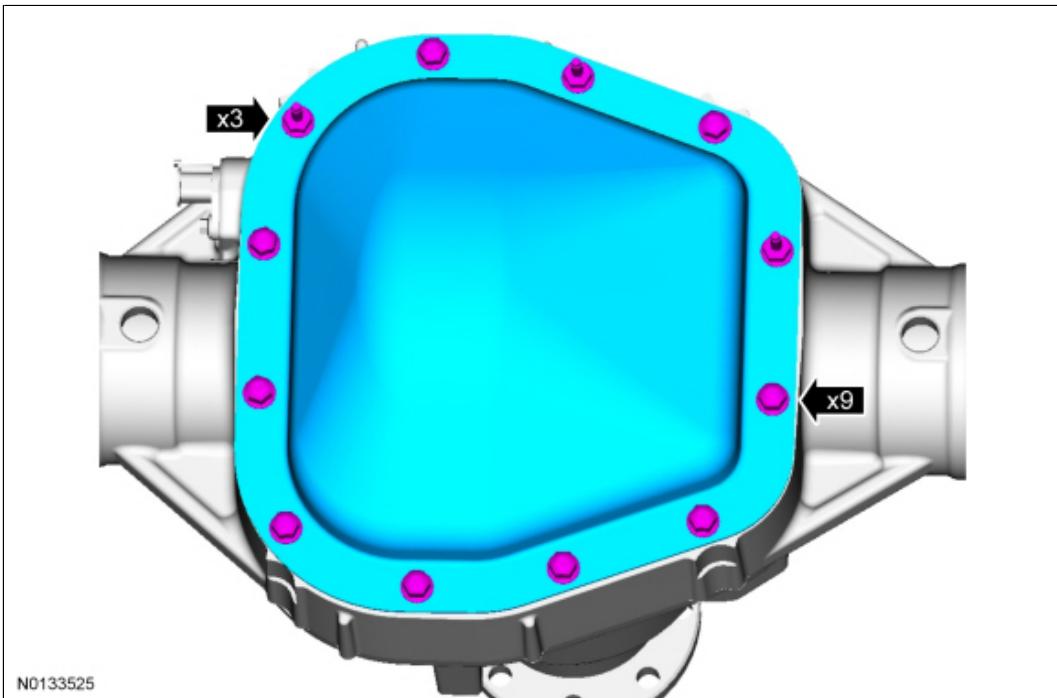
2. Apply a new, continuous bead of sealant to the differential housing cover as shown.



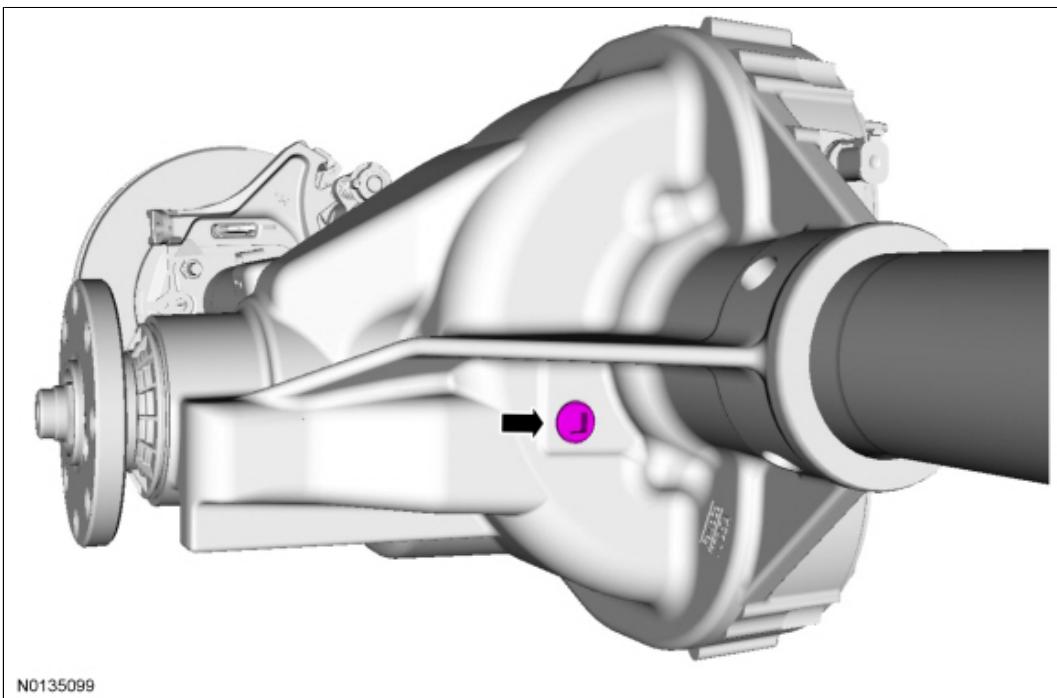
3. **NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

Install the differential housing cover and the 9 differential housing cover bolts and the 3 differential housing cover stud bolts.

- Tighten to 45 Nm (33 lb-ft).



4. Remove the fill plug.



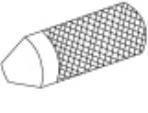
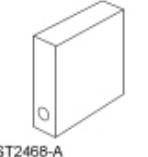
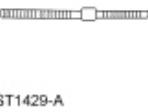
5. **NOTE:** If equipped with Traction-Lok axles, first fill the axle with 118 ml (4 oz) of friction modifier. No friction modifier is used on Electronic Locking Differential (ELD) axles.

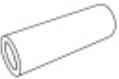
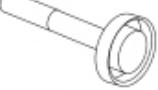
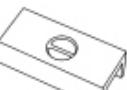
Fill the axle with the specified amount of axle lubricant and install the fill plug.

- Tighten to 30 Nm (22 lb-ft).
-

## Differential Ring And Pinion

### Special Tool(s)

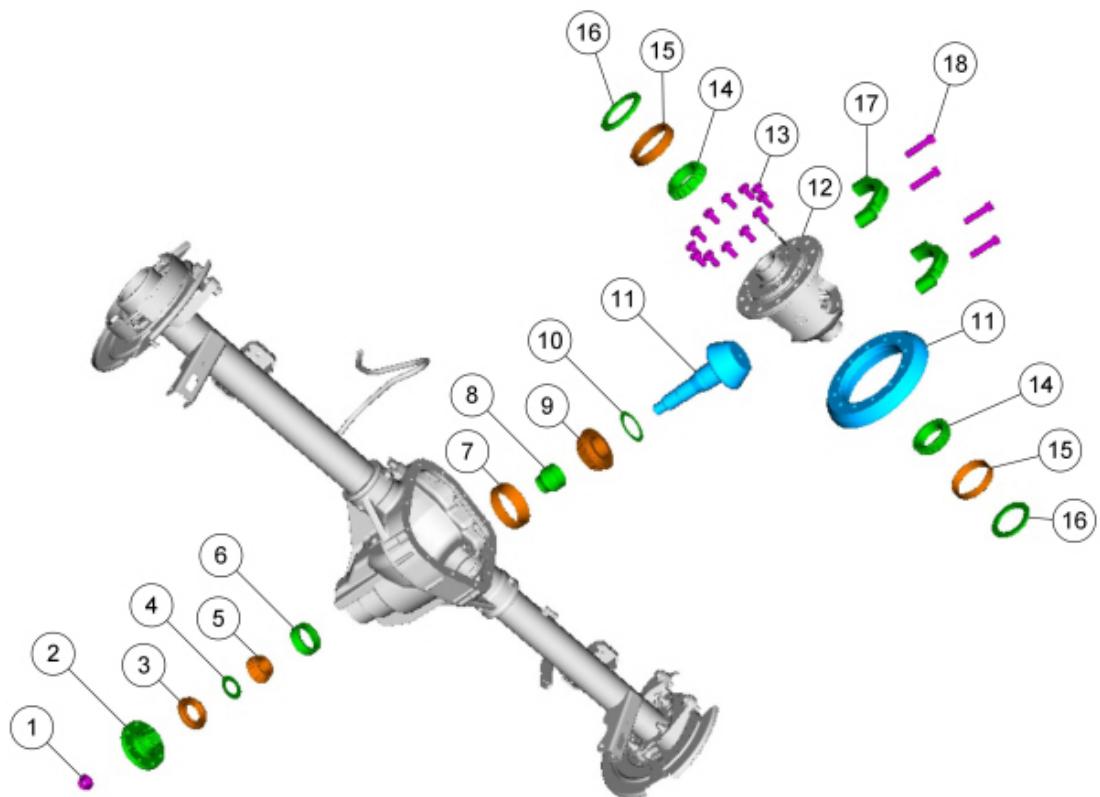
 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST2468-A	Adapter for 205-S156 205-159 (T80T-4020-F42)
 ST1429-A	Adapter for 205-S156 205-160 (T80T-4020-F43)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-937 (TKIT-2009C-F)
 ST1743-A	Depth Gauge/Aligner, Drive Pinion 205-383 (T97T-4020-B)
	Gauge Tube, Drive Pinion 205-377 (T97T-4020-A)

	ST1434-A
	ST2473-A Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
	ST1367-A Installer, Drive Pinion Bearing Cone 205-488
	ST1678-A Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
	ST2368-A Installer, Input Shaft Bearing Cup 308-391
	ST1741-A Installer, Rear Axle Pinion Bearing Cup 205-852
	ST1254-A Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
	ST1744-A Protector, Drive Pinion Thread 205-229 (T85T-4209-AH)
	Puller, Bearing 205-D064 (D84L-1123-A)

 ST1368-A	
 ST1725-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent

#### Material

Item	Specification
Maximum Strength Retaining Compound Loctite® 638™	—
Motorcraft® Premium Long-Life Grease XG-1-C (US); CXG-1-C (Canada)	ESA-M1C75-B



N0129177

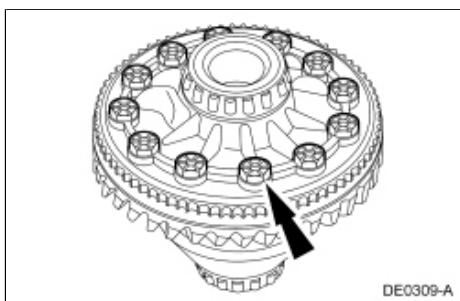
Item	Part Number	Description
1	4C121	Drive pinion nut (part of 4320)
2	4851	Drive pinion flange
3	4676	Drive pinion oil seal
4	4670	Pinion oil slinger
5	4621	Outer pinion bearing
6	—	Outer pinion bearing cup (part of 4621)
7	—	Inner pinion bearing cup (part of 4630)
8	4662	Collapsible spacer (part of 4320)

9	4630	Inner pinion bearing
10	4663	Pinion bearing adjustment shim
11	4209	Drive pinion and ring gear
12	4204	Differential assembly
13	4216	Differential ring gear bolt (12 required)
14	4220	Differential carrier bearings (2 required)
15	—	Differential carrier bearing cups (part of 4220)
16	4067	Differential carrier bearing shims (2 required)
17	—	Differential bearing cap (part of 4010) (2 required)
18	46108	Differential bearing cap bolts (part of 4010) (4 required)

## Removal

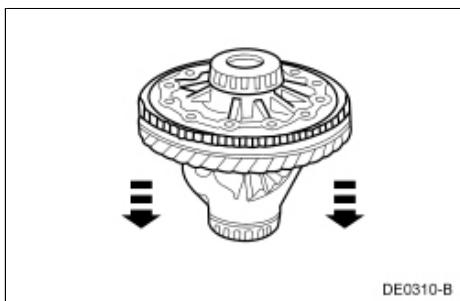
### All vehicles

1. Remove the drive pinion flange seal. For additional information, refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.
2. Remove the differential carrier assembly. For additional information, refer to [Differential Carrier](#) in this section.
3. Remove and discard the 12 ring gear bolts.



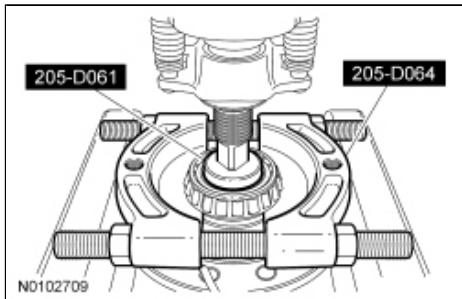
4. **NOTE:** Do not damage the ring gear bolt hole threads.

Insert a punch in the ring gear bolt holes and drive the differential ring gear off.

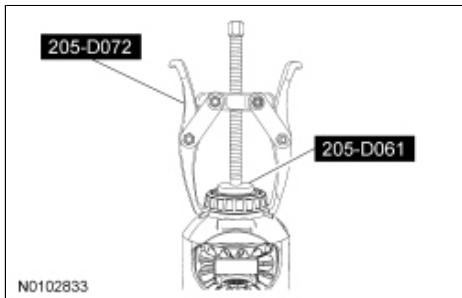


### **Electronic Locking Differential (ELD) equipped vehicles**

5. Using the Bearing Puller plate, Step Plate and a suitable press, remove the LH differential bearing.

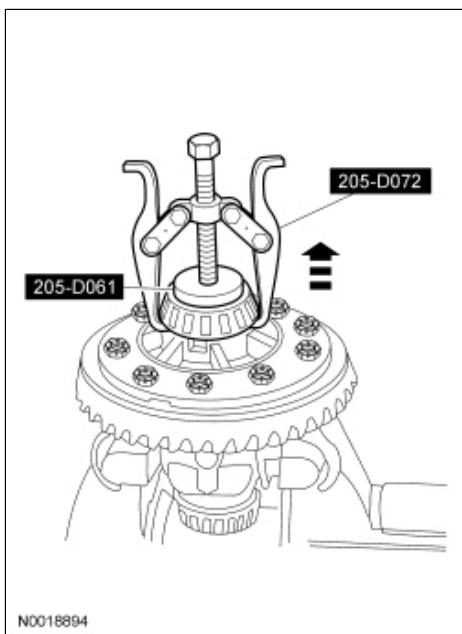


6. Using the 2 Jaw Puller and Step Plate, remove the RH differential bearing.



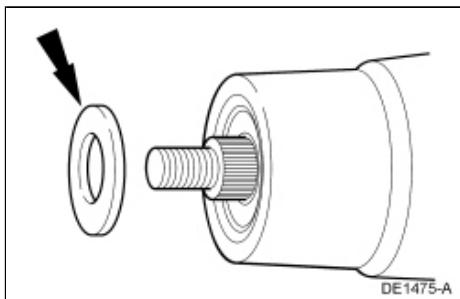
### **Non- ELD equipped vehicles**

7. Remove the 2 differential bearings with the 2 Jaw Puller and Step Plate.

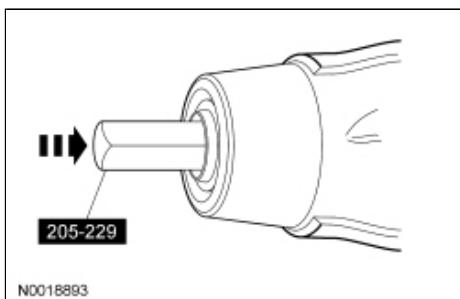


## All Vehicles

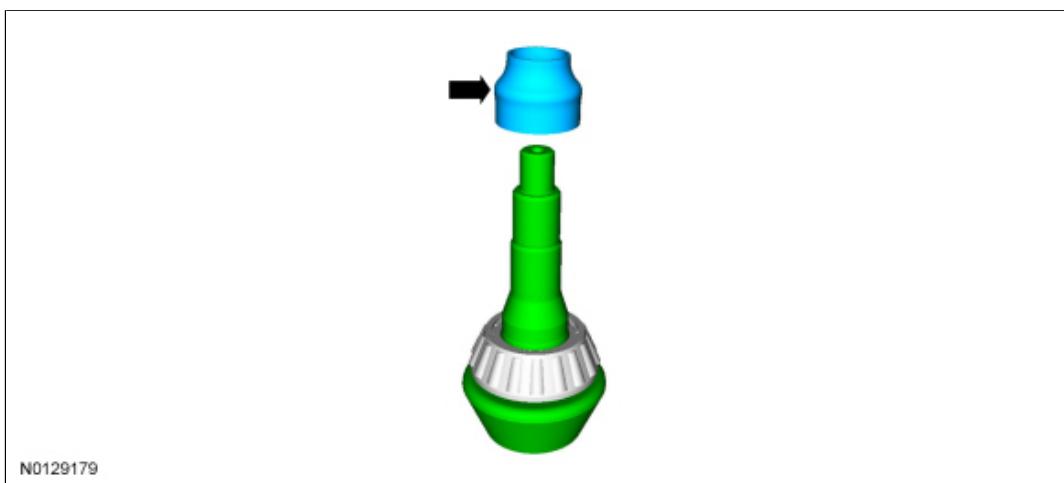
8. Remove the drive pinion shaft oil slinger.



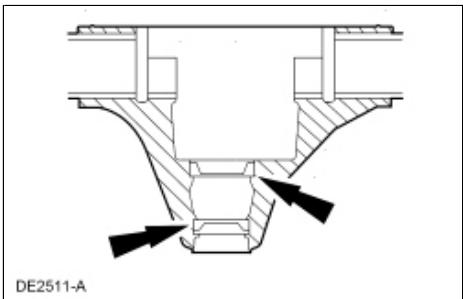
9. Install the Drive Pinion Thread Protector, then use a soft-faced hammer to drive the pinion gear out of the outer drive pinion bearing and remove the pinion gear.



10. Remove and discard the drive pinion collapsible spacer.



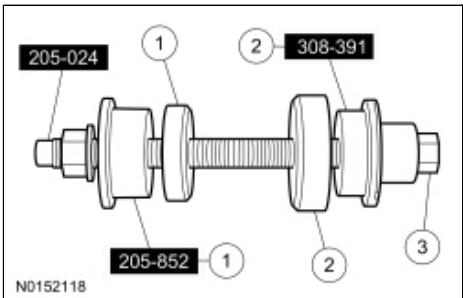
11. Using a brass drift, remove the 2 drive pinion bearing cups by tapping alternately on opposite sides of the 2 drive pinion bearing cups.



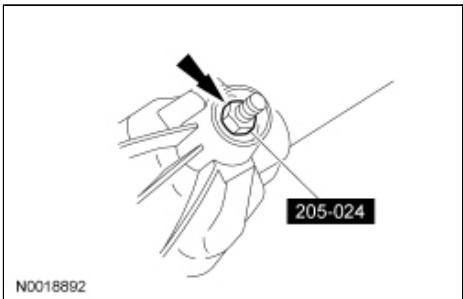
## Installation

### All vehicles

1. Position the Drive Pinion Bearing Cup Installer and the inner and outer drive pinion bearing cups in their respective bores.
  1. Place the Rear Axle Pinion Bearing Cup Installer on the outer drive pinion bearing cup.
  2. Place the Rear Axle Pinion Bearing Cup Installer on the inner drive pinion bearing cup.
  3. Install the Drive Pinion Bearing Cup Installer.

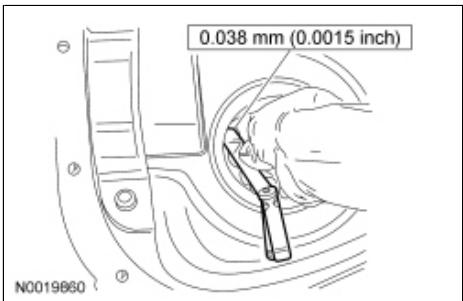


2. Tighten the Drive Pinion Bearing Cup Installer to fully seat the 2 differential drive pinion bearing cups.



3. **NOTE:** If a feeler gauge of the specification shown can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not correctly seated.

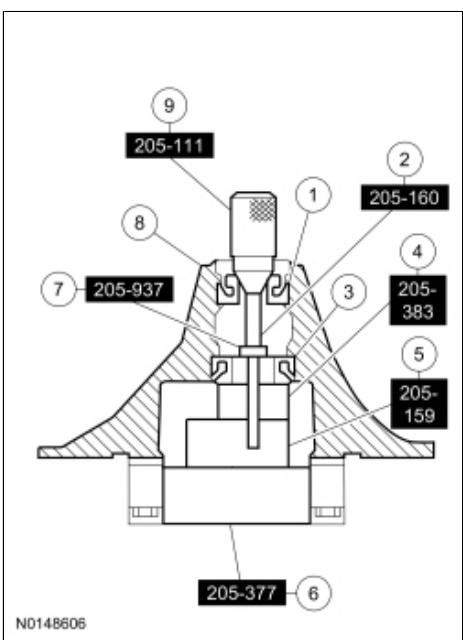
Make sure the differential pinion bearing cups are correctly seated.



4. **NOTICE:** Use the same drive pinion bearings and the drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly or damage to the component may occur.

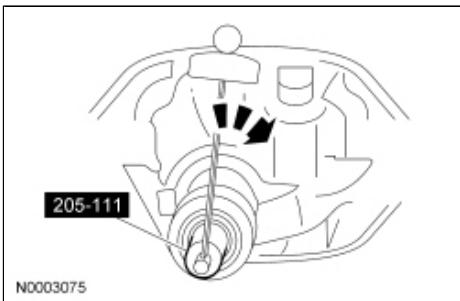
**NOTE:** Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

Install the new drive pinion bearings and Adapters as shown.



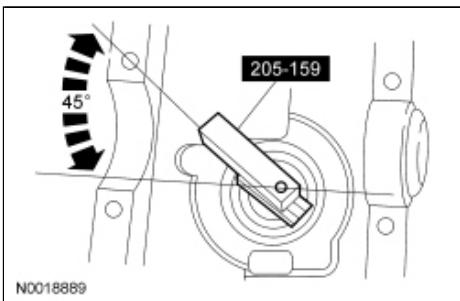
Item	Part Number	Description
1	4621	Outer pinion bearing
2	205-160	Adapter for 205-S127
3	4630	Inner pinion bearing
4	205-383	Depth Gauge/Aligner, Drive Pinion
5	205-159	Adapter for 205-S127
6	205-377	Drive Pinion Gauge Tube
7	205-937	Depth Gauge/Aligner, Drive Pinion
8	4010	Rear axle housing outer (front) pinion bearing

5. Tighten the Adapter to the specified rotational torque.
  - Tighten to 2.2 Nm (20 lb-in).

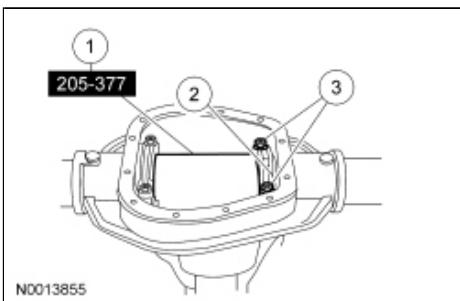


6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings.



7. Install the Drive Pinion Gauge Tube.
  1. Position the Drive Pinion Gauge Tube.
  2. Install the 2 differential bearing caps.
  3. Install the 4 differential bearing cap bolts.
    - Tighten to 105 Nm (77 lb-ft).



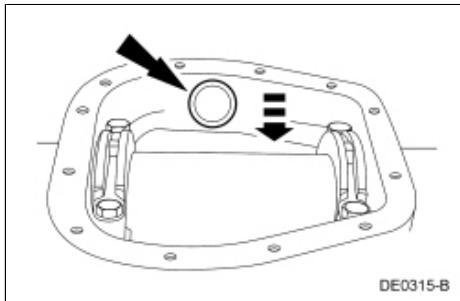
8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

**NOTE:** A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the gauge block and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required,

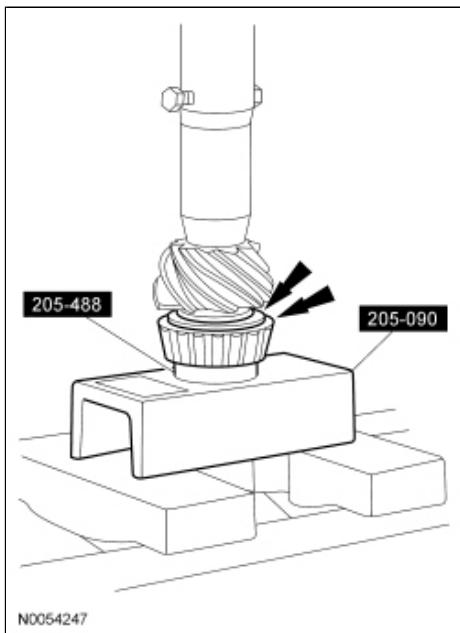
which results in a deep tooth contact in the final assembly of integral axle assemblies.

Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.

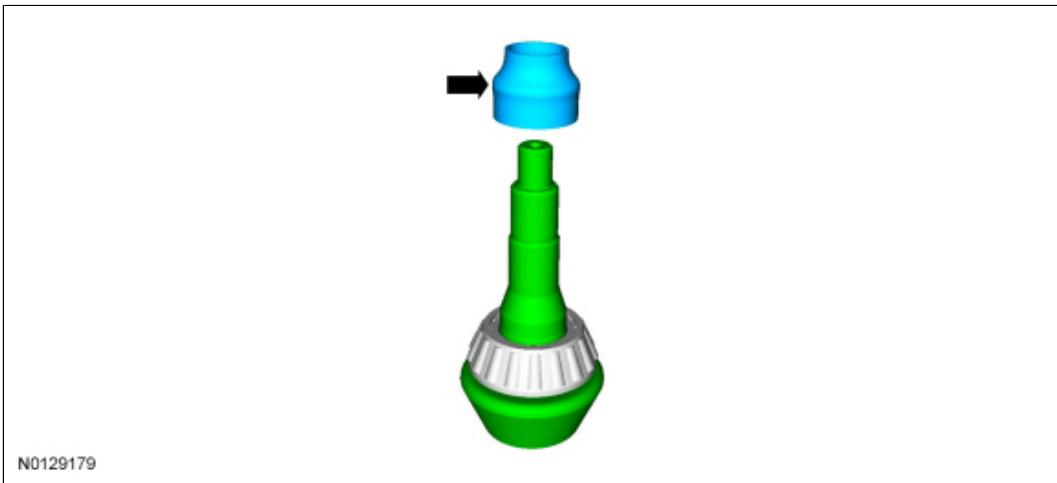
- After the correct drive pinion bearing adjustment shim thickness has been determined, remove the Adapters.



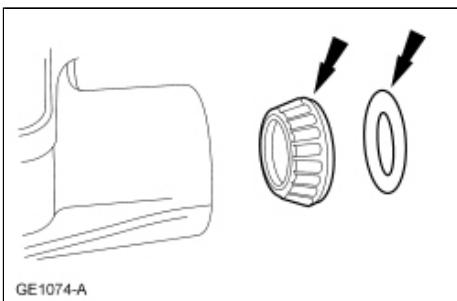
9. Using the Bearing/Oil Seal Plate and Drive Pinion Bearing Cone Installer, press the drive pinion bearing and selected drive pinion bearing adjustment shim until they are firmly seated on the pinion gear.



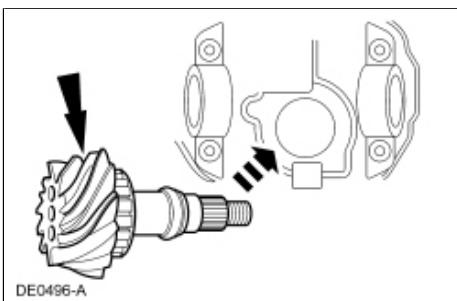
10. Place a new drive pinion collapsible spacer on the pinion gear against the pinion gear shoulder.



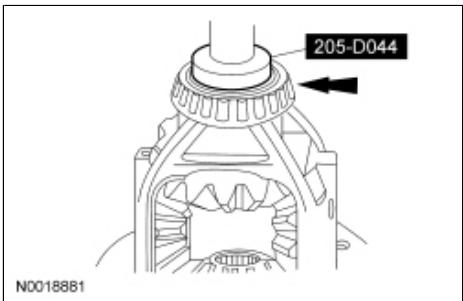
11. Install the outer drive pinion bearing and drive pinion shaft oil slinger.



12. Lubricate the pinion flange splines with grease.
13. Install the pinion gear in the pinion gear bore from inside the axle housing.



14. Install the drive pinion seal and flange. For additional information, refer to [Drive Pinion Flange and Drive Pinion Seal](#) in this section.
15. Using the Differential Carrier Bearing Installer, press the LH and RH differential bearing on the differential assembly.



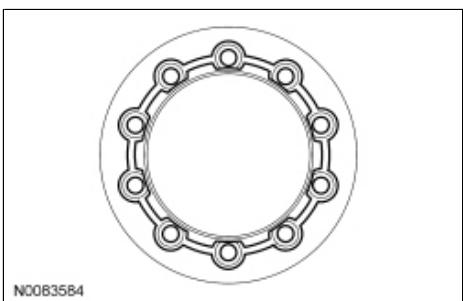
**Electronic Locking Differential (ELD) equipped vehicles and all vehicles equipped with 3.55, 3.73, and 4.10 ratio gear sets**

16. **NOTE:** The differential flange and ring gear flange must be free of any old retaining compound material. Make sure both surfaces are clean and free of oil, dust and debris. Failure to clean the surfaces can result in ring gear runout concerns.

Clean all traces of the old retaining compound material from the differential flange.

- Use solvent and Scotch-Brite® pads to remove.

17. Apply a one-eighth inch bead of maximum strength retaining compound on the rear face of the ring gear in the pattern shown.

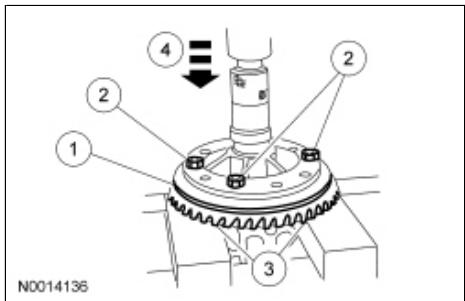


**All vehicles**

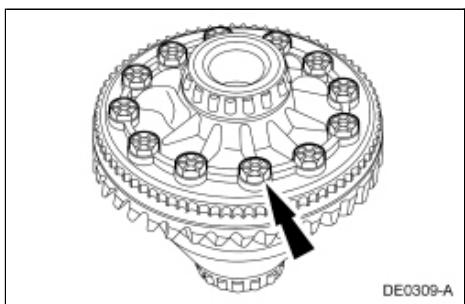
18. **NOTE:** If removed, press the speed sensor ring on with the differential ring gear.

Install the differential ring gear.

1. Place the differential ring gear on the differential assembly.
2. Hand-start 3 new ring gear bolts to align the holes in the differential ring gear and the differential assembly.
3. Place the differential assembly and differential ring gear onto the press bed blocks with the differential ring gear teeth facing downward.
4. Press the differential ring gear into place.



19. Install the remaining 9 new differential ring gear bolts.
  - Tighten to 150 Nm (111 lb-ft).



20. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
-

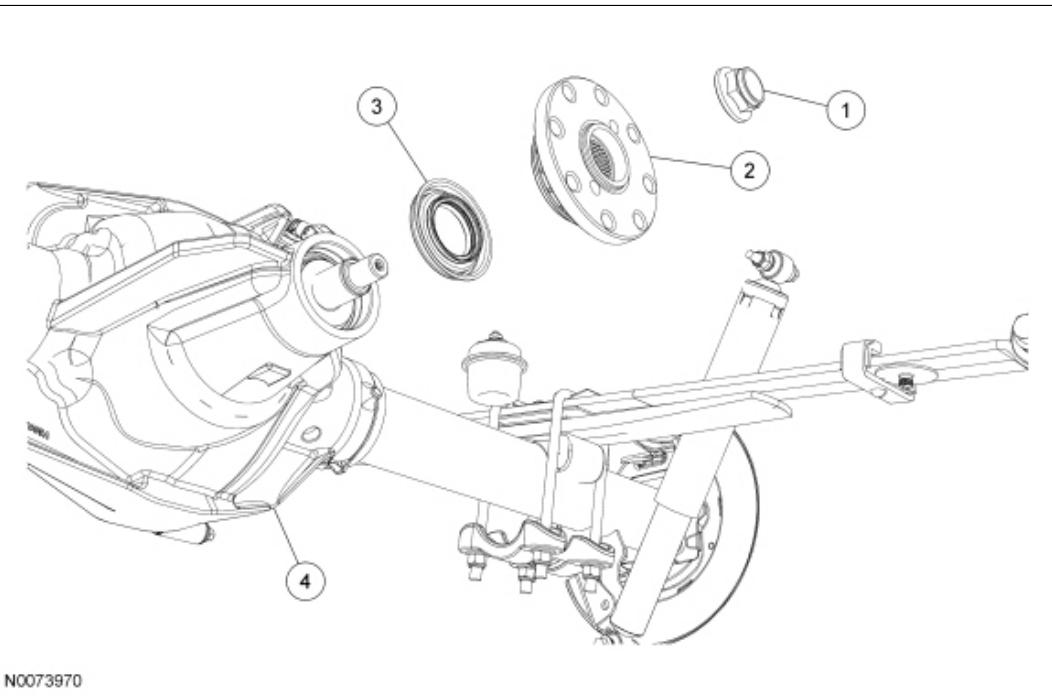
## Drive Pinion Flange and Drive Pinion Seal

### Special Tool(s)

 ST2026-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
	Installer, Drive Pinion Flange 205-233 (T85T-4851-AH)
 ST1325-A	Installer, Drive Pinion Oil Seal 205-208 (T83T-4676-A)

### Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Motorcraft® Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



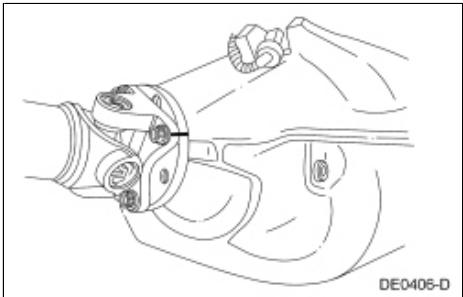
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Item	Part Number	Description
1	4320	Drive pinion nut
2	4851	Drive pinion flange
3	4676	Drive pinion oil seal
4	4010	Differential housing

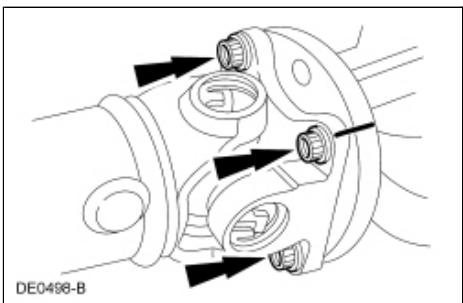
### Removal

**NOTICE:** The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the brake disc. For additional information, refer to [Section 206-04](#).
3. Index-mark the driveshaft flange and pinion flange for correct alignment during installation.



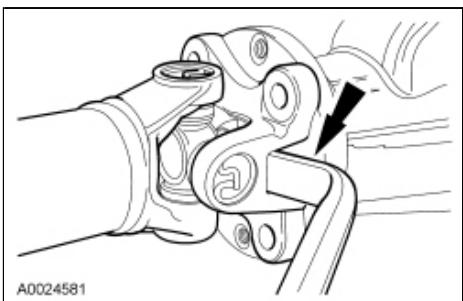
4. Remove the 4 driveshaft flange bolts.



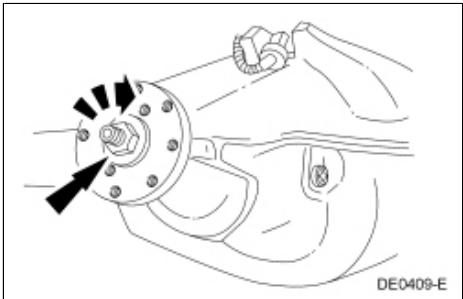
5. **NOTE:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft centering socket yoke from the pinion flange. Pry only in the area shown with a suitable tool to disconnect the driveshaft centering socket yoke from the pinion flange.

Using a suitable tool as shown, disconnect the driveshaft centering socket yoke from the pinion flange.

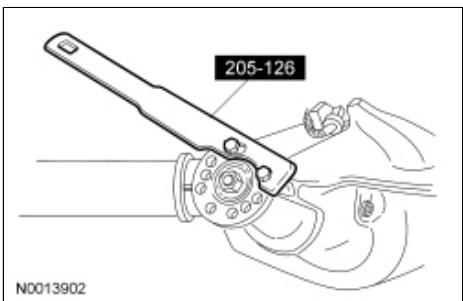
- Using mechanic's wire, position the driveshaft aside.



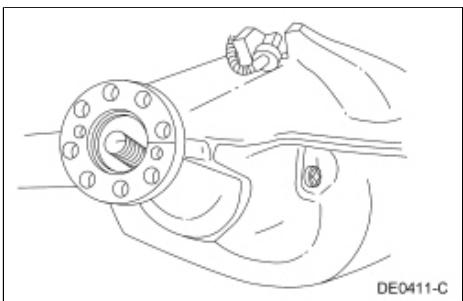
6. Using a Nm (lb-in) torque wrench on the pinion nut, record the torque required to maintain rotation of the pinion gear through several revolutions.



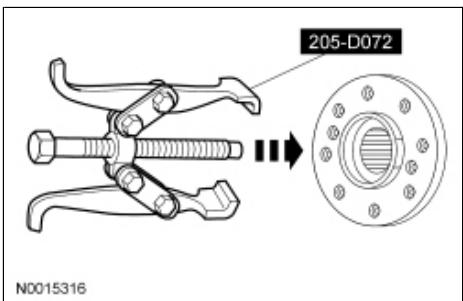
7. Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, remove and discard the pinion nut.



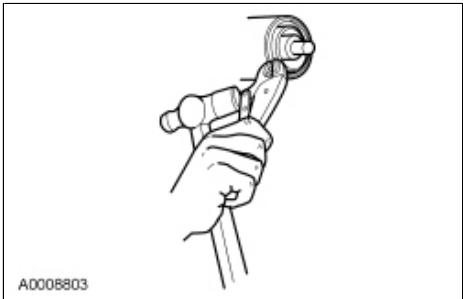
8. Index-mark the pinion flange in relation to the drive pinion stem to make sure of correct alignment during installation.



9. Using the 2 Jaw Puller, remove the pinion flange.

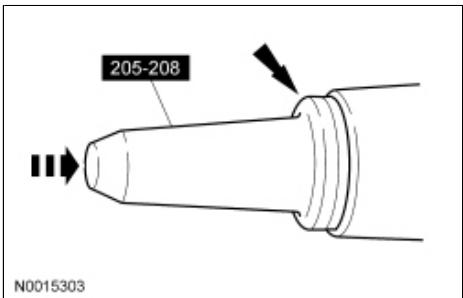


10. Force up on the metal flange of the drive pinion seal. Install gripping pliers and strike with a hammer until the drive pinion seal is removed.



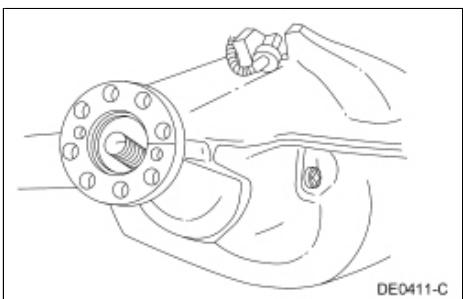
## Installation

1. Lubricate the new drive pinion seal with grease.
2. Using the Drive Pinion Oil Seal Installer, install a new drive pinion seal.

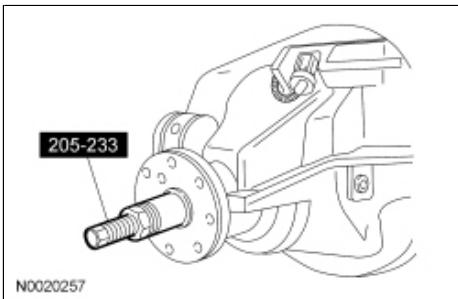


3. Lubricate the pinion flange splines with axle lubricant.
4. **NOTE:** Disregard the scribe marks if a new pinion flange is being installed.

Align the pinion flange with the drive pinion shaft.



5. Using the Drive Pinion Flange Installer, install the pinion flange.

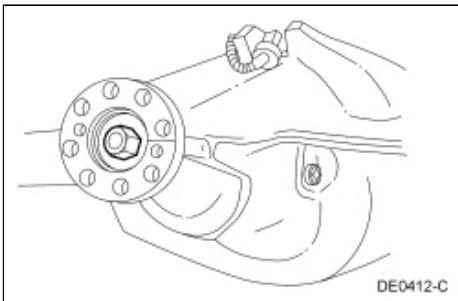


6. **NOTICE:** Install a new pinion nut with the same color as the original if not replacing the collapsible spacer. If a new collapsible spacer is installed, install the nut in the kit, as indicated in the chart below, or damage to the component may occur.

Position the new pinion nut.

#### 9.75 Inch Drive Pinion Nut

Part Number	Color Description	Application
19G405	Green	Axles built before 7/16/07
4320	White	Axles built after 7/16/07
4C121	White	Kit with spacer for all 9.75-in axles

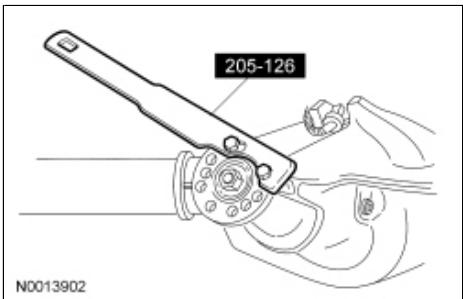


7. **NOTICE:** Under no circumstances is the pinion nut to be backed off to reduce drive pinion bearing preload. If reduced drive pinion bearing preload is required, a new drive pinion collapsible spacer and pinion nut must be installed or damage to the component may occur.

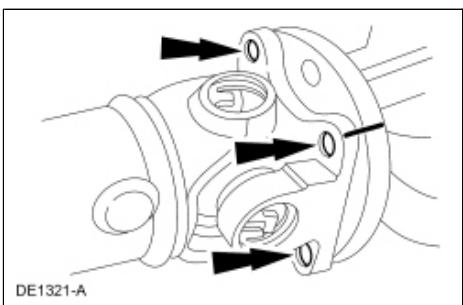
**NOTE:** Remove the Drive Pinion Flange Holding Fixture while taking drive pinion bearing preload readings with the Nm (lb-in) torque wrench.

Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, tighten the pinion nut.

- Rotate the drive pinion occasionally to make sure the drive pinion bearings are seating correctly.
- Install a Nm (lb-in) torque wrench on the pinion nut.
- Rotating the drive pinion through several revolutions, take frequent drive pinion bearing preload readings until the original recorded drive pinion bearing preload reading is obtained.
- If the original recorded drive pinion bearing preload is lower than specification, tighten to the appropriate specification for used drive pinion bearings. If the drive pinion bearing preload is higher than specification, tighten the pinion nut to the original reading as recorded. For additional information, refer to the Specification portion of this section.



- Position the driveshaft and align the index mark on the pinion flange.

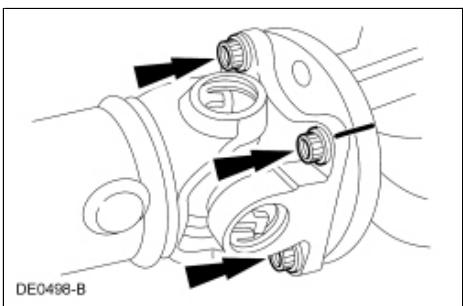


- NOTE:** The driveshaft centering socket yoke fits tightly on the pinion flange pilot. To make sure that the driveshaft centering socket yoke seats squarely on the pinion flange, tighten the driveshaft flange bolts evenly in a cross pattern.

**NOTE:** If new bolts are not available, coat the threads of the original driveshaft flange bolts with threadlock and sealer.

Install the 4 new driveshaft flange bolts.

- Tighten to 103 Nm (76 lb-ft).

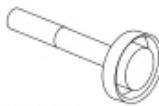


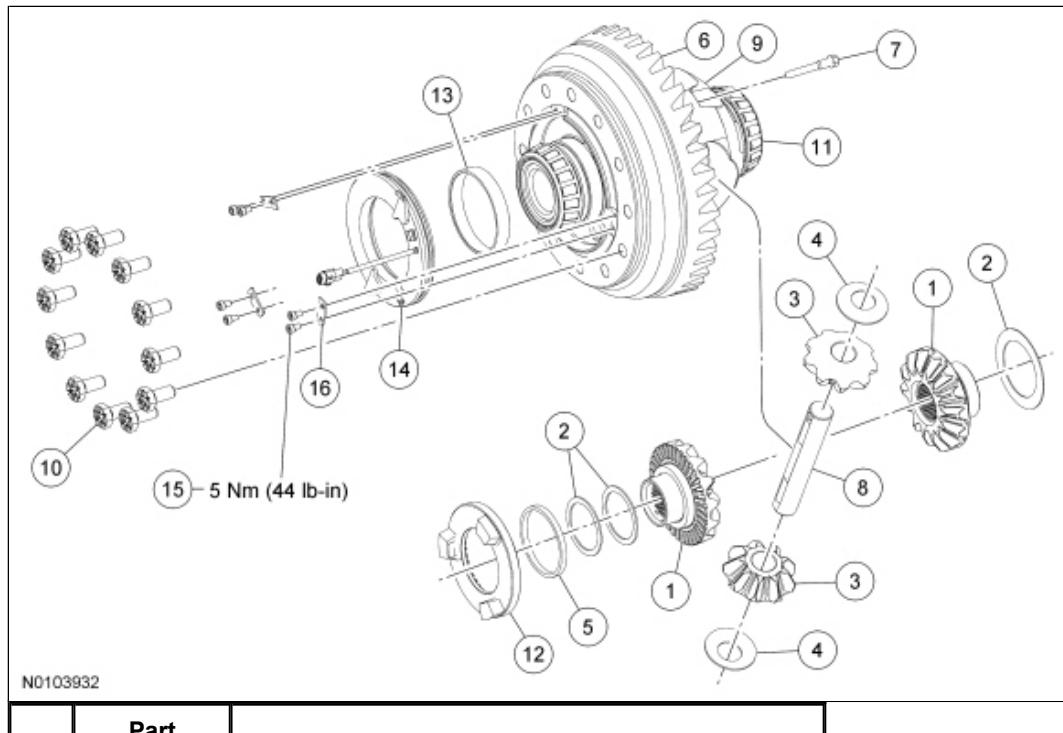
- Install the rear brake disc. For additional information, refer to [Section 206-04](#).



## Electronic Locking Differential (ELD) Field Coil

### Special Tool(s)

	Installer, Differential Carrier Bearing 205-D044 9D81T-4221-A) or equivalent  ST2473-A
	Puller, Bearing 205-D064 (D84L-1123-A)  ST1368-A
	Step Plate 205-D061 (D83T-4205-C2) or equivalent  ST1725-A

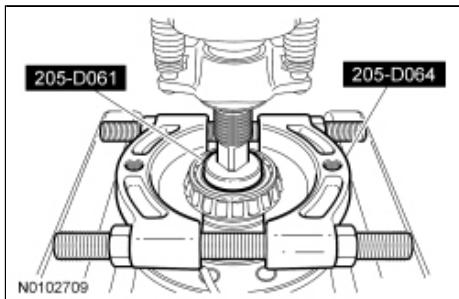


Part

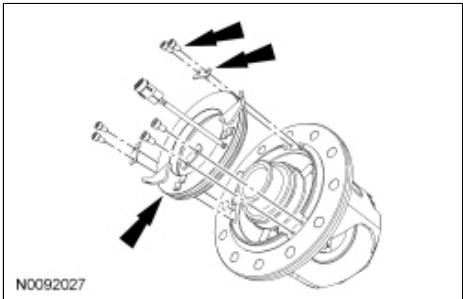
Item	Number	Description
1	—	Differential side gears (part of kit 4880)
2	—	Differential side gear thrust washers (part of kit 4880)
3	—	Differential pinion gears (part of kit 4880)
4	—	Differential pinion thrust washers (part of kit 4880)
5	—	Differential pinion spring (part of kit 4880)
6	4209	Differential ring gear
7	—	Differential pinion shaft lock bolt (part of kit 4880)
8	4211	Differential pinion shaft
9	4204	Differential case
10	4216	Differential ring gear bolt (12 required)
11	4221	Differential bearing
12	—	Cam-ring (part of kit 4880)
13	—	Plunger (part of kit 4880)
14	—	Electronic Locking Differential (ELD) coil (part of kit 4880)
15	—	<u>ELD</u> coil screw (part of kit 4880) (6 required)
16	—	Stopper (part of kit 4880) (3 required)

### Removal

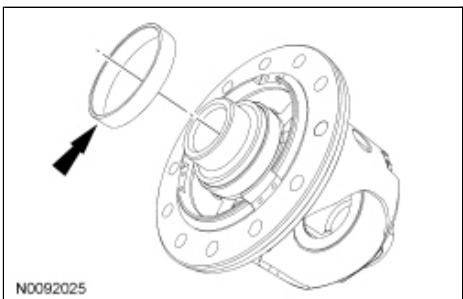
1. Remove the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
2. Using the Bearing Puller plate, Step Plate and a suitable press, remove the LH differential bearing.



3. Remove and discard the 6 screws and 3 stoppers that hold the Electronic Locking Differential (ELD) coil in place and remove the coil.

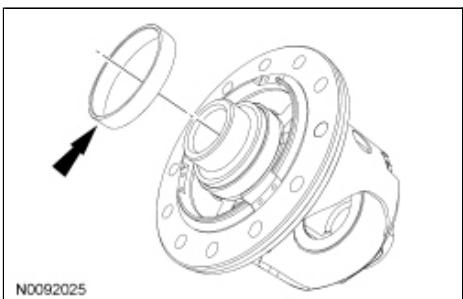


4. Remove and discard the plunger assembly.

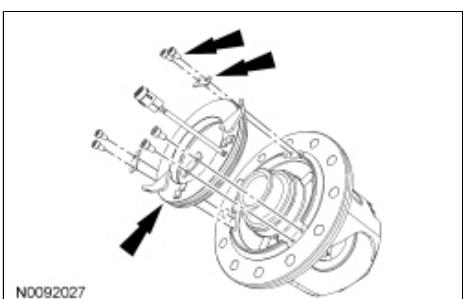


## Installation

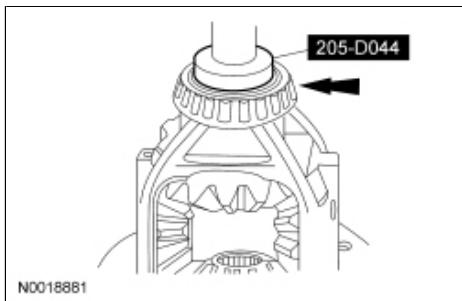
1. Install a new plunger assembly.



2. Install the new ELD coil, 3 stoppers and 6 screws that hold the coil in place.
  - Tighten to 5 Nm (44 lb-in).



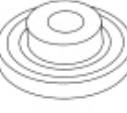
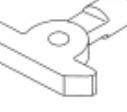
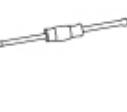
3. Use the Differential Carrier Bearing Installer to install the LH differential bearing.



4. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
-

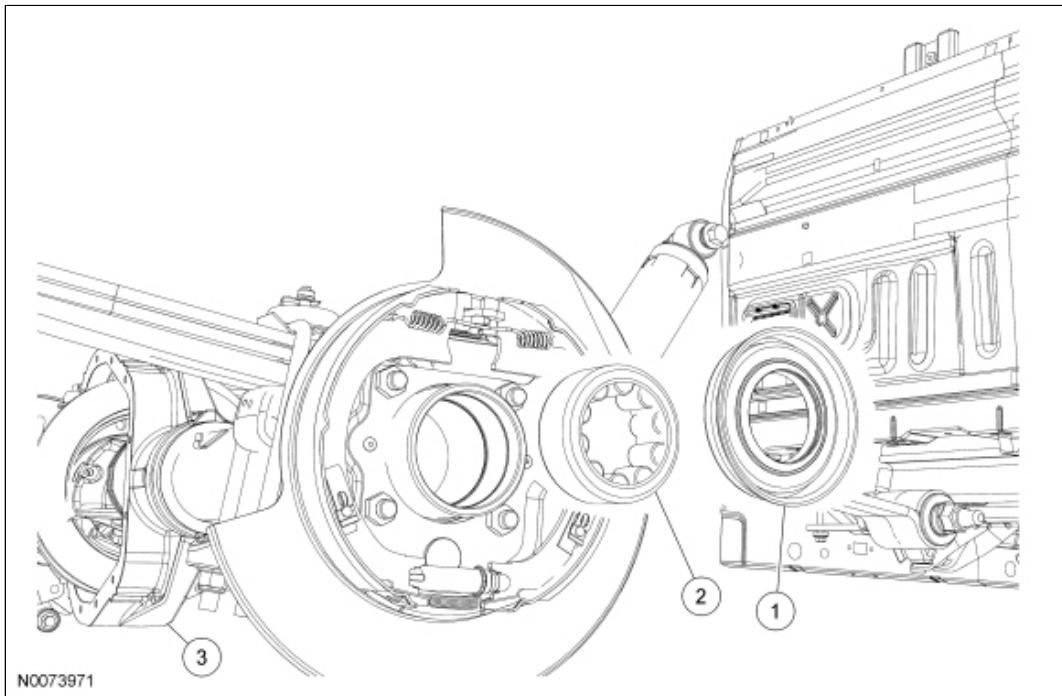
## Rear Wheel Bearing and Axle Shaft Seal

### Special Tool(s)

 ST1326-A	Adapter For 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1322-A	Installer, Axle Bearing 205-382 (T97T-1225-A)
 ST1736-A	Installer, Axle Oil Seal 205-381 (T97T-1177-A)
 ST2035-A	Remover, Axle Bearing 205-224 (T85T-1225-AH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

### Material

Item	Specification
Motorcraft® SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL (US); CXY-75W140-1L (Canada)	WSL-M2C192-A and GL-5
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B



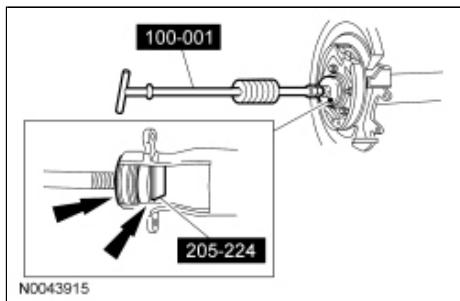
Item	Part Number	Description
1	1177	Axle shaft oil seal
2	1225	Axle shaft bearing
3	4010	Differential housing

### Removal

1. Remove the axle shaft. For additional information, refer to [Axle Shaft](#) in this section.
2. **NOTE:** If only a new axle shaft oil seal needs to be installed, use care to avoid damaging the axle shaft oil seal bore.

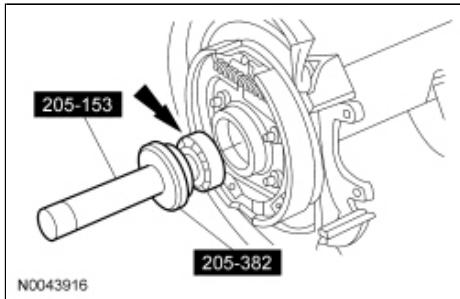
Using a suitable seal remover, remove and discard the axle shaft oil seal.

3. Inspect the rear wheel bearing and axle shaft for wear or damage.
4. Using the Axle Bearing Remover and Slide Hammer, remove the rear wheel bearing.

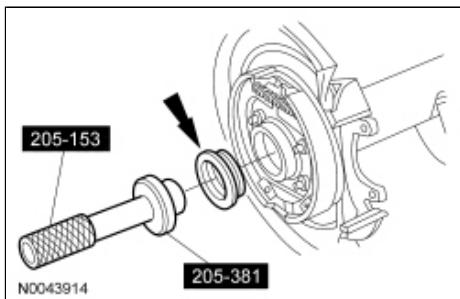


## Installation

1. Lubricate the new rear wheel bearing with axle lubricant.
2. Using the Axle Bearing Installer and Handle, install the rear wheel bearing.



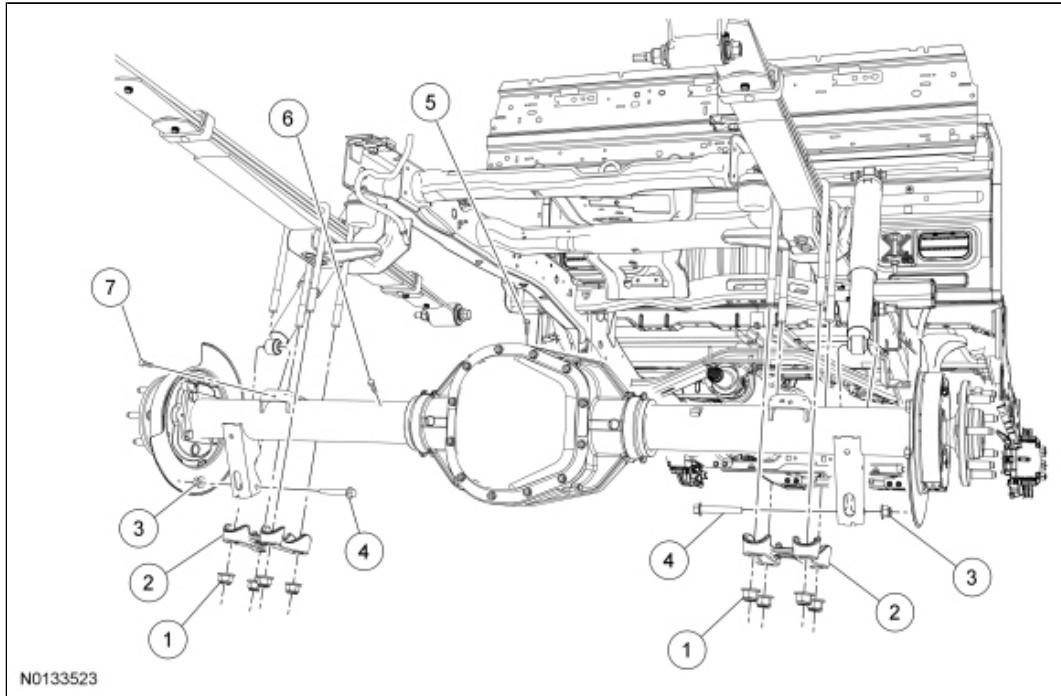
3. Lubricate the lip of the new axle shaft oil seal with grease.
4. Using the Axle Oil Seal Installer and Handle, install the new axle shaft oil seal.



5. Install the axle shaft. For additional information, refer to [Axle Shaft](#) in this section.



## Axle Assembly



Item	Part Number	Description
1	W705518	U-bolt nuts (8 required)
2	5798	U-bolt plates (2 required)
3	W520214	Lower shock absorber nuts (2 required)
4	W506545	Lower shock absorber bolts (2 required)
5	57632	Brake tube/ parking brake cable bracket bolt
6	4022	Axle vent
7	W712215	Brake hose bracket bolt (2 required)

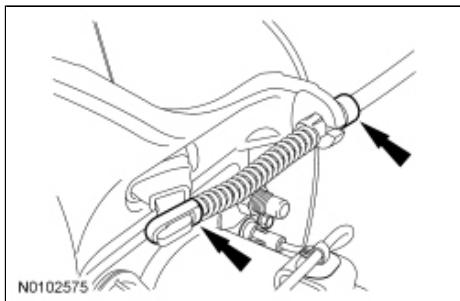
### Removal and Installation

#### All vehicles

**NOTICE:** Suspension fasteners are critical components because they affect performance of vital components and systems and their failure can result in major service expense. Install new components with the same component number or an equivalent component if installation is necessary. Do not use an installation component of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these components.

1. Remove the driveshaft. For additional information, refer to [Section 205-01](#).

2. Remove the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.
3. Release the parking brake cable tension. For additional information, refer to [Section 206-05](#).
4. Disconnect the parking brake cables.



5. Disconnect the wheel speed sensor harness retainers from the axle.

#### Vehicles with Electronic Locking Differential (ELD)

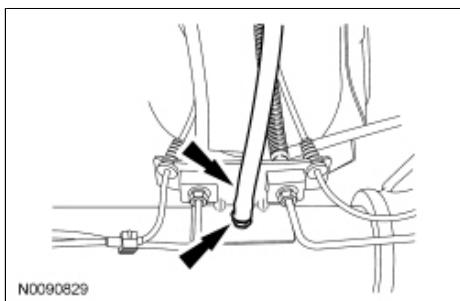
6. Disconnect the ELD electrical connector.

#### All vehicles

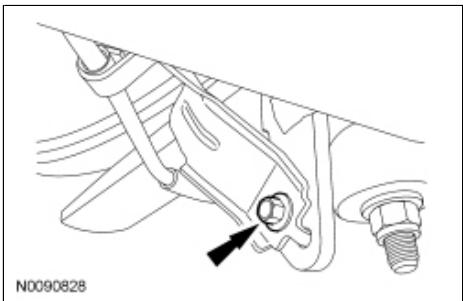
7. **NOTE:** If the vent hose is disconnected from the vehicle body, a new retainer must be installed.

Disconnect the vent hose and remove the axle vent.

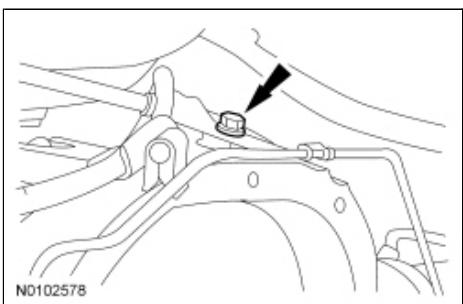
- To install, tighten to 18 Nm (159 lb-in).



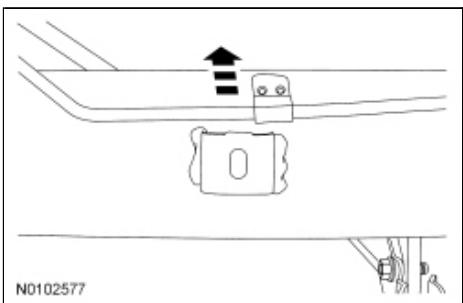
8. Remove the RH parking brake cable bracket bolt.
  - To install, tighten to 30 Nm (22 lb-ft).



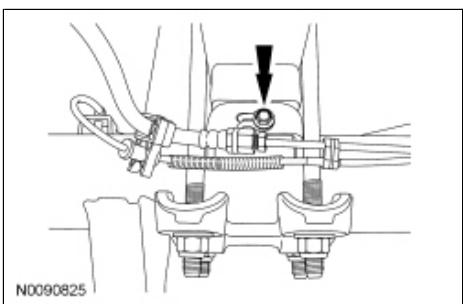
9. Remove the brake tube/parking brake cable bracket bolt.
  - To install, tighten to 25 Nm (18 lb-ft).



10. Disconnect the brake tube from the brake tube retaining clip.



11. Remove the 2 brake hose bracket bolts.
  - To install, tighten to 30 Nm (22 lb-ft).

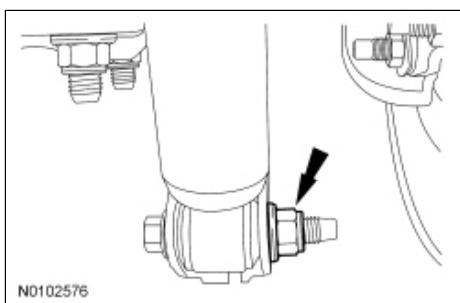


12. Support the axle with a suitable transmission jack.

- ⚠️ WARNING:** Do not apply heat or flame to the shock absorber or strut tube. The shock absorber and strut tube are gas pressurized and could explode if heated. Failure to follow this instruction may result in serious personal injury.

Remove and discard the 2 lower shock absorber nuts and 2 bolts.

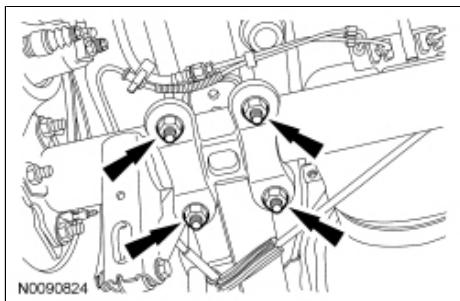
- To install, tighten the new nuts to 90 Nm (66 lb-ft).



- 14. NOTICE:** Final tightening of the U-bolt nuts must be done with the suspension at curb height or incorrect clamp load may occur.

Remove and discard the 8 U-bolt nuts and the 4 U-bolts.

- To install, with the suspension at curb height, tighten the new nuts evenly in a cross-type pattern in 4 stages.
  - Stage 1: Tighten to 35 Nm (26 lb-ft).
  - Stage 2: Tighten to 70 Nm (52 lb-ft).
  - Stage 3: Tighten to 100 Nm (74 lb-ft).
  - Stage 4: Tighten to 133 Nm (98 lb-ft).



- 15. ⚠️ WARNING:** Always secure transmission, transfer case, and axle assemblies to their service jack. Avoid obstructions while lowering and raising the jack. Improperly secured assemblies or contact with obstructions may cause the assembly to fall off the jack, which could result in serious personal injury.

Lower and remove the axle assembly.

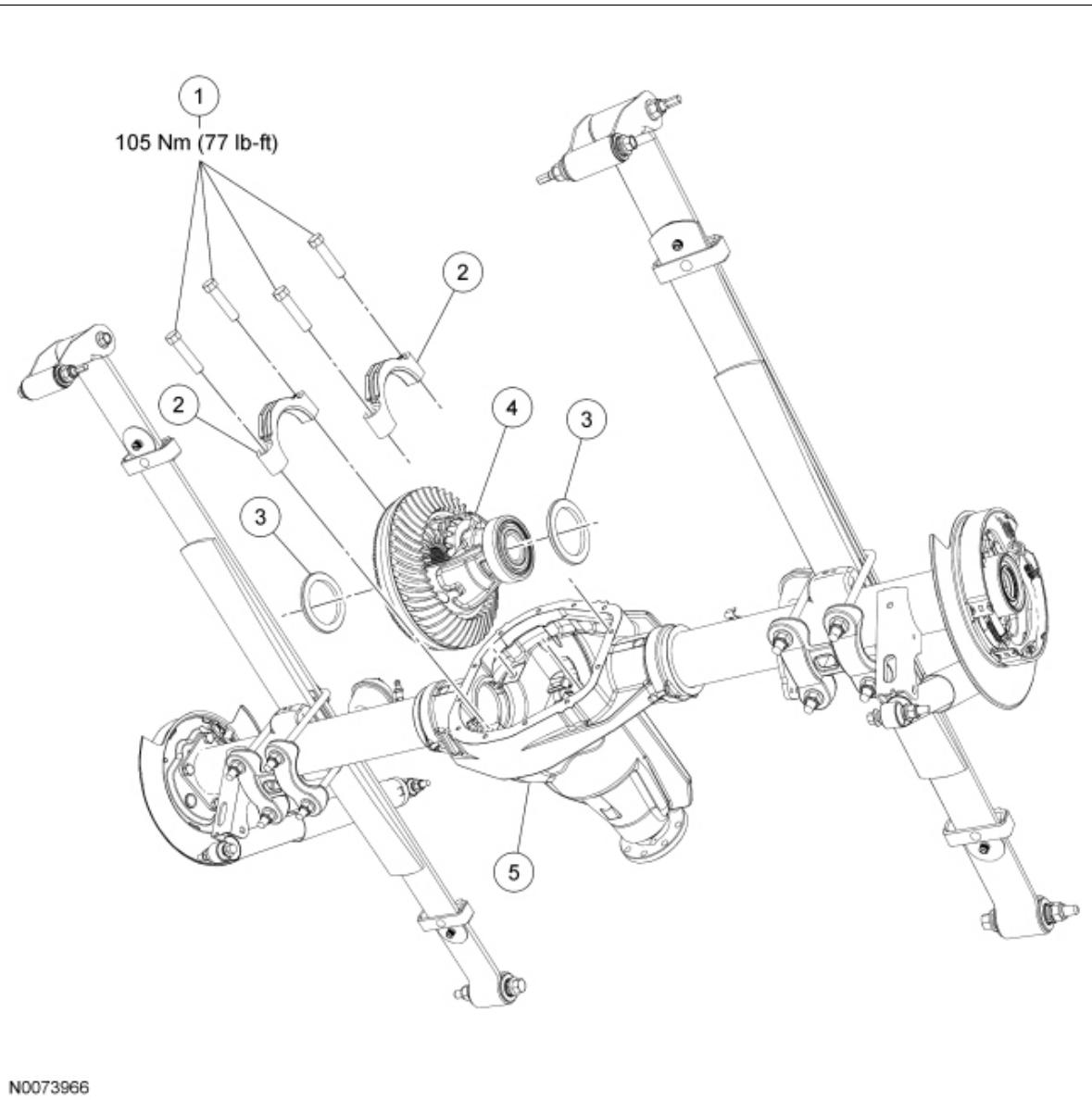
- To install the original assembly, reverse the removal procedure.
- Check the rear axle fluid level after installation.



## Differential Carrier

### Special Tool(s)

 ST1485-A	Shim Driver 205-228 (T85T-4067-AH)
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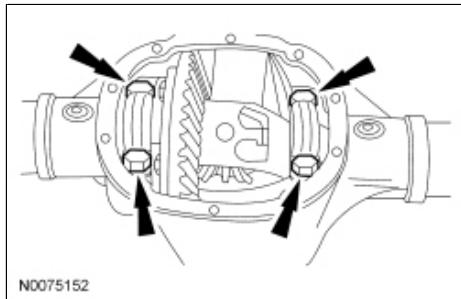
Item	Part Number	Description
1	—	Differential bearing cap bolts (part of 4010) (4 required)
2	—	Differential bearing caps (part of 4010) (2 required)
3	4067	Differential carrier bearing shims (2 required)
4	4204	Differential assembly
5	4010	Differential housing

### Removal

#### All vehicles

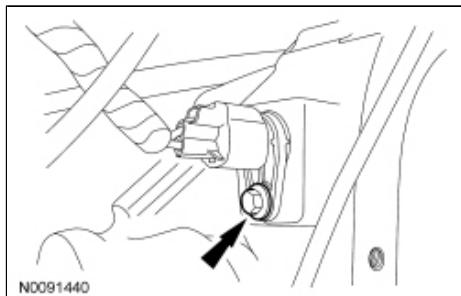
1. Remove the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.
2. **NOTE:** Index-mark the position of the differential bearing caps, as arrows may not be visible. The differential bearing caps must be installed in their original locations and positions.

Remove the 4 differential bearing cap bolts and the 2 differential bearing caps.

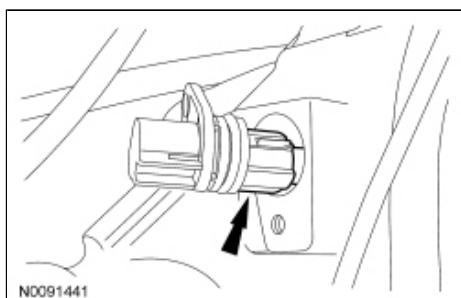


#### Electronic Locking Differential (ELD) equipped vehicles

3. Disconnect the Electronic Locking Differential (ELD) electrical connector and remove the bolt that holds the connector adapter to the housing.



4. Pull the connector adapter out and disconnect the ELD coil electrical connector from the connector adapter. Discard the adapter.



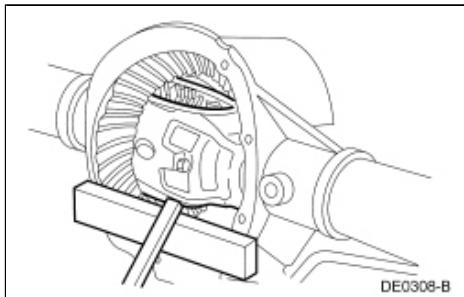
#### All vehicles

5. **NOTICE:** Place a wood block between the pry bar and the axle housing to protect the machined surface from damage.

**NOTE:** Index-mark the position of the differential bearing shims. The differential bearing shims must

be installed in their original locations and positions.

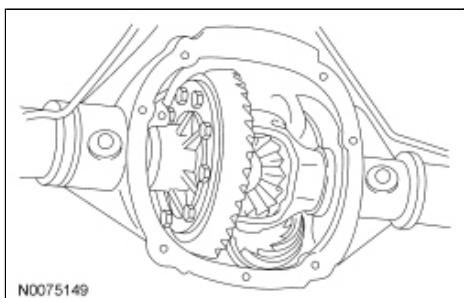
Using pry bars and wood blocks, remove the differential carrier assembly from the axle housing.



## Installation

### All vehicles

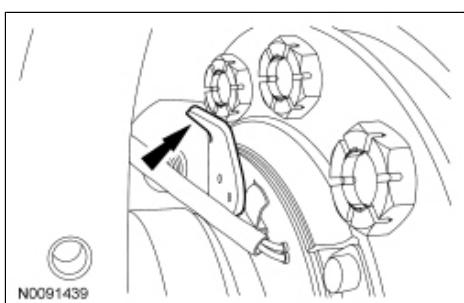
1. Position the differential assembly in the axle housing.



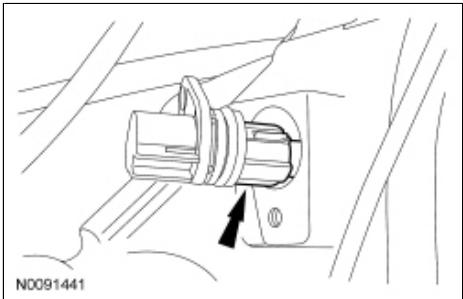
2. Install the original differential bearing shim on the LH side.

### ELD equipped vehicles

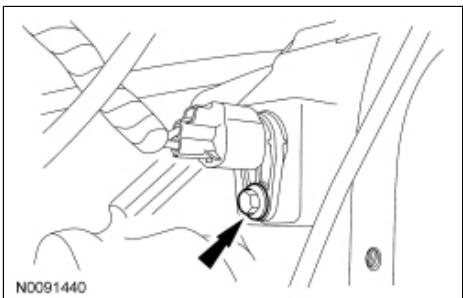
3. Install the differential with the tabs on the ELD coil up against the differential bearing cap mounting surface.



4. Push the ELD coil electrical connector through the differential case and connect the connector to the new adapter.



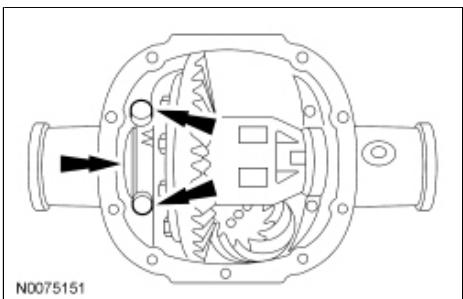
5. Seat the connector adapter into the differential housing and install the bolt. Connect the electrical connector.
  - Tighten to 7 Nm (62 lb-in).



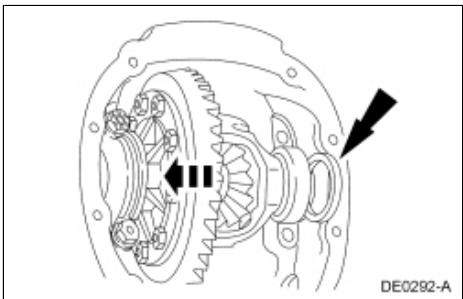
#### All vehicles

6. **NOTE:** Apply pressure toward the LH side to make sure the LH differential bearing cap is seated.

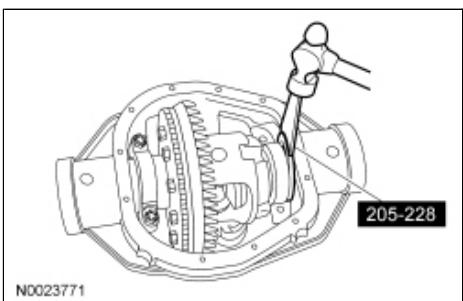
Install the LH differential bearing cap and loosely install the 2 differential bearing cap bolts.



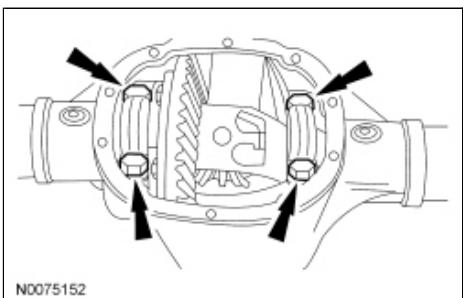
7. Install the original differential bearing shim on the RH side.



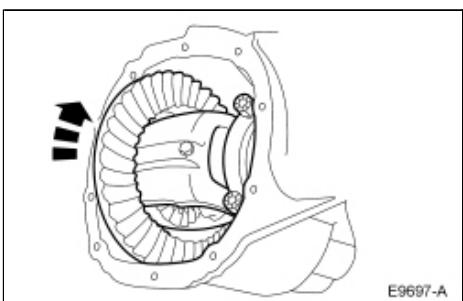
- Using the Shim Driver, fully seat the differential bearing shims.



- Install the RH side differential bearing cap and tighten the 2 LH side and 2 RH side differential bearing cap bolts.
  - Tighten to 105 Nm (77 lb-ft).



- Rotate the differential assembly to make sure it rotates freely.



- Adjust the ring and pinion backlash. For additional information, refer to [Ring Gear Backlash Adjustment](#) in this section.

12. Install the axle shafts. For additional information, refer to [Axle Shaft](#) in this section.

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**Material**

Item	Specification	Fill Capacity
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A	1.66L (3.5 pt)
Additive Friction Modifier XL-3 (US); CXL-3 (Canada)	EST-M2C118-A	4.0 oz
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Threadlock and Sealer TA-25	WSK-M2G351-A5	—

**General Specifications**

Item	Specification
<b>Backlash Specifications</b>	
Ring gear backlash	0.204-0.305 mm (0.008-0.012 in)
Ring gear maximum backlash between teeth	0.101mm (0.004 in)
<b>Clearance Specifications</b>	
Differential case maximum runout	0.076 mm (0.003 in)
Housing spreader adapter thread engagement	12.5 mm (0.500 in)
Maximum differential housing spread	0.762 mm (0.030 in)
<b>Lubricant Fill Level Checks</b>	
Front axle	
Lubricant level	9.56 mm (0.38 in) below bottom of differential housing fill hole
<b>Rotational Torque Ranges</b>	
Pinion bearing torque preload	1.8-3.3 Nm (16-29 lb-in)

**Torque Specifications**

Description	Nm	lb-ft
Axle housing tube bolts	73	54
Axle housing tube bushing bolt	175	129

Crossmember bolts and nuts	90	66
Differential bearing cap bolts	105	77
Differential housing cover bolts	32	24
Differential pinion shaft lock bolt	30	22
Fill plug	25	18
Front axle housing bushing bolt	175	129
Rear axle housing bushing bolt	175	129
Ring gear bolts <sup>a</sup>	—	—
Lower steering column shaft-to-steering gear bolt	30	22

<sup>a</sup> Refer to the procedure in this section.

---

## Front Drive Axle and Differential

The front drive axle consists of:

- a cast-aluminum center section, a removable cast-aluminum axle housing tube and a differential housing cover. Both the axle housing tube and the differential housing cover use silicone sealant as a gasket.
- a hypoid-design gearset of an 8.8-inch ring gear and a pinion gear. Two opposed tapered roller bearings support the drive pinion in the axle housing.
- a drive pinion collapsible spacer, located on the pinion shaft, maintains pinion bearing preload. The pinion nut adjusts the preload.
- differential bearing shims, located between the differential bearing cups and the axle housing, adjust the differential bearing preload and the ring gear backlash.
- a differential case, a 1-piece design with 2 openings to allow for assembly of the internal components and lubricant flow. Two opposed tapered roller bearings (differential bearings) support the differential case in the axle housing. Removable differential bearing caps retain the differential assembly in the axle housing.
- inside the differential case, the differential pinion shaft supports 2 differential pinion gears. The pinion gear speed is synchronized by a differential clutch spring. The pinion gears engage the differential side gears, to which the left axle shaft and the right axle shaft are splined. The differential pinion shaft bolt retains the differential pinion shaft in the differential case.
- The bar code tag located on the differential cover contains the axle information.

The front drive axle receives input from the transfer case by way of the front driveshaft. Rotational torque is transferred through the drive pinion to the ring gear, which in turn drives the differential case. Inside the differential case are the pinion gears which rotate on the stationary pinion shaft and the side gears which are splined to the axle shafts. The differential assembly is a gear arrangement that allows the drive wheels to be driven at different speeds and divides the input torque of the pinion gear between the axle halfshafts. The front axle transmits torque only and carries no vehicle load. CV joints located at each end of the halfshafts allow the axle to remain stationary in relationship to front wheels, yet articulate at the knuckle. These CV joints permit the wheels to be driven and turned at the same time. Lack of lubrication is among the most common causes of CV joint concerns. It is essential that all CV boots and clamps be inspected for damage or signs of leakage. Refer to [Section 205-04](#).

The Torsen® front differential case houses the parallel axis planetary helical side gears to which the axle halfshafts are splined. It is the unique arrangement of the differential that allows the continuous, uninterrupted torque output and allows the axle halfshafts to be driven at different speed when needed, such as when driving around corners. There are no clutch plates or discs in this axle design. The Torsen® differential requires 4.0 oz of friction modifier to be added with the axle lubricant. The axle shafts are retained in this differential with the circlips.



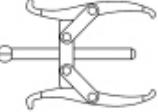
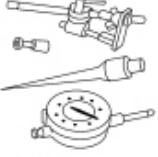
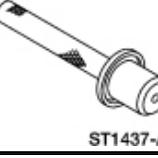
## **Front Drive Axle**

Refer to [Section 205-00](#).

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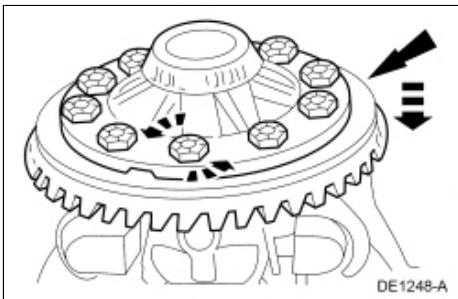
## Differential Case Runout Check

### Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1214-A	Dial Indicator Gauge With Holding Fixture 100-002 (TOOL-4201-C)
 ST1437-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST1259-A	Spreader, Differential Carrier 205-001 (TOOL-4000-E)
 ST2043-A	Step Plate 205-D061 (D83T-4205-C2)

1. Remove the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
2. **NOTE:** Use a drift punch to separate the ring gear from the differential case.

Remove and discard the 10 bolts. Remove the ring gear.

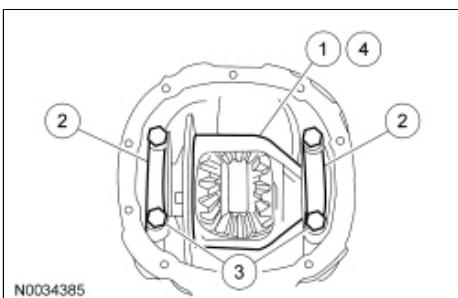


3. **NOTE:** Visually inspect the differential bearing cups and cones for discoloration indicating bearing overheating or failure.

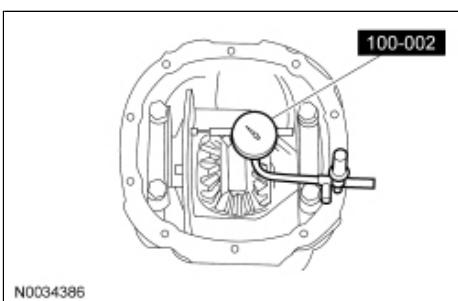
**NOTE:** It may be necessary to use the Differential Carrier Spreader to carry out this step.

Install the differential case with the bearing cups and all the shims in the housing.

1. Position the differential case with the bearing cups and shims in their original location.
2. Install the 2 bearing caps.
3. Install the 4 bolts.
  - Tighten to 105 Nm (77 lb-ft).
4. Rotate the differential case to make sure the bearings have seated correctly.

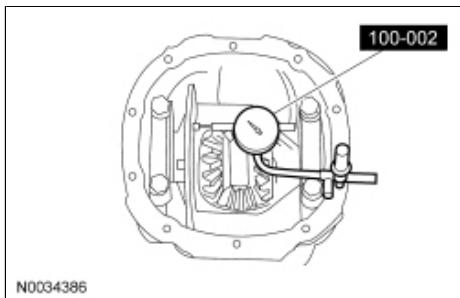


4. Install the Dial Indicator Gauge with Holding Fixture.

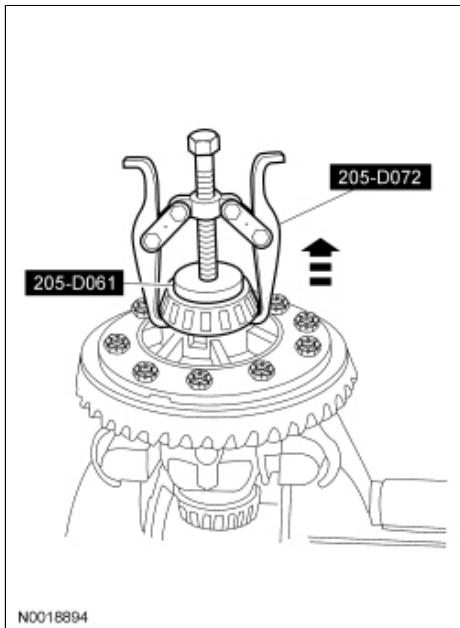


5. Rotate the differential case and check the differential case runout using the Dial Indicator Gauge with Holding Fixture.
  - If the runout does not exceed the specification, install a new ring gear and pinion.
  - If runout exceeds the specification, the ring gear is true and the condition is due to differential case/differential bearing damage.
    - Inspect the differential bearings and the differential case. Always install new differential bearings when installing a new differential case, or if a bearing condition is

questionable.



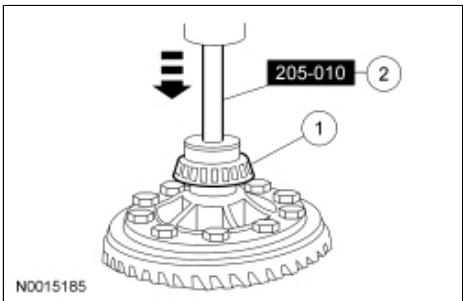
6. Remove the bearing caps and the differential case with the bearing cups and shims from the housing.
7. If necessary, using the 2 Jaw Puller and Step Plate, remove the differential bearings.



8. **NOTICE:** Press against the differential bearing inner cone only or damage to the component may occur.

Install the new differential bearings.

1. Position the appropriate differential bearing (RH or LH).
2. Using a suitable press and the Differential Side Bearing Installer, install the differential bearing.
  - Repeat the steps for the other differential bearing.

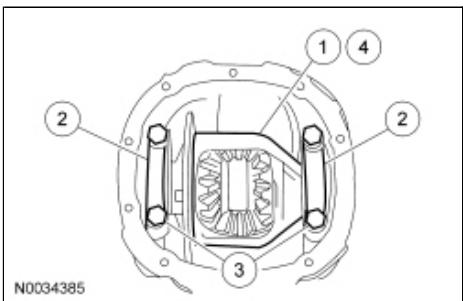


9. **NOTE:** It may be necessary to use the Differential Carrier Spreader to carry out this step.

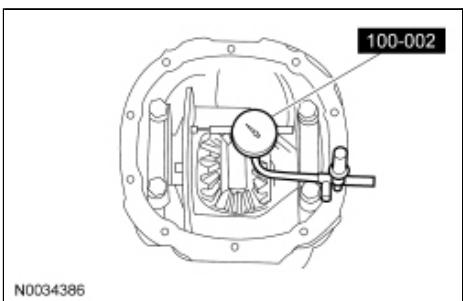
**NOTE:** Recheck the flange runout.

Install the differential case with the bearing cups and the shims in the housing.

1. Position the differential case with the bearing cups and shims in their original locations.
2. Install the 2 bearing caps.
3. Install the 4 bolts.
  - Tighten to 105 Nm (77 lb-ft).
4. Rotate the differential case to make sure the bearings have seated correctly.

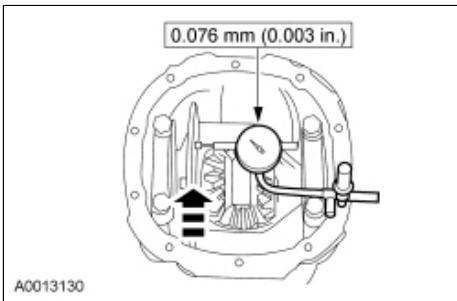


10. Install the Dial Indicator Gauge with Holding Fixture.

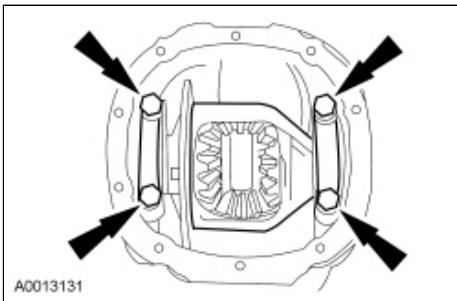


11. **NOTE:** If the runout is still excessive, install a new differential case.

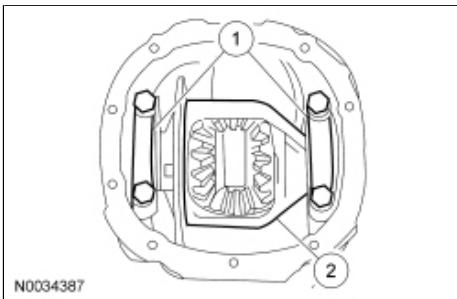
Using the Dial Indicator Gauge with Holding Fixture, check the runout with the new differential bearings. If the runout does not exceed the specification, use the new differential bearings for assembly.



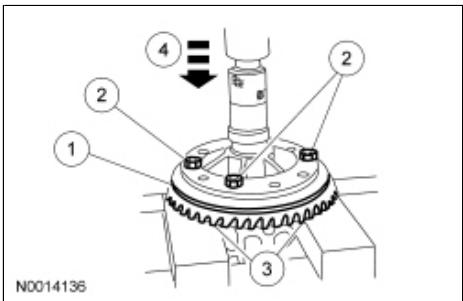
12. Remove the 4 bolts.



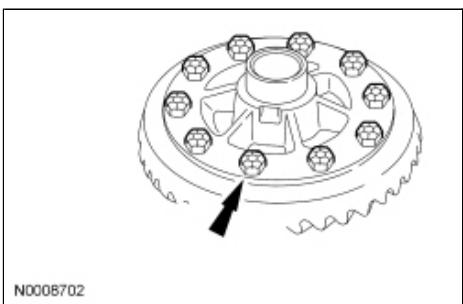
13. Remove the differential case with the bearing cups and the shims from the housing.
  1. Remove the 2 bearing caps.
  2. Remove the differential case with the bearing cups and the shims from the housing.



14. Install the differential ring gear.
  1. Place the differential ring gear on the differential assembly.
  2. Hand-start 3 new ring gear bolts to align the holes in the differential ring gear and the differential assembly.
  3. Place the differential carrier and differential ring gear onto the press bed blocks with the differential ring gear teeth facing downward.
  4. Press the differential ring gear into place.



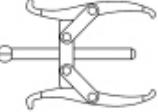
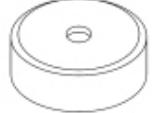
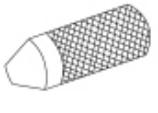
15. Install the 10 new ring gear bolts.
  - Tighten to 128 Nm (95 lb-ft).

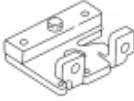
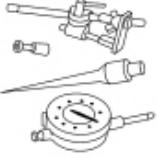
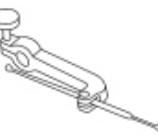
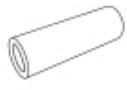


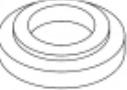
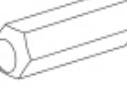
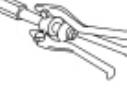
16. Install the differential carrier. For additional information, refer to [Differential Carrier](#) in this section.
-

## Axle

### Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1433-B	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)

	ST1150-B
	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
	ST1214-A
	Gauge, Clutch Housing 308-021 (T75L-4201-A)
	ST1434-A
	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
	ST1257-A
	ST1186-A
	ST1357-A
	ST1437-A
	Installer, Differential Carrier Bearings 205-D044 (D81T-4221-A) or equivalent
	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Installer, Drive Pinion Bearing Cone

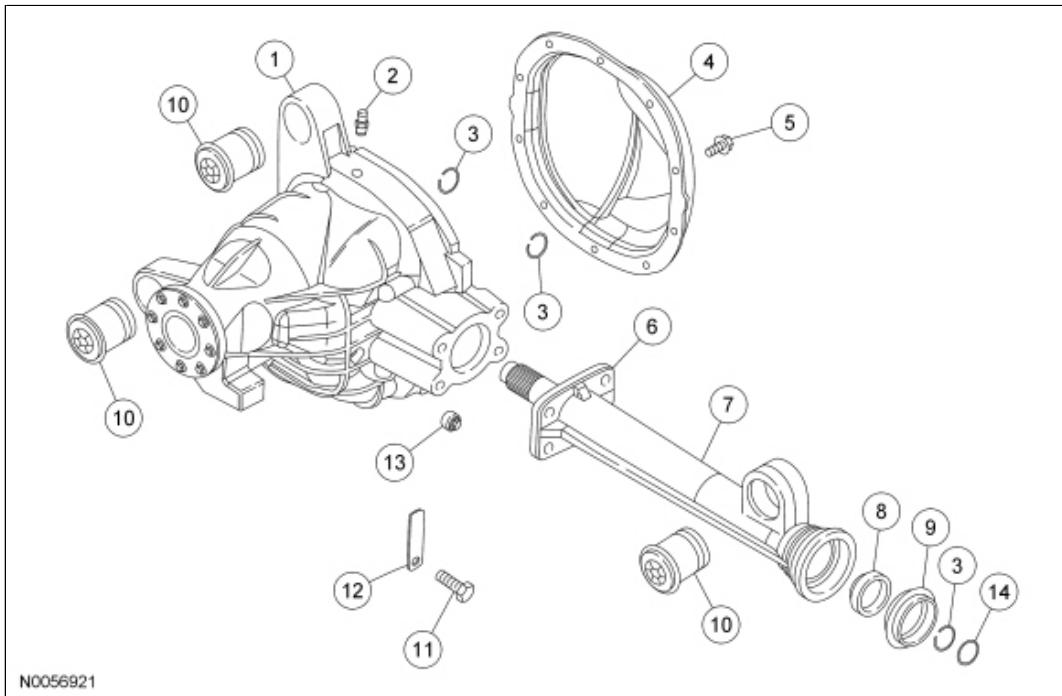
 ST1484-A	205-005 (T53T-4621-C)
 ST1361-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-208 (T83P-4676-A)
 ST1882-A	Protector, Drive Pinion Thread 205-460
 ST1310-A	Remover, Bearing 205-055 (T71P-4621-B)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2418-A	Remover, Transmission Fluid Pump 307-397
	Slide Hammer 100-001 (T50T-100-A)

	ST1185-A
	ST1259-A Spreader, Differential Carrier 205-001 (TOOL-4000-E) or equivalent
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)
	Step Plate 205-D061 (D83T-4205-C2) ST2043-A

#### Material

Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

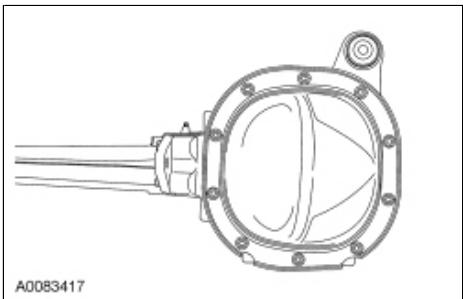
#### Front Axle Assembly — Disassembled View



Item	Part Number	Description
1	3C202	Differential carrier assembly
2	4338	Axle housing vent
3	4B422	Circlips
4	3N136	Differential housing cover
5	390919	Differential housing cover bolt (10 required)
6	3A380	Intermediate shaft
7	3B210	Axle housing tube
8	4B413	Axle shaft bearing assembly (outer)
9	4B416	Axle shaft dust seal
10	5638	Front axle support mounting bushings (3 required)
11	N808703	Axle housing tube bolt (4 required)
12	4121	Axle identification tag
13	373098	Fill plug
14	4369	O-ring

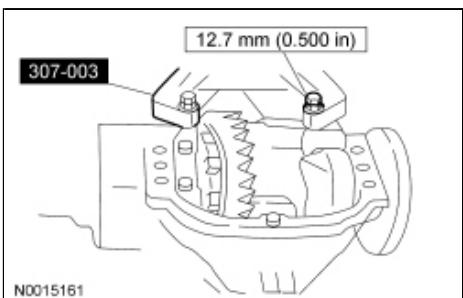
### Disassembly

1. Remove the axle assembly. For additional information, refer to [Axle Assembly](#) in this section.
2. Remove the 10 bolts and the differential housing cover.
  - Drain the fluid.
  - Remove the bolts.
  - Remove the differential housing cover.

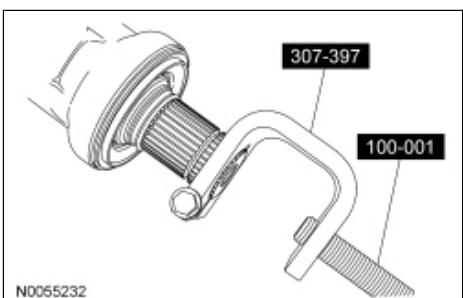


3. **NOTICE:** The fixture mounting bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.

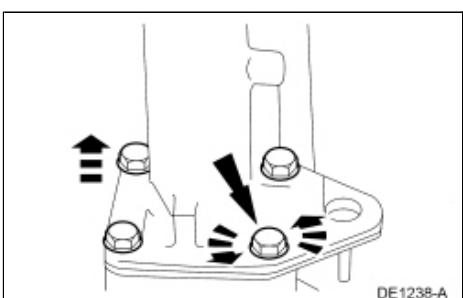
Install the Transmission Holding Fixture.



4. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.



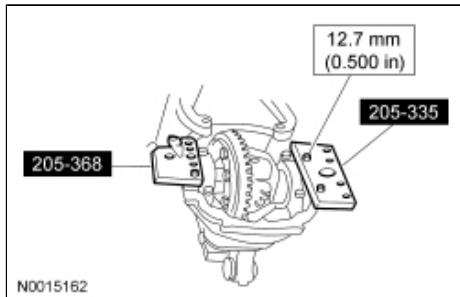
5. Remove the 4 bolts and the axle housing tube.



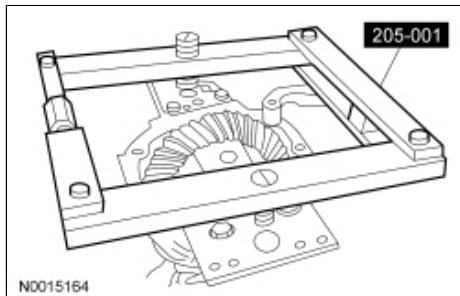
6. **NOTICE:** The housing spreader adapter bolts must have the minimum specified thread

**engagement in the carrier or damage to the component may occur.**

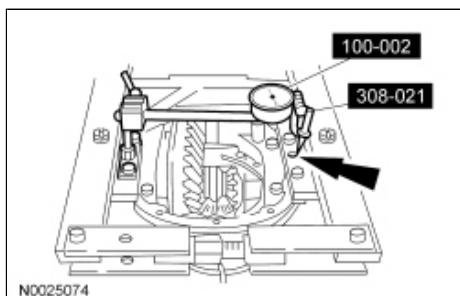
Install the Differential Housing Spreader Plate and Adapter for Differential Housing Spreader.



7. Position the Differential Carrier Spreader on the spreader adapters.



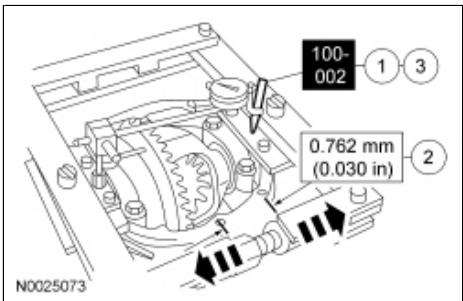
8. Install the Dial Indicator Gauge with Holding Fixture and Clutch Holding Gauge.
  - Position the adapter tip in the spreader adapter hole.



9. **NOTICE: Overspreading may damage the axle housing.**

Spread the axle housing to the specification.

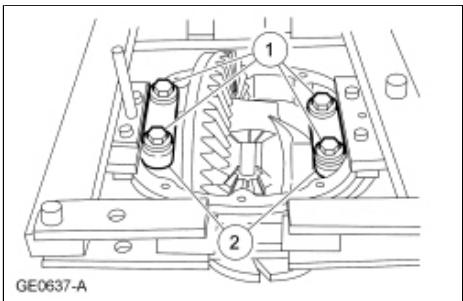
1. Adjust the Dial Indicator Gauge to zero.
2. Tighten the housing spreader screw to spread the axle housing to the specification.
3. Remove the Dial Indicator Gauge with Holding Fixture.



10. **NOTE:** Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the bearing caps in their original place and position.

Mark and remove the 2 differential bearing caps.

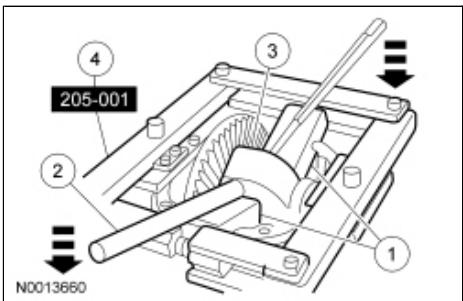
1. Remove the bolts.
2. Remove the differential bearing caps.



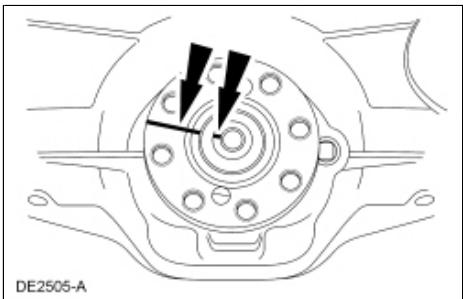
11. **NOTICE:** Use wood blocks to avoid axle housing damage.

Remove the differential assembly from the axle housing.

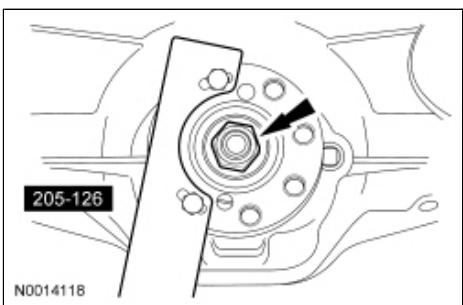
1. Position the wood blocks.
2. Position and push down on the 2 pry bars.
3. Remove the differential assembly.
4. Remove the Differential Carrier Spreader.



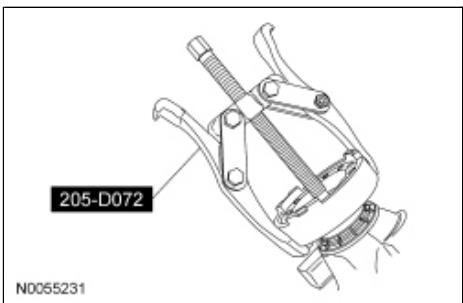
12. Index-mark the axle U-joint flange to the pinion stem.



13. Install the Drive Pinion Flange Holding Fixture and loosen, but do not remove, the pinion nut.

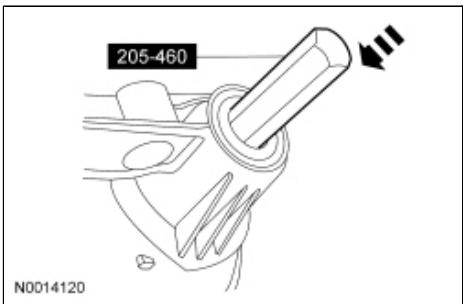


14. With the pinion nut still engaged by a few threads, use the 2 Jaw Puller to separate the axle U-joint flange from the pinion gear.

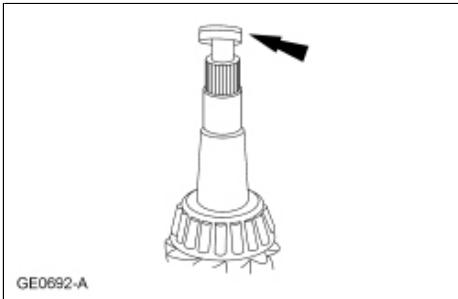


15. Remove the nut and the flange.

16. Using the Drive Pinion Thread Protector and a soft hammer, remove the pinion gear.



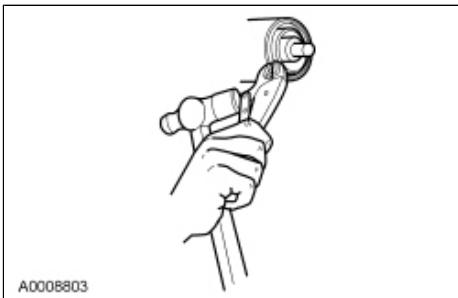
17. Discard the drive pinion collapsible spacer.



18. **NOTICE:** Do not damage the carrier housing while removing the pinion seal.

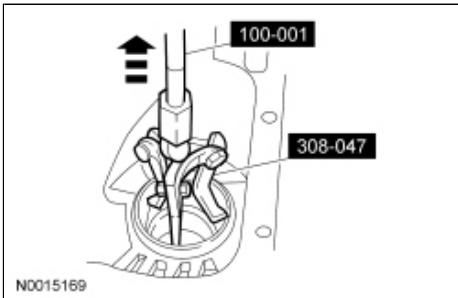
Remove the pinion seal and slinger.

- Pry up on the seal flange. Install gripping pliers, and strike with a hammer to remove the seal.



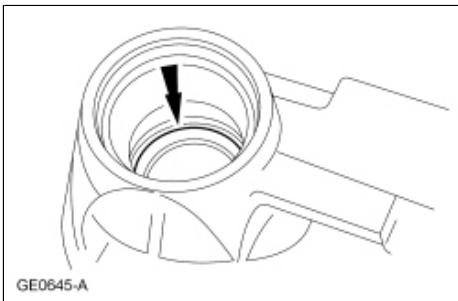
19. Remove the outer pinion bearing.

20. Using the Bearing Cup Remover and Slide Hammer, remove the inner pinion bearing cup.

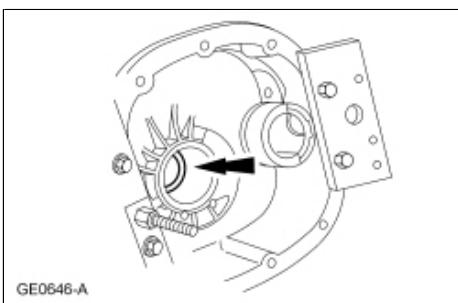


21. **NOTE:** The pinion bearing oil baffle aids in bearing lubrication. Normally, it is not necessary to remove the baffle.

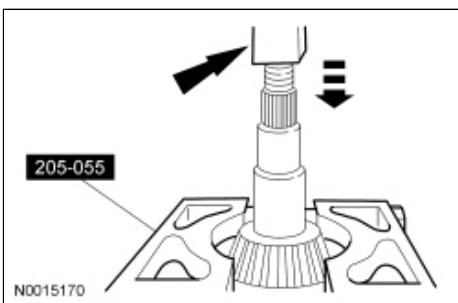
If necessary, remove the pinion bearing oil baffle.



22. Remove the outer pinion bearing cup by tapping alternately on each side to prevent the cup from cocking.

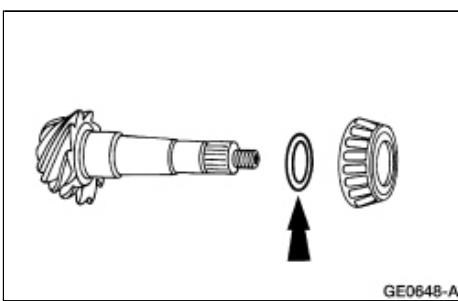


23. Using the Bearing Remover and a suitable press, remove the pinion bearing.



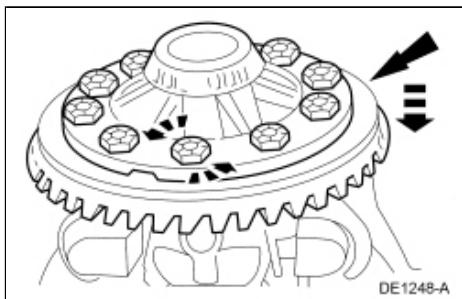
24. **NOTE:** A drive pinion bearing adjustment shim sits under the pinion bearing. Use a micrometer to measure the shim thickness. Record the measurement for comparison to the shim gauge reading taken prior to installing the pinion bearing.

Remove and measure the drive pinion bearing adjustment shim.

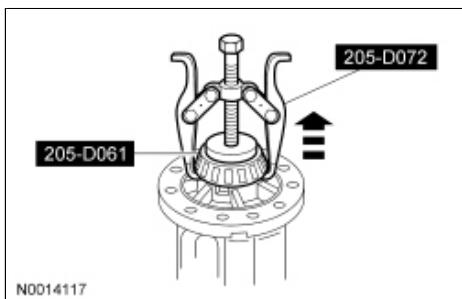


25. **NOTE:** Use a drift punch to separate the ring gear from the differential case.

Remove and discard the 10 bolts and remove the ring gear.



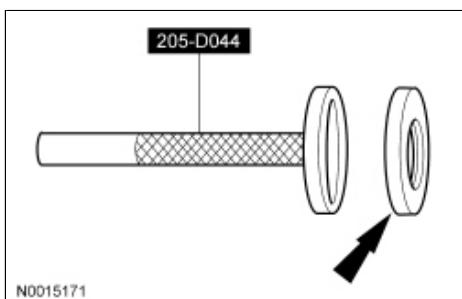
26. Using the 2 Jaw Puller and Step Plate, remove the differential bearings.



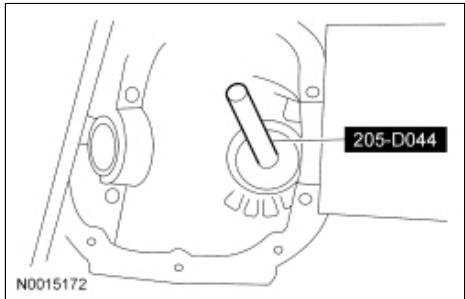
### Assembly

1. **NOTICE:** Do not omit the pinion bearing oil baffle; bearing failure may result.

If removed, position the baffle on the Drive Carrier Bearings Installer.



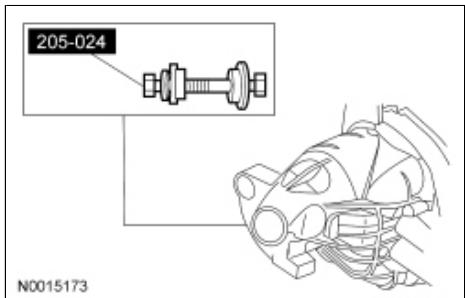
2. Using the Drive Carrier Bearings Installer, install the baffle.



3. **NOTE:** Always install new pinion bearings when installing new pinion bearing cups.

Lightly oil the new pinion bearing cups and pinion bearings with front axle lubricant.

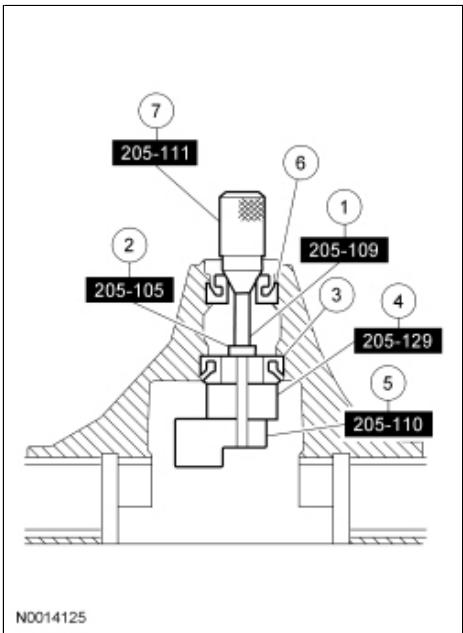
4. Using the Drive Pinion Bearing Cup Installer, install the bearing cups.



5. **NOTE:** The pinion bearings assembled in this procedure step must be used at final assembly.

Assemble and position the Adapters and the pinion bearings in the carrier housing.

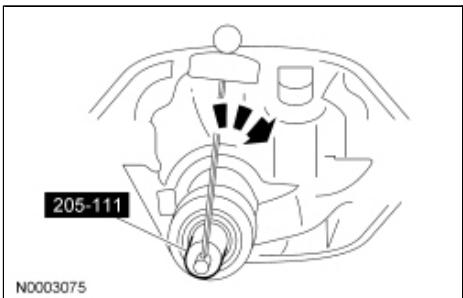
1. Position the screw adapter.
2. Position the aligning adapter.
3. Position the pinion bearing.
4. Position the gauge disc adapter.
5. Position the gauge block adapter.
6. Position the pinion bearing.
7. Thread on the handle adapter.



6. **NOTE:** This step duplicates final pinion bearing preload.

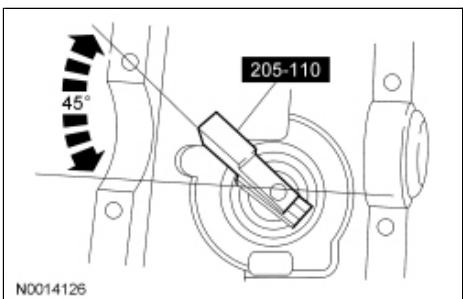
Tighten the Adapter to simulate bearing preload.

- Tighten to 2.2 Nm (20 lb-in).

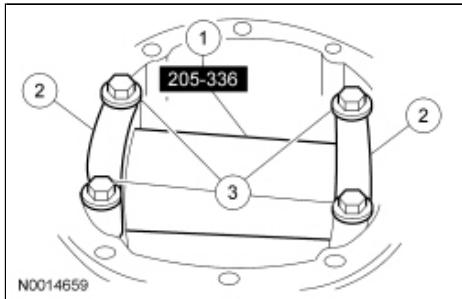


7. **NOTE:** Offset the gauge block adapter to obtain an accurate reading.

Rotate the gauge block Adapter several half-turns to make sure the pinion bearings seat correctly and position the gauge block adapter.



8. Install the Drive Pinion Gauge Tube.
  1. Position the Drive Pinion Gauge Tube.
  2. Install the 2 differential bearing caps.
  3. Install the 4 bolts.
    - Tighten to 105 Nm (77 lb-ft).

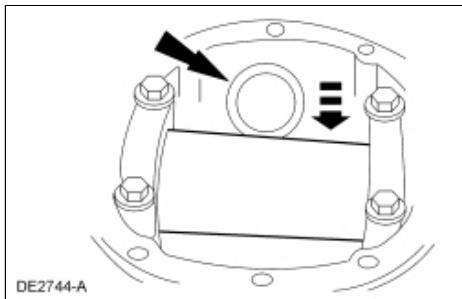


9. **NOTE:** Use only flat, clean drive pinion bearing adjustment shims.

**NOTE:** Do not attempt to force the shim between the gauge block adapter and the gauge tube adapter. A slight drag indicates correct shim selection.

Use a drive pinion bearing adjustment shim as a gauge for shim selection.

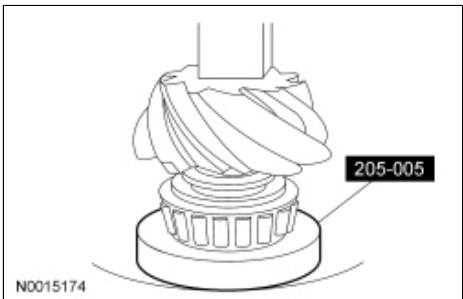
- Check the adjustment shim thickness between the gauge block adapter and the gauge tube adapter.
- After determining the correct shim thickness, remove the Drive Pinion Gauge Tube.



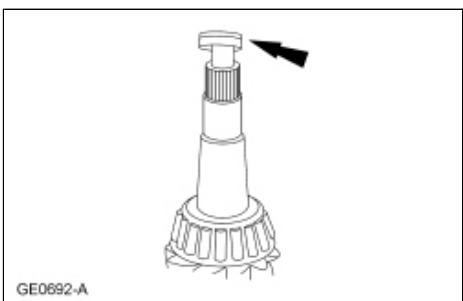
10. **NOTE:** The same pinion bearings from the previous steps must be used.

Install the pinion bearing.

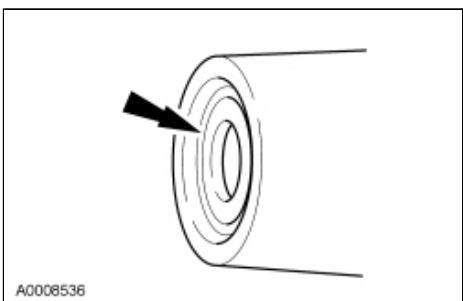
- Place the drive pinion bearing adjustment shim on the pinion gear.
- Using a suitable press and the Drive Pinion Bearing Cone Installer, press the pinion bearing until it is firmly seated on the pinion gear.



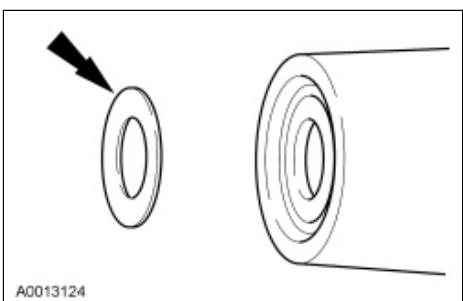
11. Place a new drive pinion collapsible spacer on the pinion stem.



12. Install the outer pinion bearing.



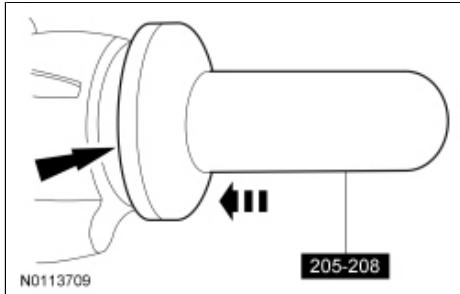
13. Install the slinger.



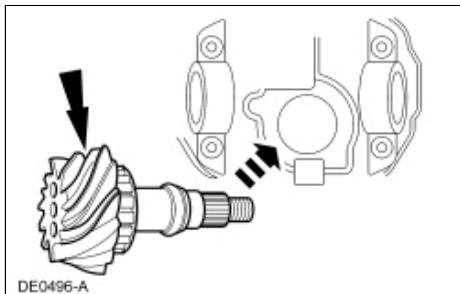
14. **NOTE:** Coat the lips of the pinion seal with front axle lubricant.

Place the pinion seal on the Drive Pinion Oil Seal Installer.

15. Place the Drive Pinion Oil Seal Installer and seal in the pinion seal bore and drive the seal into place.



16. Lightly lubricate the pinion gear splines with front axle lubricant.
17. Position the drive pinion in the housing.

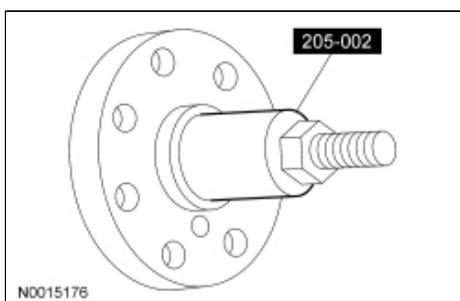


18. **NOTICE:** Never install the drive pinion U-joint flange with a hammer or power tools.

**NOTE:** Disregard the scribe marks if installing a new flange.

Align the index marks and position the U-joint flange on the drive pinion.

19. Using the Drive Pinion Flange Installer, install the drive pinion U-joint flange.

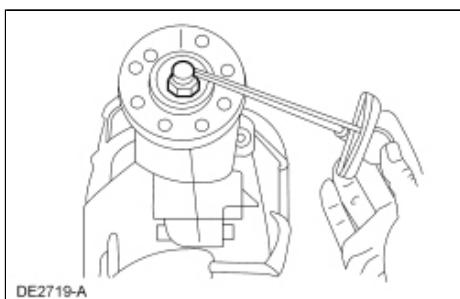
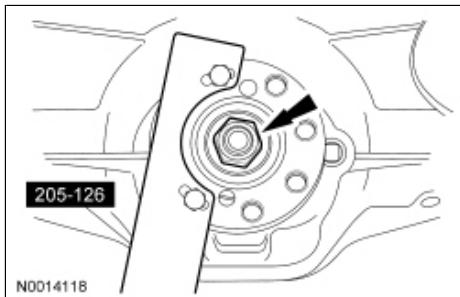


20. Apply a small amount of lubricant to the washer side of the new pinion nut, and install the nut.
21. **NOTICE:** Do not loosen the pinion nut to reduce preload under any circumstance. If it is necessary to reduce preload, install a new drive pinion collapsible spacer and pinion nut or damage to the component may occur.

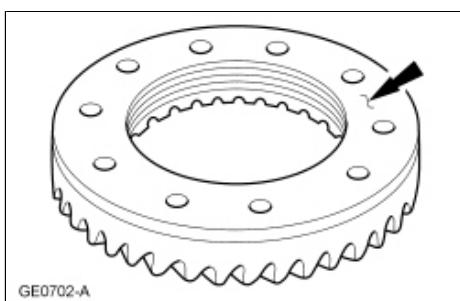
Install the Drive Pinion Flange Holding Fixture and tighten the pinion nut. Refer to the torque

specifications in the Specifications portion of this section.

- Rotate the pinion gear occasionally to make sure the pinion bearings are seating correctly. Take frequent pinion bearing torque preload readings by rotating the pinion gear with a Nm (lb-in) torque wrench.

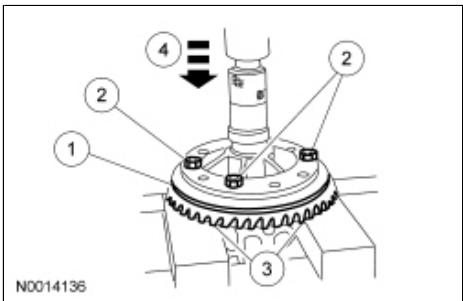


22. Use a fine flat file to remove any burrs or nicks from the ring gear mounting surface.

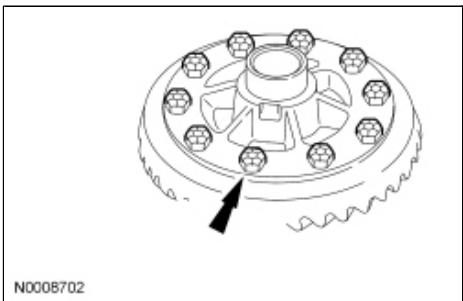


23. Install the differential ring gear.

1. Place the differential ring gear on the differential assembly.
2. Hand-start 3 ring gear bolts to align the holes in the differential ring gear and the differential assembly.
3. Place the differential carrier and differential ring gear onto the press bed blocks with the differential gear teeth facing downward.
4. Press the differential ring gear into place.



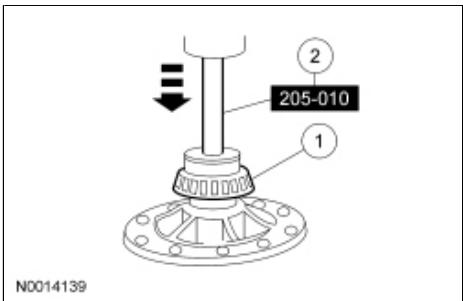
24. Install the remaining new bolts.
- Tighten to 128 Nm (95 lb-ft).



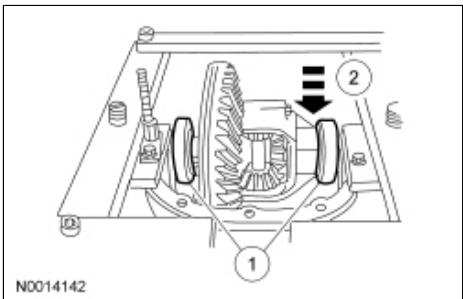
25. **NOTE:** Press against the bearing inner core only.

Using a suitable press and the Differential Side Bearing Installer, install the differential bearings.

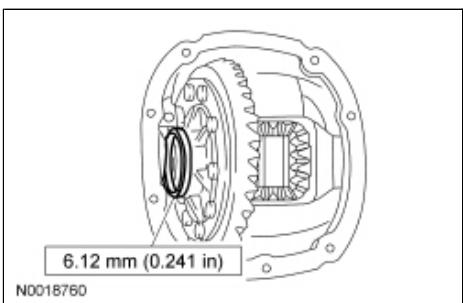
1. Position the appropriate differential bearing (RH or LH).
2. Using a suitable press and the Differential Side Bearing Installer, install the differential bearing.
  - Repeat the procedure for the other differential bearing.



26. Install the differential carrier.
1. Position the differential bearing cups on the differential bearings.
  2. Lower the differential carrier in place.

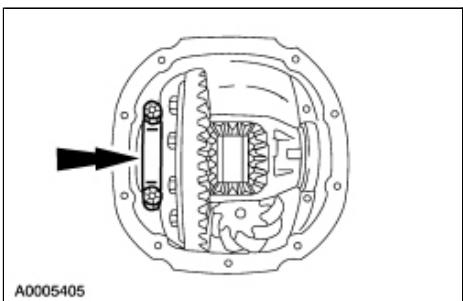


27. Install a differential bearing shim of the thickness shown on the LH side of the differential bearing.

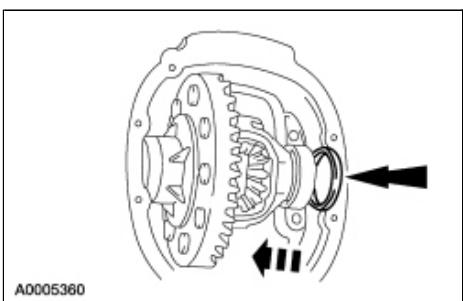


28. **NOTE:** Apply pressure to the left side to make sure the left bearing cup is seated.

Install the left bearing cap and loosely install the 2 bearing cap bolts.

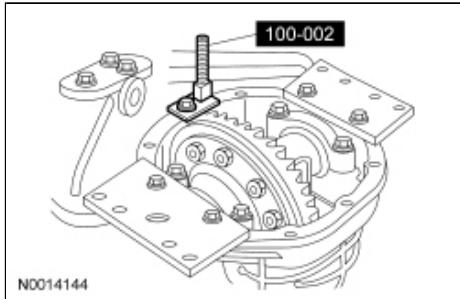


29. Install progressively thicker differential bearing shims on the right side until the thickest differential bearing shim can be inserted by hand.

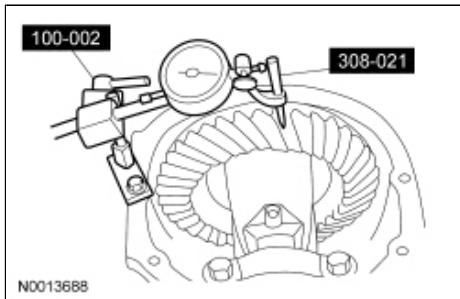


30. Install the right bearing cap and 2 bolts.

31. Tighten the 4 differential bearing cap bolts.
  - Tighten to 105 Nm (77 lb-ft).
32. Rotate the differential carrier to make sure it turns freely.
33. Install the Dial Indicator Gauge with Holding Fixture.

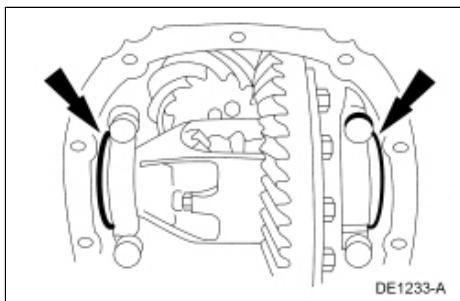


34. Using the Dial Indicator Gauge with Holding Fixture and the Clutch Housing Gauge, measure the ring gear backlash at 4 places to obtain a consistent reading.

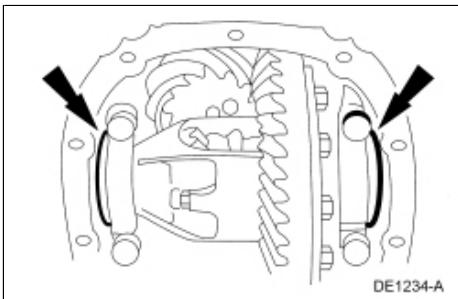


35. **NOTE:** If the backlash is not within the specifications, correct it by increasing the thickness of one differential bearing shim and decreasing the thickness on the other differential bearing shim by the same amount.

To increase the backlash, install a thicker differential bearing shim and a thinner differential bearing shim as shown.



36. To decrease the backlash, install a thicker differential bearing shim and a thinner differential bearing shim as shown.



37. Select the appropriate shim by the thickness or the stripe color.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

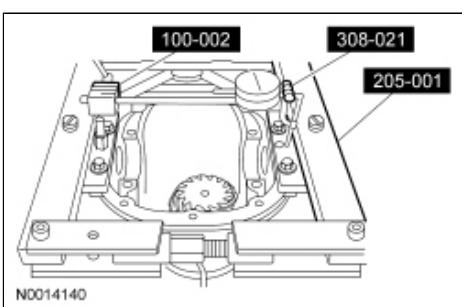
Differential Shim Size Chart

Stripes/Color	mm	Inch
2 — C-COAL	7.7978-7.8105	0.3070-0.3075
1 — C-COAL		
5 — BLU	7.7470-7.7597	0.3050-0.3055

4 — BLU	7.6962-7.7089	0.3030-0.3035
3 — BLU	7.6454-7.6581	0.3010-0.3015
2 — BLU		
1 — BLU	7.5946-7.6073	0.2990-0.2995
5 — PINK	7.5458-7.5565	0.2970-0.2975
4 — PINK		
3 — PINK	7.4930-7.5050	0.2950-0.2955
2 — PINK	7.4422-7.4549	0.2930-0.2935
1 — PINK		
5 — GRN	7.3914-7.4041	0.2910-0.2915
4 — GRN	7.3406-7.3533	0.2890-0.2895
3 — GRN		
2 — GRN	7.2898-7.3025	0.2870-0.2875
1 — GRN	7.2390-7.2517	0.2850-0.2855
5 — WH		
4 — WH	7.1882-7.2009	0.2830-0.2835
3 — WH	7.1374-7.1501	0.2810-0.2815
2 — WH		
1 — WH	7.0866-7.0993	0.2790-0.2795
5 — YEL	7.0358-7.0485	0.2770-0.2775
4 — YEL		
3 — YEL	6.9850-6.9977	0.2750-0.2755
2 — YEL	6.9342-6.9469	0.2730-0.2735
1 — YEL		
5 — ORNG	6.8834-6.8961	0.2710-0.2715
4 — ORNG	6.8326-6.8453	0.2690-0.2695
3 — ORNG		
2 — ORNG	6.7818-6.7945	0.2670-0.2675
1 — ORNG		
2 — RED	6.7310-6.7437	0.2650-0.2655

1 — RED	6.6802-6.6929	0.2630-0.2635
	6.6294-6.6421	0.2610-0.2615
	6.5786-6.5913	0.2590-0.2595
	6.5278-6.5405	0.2570-0.2575
	6.4770-6.4897	0.2550-0.2555
	6.4262-6.4389	0.2530-0.2535
	6.3754-6.3881	0.2510-0.2515
	6.3246-6.3373	0.2490-0.2495
	6.2738-6.2865	0.2470-0.2475
	6.2223-6.2357	0.2450-0.2455
	6.1722-6.1849	0.2430-0.2335
	6.1214-6.1341	0.2410-0.2415

38. Remove the 4 differential bearing cap bolts.
  - Remove the differential carrier.
39. Measure the thickness of the selected right and left bearing shims.
40. To establish differential bearing preload, increase both the left and right differential bearing shim thickness by 0.203 mm (0.008 in).
41. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.

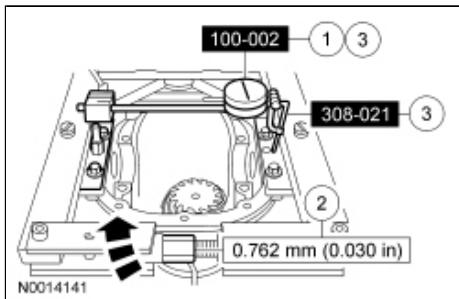


**42. NOTICE: Overspreading may damage the differential housing.**

**NOTE:** Tighten and loosen the differential carrier spreader adapters to normalize the housing adapters prior to taking the final Dial Indicator reading.

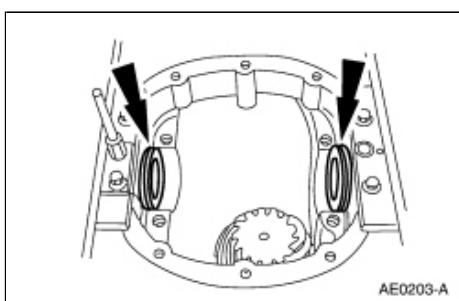
Spread the differential housing to the specification.

1. Adjust the Dial Indicator Gauge to zero.
2. Tighten the screw until spreading the differential housing to the specifications.
3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.



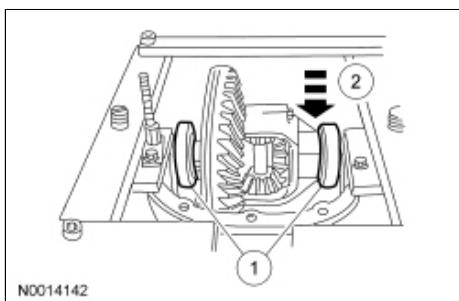
**43. NOTICE: To avoid galling the case, insert the shims with a light coating of grease before installing the differential carrier.**

Place the differential bearing shims in the differential housing.



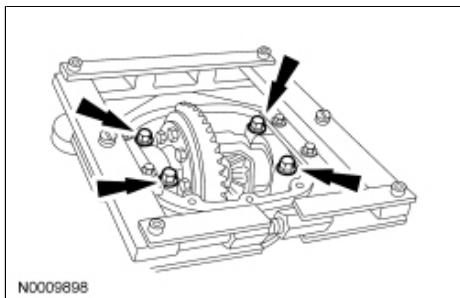
**44. Install the differential carrier.**

1. Position the 2 differential bearing cups on the differential bearings.
2. Lower the differential carrier in place between the differential bearing shims.

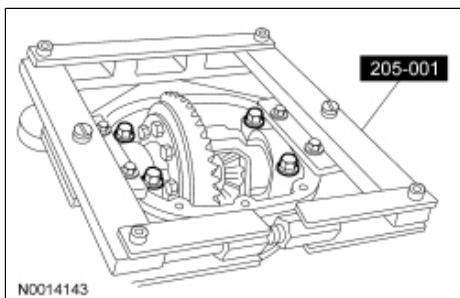


**45. NOTE: Hand-tighten the differential bearing cap bolts prior to releasing the Differential Carrier Spreader.**

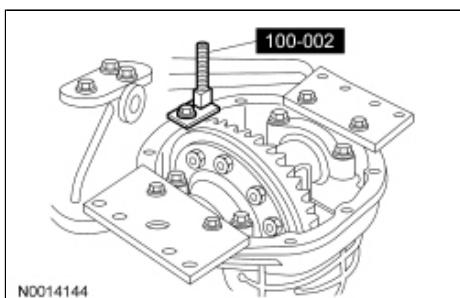
Install the 2 differential bearing caps and 4 bolts in their original location.



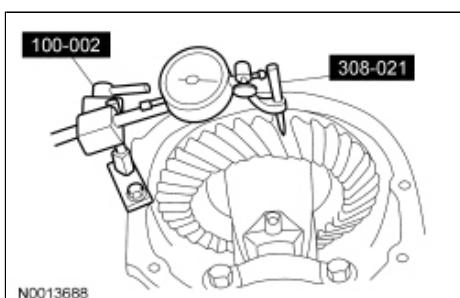
46. Loosen and remove the Differential Carrier Spreader.



47. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.

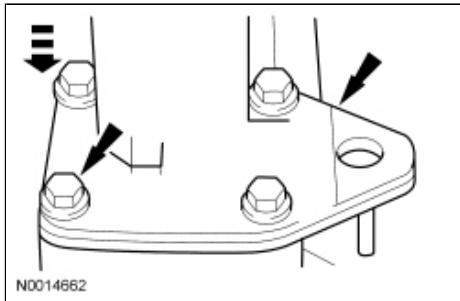


48. Using the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge, recheck the ring gear backlash.

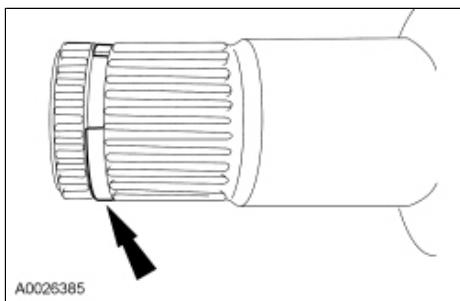


49. Apply marking compound and rotate the differential assembly 5 complete revolutions.

50. Verify an acceptable pattern check. For additional information, refer to Diagnosis and Testing in this section.
51. Assemble the axle housing tube.
  - Align the bolt holes and position the axle tube.
  - Position the axle identification tag.
  - Install the 4 bolts.
    - Tighten to 73 Nm (54 lb-ft).



52. Install a new stub shaft seal. For additional information, refer to [Stub Shaft Pilot Bearing and Seal](#) in this section.
53. Install a new circlip on the intermediate shaft end.

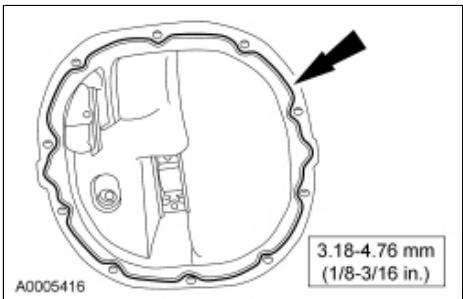


54. Insert the intermediate shaft and engage the circlip with the side gears.
55. Remove the axle assembly from the Holding Fixture and place it on the bench.
56. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

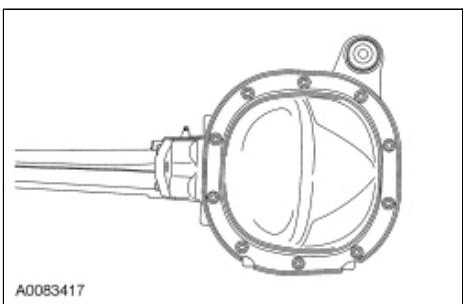
**NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface as shown in the illustration.

- Use silicone gasket and sealant.



57. Install the differential housing cover and the 10 cover bolts.
  - Tighten to 32 Nm (24 lb-ft).



58. Install the axle assembly. For additional information, refer to [Axle Assembly](#) in this section.
59. Remove the fill plug and fill the axle assembly with the specified type and amount of lubricant.
  - Tighten the fill plug to 25 Nm (18 lb-ft).

## Differential Case

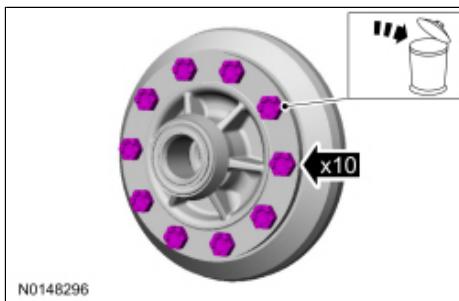
### Material

Item	Specification
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Threadlock and Sealer TA-25	WSK-M2G351-A5

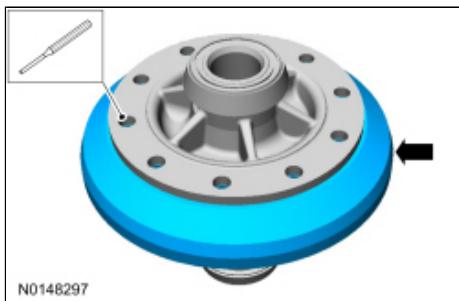
### Disassembly

**NOTE:** The Torsen® differential should be replaced as a unit only. Do not attempt to rebuild.

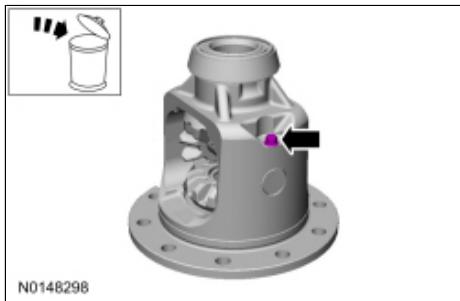
1. Remove the differential carrier. Refer to [Differential Carrier](#).
- 2.



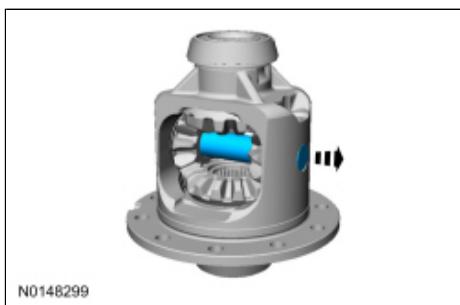
- 3.



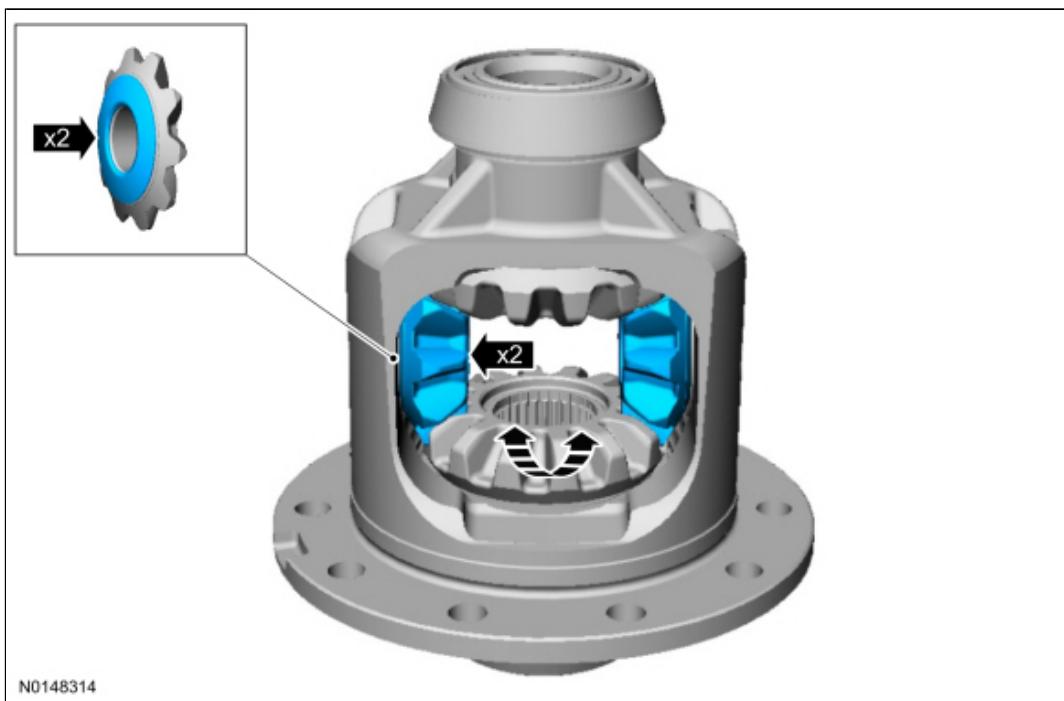
- 4.



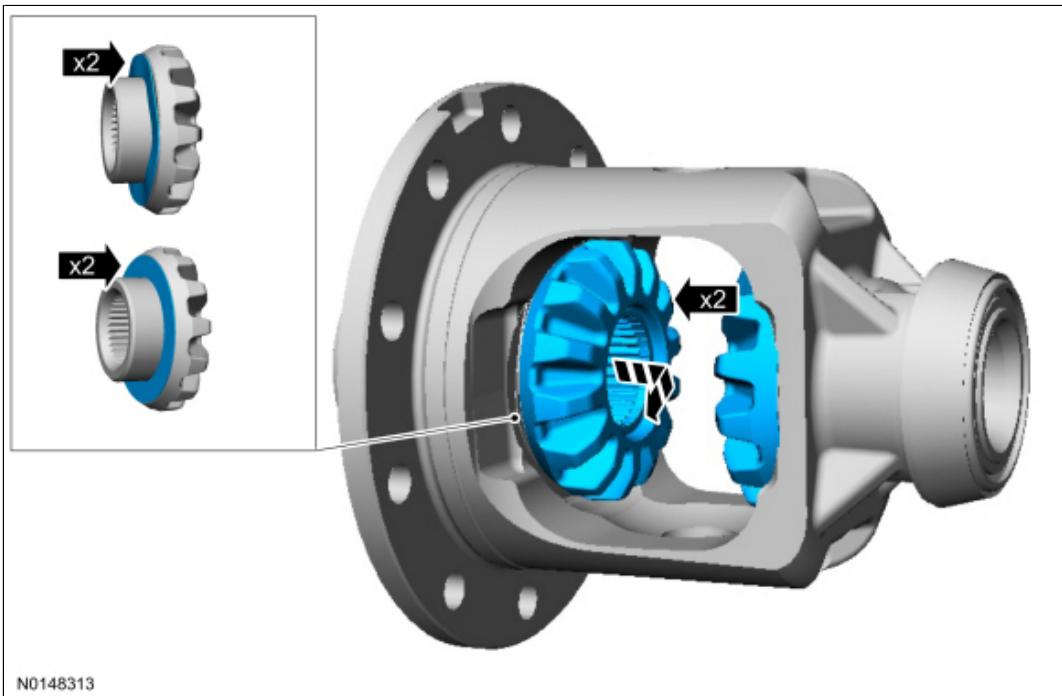
5.



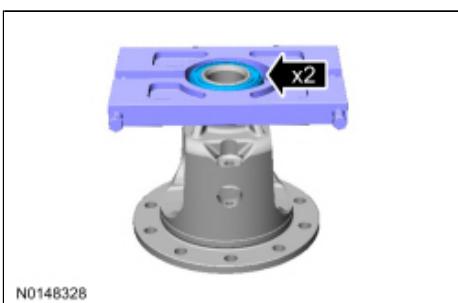
6.



7.

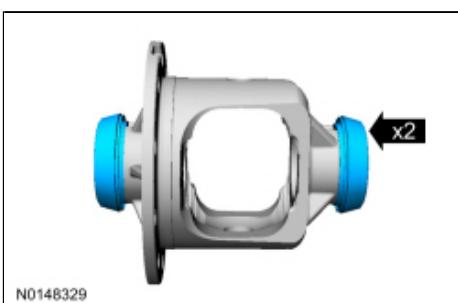


8. General Equipment: Hydraulic Press  
General Equipment: Bearing Puller

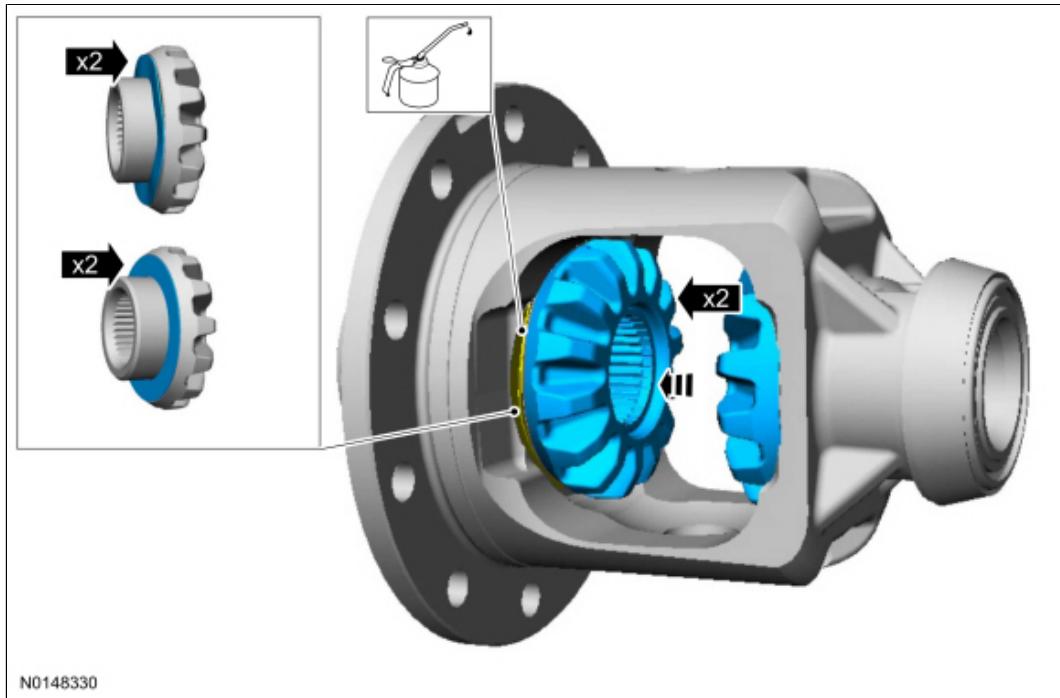


### Assembly

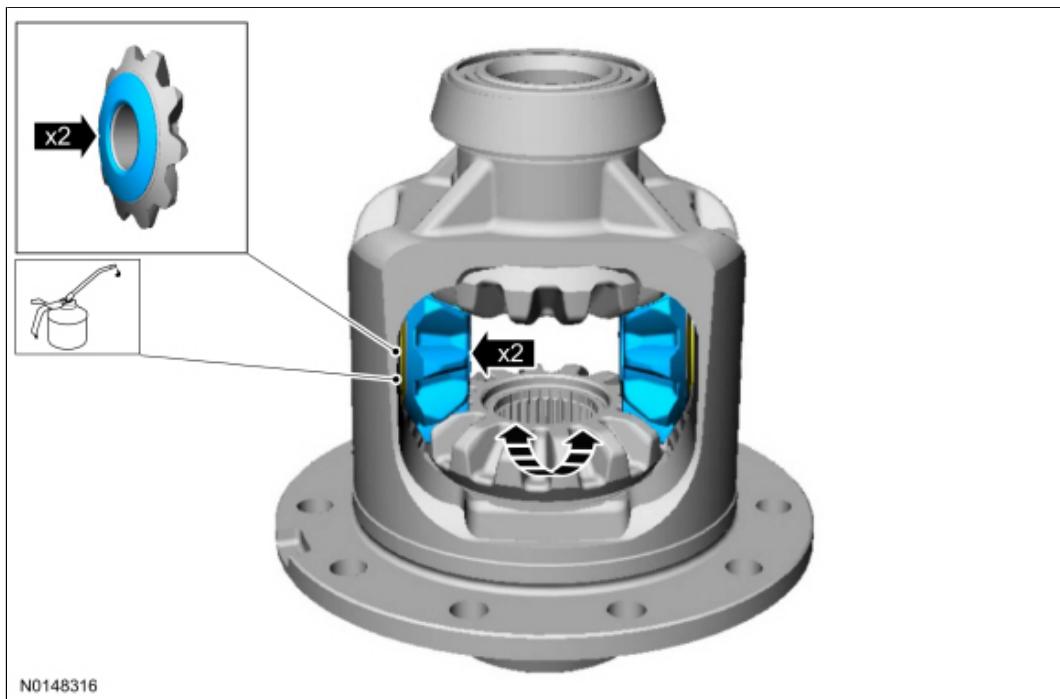
1. General Equipment: Hydraulic Press



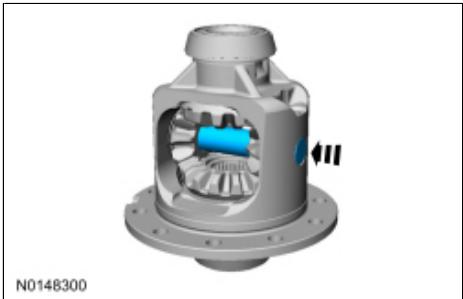
2.



3.

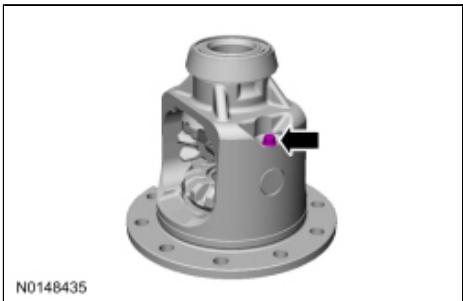


4.



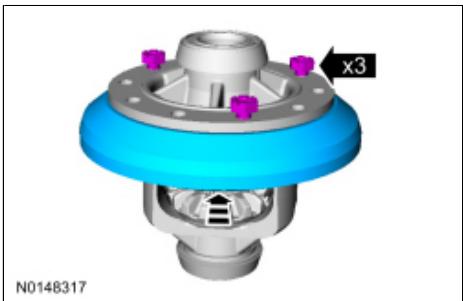
5. **NOTE:** If a new pinion shaft bolt is unavailable, coat the threads with sealer.

- Tighten to 30 Nm (22 lb-ft).



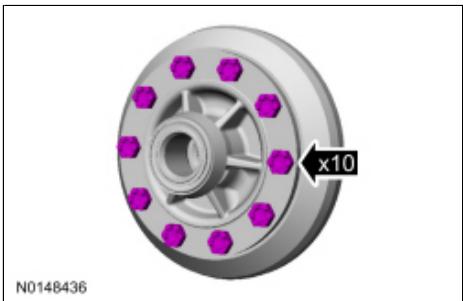
6. **NOTE:** Loosely install 3 bolts to align the ring gear and carrier bolt holes.

General Equipment: Hydraulic press



7.

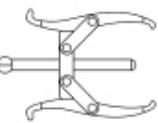
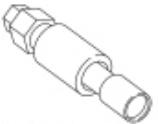
- Tighten to 128 Nm (95 lb-ft).



8. Install the differential carrier. Refer to [Differential Carrier](#).
-

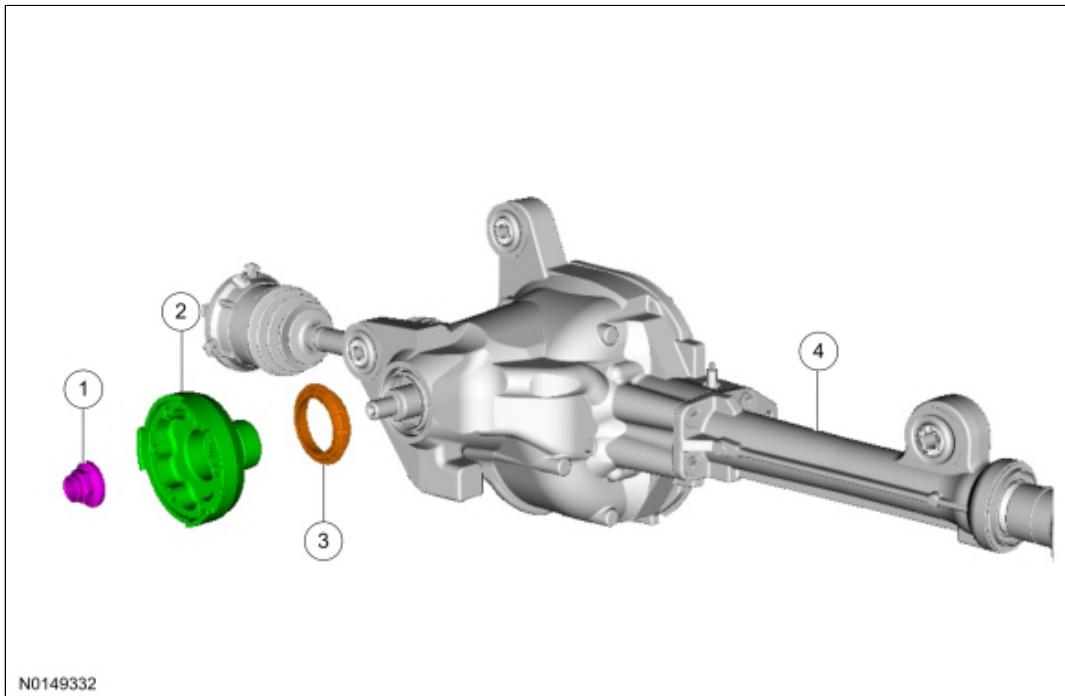
## Drive Pinion Flange and Seal

### Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-208 (T83P-4676-A)

### Material

Item	Specification
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A



N0149332

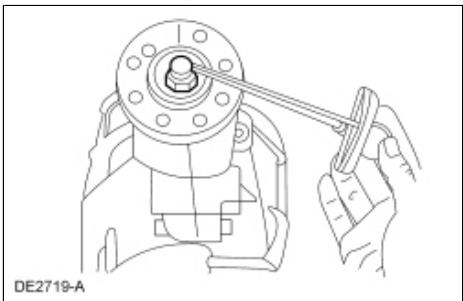
Item	Part Number	Description
1	389546	Pinion nut and washer
2	4858	Pinion flange
3	3N134	Drive pinion oil seal
4	3C202	Axle housing

### Removal

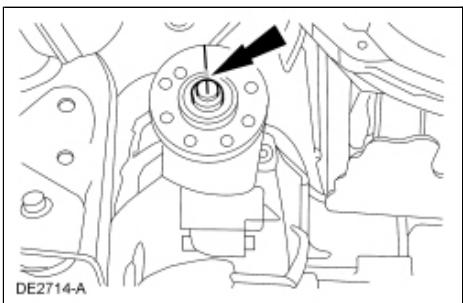
**NOTICE:** The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation as the original. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.

**NOTICE:** This operation disturbs the pinion bearing preload. Carefully reset the pinion bearing preload during assembly.

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to [Section 100-02](#).
2. Remove the front brake pads. Refer to [Section 206-03](#).
3. Remove the front driveshaft. Refer to [Section 205-01](#).
4. Measure and record the pinion bearing preload.
  - Using a Nm (lb-in) torque wrench, rotate the pinion gear. Measure the torque required to maintain pinion gear rotation.

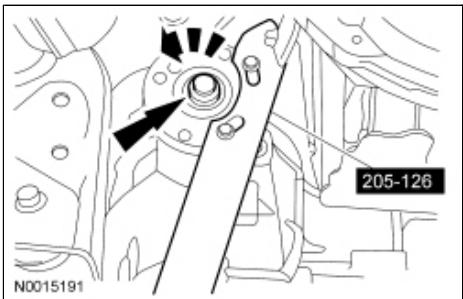


5. Index-mark the pinion flange and the drive pinion gear.

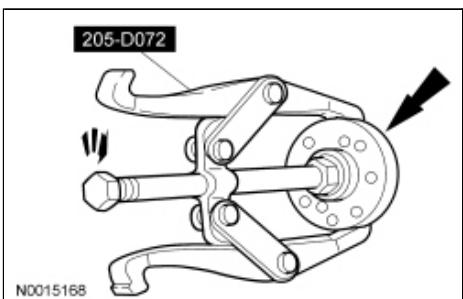


6. **NOTICE:** Install a new pinion nut with the same color as the original if not replacing the collapsible spacer. If a new collapsible spacer is installed, install the nut in the kit or damage to the component may occur.

Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, remove and discard the pinion nut and washer.

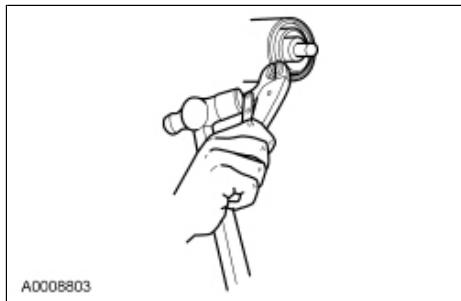


7. Using the 2 Jaw Puller, remove the pinion flange.



8. Inspect the pinion flange for burrs and damage. Inspect the end of the pinion flange that contacts the pinion bearing cone, pinion nut counterbore and drive pinion seal surface for nicks. Discard the pinion flange if damaged.
9. **NOTICE: Do not damage the axle housing.**

Force up on the metal flange of the drive pinion seal. Install gripping pliers and strike with a hammer to remove the drive pinion seal.



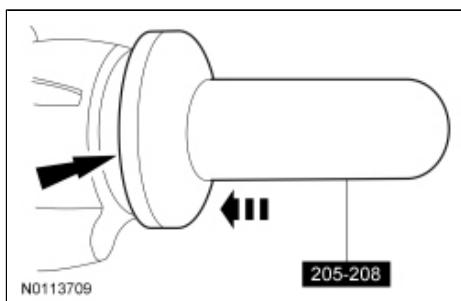
10. Verify the splines on the drive pinion gear are free of burrs. If burrs are evident, remove them with a fine crocus cloth.
11. Clean the drive pinion seal bore.

### Installation

1. **NOTE:** Lubricate the drive pinion seal lips with axle lubricant.

**NOTE:** Drive pinion seal must be fully seated all the way around or drive pinion seal damage will occur.

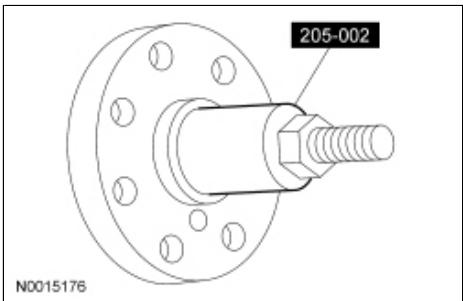
Using the Drive Pinion Oil Seal Installer, install the drive pinion seal.



2. **NOTICE: Never use a hammer or install the pinion flange with power tools.**

**NOTE:** Lubricate the pinion flange splines with axle lubricant.

Align the index marks made during removal and, using the Drive Pinion Flange Installer, install the pinion flange.



3. **NOTICE:** The color on the rear face of the drive pinion nut is critical to this repair. Use the same color new drive pinion nut for installation as the original. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.

Select the correct pinion nut for installation.

#### 8.8 In. Drive Pinion Nut

Part Number	Color Description	Part Description
389546-S100	Orange	Pinion nut
4320	Purple	Pinion nut
4C121	Purple	Kit with spacer for all 223.52 mm (8.8 in) axles

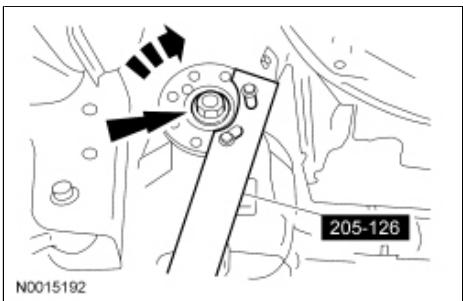
4. **NOTICE:** Install a new pinion nut with the same color as the original if not replacing the collapsible spacer or damage to the component may occur.

Install the new washer and pinion nut. Only hand-tighten the pinion nut at this time.

5. **NOTICE:** Do not loosen the pinion nut to reduce drive pinion bearing preload. Install a new drive pinion collapsible spacer and pinion nut if drive pinion bearing preload reduction is necessary. If a new collapsible spacer must be installed for pinion bearing preload reduction, install the nut supplied with the new spacer or damage to the component may occur.

Using the Drive Pinion Flange Holding Fixture to hold the pinion flange, tighten the pinion nut to set the drive pinion bearing preload.

- Tighten the pinion nut, rotating the pinion occasionally to make sure the drive pinion bearings are seating correctly. Take frequent drive pinion bearing preload readings by rotating the drive pinion gear with a Nm (lb-in) torque wrench. The final reading must be 0.56 Nm (5 lb-in) more than the initial reading taken during removal.



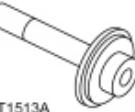
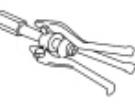
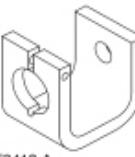
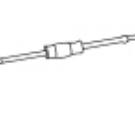
6. Install the front driveshaft. Refer to [Section 205-01](#).

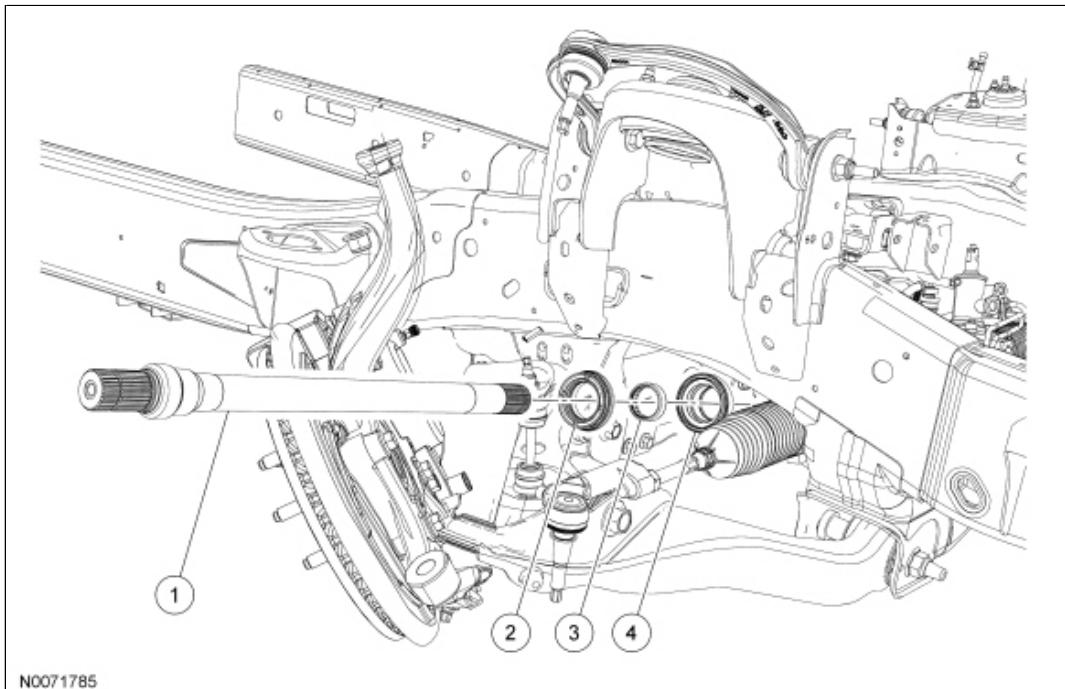
7. Install the disc brake pads. Refer to [Section 206-03](#).

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## Stub Shaft Pilot Bearing and Seal

### Special Tool(s)

 ST1326-A	Handle 205-D055 (D81L-4000-A)
 ST1513A	Installer, Axle Shaft Oil Seal 205-123 (T78P-1177-A)
 ST2369-A	Installer, Wheel Speed Sensor Ring 206-034 (T88P-20202-B)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2418-A	Remover, Transmission Fluid Pump 307-397
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)



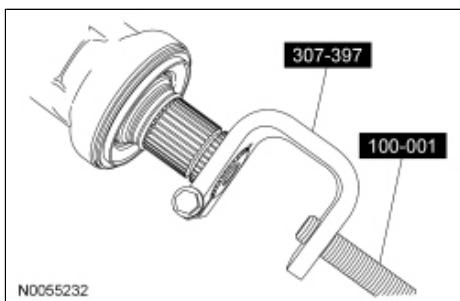
N0071785

Item	Part Number	Description
1	3A380	Intermediate shaft
2	3B112	Stub shaft seal
3	4B413	Stub shaft bearing
4	3B210	Axle housing tube

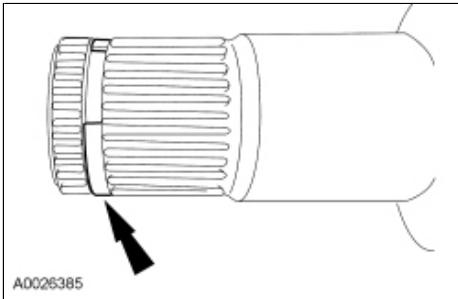
### Removal

**NOTE:** Install a new stub shaft seal whenever a halfshaft is removed.

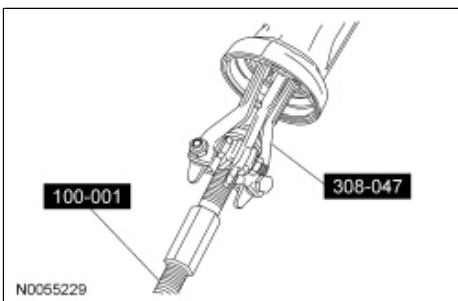
1. Remove the halfshafts. For additional information, refer to [Section 205-03](#).
2. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.



3. Remove and discard the intermediate shaft circlip.

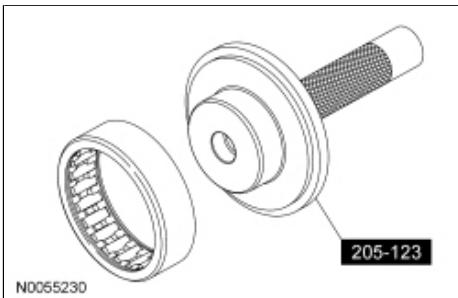


4. Using a suitable seal remover, remove and discard the stub shaft pilot bearing oil seal.
5. Using the Bearing Cup Remover and Slide Hammer, remove and discard the stub shaft pilot bearing.

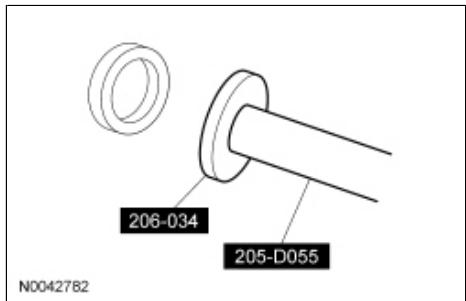


### Installation

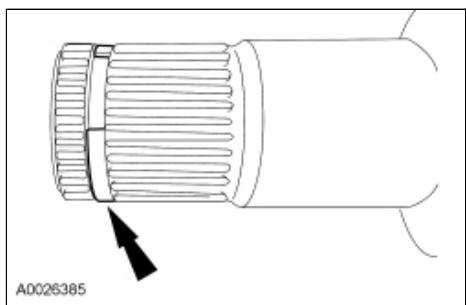
1. Position the stub shaft pilot bearing in the axle tube or differential housing bore and using the Axle Shaft Oil Seal Installer, install the bearing.



2. Carefully align the stub shaft pilot bearing oil seal with the housing bore and install the stub shaft bearing oil seal flush in the housing using the Wheel Speed Sensor Ring Installer and Handle.

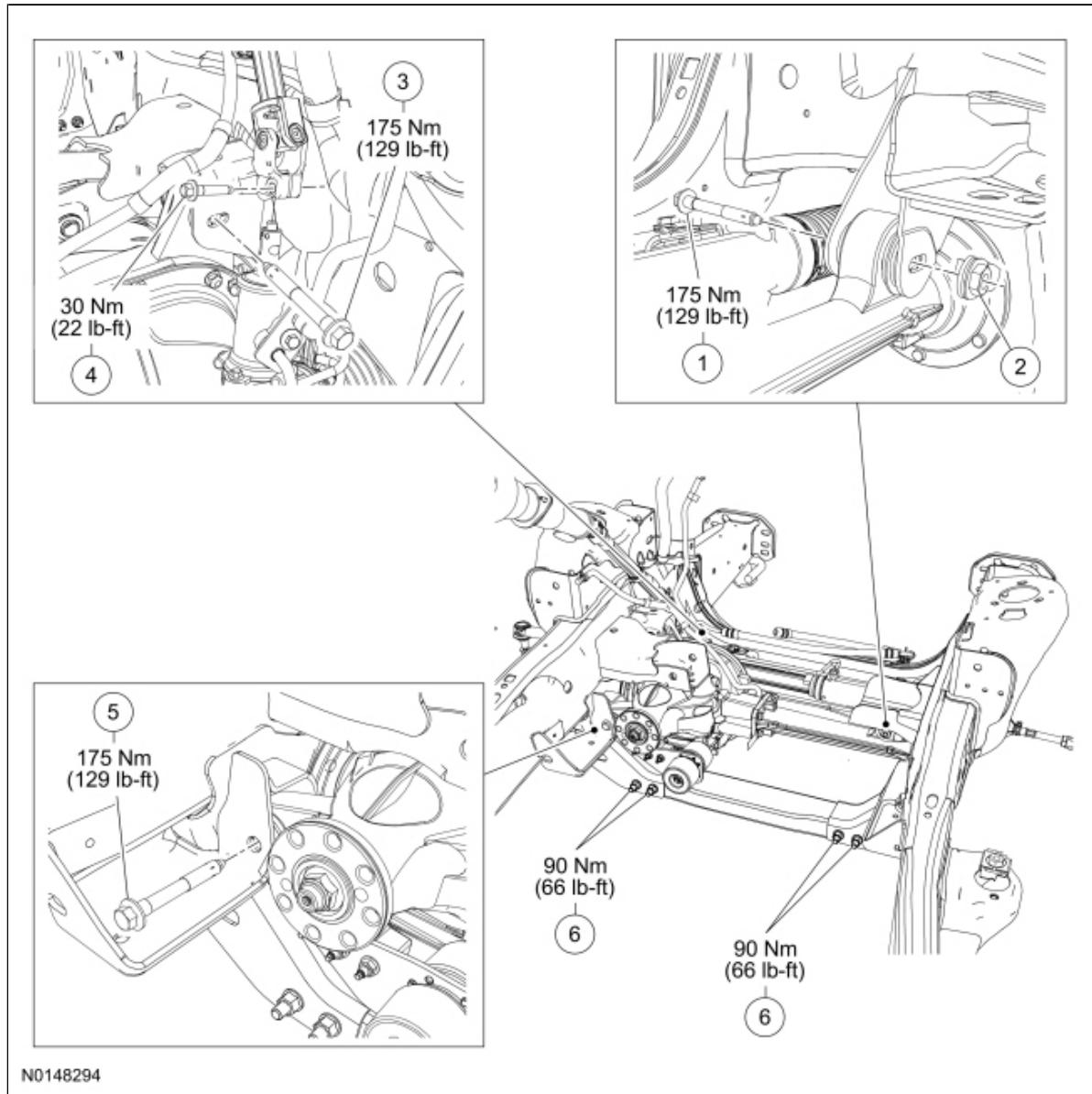


3. Install a new circlip on the intermediate shaft end.



4. Insert the intermediate shaft and engage the circlip with the differential side gear.
  5. Install the halfshafts. For additional information, refer to [Section 205-04](#).
-

## Axle Assembly

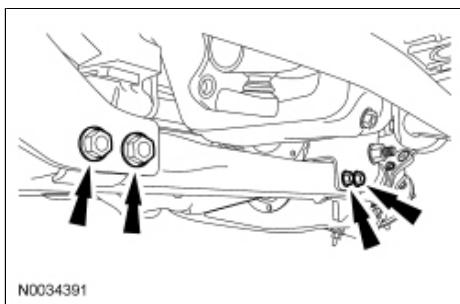


Item	Part Number	Description
1	W712724	Axle tube bushing bolt
2	W712723	Axle tube bushing flagnut
3	W712724	Rear axle housing bushing bolt
4	N808684	Steering column coupler bolt

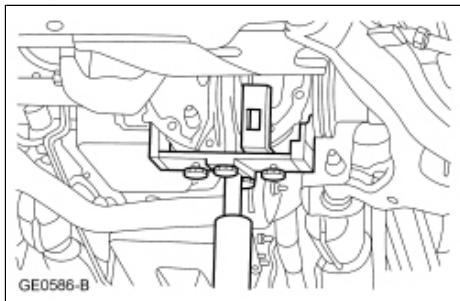
5	W712743	Front axle housing bushing support bolt
6	636893	Crossmember nuts (4 required)

### Removal and Installation

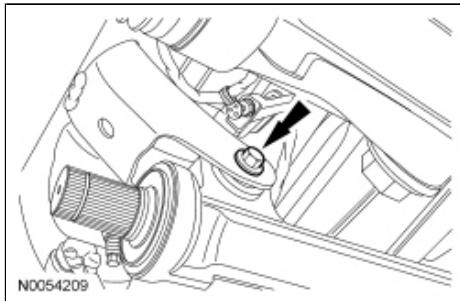
1. Remove the front driveshaft. Refer to [Section 205-01](#).
2. Remove the halfshafts. Refer to [Section 205-04](#).
3. Remove the 4 crossmember nuts and bolts and the crossmember.
  - To install, tighten to 90 Nm (66 lb-ft).



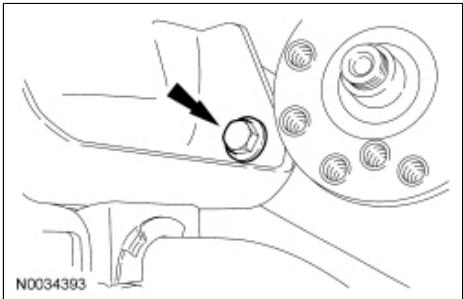
4. Use a high-lift jack to support the axle assembly.



5. Remove the axle tube bushing bolt and flagnut.
  - To install, tighten to 175 Nm (129 lb-ft).

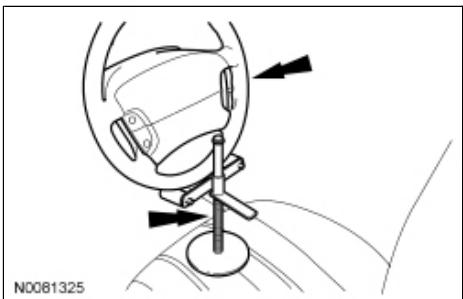


6. Remove the front axle housing bushing bolt.
  - To install, tighten to 175 Nm (129 lb-ft).



7. **NOTE:** Use a steering wheel holding device (such as a Hunter® 28-75-1 or equivalent).

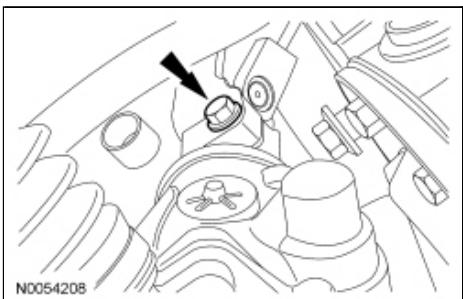
Using a suitable holding device, hold the steering wheel in the straight-ahead position.



8. **NOTICE:** Do not allow the steering column to rotate while the steering column shaft is disconnected or damage to the clockspring may result. If there is evidence that the steering column has rotated, the clockspring must be removed and recentered. Refer to [Section 501-20B](#).

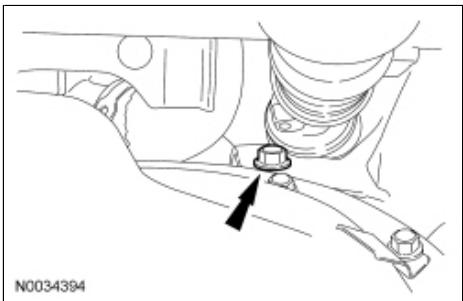
Remove and discard the steering column shaft-to-steering gear bolt and disconnect the shaft from the steering gear.

- To install, tighten the new bolt to 30 Nm (22 lb-ft).



9. Remove the rear axle housing bushing bolt.

- To install, tighten to 175 Nm (129 lb-ft).



10. Carefully lower the front drive axle assembly.
11. Disconnect the vent hose from the axle vent barbed fitting.
12. **NOTE:** Make sure the axle vent hose is connected.

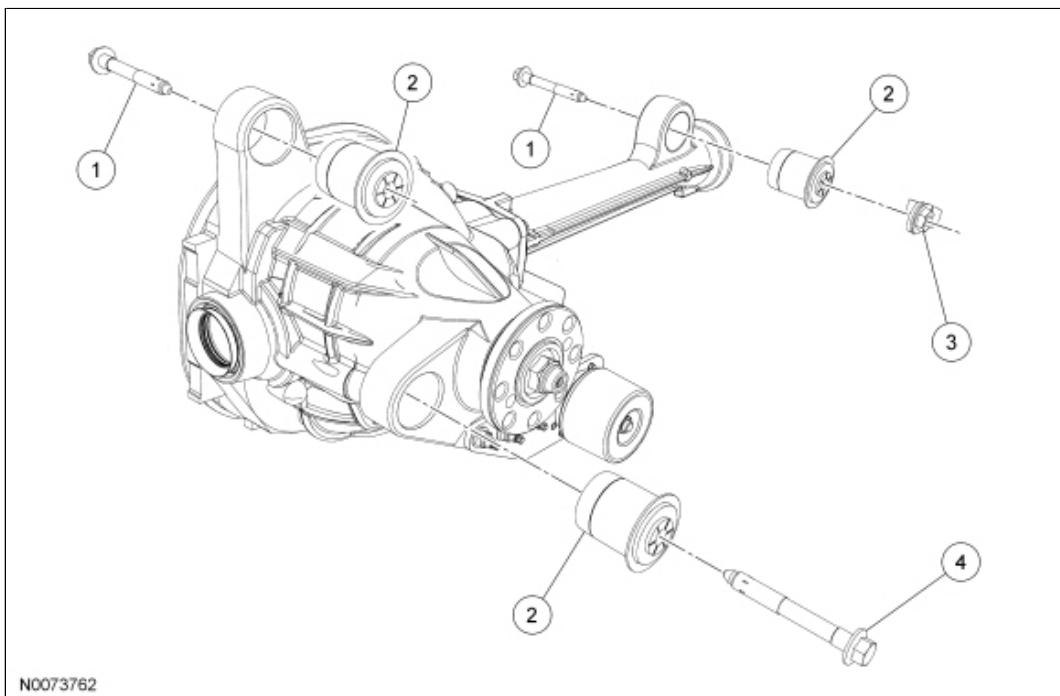
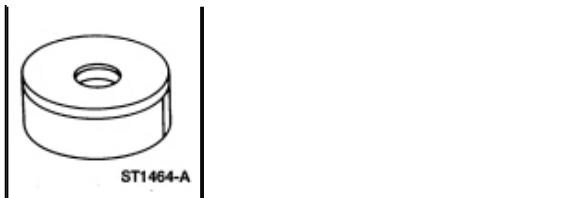
To install, reverse the removal procedure.

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## Axle Carrier Bushing

### Special Tool(s)

 ST1162-A	Installer, Front Axle Mounting Bushing Drawbolt 205-374 (T96T-5638-H)
 ST2586-A	Installer, Front Differential Mounting Bushing 204-187 (T95T-5638-AH)
 ST2265-A	Installer, Wheel Hub Dust Seal 205-289 (T89P-1249-A)
 ST1159-A	Remover, Front Axle Mounting Bushing Cup 205-371 (T96T-5638-E)
 ST1155-A	Remover, Front Axle Mounting Bushing 205-376 (T96T-5638-K)
 ST2587-A	Remover, Front Differential Housing Bushing 204-186 (T95T-5638-AH)
	Remover/Installer, Front Differential Housing Bushing 205-527/1



Item	Part Number	Description
1	W712724	Axle bushing bolts (2 required)
2	5638	Axle bushings (3 required)
3	W712723	Axle bushing flagnut
4	W712743	Axle bushing bolt

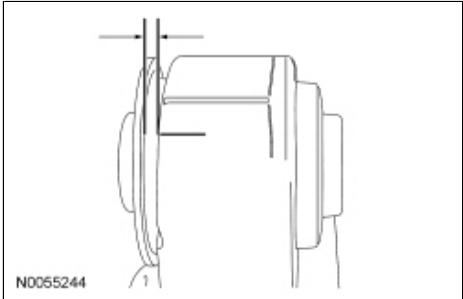
## Removal

### All bushings

1. **NOTE:** It is not necessary to remove the axle assembly from the jack.

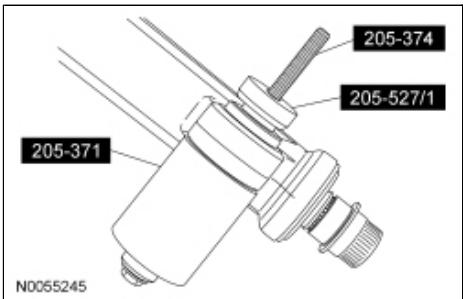
Remove the axle assembly. For additional information, refer to [Axle Assembly](#) in this section.

2. Measure and record the width of the gap between the bushing front lip and the housing. Mark the housing at the point where the measurement was taken.



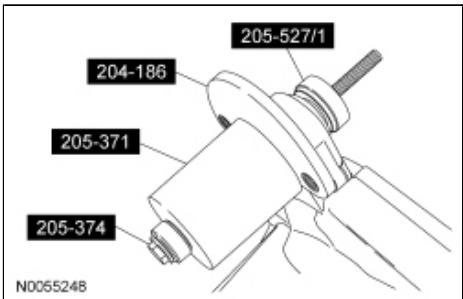
#### Axle tube bushing

3. Position the Front Axle Mounting Bushing Cup Remover, Front Differential Housing Bushing Remover/Installer and Front Axle Mounting Bushing Drawbolt Installer as shown. Turn in the drawbar to remove the bushing.



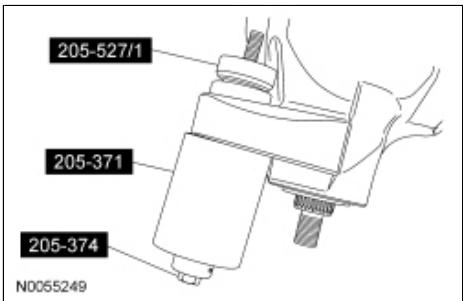
#### Rear housing bushing

4. Position the Front Differential Housing Bushing Remover, Front Axle Mounting Bushing Cup Remover, Front Differential Housing Bushing Remover/Installer and Front Axle Mounting Bushing Drawbolt Installer as shown. Turn in the drawbar to remove the bushing.



#### Front housing bushing

5. Remove the pinion flange. For additional information, refer to [Drive Pinion Flange and Seal](#) in this section.
6. Position the Front Axle Mounting Bushing Cup Remover, Front Differential Housing Bushing Remover/Installer and Front Axle Mounting Bushing Drawbolt Installer as shown. Turn in the drawbar to remove the bushing.



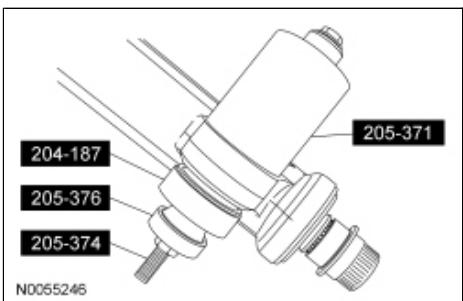
### All bushings

7. Inspect the bushing bores for wear or damage.

### Installation

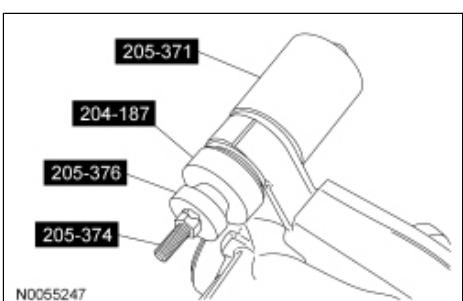
#### Axle tube bushing

1. Position the bushing and the Front Axle Mounting Bushing Remover, Front Differential Mounting Bushing Installer, Front Axle Mounting Bushing Cup Remover and Front Axle Mounting Bushing Drawbolt Installer as shown. Draw the bushing into the bushing bore to the same depth and point measured before removal.



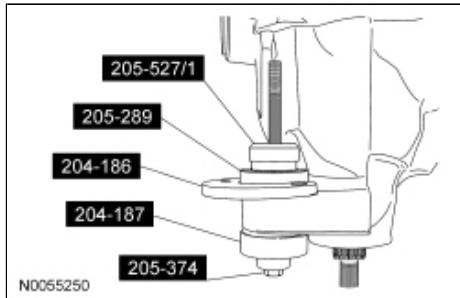
#### Rear housing bushing

2. Position the bushing and the Front Axle Mounting Bushing Remover, Front Differential Mounting Bushing Installer, Front Axle Mounting Bushing Cup Remover and Front Axle Mounting Bushing Drawbolt Installer as shown. Draw the bushing into the bushing bore to the same depth and point measured before removal.



#### Front housing bushing

3. Position the bushing and the Front Differential Housing Bushing Remover/Installer, Wheel Hub Dust Seal Installer, Front Differential Housing Bushing Remover, Front Differential Mounting Bushing Installer and Front Axle Mounting Bushing Drawbolt Installer as shown. Draw the bushing into the bushing bore to the same depth and point measured before removal.



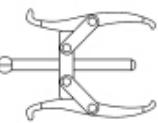
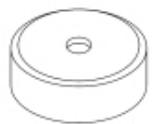
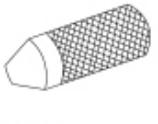
4. Install the U-joint flange. For additional information, refer to [Drive Pinion Flange and Seal](#) in this section.

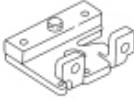
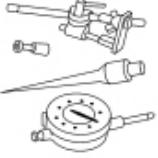
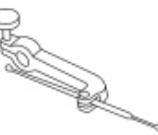
#### All bushings

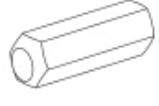
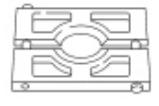
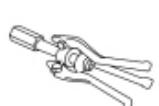
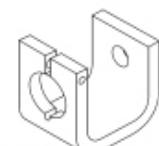
5. Install the axle assembly. For additional information, refer to [Axle Assembly](#) in this section.
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## Differential Bearings

### Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1433-B	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)

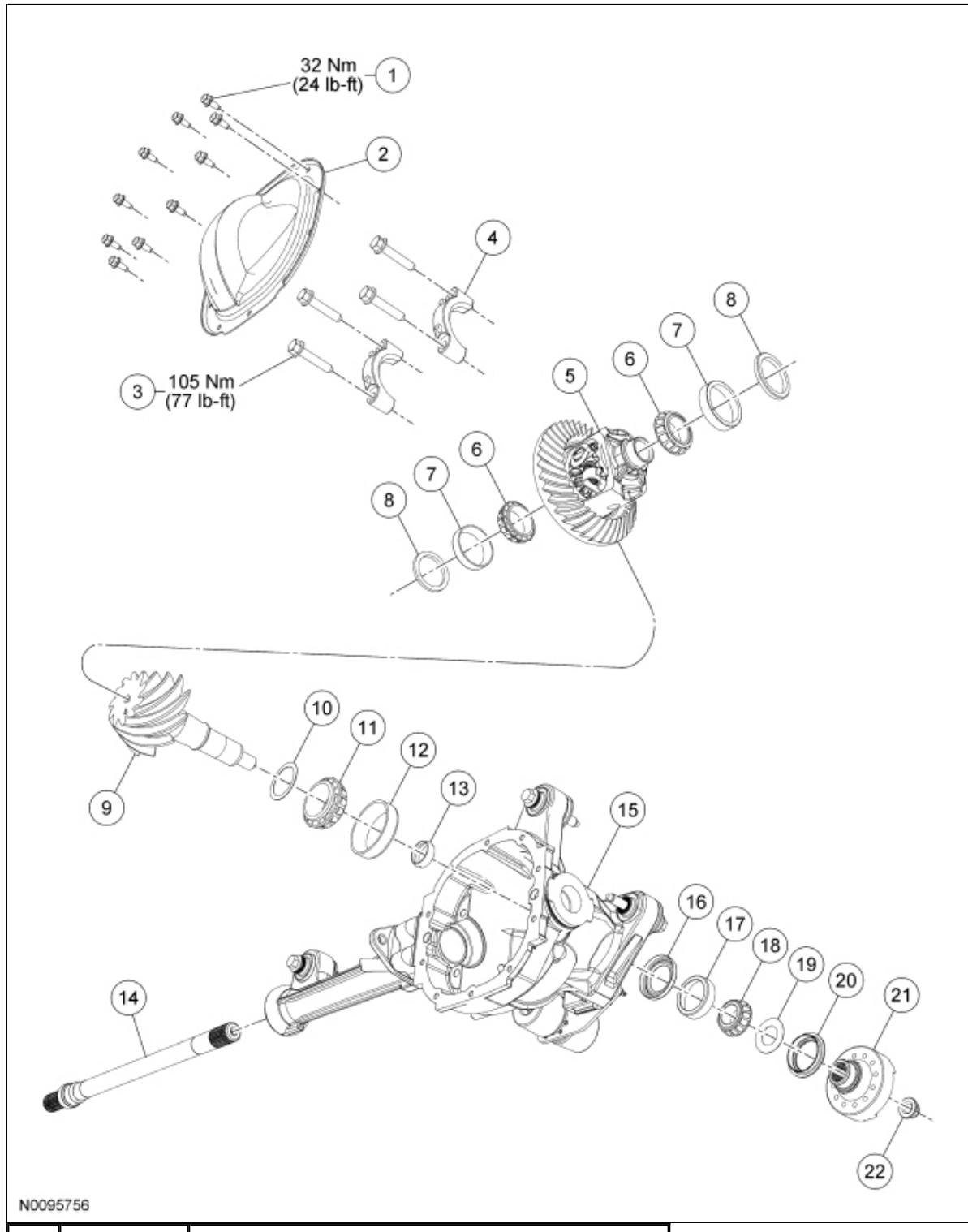
	 ST1150-B
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1357-A	Installer, Differential Carrier Bearing 205-D044 (D81T-4221-A) or equivalent
 ST1437-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Installer, Drive Pinion Bearing Cone

 ST1484-A	205-005 (T53T-4621-C)
 ST1361-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-208 (T83P-4676-A)
 ST1882-A	Protector, Drive Pinion Thread 205-460
 ST1310-A	Remover, Bearing 205-055 (T71P-4621-B)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2418-A	Remover, Transmission Fluid Pump 307-397
	Slide Hammer 100-001 (T50T-100-A)

	
ST1185-A	
	Spreader, Differential Carrier 205-001 (TOOL-4000-E)
ST1259-A	
	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)
ST1344-A	

#### Material

Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

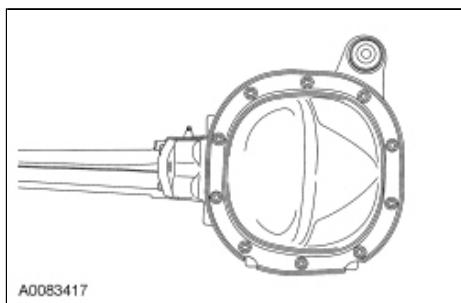


Item	Part Number	Description
1	390919	Differential housing cover bolt (10 required)

2	3N136	Differential housing cover
3	—	Differential bearing cap bolt (part of 3A412) (4 required)
4	—	Differential bearing cap (part of 3A412) (2 required)
5	3C202	Differential assembly
6	4221	Differential bearings (2 required)
7	4221	Differential bearing cups (2 required)
8	4A451	Differential bearing shims (2 required)
9	—	Pinion gear (part of 4209)
10	4663	Drive pinion bearing adjustment shim
11	4628	Inner drive pinion bearing cup
12	4630	Inner drive pinion bearing
13	4662	Drive pinion collapsible spacer
14	3A380	Intermediate axle shaft
15	3A412	Differential housing
16	4631	Drive pinion oil baffle
17	4616	Drive pinion outer bearing cup
18	4621	Drive pinion outer bearing
19	386989	Drive pinion oil slinger
20	3N134	Drive pinion oil seal
21	4858	Drive pinion flange
22	389546	Drive pinion nut and washer

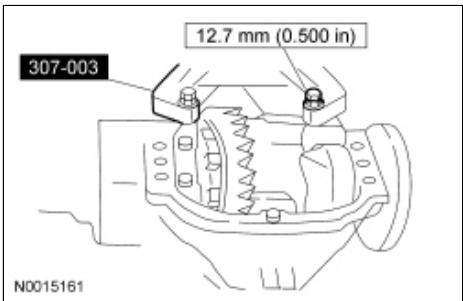
### Removal

1. Remove the axle assembly. For additional information, refer to [Axle Assembly](#) in this section.
2. Remove the 10 bolts and the differential housing cover.
  - Drain the fluid.

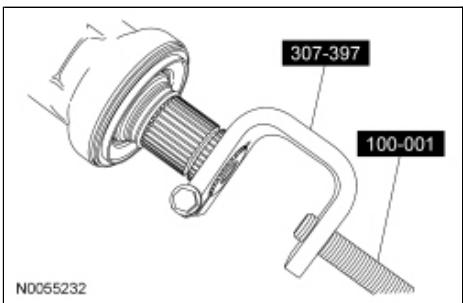


3. **NOTICE:** The fixture mounting bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.

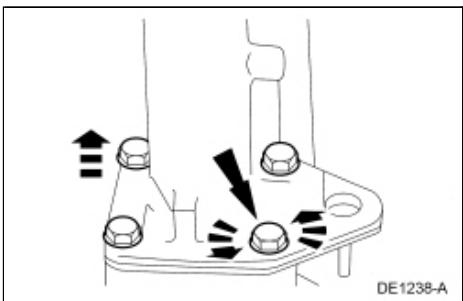
Install the Transmission Holding Fixture.



4. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.

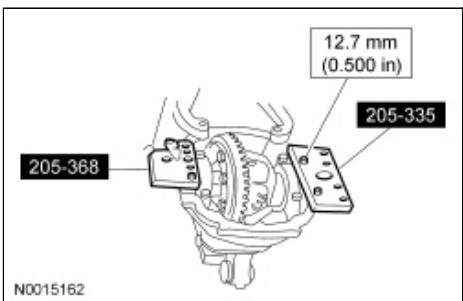


5. Remove the 4 bolts and the axle housing tube.



6. **NOTICE:** The housing spreader adapter bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.

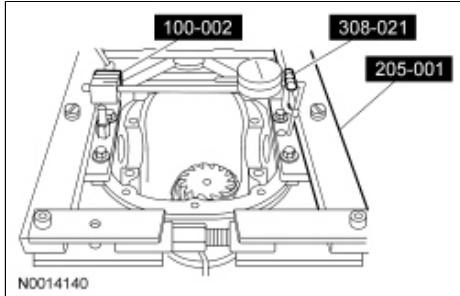
Install the Differential Housing Spreader Plate and Adapter for Differential Housing Spreader.



7. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier

Spreader.

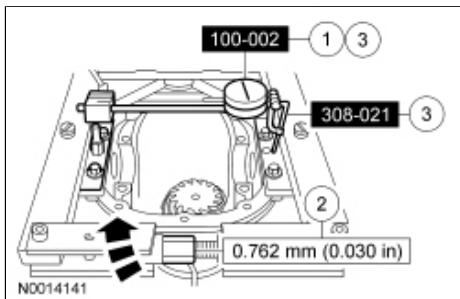
- Position the adapter tip in the spreader adapter hole.



8. **NOTICE:** Overspreading may damage the axle housing.

Spread the axle housing to the specification.

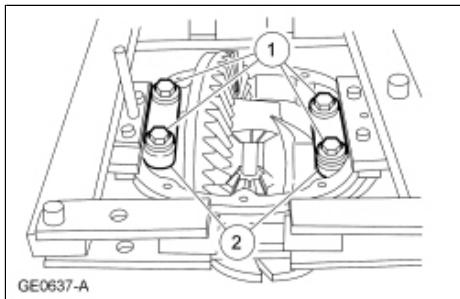
1. Adjust the Dial Indicator Gauge to zero.
2. Tighten the housing spreader screw to spread the axle housing to the specification.
3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.



9. **NOTICE:** Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the bearing caps in their original location and position or damage to the component may occur.

Mark and remove the 2 differential bearing caps.

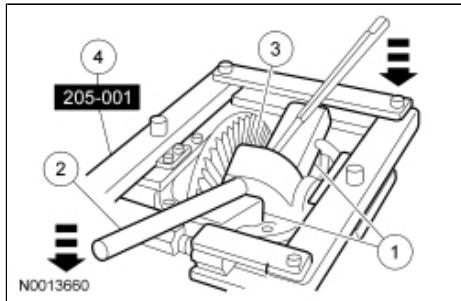
1. Remove the 4 bolts.
2. Remove the 2 differential bearing caps.



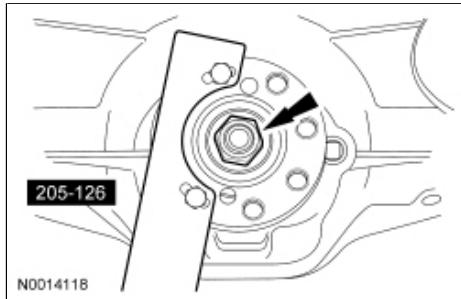
10. **NOTE:** Use wood blocks to avoid axle housing damage.

Remove the differential assembly from the axle housing.

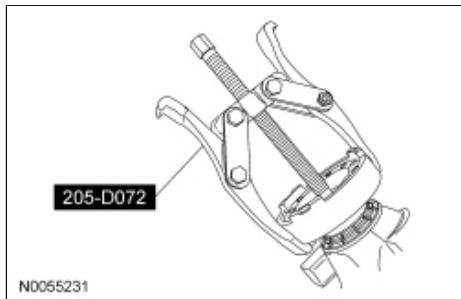
1. Position the wood blocks.
2. Position and push down on the 2 pry bars.
3. Remove the differential assembly.
4. Remove the Differential Carrier Spreader.



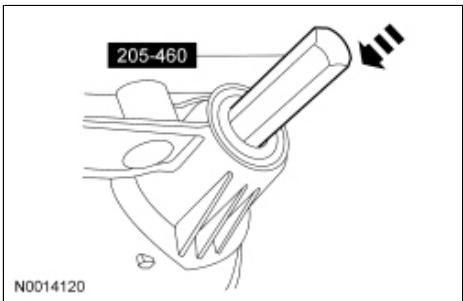
11. Install the Drive Pinion Flange Holding Fixture and loosen, but do not remove, the pinion nut.



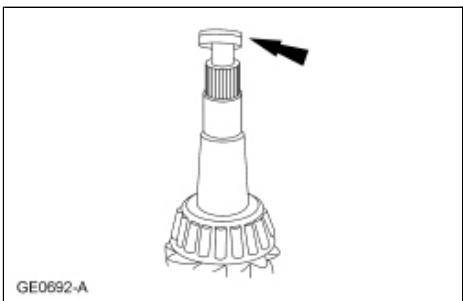
12. With the pinion nut still engaged by a few threads, use the 2 Jaw Puller to separate the axle U-joint flange from the pinion gear.



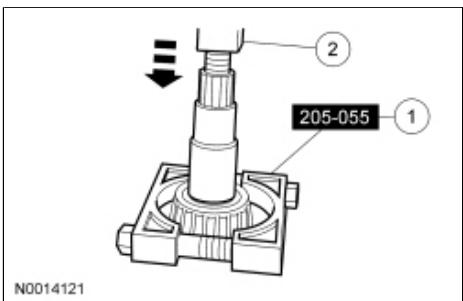
13. Remove the nut and the flange.
14. Using the Drive Pinion Thread Protector and a soft hammer, remove the pinion gear.



15. Remove and discard the drive pinion collapsible spacer.



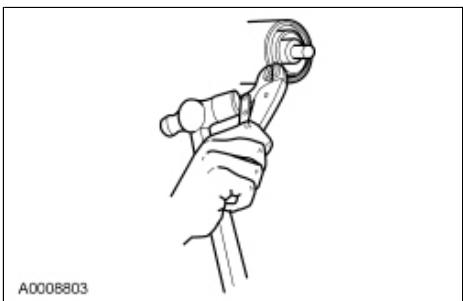
16. Using the Bearing Remover and a press, remove the drive pinion inner bearing.
  1. Position the Bearing Remover under the drive pinion inner bearing.
  2. Using a press, remove the inner drive pinion bearing and shim.



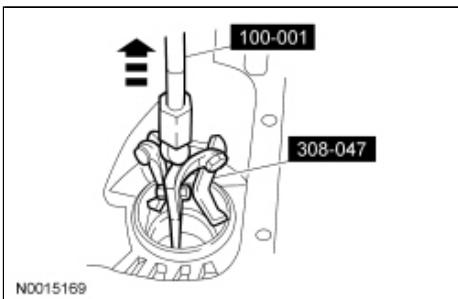
17. **NOTE:** Do not damage the carrier housing while removing the pinion seal.

Remove the pinion seal and slinger.

- Pry up on the seal flange. Install gripping pliers and strike with a hammer to remove the seal.

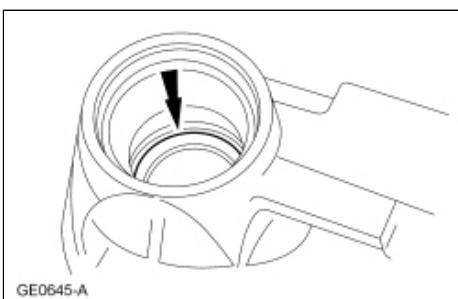


18. Remove the outer pinion bearing.
19. Using the Bearing Cup Remover and Slide Hammer, remove the inner drive pinion bearing cup.

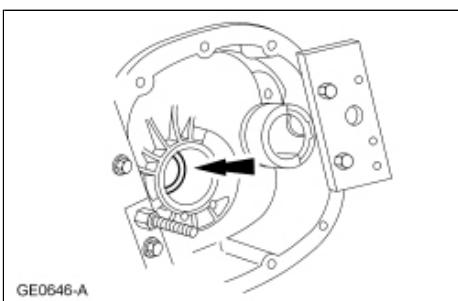


20. **NOTE:** The pinion bearing oil baffle aids in bearing lubrication. Normally, it is not necessary to remove the baffle.

If necessary, remove the pinion bearing oil baffle.



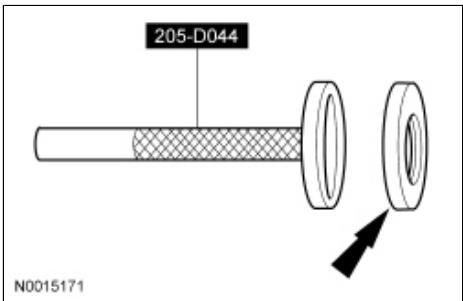
21. Remove the outer drive pinion bearing cup by tapping alternately on each side to prevent the drive pinion bearing cup from becoming misaligned.



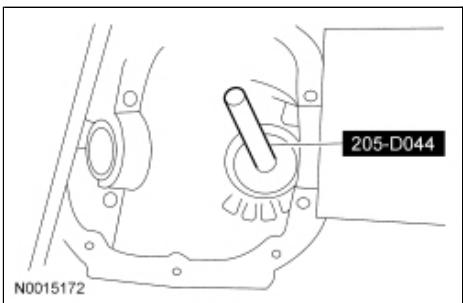
## Installation

1. **NOTICE:** Do not omit the drive pinion bearing oil baffle or drive pinion bearing failure may result.

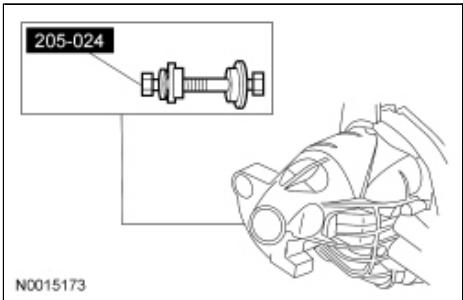
If removed, position the drive pinion bearing oil baffle on the Differential Carrier Bearing Installer.



2. Using the Differential Carrier Bearing Installer, install the drive pinion bearing oil baffle.



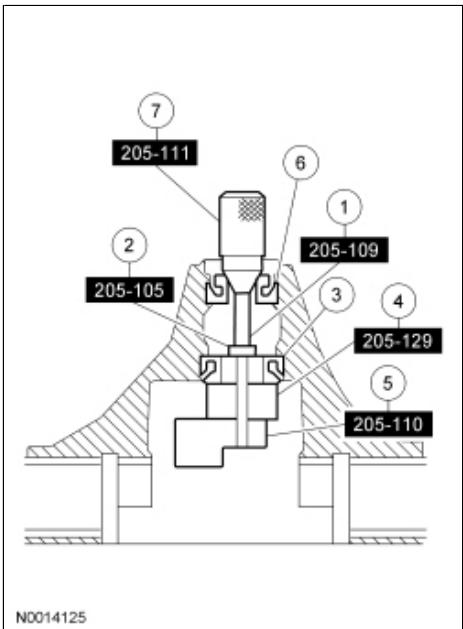
3. Using the Drive Pinion Bearing Cup Installer, install the drive pinion bearing cups.



4. **NOTICE:** Use the same drive pinion bearings and the drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly or damage to the component may occur.

**NOTE:** Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

Assemble and position the Adapters.



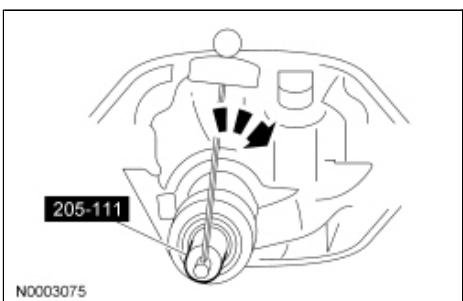
N0014125

Item	Part Number	Description
1	205-109	Adapter for 205-S127 (T76P-4020-A9)
2	205-105	Adapter for 205-S127 (T76P-4020-A3)
3	4630	Drive pinion bearing (inner)
4	205-129	Adapter for 105-S127 (T79P-4020-A18)
5	205-110	Adapter for 205-S127 (T76P-4020-A10)
6	4621	Drive pinion bearing (outer)
7	205-111	Adapter for 205-S127 (T76P-4020-A11)

5. **NOTE:** This step duplicates final drive pinion bearing preload.

Tighten the Adapter.

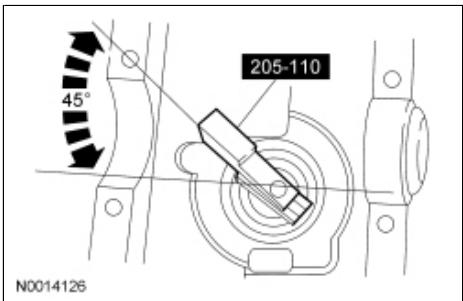
- Tighten to 2.2 Nm (20 lb-in).



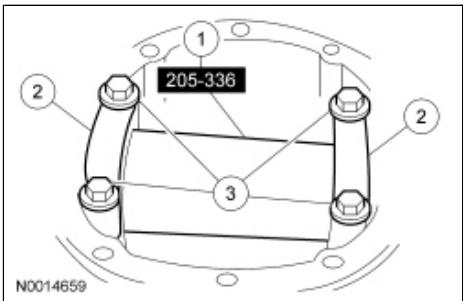
N0003075

6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings and position the Adapter.



7. Install the Drive Pinion Gauge Tube.
  1. Position the Drive Pinion Gauge Tube.
  2. Install the 2 differential bearing caps.
  3. Install the 4 differential bearing cap bolts.
    - Tighten to 105 Nm (77 lb-ft).

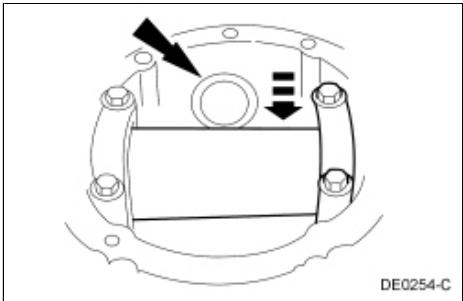


8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

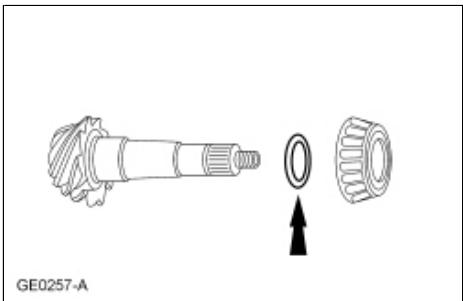
**NOTE:** A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the gauge block and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required, which results in a deep tooth contact in final assembly of integral axle assemblies.

Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.

- After the correct drive pinion bearing adjustment shim thickness has been determined, remove all of the Adapters.



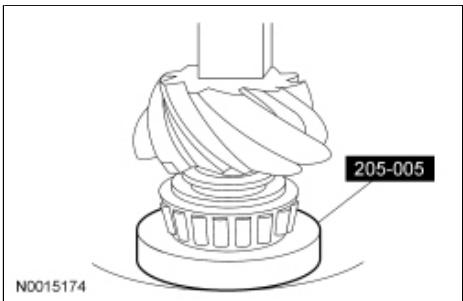
9. Position the drive pinion bearing adjustment shim and the inner pinion bearing on the drive pinion gear stem.



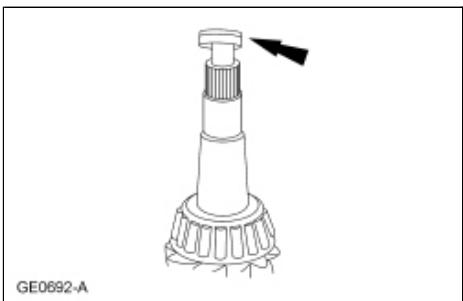
10. **NOTE:** The same drive pinion bearing from the previous steps must be used.

Install the inner drive pinion bearing.

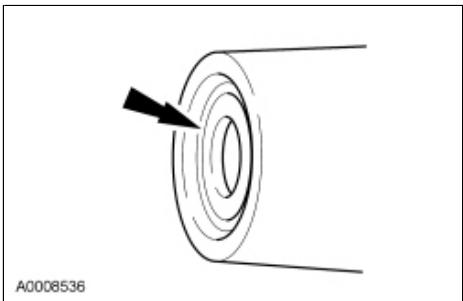
- Place the drive pinion bearing adjustment shim on the drive pinion gear.
- Using a suitable press and the Drive Pinion Bearing Cone Installer, press the inner drive pinion bearing until it is firmly seated on the pinion gear.



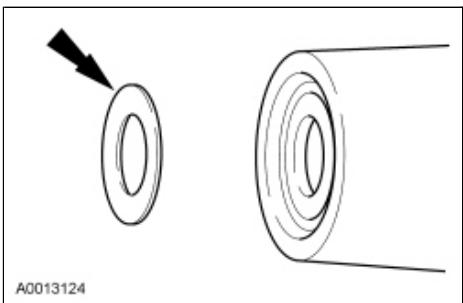
11. Place a new drive pinion collapsible spacer on the drive pinion gear.



12. Install the outer drive pinion bearing.



13. Install the drive pinion oil slinger.

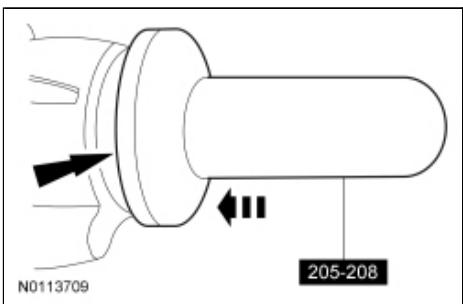


14. **NOTE:** Coat the drive pinion seal lips with long-life grease.

Install the drive pinion seal on the Drive Pinion Oil Seal Installer.

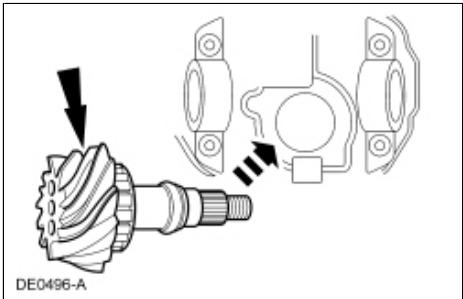
15. **NOTE:** If the drive pinion seal becomes misaligned during installation, remove it and install a new drive pinion seal.

Using the Drive Pinion Oil Seal Installer, install the drive pinion seal.

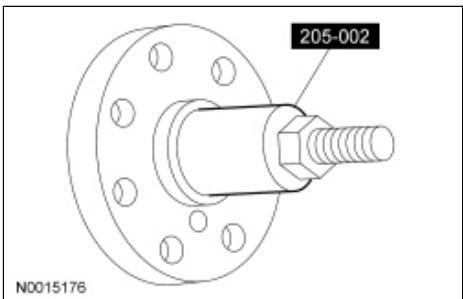


16. Lightly lubricate the drive pinion gear splines with rear axle lubricant.

17. Position the drive pinion gear in the axle housing.



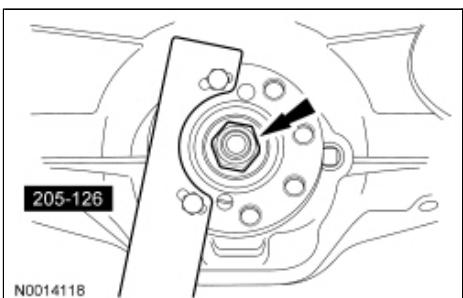
18. Position the pinion flange.
19. Using the Drive Pinion Flange Installer, install the pinion flange.

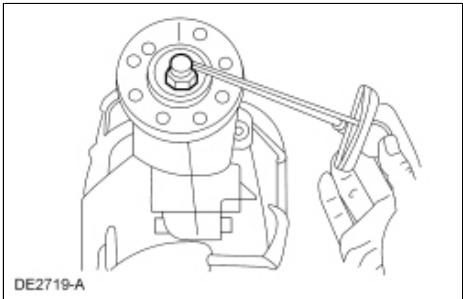


20. Apply a small amount of axle lubricant to the washer side of the new pinion nut and install the new pinion nut.
21. **NOTICE:** Do not loosen the pinion nut to reduce drive pinion bearing preload under any circumstance. If it is necessary to reduce drive pinion bearing preload, install a new drive pinion collapsible spacer and pinion nut or damage to the component may occur.

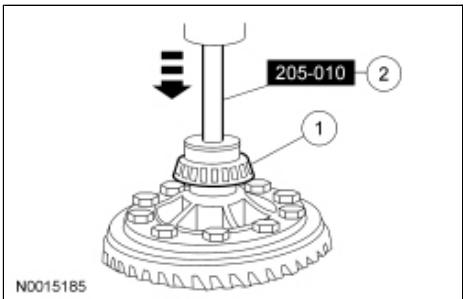
Install the Drive Pinion Flange Holding Fixture and tighten the pinion nut. Refer to the torque specifications in the Specifications portion of this section.

- Rotate the drive pinion gear occasionally to make sure the drive pinion bearings are seating correctly. Take frequent drive pinion bearing preload readings by rotating the drive pinion gear with a Nm (lb-in) torque wrench.

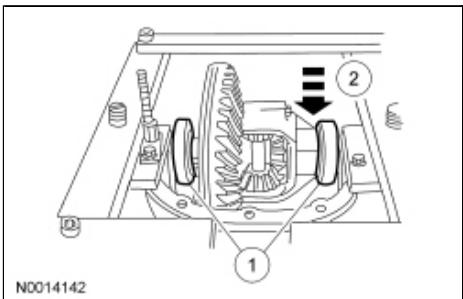




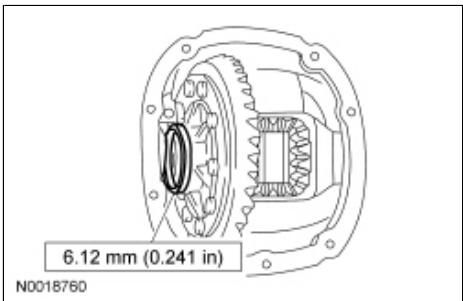
22. Press the left and right differential bearing on the differential case.
  1. Position the differential bearing.
  2. Using the Differential Side Bearing Installer, press the differential bearing on the differential case.
    - Repeat for the other side.



23. Install the differential carrier.
  1. Position the 2 differential bearing cups on the differential bearings.
  2. Lower the differential carrier in place.

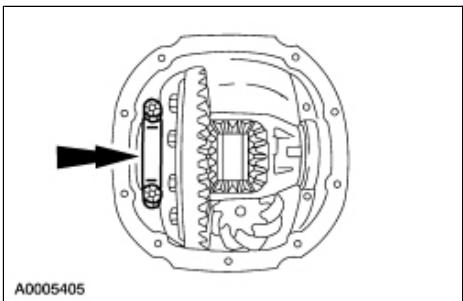


24. Install a differential bearing shim of the thickness shown on the LH side of the differential bearing.



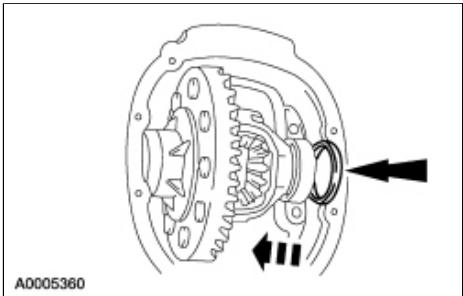
25. **NOTE:** Apply pressure toward the left side to make sure the left bearing cap is seated.

Install the left bearing cap and loosely install the 2 bearing cap bolts.



26. **NOTE:** Apply pressure toward the left side to make sure the left bearing cap is seated.

Install progressively thicker differential bearing shims on the right side until the thickest differential bearing shim can be inserted by hand.

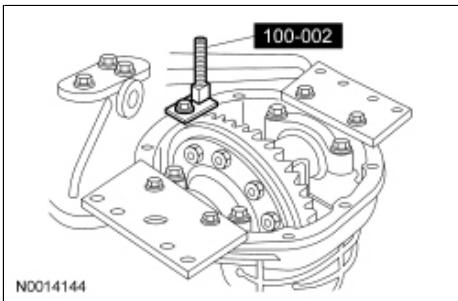


27. Install the right bearing cap and 2 bolts.

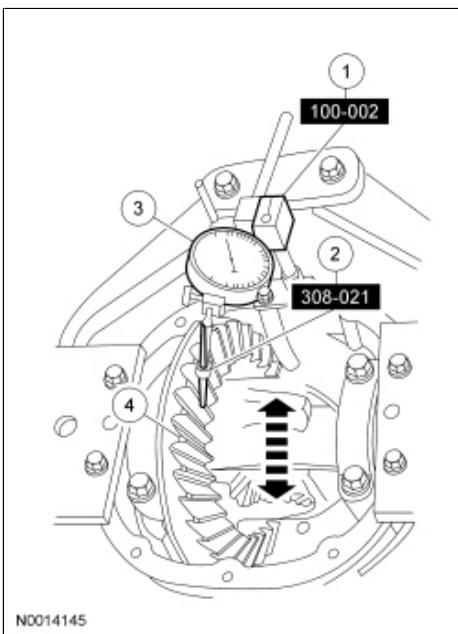
28. Tighten the 4 differential bearing cap bolts.  
• Tighten to 105 Nm (77 lb-ft).

29. Rotate the differential carrier to make sure it turns freely.

30. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.



31. Using the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge, measure the differential ring gear backlash at 4 equally spaced points.
1. Attach the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.
  2. Position the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge tip centrally on a drive tooth.
  3. Zero the Dial Indicator.
  4. Turn the differential ring gear without turning the drive pinion gear. Record the indicator reading. The allowable backlash is 0.203 mm (0.008 in) to 0.305 mm (0.012 in) and must not vary more than 0.101 mm (0.004 in) between points measured.
    - To correct for a high or low backlash, proceed as follows.



32. To correct for high or low backlash, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004

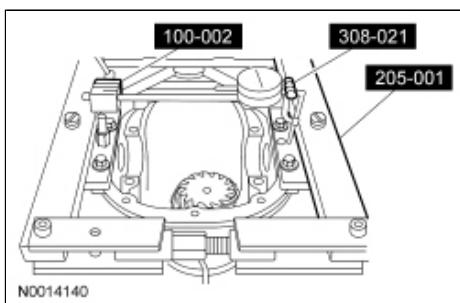
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

#### Differential Shim Size Chart — 4067

Numbers of Stripes and Color Code	Dimension A	
	mm	Inch
2 — C-COAL	7.7978- 7.8105	0.3070- 0.3075
1 — C-COAL	7.7470- 7.7597	0.3050- 0.3055
5 — BLU	7.6962- 7.7089	0.3030- 0.3035
4 — BLU	7.6454- 7.6581	0.3010- 0.3015
3 — BLU	7.5946- 7.6073	0.2990- 0.2995
2 — BLU	7.5458- 7.5565	0.2970- 0.2975
1 — BLU	7.493- 7.505	0.2950- 0.2955
5 — PINK	7.4422- 7.4549	0.2930- 0.2935
4 — PINK	7.3914- 7.4041	0.2910- 0.2915
3 — PINK	7.3406- 7.3533	0.2890- 0.2895
2 — PINK	7.2898- 7.3025	0.2870- 0.2875
1 — PINK	7.2390- 7.2517	0.2850- 0.2855
5 — GRN	7.1882- 7.2009	0.2830- 0.2835
4 — GRN	7.1374- 7.1501	0.2810- 0.2815
3 — GRN	7.0866- 7.0993	0.2790- 0.2795
2 — GRN	7.0358- 7.0485	0.2770- 0.2775
1 — GRN	6.9850- 7.0485	0.2750- 0.2755
5 — WH	6.9342- 6.9469	0.2730- 0.2735
4 — WH	6.8834- 6.8961	0.2710- 0.2715
3 — WH	6.8326- 6.8453	0.2690- 0.2695
2 — WH	6.7818- 6.7945	0.2670- 0.2675
1 — WH	6.7310- 6.7437	0.2650- 0.2655

5 — YEL	6.6802- 6.6929	0.2630- 0.2635
4 — YEL	6.6294- 6.6421	0.2610- 0.2615
3 — YEL	6.5786- 6.5913	0.2590- 0.2595
2 — YEL	6.5278- 6.5405	0.2570- 0.2575
1 — YEL	6.4770- 6.4897	0.2550- 0.2555
5 — ORNG	6.4262- 6.4389	0.2530- 0.2535
4 — ORNG	6.3754- 6.3881	0.2510- 0.2515
3 — ORNG	6.3246- 6.3373	0.2490- 0.2495
2 — ORNG	6.2738- 6.2865	0.2470- 0.2475
1 — ORNG	6.2223- 6.2357	0.2450- 0.2455
2 — RED	6.1722- 6.1849	0.2430- 0.2435
1 — RED	6.1214- 6.1341	0.2410- 0.2415

33. Remove the 4 differential bearing cap bolts.
  - Remove the differential carrier.
34. Measure the thickness of the selected right and left bearing shims.
35. To establish differential bearing preload, increase both the left and right differential bearing shim thickness by 0.203 mm (0.008 in).
36. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.

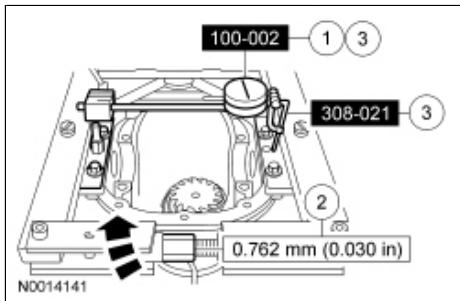


37. **NOTICE:** Overspreading may damage the differential housing.

**NOTE:** Tighten and loosen the differential carrier spreader screw to normalize the housing spreader adapters prior to taking the final Dial Indicator reading.

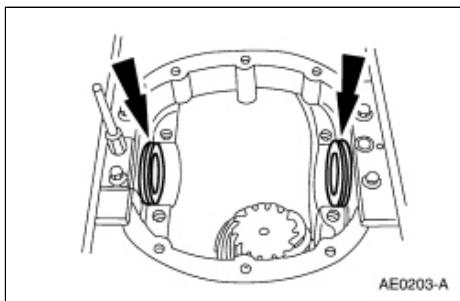
Spread the differential housing to the specification.

1. Adjust the Dial Indicator Gauge to zero.
2. Tighten the screw until spreading the differential housing to the specification.
3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.

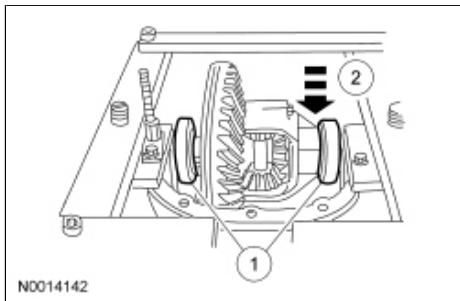


38. **NOTICE:** To avoid galling the case, insert shims with a light coating of grease before installing the differential assembly. If not carried out in this order, the aluminum housing can be damaged.

Place the differential bearing shims in the differential housing.

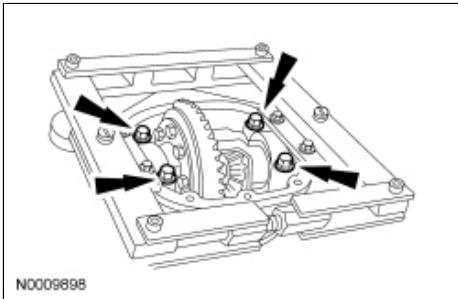


39. Install the differential carrier.
1. Position the differential bearing cups on the differential bearings.
  2. Lower the differential carrier in place between the differential bearing shims.

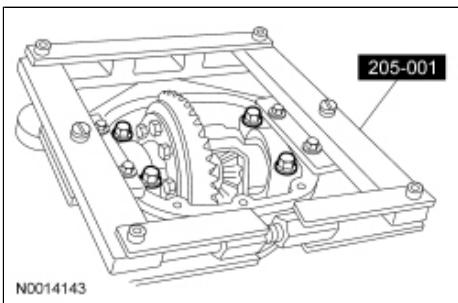


40. **NOTE:** Hand-tighten the differential bearing cap bolts prior to releasing the Differential Carrier Spreader.

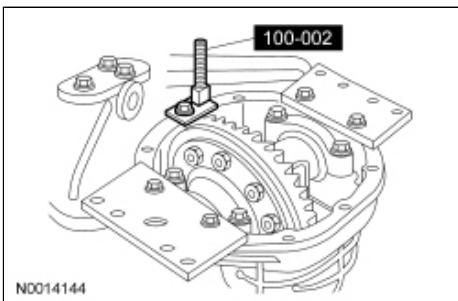
Install the 2 differential bearing caps and the 4 differential bearing cap bolts in their original locations and positions.



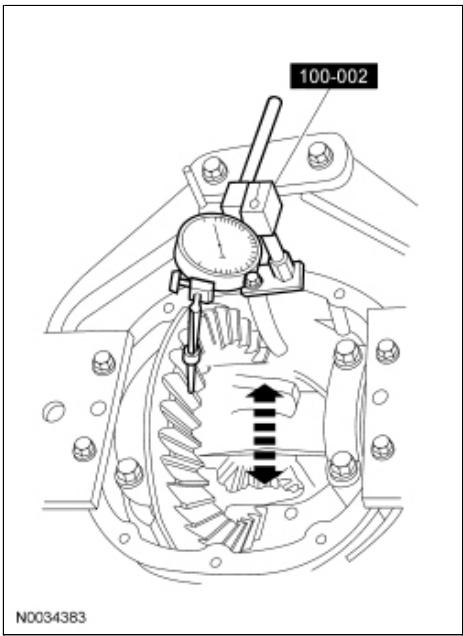
41. Loosen and remove the Differential Carrier Spreader.



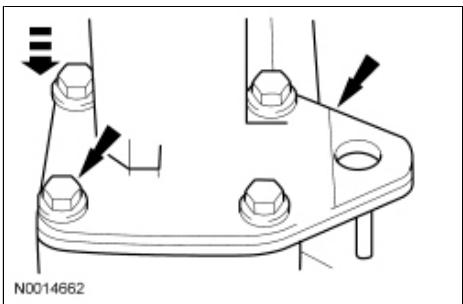
42. Tighten the 4 differential bearing cap bolts.
  - Tighten to 105 Nm (77 lb-ft).
43. Rotate the differential carrier to make sure it turns freely.
44. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.



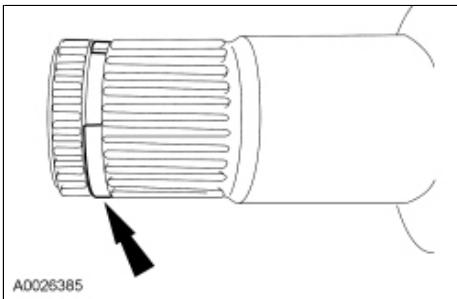
45. Using the Dial Indicator Gauge with Holding Fixture, recheck the ring gear backlash.



46. Apply marking compound and rotate the differential assembly 5 complete revolutions.
47. Verify an acceptable pattern check. For additional information, refer to Diagnosis and Testing in this section.
48. Install the axle housing tube and the 4 bolts.
  - Tighten to 73 Nm (54 lb-ft).



49. Install a new stub shaft seal. For additional information, refer to [Stub Shaft Pilot Bearing and Seal](#) in this section.
50. Install a new circlip on the intermediate shaft end.

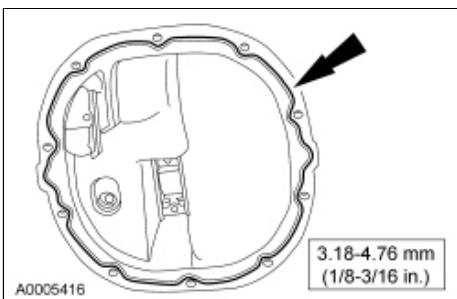


51. Insert the intermediate shaft and engage the circlip with the differential side gear.
52. Remove the axle assembly from the Transmission Holding Fixture and place it on the bench.
53. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

**NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface as shown in the illustration.

- Use silicone gasket and sealant.



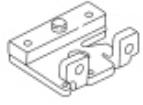
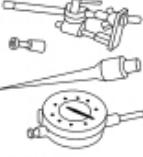
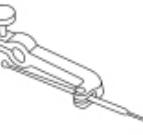
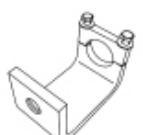
54. Install the differential housing cover and the 10 bolts.
  - Tighten to 32 Nm (24 lb-ft).
55. Install the axle assembly. For additional information, refer to [Axle Assembly](#) in this section.
56. Remove the fill plug and fill the axle assembly with the specified type and amount of axle lubricant.
  - Tighten the fill plug to 25 Nm (18 lb-ft).

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## Differential Carrier

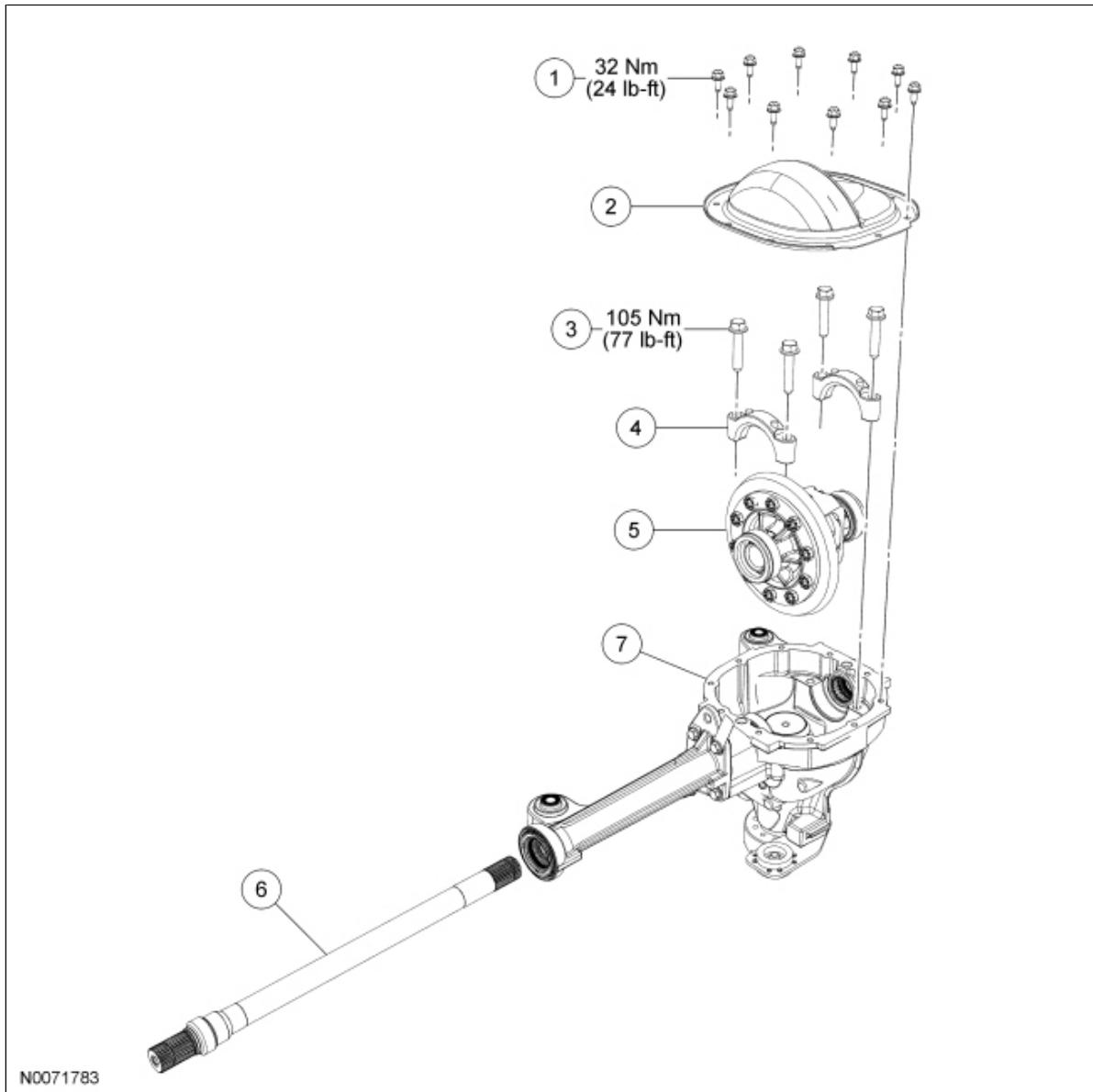
### Special Tool(s)

 ST1150-B	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST2891-A	Remover, Transmission Fluid Pump 307-397
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
	Spreader, Differential Carrier 205-001 (TOOL-4000-E)

	
	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)

#### Material

Item	Specification
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

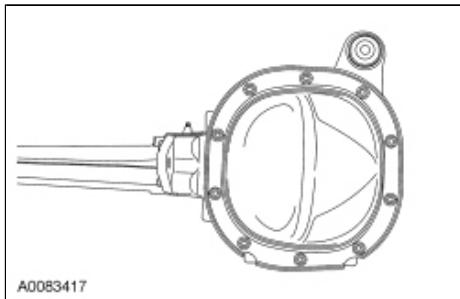


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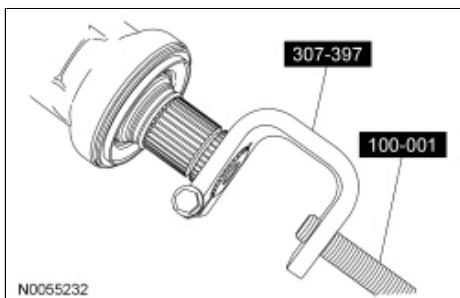
Item	Part Number	Description
1	390919	Differential housing cover bolt (10 required)
2	3N136	Differential housing cover
3	—	Differential bearing cap bolt (part of 3A412) (4 required)
4	—	Differential bearing cap (part of 3A412) (2 required)
5	3C202	Differential assembly
6	3A380	Intermediate axle shaft
7	3A412	Differential housing

## Removal

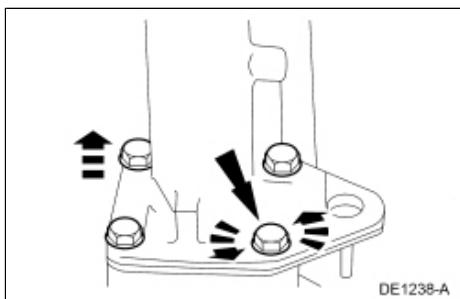
1. Remove the axle assembly. For additional information, refer to [Axe Assembly](#) in this section.
2. Remove the 10 bolts and the differential housing cover.
  - Drain the fluid.



3. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.

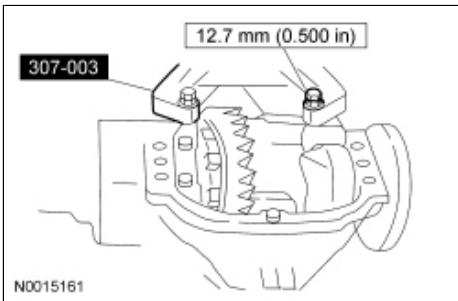


4. Remove the 4 bolts and the axle housing tube.



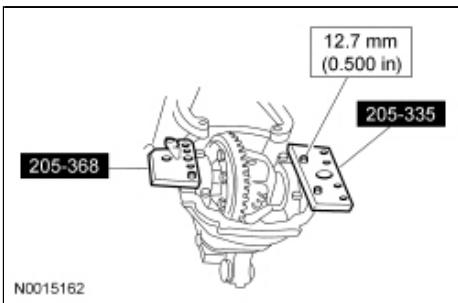
5. **NOTICE:** The fixture mounting bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.

Install the Transmission Holding Fixture.

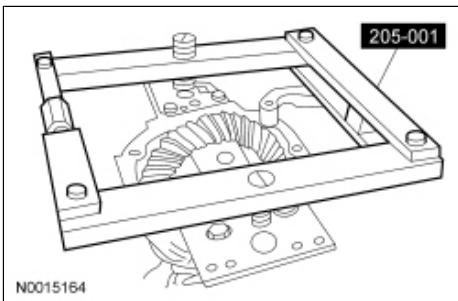


6. **NOTICE:** The housing spreader adapter bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.

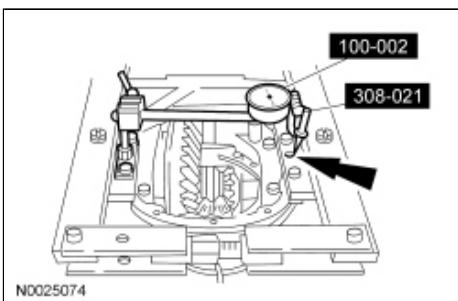
Install the Differential Housing Spreader Plate and Adapter for Differential Housing Spreader.



7. Position the Differential Carrier Spreader on the spreader adapters.



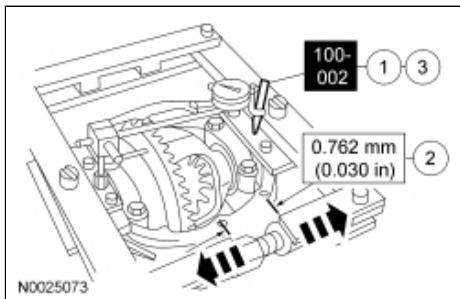
8. Install the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.
  - Position the adapter tip in the spreader adapter hole.



**9. NOTICE: Overspreading may damage the component.**

Spread the axle housing to the specification.

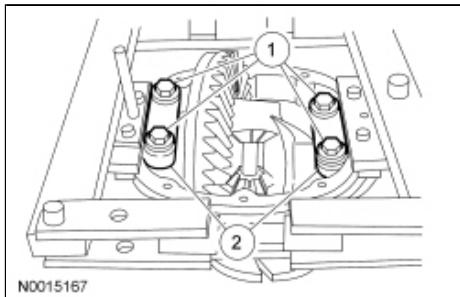
1. Adjust the Dial Indicator Gauge to zero.
2. Tighten the housing spreader screw to spread the axle housing to the specification.
3. Remove the Dial Indicator Gauge with Holding Fixture.



**10. NOTICE: Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the differential bearing caps in their original positions or damage to the component may occur.**

Mark and remove the 2 differential bearing caps.

1. Remove the 4 differential bearing cap bolts.
2. Remove the 2 differential bearing caps.

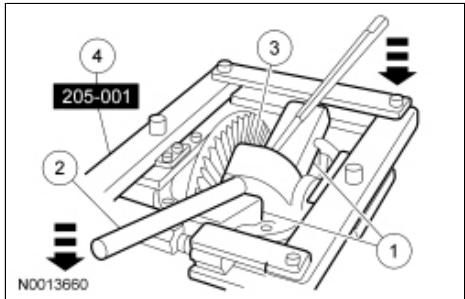


**11. NOTE: Use wood blocks to avoid axle housing damage.**

**NOTE:** Index-mark the position of the differential bearing shims. The differential bearing shims must be installed in their original locations and positions.

Remove the differential carrier from the axle housing.

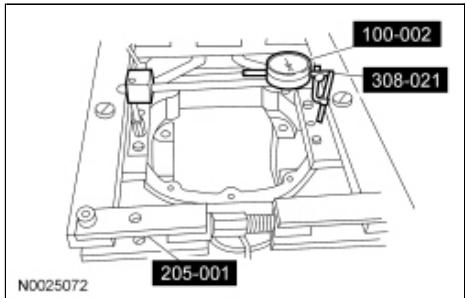
1. Position the wood blocks.
2. Position and push down on the 2 pry bars.
3. Remove the differential carrier.
4. Remove the Differential Carrier Spreader.



## Installation

1. **NOTE:** Make sure the Dial Indicator needle is in the spreader adapter hole.

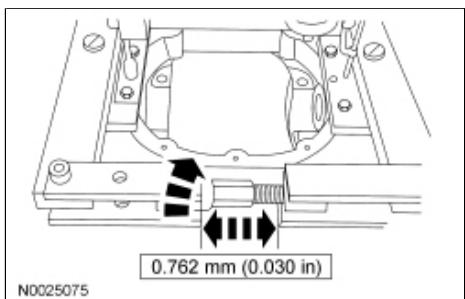
Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.



2. **NOTICE:** Overspreading may damage the component.

Spread the axle housing to the specification.

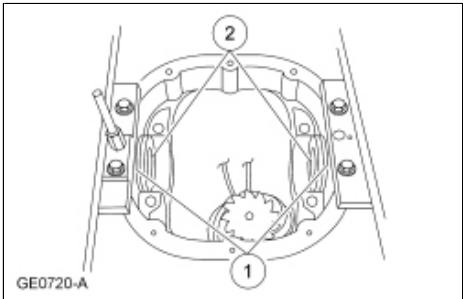
- Remove the Dial Indicator.



3. **NOTICE:** Never attempt to drive the differential bearing shim in place. Permanent damage to the machined axle housing surfaces may occur.

Position the differential bearing shims.

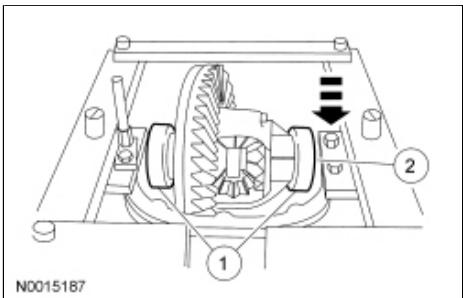
1. Apply a light coating of grease to one side of the differential bearing shims to help hold them in place.
2. Position the differential bearing shims.



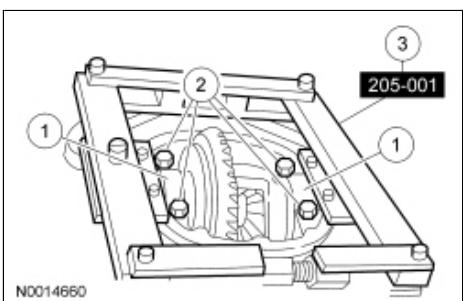
4. **NOTE:** Push the differential carrier downward to fully seat the differential bearing cups in the axle housing.

Position the differential carrier.

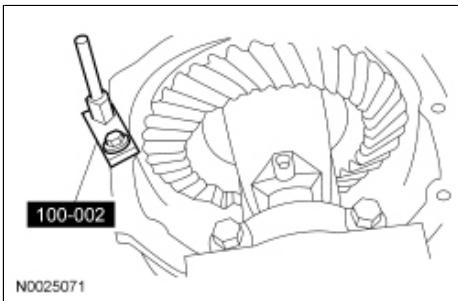
1. Position the differential bearing cups on the differential bearings.
2. Lower the differential assembly in place between the differential bearing shims.



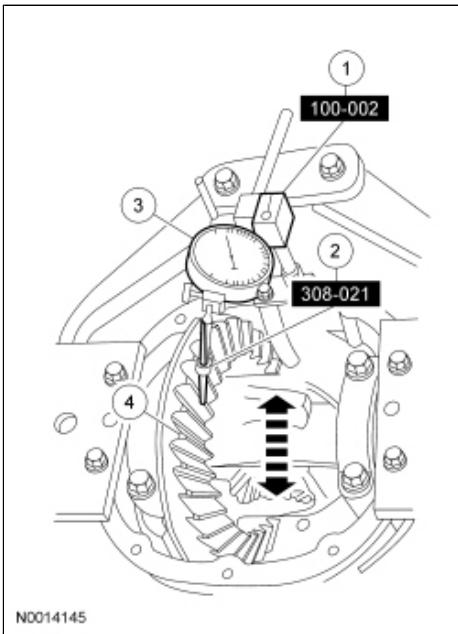
5. Install the differential bearing caps in their original positions and tighten with the housing still spread.
  1. Position the 2 differential bearing caps.
  2. Install the 4 differential bearing cap bolts.
    - Tighten to 105 Nm (77 lb-ft).
  3. Remove the Differential Carrier Spreader.



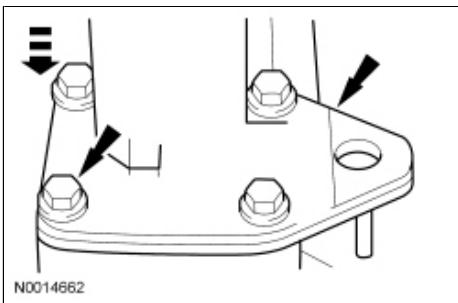
6. Install the Dial Indicator Gauge with Holding Fixture.



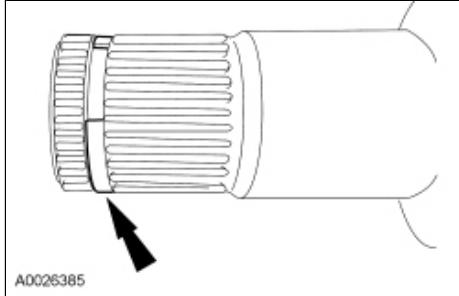
7. Using the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge, measure the differential ring gear backlash at 4 equally spaced points.
1. Attach the Dial Indicator Gauge with Holding Fixture.
  2. Position the Clutch Housing Gauge tip centrally on a drive tooth.
  3. Zero the Dial Indicator.
  4. Turn the differential ring gear without turning the drive pinion gear.



8. Install the axle housing tube and the 4 bolts.
- Tighten to 73 Nm (54 lb-ft).



9. Install a new stub shaft seal. For additional information, refer to [Stub Shaft Pilot Bearing and Seal](#) in this section.
10. Install a new circlip on the intermediate shaft end.

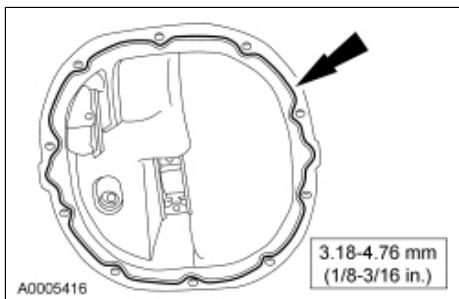


11. Insert the intermediate shaft and engage the circlip with the differential side gear.
12. Remove the axle assembly from the Transmission Holding Fixture and place it on the bench.
13. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

**NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

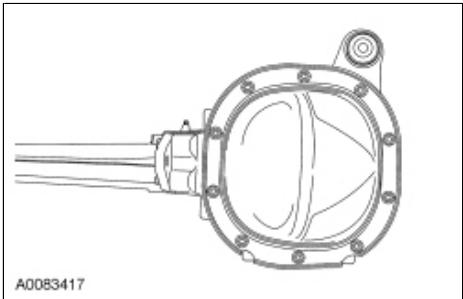
Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface as shown in the illustration.

- Use silicone gasket and sealant.



14. Install the differential housing cover and the 10 differential housing cover bolts.

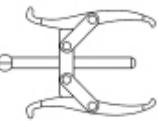
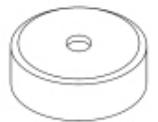
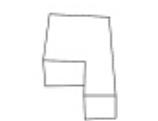
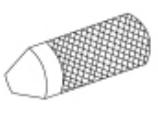
- Tighten to 32 Nm (24 lb-ft).

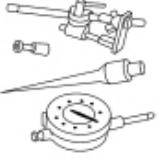
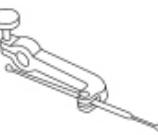
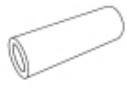


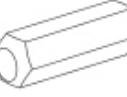
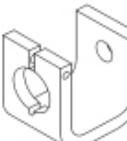
15. Install the axle assembly. For additional information, refer to [Axle Assembly](#) in this section.
  16. Remove the fill plug and fill the axle assembly with the specified type and amount of axle lubricant.
    - Tighten the fill plug to 25 Nm (18 lb-ft).
-

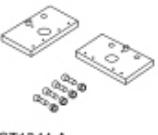
## Differential Ring And Pinion

### Special Tool(s)

 ST1321-A	2 Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1743-A	Adapter for 205-S127 205-105 (T76P-4020-A3)
 ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1433-B	Adapter for 205-S127 205-129 (T79P-4020-A18)
	Adapter for Differential Housing Spreader 205-368 (T96T-4000-A)

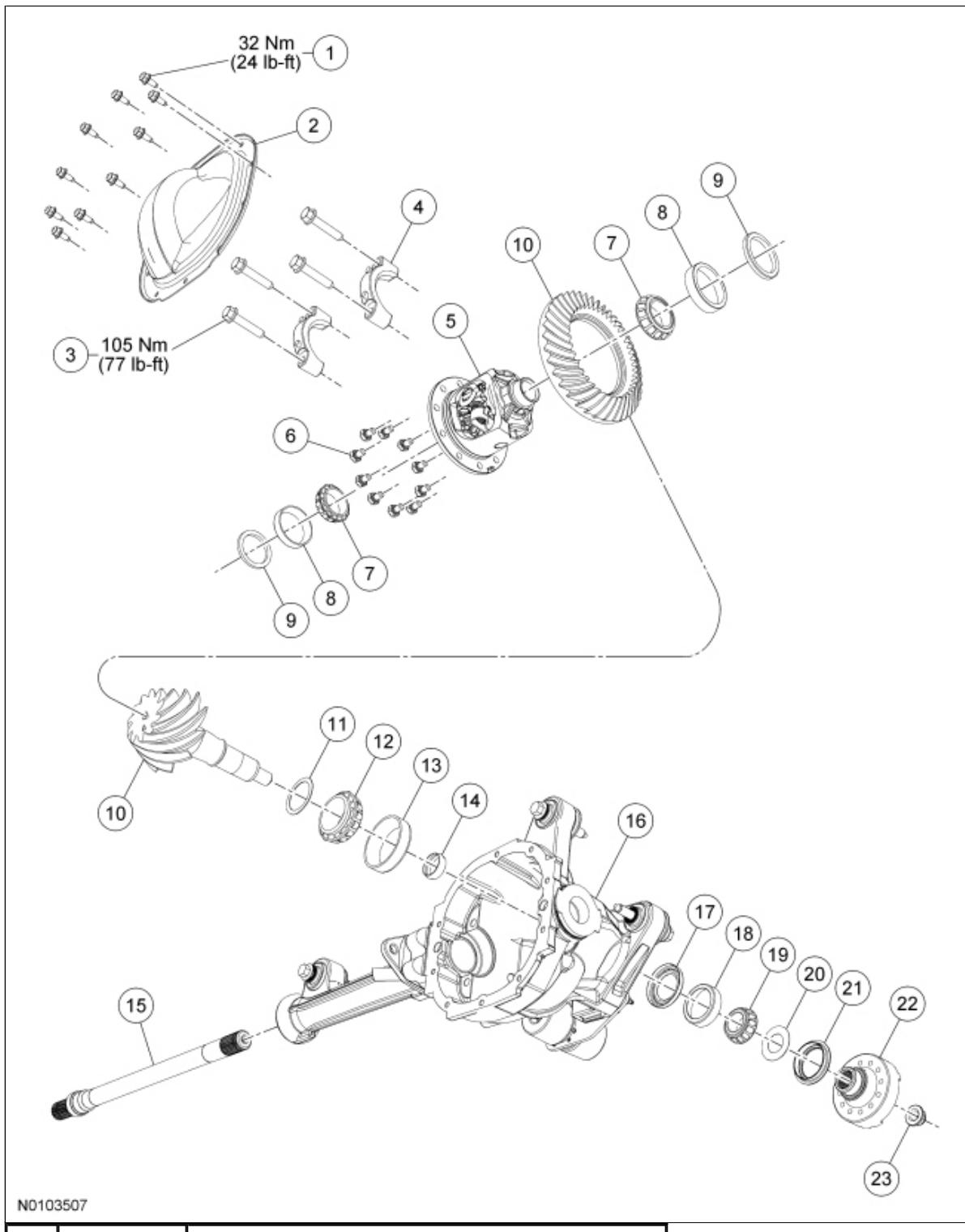
	 ST1150-B
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
 ST1257-A	Holding Fixture, Drive Pinion Flange 205-126 (T78P-4851-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1357-A	Installer, Differential Carrier Bearings 205-D044 (D81T-4221-A) or equivalent
 ST1437-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
	Installer, Drive Pinion Bearing Cone

 ST1484-A	205-005 (T53T-4621-C)
 ST1361-A	Installer, Drive Pinion Bearing Cup 205-024 (T67P-4616-A)
 ST1800-A	Installer, Drive Pinion Flange 205-002 (TOOL-4858-E)
 ST1358-A	Installer, Drive Pinion Oil Seal 205-208 (T83P-4676-A)
 ST1882-A	Protector, Drive Pinion Thread 205-460
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2418-A	Remover, Transmission Fluid Pump 307-397
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
	Spreader, Differential Carrier 205-001 (TOOL-4000-E)

	
	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A) (RH)
	Step Plate 205-D061 (D83T-4205-C2) or equivalent

#### Material

Item	Specification
Motorcraft® High Contrast Hypoid Gear Marking Compound XG-14	—
Motorcraft® SAE 80W-90 Premium Rear Axle Lubricant XY-80W90-QL (US); CXY-80W90-1L (Canada)	WSP-M2C197-A
Premium Long-Life Grease XG-1-C or XG-1-K (US); CXG-1-C (Canada)	ESA-M1C75-B
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

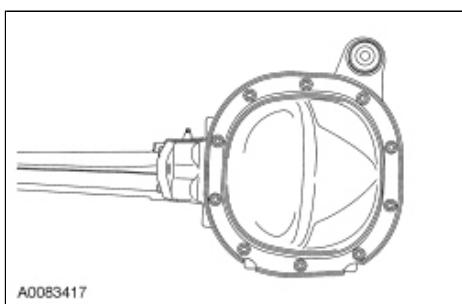


Item	Part Number	Description
1	390919	Differential housing cover bolt (10 required)

2	3N136	Differential housing cover
3	—	Differential bearing cap bolt (part of 3A412) (4 required)
4	—	Differential bearing cap (part of 3A412) (2 required)
5	3C202	Differential assembly
6	388056	Ring gear bolt (10 required)
7	4221	Differential bearings (2 required)
8	4221	Differential bearing cups (2 required)
9	4A451	Differential bearing shims (2 required)
10	—	Ring gear (part of 4209)
10	—	Pinion gear (part of 4209)
11	4663	Drive pinion bearing adjustment shim
12	4628	Inner drive pinion bearing cup
13	4630	Inner drive pinion bearing
14	4662	Drive pinion collapsible spacer
15	3A380	Intermediate axle shaft
16	3A412	Differential housing
17	4631	Drive pinion oil baffle
18	4616	Drive pinion outer bearing cup
19	4621	Drive pinion outer bearing
20	386989	Drive pinion oil slinger
21	3N134	Drive pinion oil seal
22	4858	Drive pinion flange
23	389546	Drive pinion nut and washer

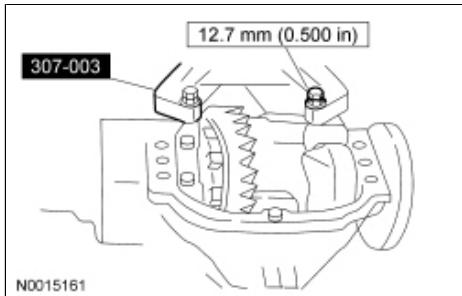
## Removal

1. Remove the axle assembly. For additional information, refer to [Axle Assembly](#) in this section.
2. Remove the 10 bolts and the differential housing cover.
  - Drain the fluid.

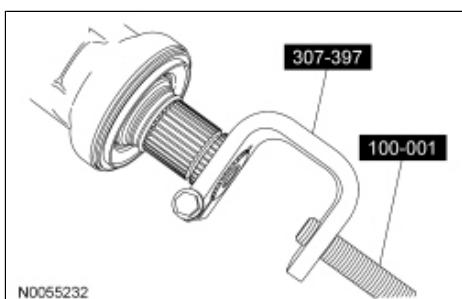


3. **NOTICE:** The fixture mounting bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.

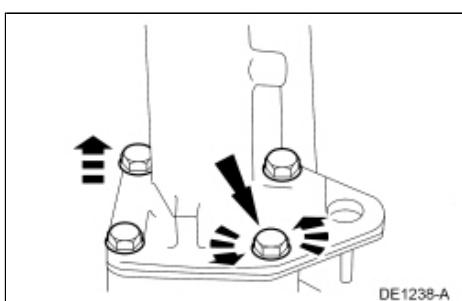
Install the Transmission Holding Fixture.



4. Using the Transmission Fluid Pump Remover and Slide Hammer, remove the intermediate shaft.

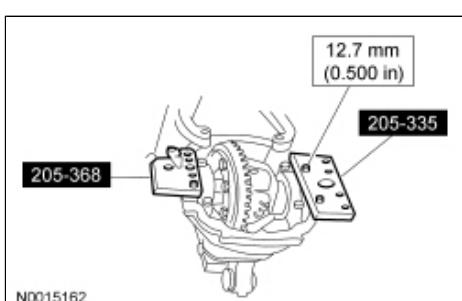


5. Remove the 4 bolts and the axle housing tube.



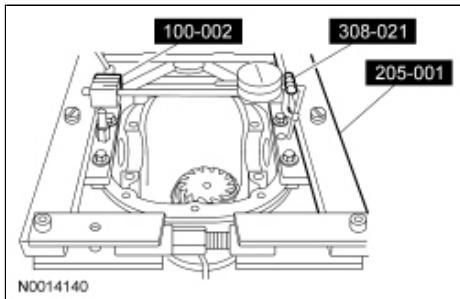
6. **NOTICE:** The housing spreader adapter bolts must have the minimum specified thread engagement in the carrier or damage to the component may occur.

Install the Adapter for Differential Housing Spreader and Differential Housing Spreader Plate.



7. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.

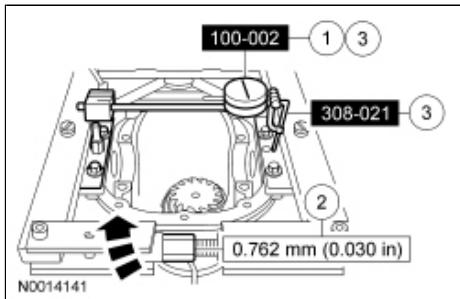
- Position the adapter tip in the spreader adapter hole.



8. **NOTICE: Overspreading may damage the axle housing.**

Spread the axle housing to the specification.

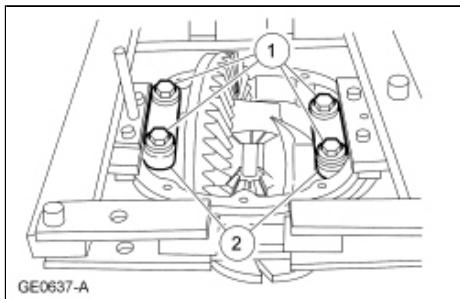
1. Adjust the Dial Indicator Gauge to zero.
2. Tighten the housing spreader screw to spread the axle housing to the specification.
3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.



9. **NOTICE: Mark the differential bearing caps Top or Bottom and LH or RH appropriately before removing them. Always install the bearing caps in their original location and position or damage to the component may occur.**

Mark and remove the 2 differential bearing caps.

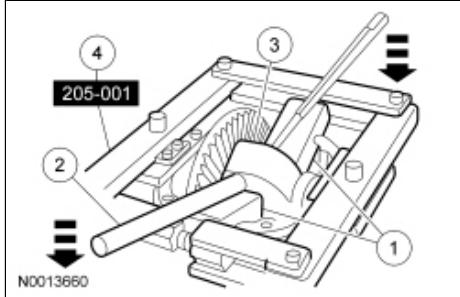
1. Remove the 4 bolts.
2. Remove the 2 differential bearing caps.



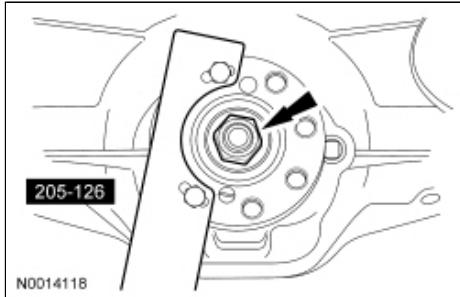
10. **NOTICE: Use wood blocks to avoid axle housing damage.**

Remove the differential assembly from the axle housing.

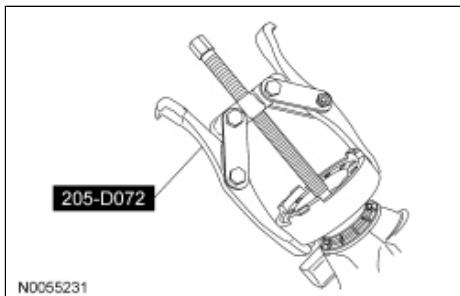
1. Position the wood blocks.
2. Position and push down on the 2 pry bars.
3. Remove the differential assembly.
4. Remove the Differential Carrier/Spreader.



11. Install the Drive Pinion Flange Holding Fixture and loosen, but do not remove, the pinion nut.

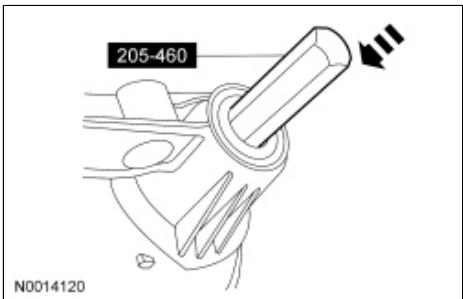


12. With the pinion nut still engaged by a few threads, use the 2 Jaw Puller to separate the axle U-joint flange from the pinion gear.

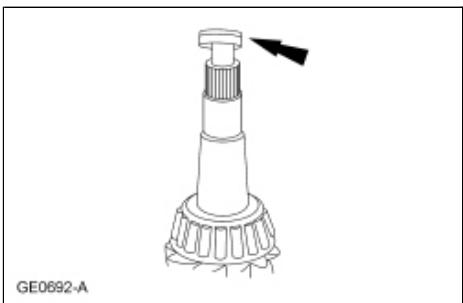


13. Remove the nut and the flange.

14. Using the Drive Pinion Thread Protector and a soft hammer, remove the pinion gear.



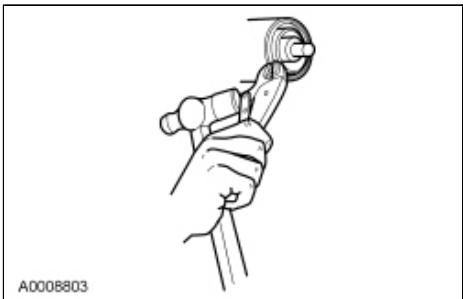
15. Discard the drive pinion collapsible spacer.



16. **NOTICE:** Do not damage the carrier housing while removing the pinion seal.

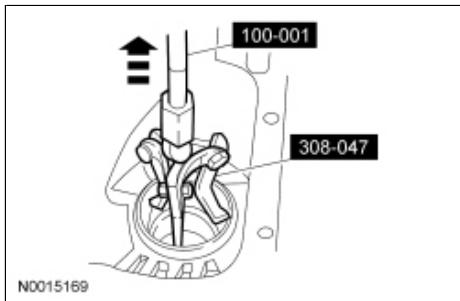
Remove the pinion seal and slinger.

- Pry up on the seal flange. Install gripping pliers and strike with a hammer to remove the seal.



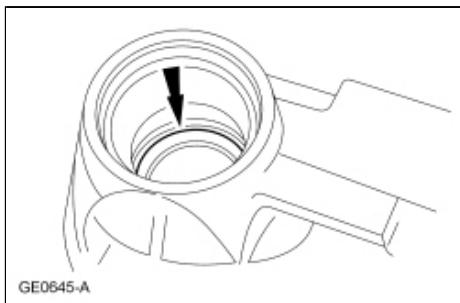
17. Remove the outer pinion bearing.

18. Using the Bearing Cup Remover and Slide Hammer, remove the inner pinion bearing cup.

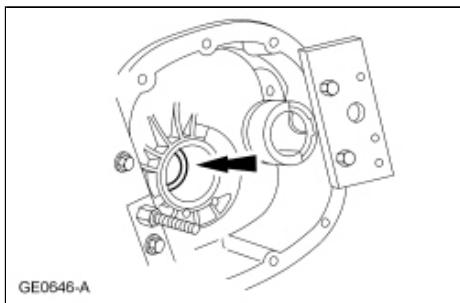


19. **NOTE:** The pinion bearing oil baffle aids in bearing lubrication. Normally, it is not necessary to remove the baffle.

If necessary, remove the pinion bearing oil baffle.

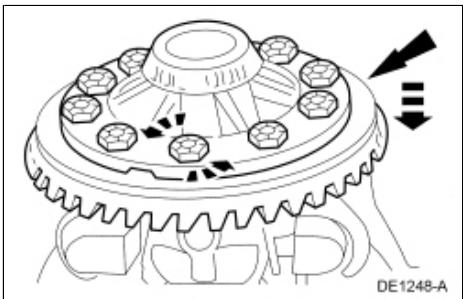


20. Remove the outer pinion bearing cup by tapping alternately on each side to prevent the cup from cocking.

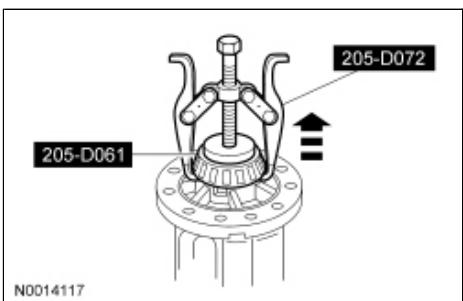


21. **NOTE:** Use a drift punch to separate the differential ring gear from the differential case.

Remove and discard the 10 differential ring gear bolts and remove the differential ring gear.



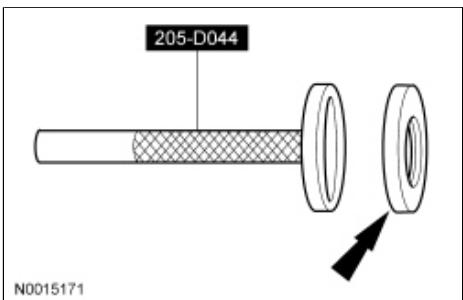
- Using the 2 Jaw Puller and Step Plate, remove the 2 differential bearings.



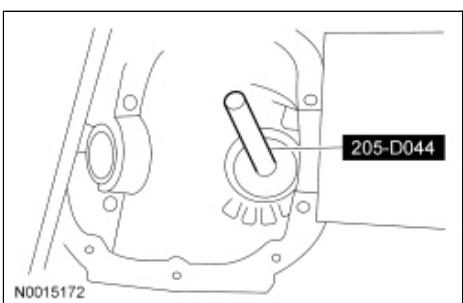
### Installation

- NOTICE:** Do not omit the drive pinion bearing oil baffle or damage to the component may occur.

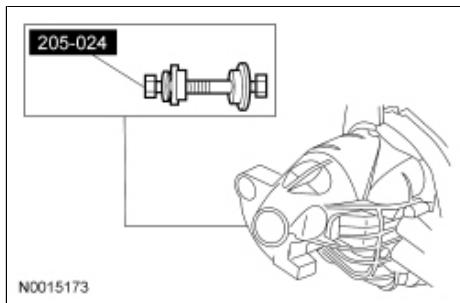
If removed, position the drive pinion bearing oil baffle on the Differential Carrier Bearings Installer.



- Using the Differential Carrier Bearings Installer, install the drive pinion bearing oil baffle.



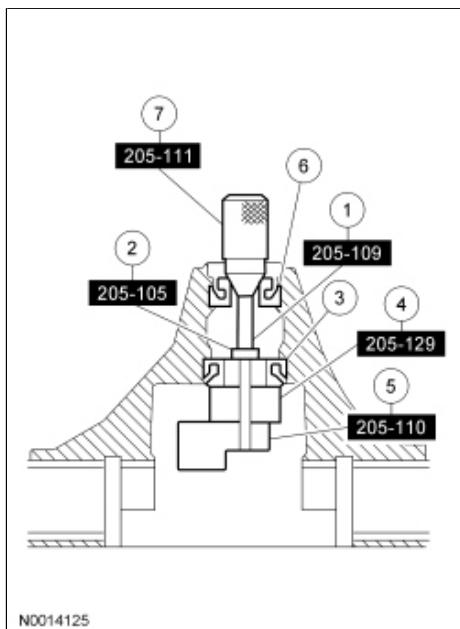
- Using the Drive Pinion Bearing Cup Installer, install the drive pinion bearing cups.



- NOTICE:** Use the same drive pinion bearings and the drive pinion bearing adjustment shim from the drive pinion bearing adjustment shim selection procedure for final assembly or damage to the component may occur.

**NOTE:** Install new drive pinion bearings without any additional lubricant since the anti-rust oil provides adequate lubricant without upsetting the drive pinion bearing preload settings.

Assemble and position the Adapters.

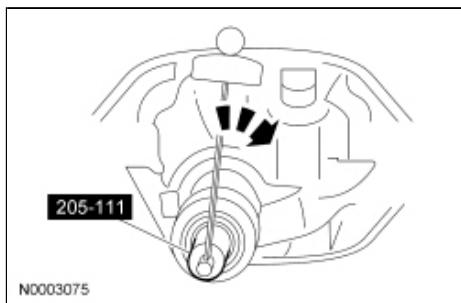


Item	Part Number	Description
1	205-109	Adapter for 205-S127 (T76P-4020-A9)
2	205-105	Adapter for 205-S127 (T76P-4020-A3)
3	4630	Drive pinion bearing (inner)
4	205-129	Adapter for 105-S127 (T79P-4020-A18)
5	205-110	Adapter for 205-S127 (T76P-4020-A10)
6	4621	Drive pinion bearing (outer)
7	205-111	Adapter for 205-S127 (T76P-4020-A11)

5. **NOTE:** This step duplicates final drive pinion bearing preload.

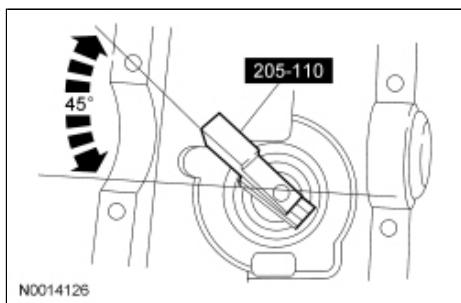
Tighten the Adapter.

- Tighten to 2.2 Nm (20 lb-in).



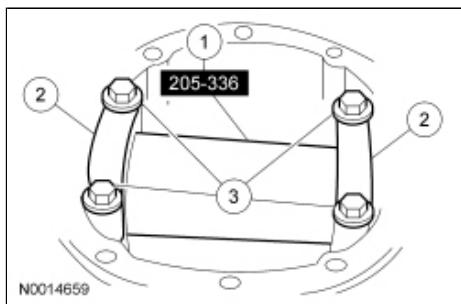
6. **NOTE:** The Adapter must be offset to obtain an accurate reading.

Rotate the Adapter several half-turns to make sure of correct seating of the drive pinion bearings and position the Adapter.



7. Install the Drive Pinion Gauge Tube.

1. Position the Drive Pinion Gauge Tube.
2. Install the 2 differential bearing caps.
3. Install the 4 differential bearing cap bolts.
  - Tighten to 105 Nm (77 lb-ft).



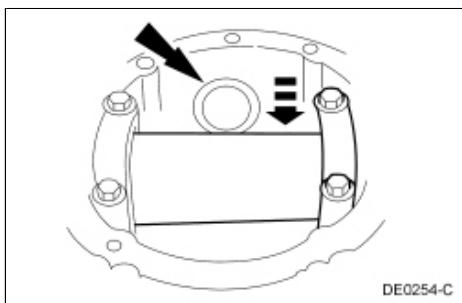
8. **NOTE:** Drive pinion bearing adjustment shims must be flat and clean.

**NOTE:** A slight drag should be felt for correct drive pinion bearing adjustment shim selection. Do not attempt to force the drive pinion bearing adjustment shim between the gauge block and the gauge tube. This will minimize selection of a drive pinion bearing adjustment shim thicker than required,

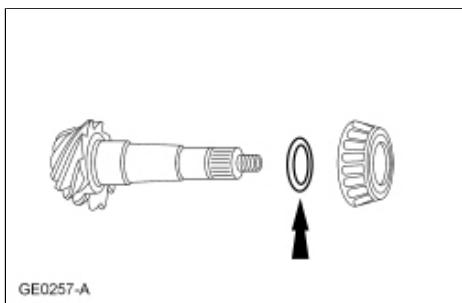
which results in a deep tooth contact in final assembly of integral axle assemblies.

Use a drive pinion bearing adjustment shim as a gauge for drive pinion bearing adjustment shim selection.

- After the correct drive pinion bearing adjustment shim thickness has been determined, remove all of the special tools.



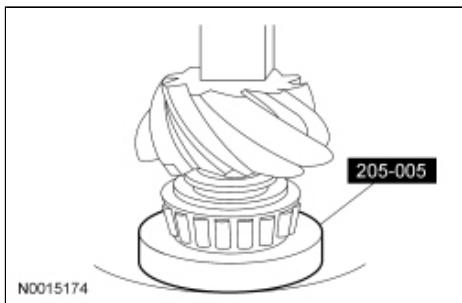
9. Position the drive pinion bearing adjustment shim and the inner pinion bearing on the new drive pinion gear stem.



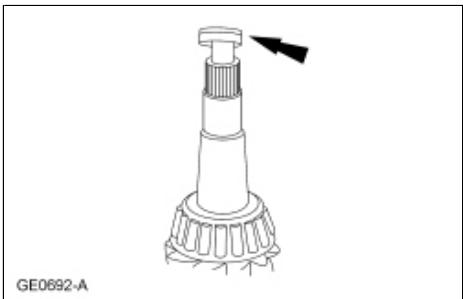
10. **NOTE:** The same drive pinion bearings from the previous steps must be used.

Install the inner drive pinion bearing.

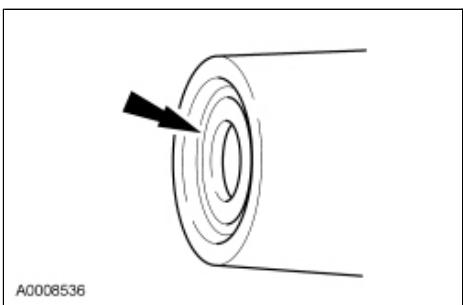
- Place the drive pinion bearing adjustment shim on the drive pinion gear.
- Using a suitable press and the Drive Pinion Bearing Cone Installer, press the inner drive pinion bearing until it is firmly seated on the pinion gear.



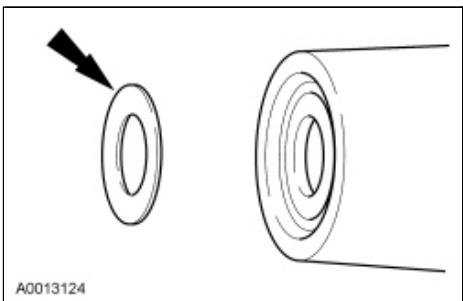
11. Place a new drive pinion collapsible spacer on the drive pinion gear.



12. Install the outer drive pinion bearing.



13. Install the drive pinion oil slinger.

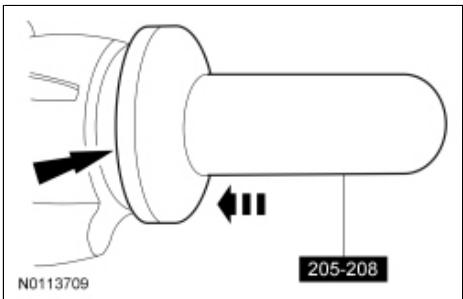


14. **NOTE:** Coat the drive pinion seal lips with long-life grease.

Install the drive pinion seal on the Drive Pinion Oil Seal Installer.

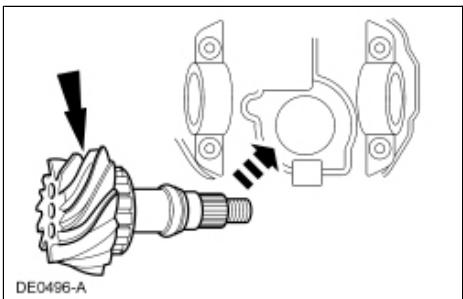
15. **NOTE:** If the drive pinion seal becomes misaligned during installation, remove it and install a new drive pinion seal.

Using the Drive Pinion Oil Seal Installer, install the drive pinion seal.

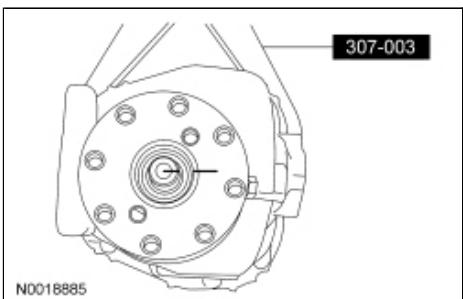


16. Lightly lubricate the drive pinion gear splines with axle lubricant.

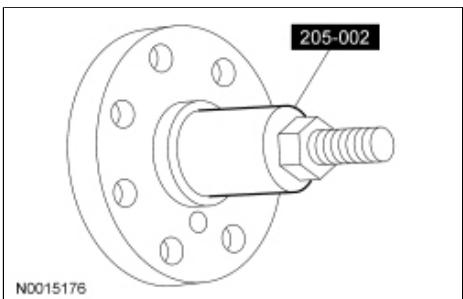
17. Position the drive pinion gear in the axle housing.



18. Position the pinion flange onto the pinion shaft while mounted on the Transmission Holding Fixture.



19. Using the Drive Pinion Flange Installer, install the pinion flange.

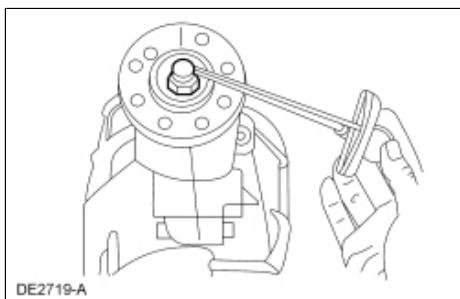
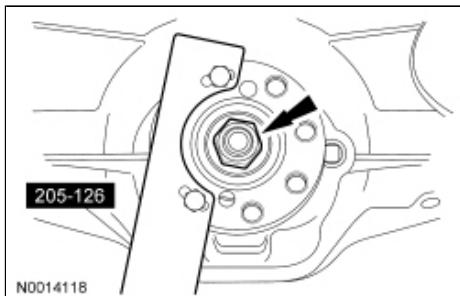


20. Apply a small amount of axle lubricant to the washer side of the new pinion nut and install the new pinion nut.

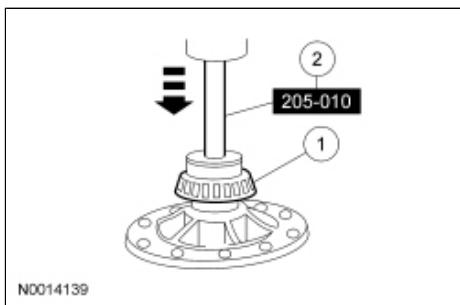
21. **NOTICE:** Do not loosen the pinion nut to reduce drive pinion bearing preload under any circumstance. If it is necessary to reduce drive pinion bearing preload, install a new drive pinion collapsible spacer and pinion nut or damage to the component may occur.

Install the Drive Pinion Flange Holding Fixture and tighten the pinion nut. For additional information, refer to the torque specifications in the Specifications portion of this section.

- Rotate the drive pinion gear occasionally to make sure the drive pinion bearings are seating correctly. Take frequent drive pinion bearing preload readings by rotating the drive pinion gear with a Nm (lb-in) torque wrench.

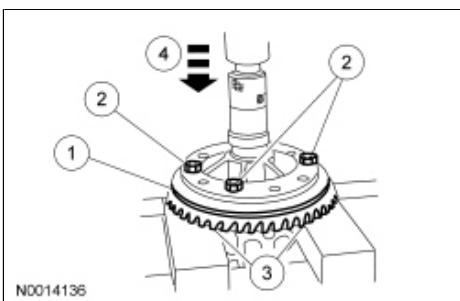


22. Press the left and right differential bearing on the differential carrier.
1. Position the differential bearing.
  2. Using the Differential Side Bearing Installer, press the differential bearing on the differential carrier.
  - Repeat for the other side.

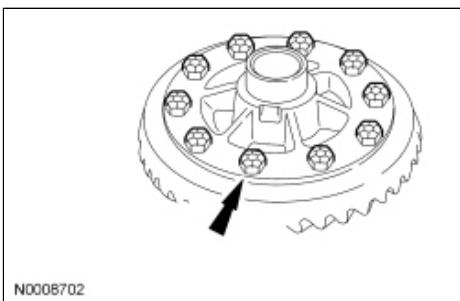


23. Install the differential ring gear.
1. Place the differential ring gear on the differential assembly.
  2. Hand-start 3 new ring gear bolts to align the holes in the differential ring gear and the differential assembly.
  3. Place the differential carrier and differential ring gear onto the press bed blocks with the differential ring gear teeth facing downward.

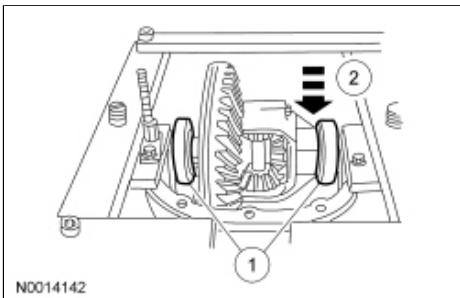
4. Press the differential ring gear into place.



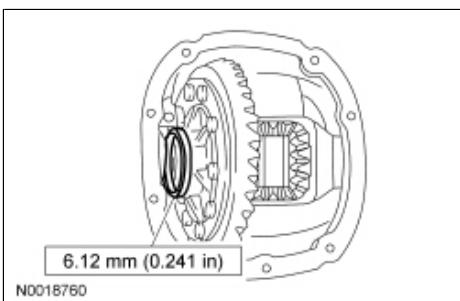
24. Install the 10 new ring gear bolts.
- Tighten to 128 Nm (95 lb-ft).



25. Install the differential carrier.
1. Position the differential bearing cups on the differential bearings.
  2. Lower the differential carrier in place.

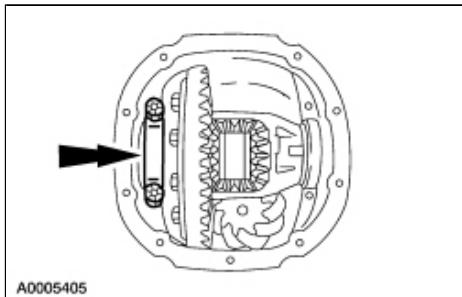


26. Install a differential bearing shim of the thickness shown on the LH side of the differential bearing.



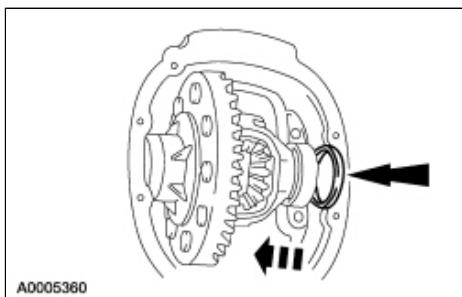
27. **NOTE:** Apply pressure toward the left side to make sure the left bearing cup is seated.

Install the left bearing cap and loosely install the 2 bearing cap bolts.



28. **NOTE:** Apply pressure toward the left side to make sure the left bearing cap is seated.

Install progressively thicker differential bearing shims on the right side until the thickest differential bearing shim can be inserted by hand.



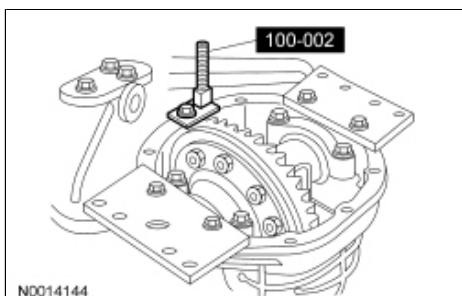
29. Install the right bearing cap and 2 bolts.

30. Tighten the 4 differential bearing cap bolts.

- Tighten to 105 Nm (77 lb-ft).

31. Rotate the differential carrier to make sure it turns freely.

32. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.

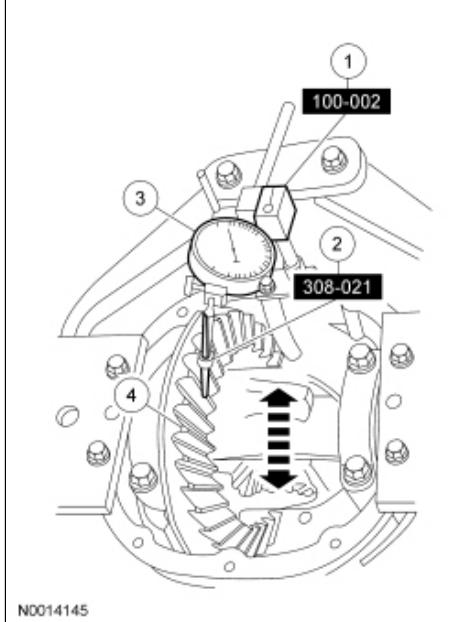


33. Using the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge, measure the differential ring gear backlash at 4 equally spaced points.

1. Attach the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.

2. Position the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge tip centrally on a drive tooth.
3. Zero the Dial Indicator.
4. Turn the differential ring gear without turning the drive pinion gear. Record the indicator reading. The allowable backlash is 0.203 mm (0.008 in) to 0.305 mm (0.012 in) and must not vary more than 0.101 mm (0.004 in) between points measured. A backlash variation of more than 0.101 mm (0.004 in) between points checked indicates gear/case runout.

■ To correct for a high or low backlash, proceed as follows.



34. To correct for high or low backlash, increase the thickness of one differential bearing shim and decrease the thickness of the other differential bearing shim by the same amount. Refer to the following tables when adjusting the backlash.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016

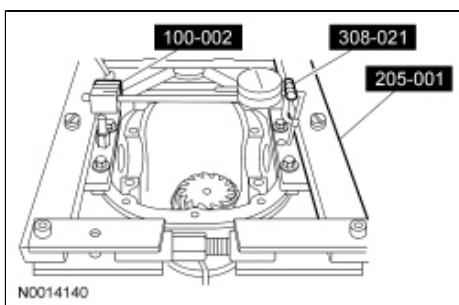
0.330	0.013	0.457	0.018
0.335	0.014	0.457	0.018
0.381	0.015	0.508	0.020

**Differential Shim Size Chart — 4067**

Numbers of Stripes and Color Code	Dimension A	
	mm	Inch
2 — C-COAL	7.7978- 7.8105	0.3070- 0.3075
1 — C-COAL	7.7470- 7.7597	0.3050- 0.3055
5 — BLU	7.6962- 7.7089	0.3030- 0.3035
4 — BLU	7.6454- 7.6581	0.3010- 0.3015
3 — BLU	7.5946- 7.6073	0.2990- 0.2995
2 — BLU	7.5458- 7.5565	0.2970- 0.2975
1 — BLU	7.493- 7.505	0.2950- 0.2955
5 — PINK	7.4422- 7.4549	0.2930- 0.2935
4 — PINK	7.3914- 7.4041	0.2910- 0.2915
3 — PINK	7.3406- 7.3533	0.2890- 0.2895
2 — PINK	7.2898- 7.3025	0.2870- 0.2875
1 — PINK	7.2390- 7.2517	0.2850- 0.2855
5 — GRN	7.1882- 7.2009	0.2830- 0.2835
4 — GRN	7.1374- 7.1501	0.2810- 0.2815
3 — GRN	7.0866- 7.0993	0.2790- 0.2795
2 — GRN	7.0358- 7.0485	0.2770- 0.2775
1 — GRN	6.9850- 7.0485	0.2750- 0.2755
5 — WH	6.9342- 6.9469	0.2730- 0.2735
4 — WH	6.8834- 6.8961	0.2710- 0.2715
3 — WH	6.8326- 6.8453	0.2690- 0.2695
2 — WH	6.7818- 6.7945	0.2670- 0.2675
1 — WH	6.7310- 6.7437	0.2650- 0.2655
5 — YEL	6.6802- 6.6929	0.2630- 0.2635
4 — YEL	6.6294- 6.6421	0.2610- 0.2615
3 — YEL	6.5786- 6.5913	0.2590- 0.2595
2 — YEL	6.5278- 6.5405	0.2570- 0.2575
1 — YEL	6.4770- 6.4897	0.2550- 0.2555
5 — ORNG	6.4262- 6.4389	0.2530- 0.2535
4 — ORNG	6.3754- 6.3881	0.2510- 0.2515
3 — ORNG	6.3246- 6.3373	0.2490- 0.2495
2 — ORNG	6.2738- 6.2865	0.2470- 0.2475

1 — ORNG	6.2223- 6.2357	0.2450- 0.2455
2 — RED	6.1722- 6.1849	0.2430- 0.2435
1 — RED	6.1214- 6.1341	0.2410- 0.2415

35. Remove the 4 differential bearing cap bolts.
  - Remove the differential carrier.
36. Measure the thickness of the selected right and left bearing shims.
37. To establish differential bearing preload, increase both the left and right differential bearing shim thickness by 0.203 mm (0.008 in).
38. Install the Dial Indicator Gauge with Holding Fixture, Clutch Housing Gauge and Differential Carrier Spreader.

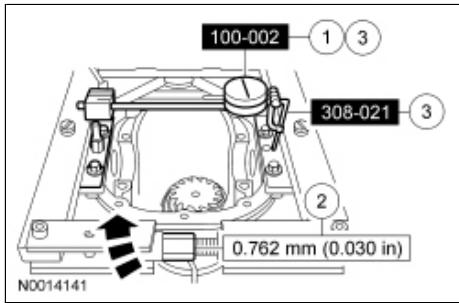


39. **NOTICE:** Overspreading may damage the differential housing.

**NOTE:** Tighten and loosen the differential carrier spreader screw to normalize the housing spreader adapters prior to taking the final Dial Indicator reading.

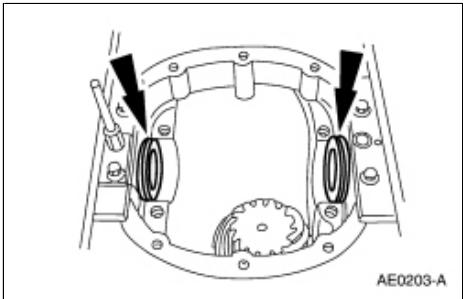
Spread the differential housing to the specification.

1. Adjust the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge to zero.
2. Tighten the screw until spreading the differential housing to the specification.
3. Remove the Dial Indicator Gauge with Holding Fixture and Clutch Housing Gauge.



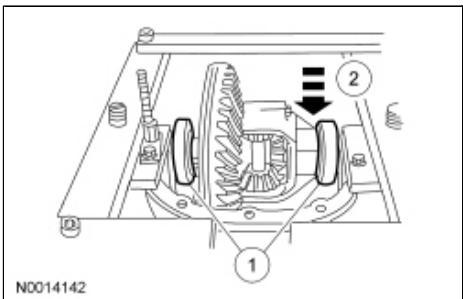
40. **NOTICE:** To avoid galling the case, insert shims with a light coating of grease before installing the differential assembly. If not carried out in this order, the aluminum housing may be damaged.

Place the differential bearing shims in the differential housing.



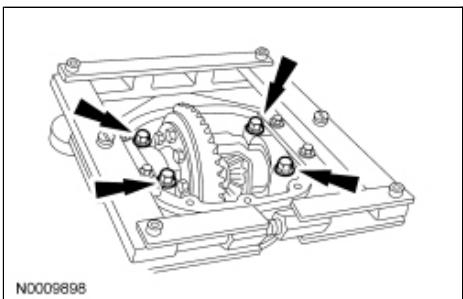
41. Install the differential carrier.

1. Position the differential bearing cups on the differential bearings.
2. Lower the differential carrier in place between the differential bearing shims.

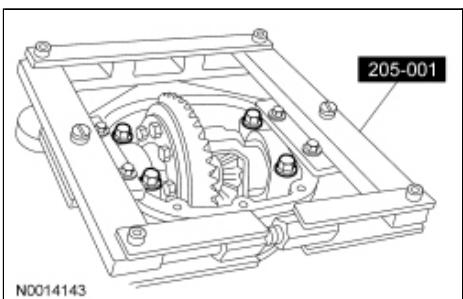


42. **NOTE:** Hand-tighten the differential bearing cap bolts prior to releasing the carrier spreader.

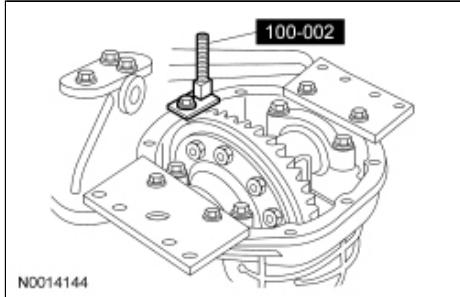
Install the 2 differential bearing caps and the 4 differential bearing cap bolts in their original locations and positions.



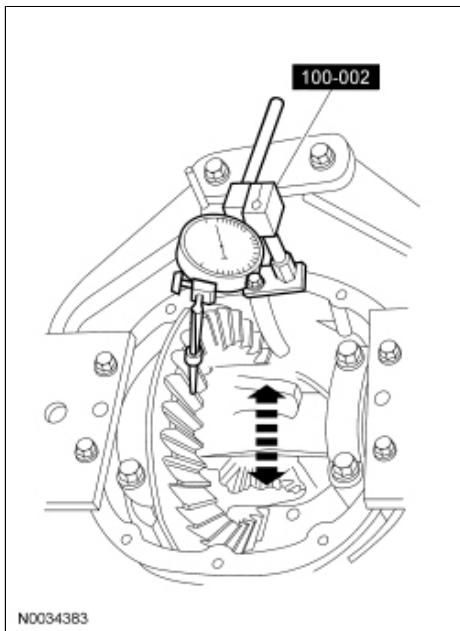
43. Loosen and remove the Differential Carrier Spreader.



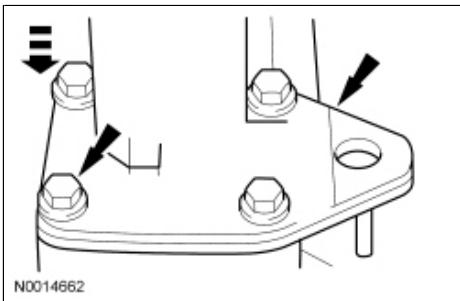
44. Tighten the 4 differential bearing cap bolts.
  - Tighten to 105 Nm (77 lb-ft).
45. Rotate the differential carrier to make sure it turns freely.
46. Install the Dial Indicator Gauge with Holding Fixture at the 12 o'clock position.



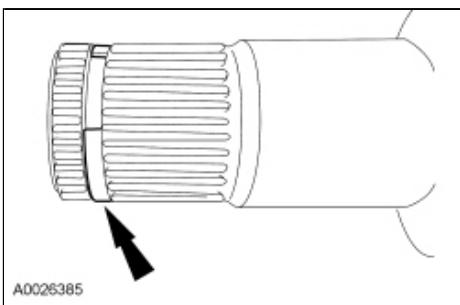
47. Using the Dial Indicator Gauge with Holding Fixture, recheck the ring gear backlash.



48. Apply marking compound and rotate the differential assembly 5 complete revolutions.
49. Verify an acceptable pattern check. For additional information, refer to Diagnosis and Testing in this section.
50. Install the 4 bolts and the axle housing tube.
  - Tighten to 73 Nm (54 lb-ft).



51. Install a new stub shaft seal. For additional information, refer to [Stub Shaft Pilot Bearing and Seal](#) in this section.
52. Install a new circlip on the intermediate shaft end.

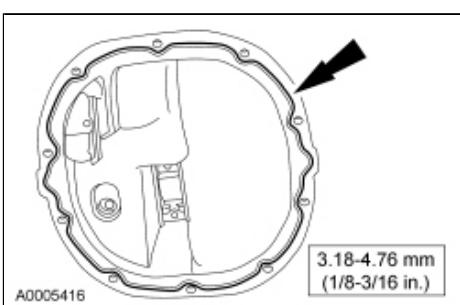


53. Insert the intermediate shaft and engage the circlip with the differential side gear.
54. Remove the axle assembly from the Transmission Holding Fixture and place it on the bench.
55. **NOTE:** Remove all of the silicone gasket and make sure the surfaces are free of oil before applying the new silicone gasket.

**NOTE:** The differential housing cover must be installed within 15 minutes of application of the silicone, or new sealant must be applied. If possible, allow one hour before filling with lubricant to make sure the silicone sealant has correctly cured.

Apply a continuous bead of sealant, of the specified thickness, to the differential housing cover mounting surface as shown in the illustration.

- Use silicone gasket and sealant.



56. Install the differential housing cover and 10 bolts.

- Tighten to 32 Nm (24 lb-ft).
57. Install the axle assembly. For additional information, refer to [Axe Assembly](#) in this section.
58. Remove the fill plug and fill the axle assembly with the specified amount and type of axle lubricant.
- Tighten the fill plug to 25 Nm (18 lb-ft).
-

**Material**

Item	Specification	Fill Capacity
Constant Velocity Joint Grease (High Temperature) XG-5	WSS-M1C258-A1	—

**General Specifications**

Item	Specification
Left halfshaft assembled length	406.45 mm (16.00 in)
Right halfshaft assembled length	411.85 mm (16.21 in)

**Torque Specifications**

Description	Nm	lb-ft	lb-in
Brake flexible hose bracket bolt	30	22	—
Integrated Wheel End (IWE) bolts	12	—	106
Tie-rod end nut	115	85	—
Upper ball joint nut	150	111	—
Wheel hub nut	40	30	—
Wheel speed sensor harness bracket bolt	12	—	106

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## Front Drive Halfshafts

The front drive halfshafts consist of the following:

- Inner CV joints
- Outer CV joints
- Interconnecting shafts
- Convoluted CV joint boots
- CV joint boot clamps
- Special CV high-temperature grease
- Tripod joint housings
- Ball and cage housings
- A circlip stopper that holds the cross-groove inboard race assembly (inboard CV joint) together
- A circlip that retains the splined inboard CV joint to the differential side gear

The front drive halfshafts link the front axle to the front wheel hubs. The CV joints allow the halfshafts to rotate smoothly through the required changes in angles between the stationary axle and the varying angles of the front wheels including jounce and rebound plus changes while turning. The CV joints are either tri-loped style or the caged ball type depending on inboard or outboard. New halfshaft components are available as kits containing grease, boots and clamps.

### Halfshaft Handling

Handle all halfshaft components carefully during removal and installation and during various component disassembly and assembly procedures.

- Never pick up or hold the halfshaft only by the inboard or outboard CV joint.
- Do not overangle the CV joints.
- Damage will occur to an assembled inboard CV joint if it is overplunged outward from the joint housing.
- Never use a hammer to remove or install the halfshafts from the hub.
- Never use the halfshaft assembly as a lever to position other components. Always support the free end of the halfshaft.
- Do not allow the boots to contact sharp edges or hot exhaust components.
- Handle the halfshaft only by the interconnecting shaft to avoid pull-apart and potential damage to the CV joints.
- Excessive pulling force on the interconnecting shaft between joints of the halfshaft will result in internal joint damage. Axial loads used in assisting removal must be applied through the inboard joint housing only.
- Do not drop assembled halfshafts. The impact will cut the boots from the inside without evidence of external damage.
- Do not remove the outer CV joint by pulling on the interconnecting shaft.
- Inspect all machined surfaces and splines for damage.



## **Front Drive Halfshafts**

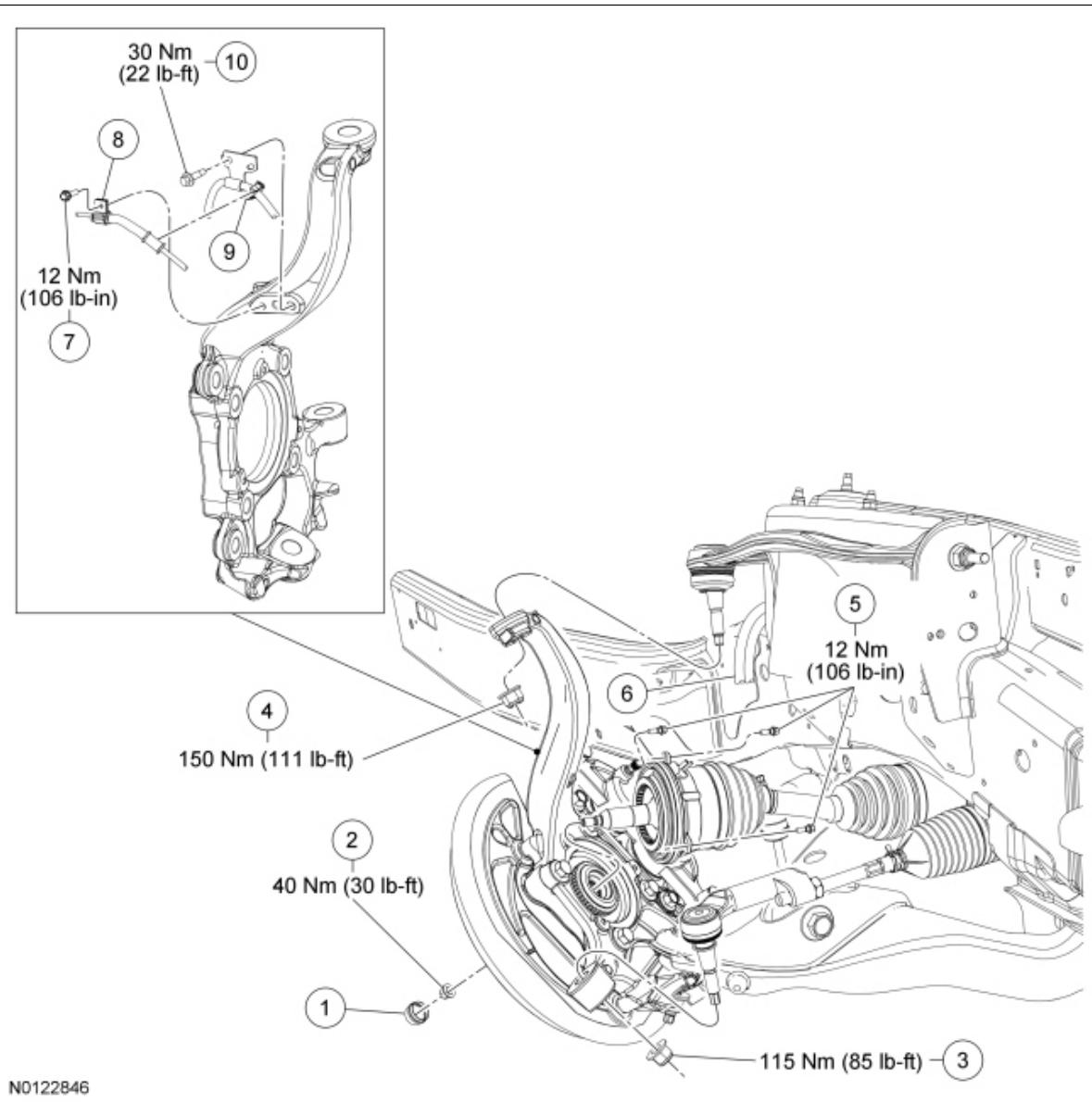
Refer to [Section 205-00](#).

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## **Halfshaft**

### **Special Tool(s)**

	Halfshaft Remover 205-832
	Slide Hammer 100-001 T50T-100-A



N0122846

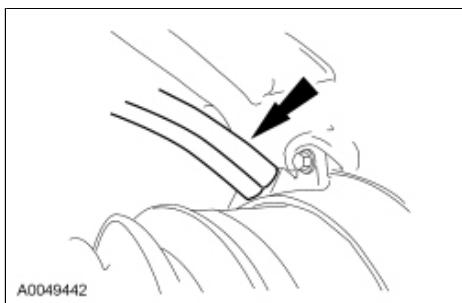
Item	Part Number	Description
1	1131	Dust cap
2	N802827-S100	Wheel hub nut
3	W520215	Tie-rod end nut
4	W520215	Upper ball joint nut
5	W505211	Integrated Wheel End (IWE) bolts (3 required)
6	—	Vacuum vent and apply tube
7	—	Wheel speed sensor harness bracket bolt
8	—	Wheel speed sensor harness bracket (part of 2C204)

9	—	Brake flexible hose retainer (part of 2078)
10	W611633	Brake flexible hose bracket bolt

### Removal and Installation

**NOTICE:** Whenever a halfshaft is removed, install a new circlip and stub shaft pilot bearing seal or damage to the component may occur.

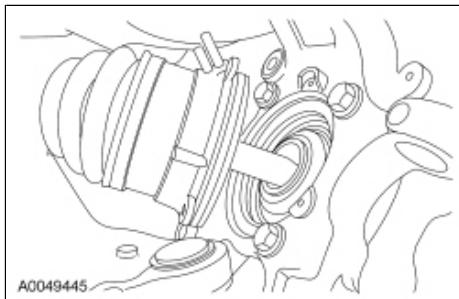
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the dust cap.
3. Remove and discard the wheel hub nut.
  - To install, tighten the new wheel hub nut to 40 Nm (30 lb-ft).
4. Remove the wheel speed sensor harness bracket bolt and position the wheel speed sensor harness aside.
  - To install, tighten to 12 Nm (106 lb-in).
5. Detach the brake flexible hose retainer from the wheel speed sensor harness.
6. Remove the brake flexible hose bracket bolt and disconnect the brake flexible hose bracket from the wheel knuckle.
  - To install, tighten to 30 Nm (22 lb-ft).
7. Remove the vacuum vent and apply tube at the vacuum vent and apply tube port of the Integrated Wheel End (IWE) disconnect.



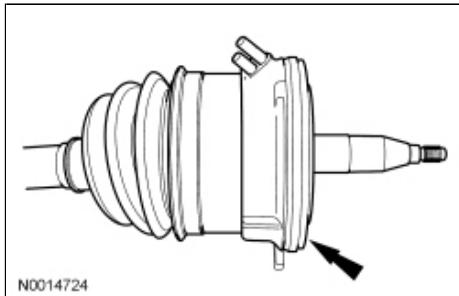
8. Remove the 3 IWE bolts.
  - To install, tighten to 12 Nm (106 lb-in).
9. Remove and discard the tie-rod end nut.
  - Disconnect the tie-rod end from the wheel knuckle.
  - To install, tighten the new tie-rod end nut to 115 Nm (85 lb-ft).
10. Remove and discard the upper ball joint nut.
  - Disconnect the upper ball joint from the wheel knuckle.
  - To install, tighten the new upper ball joint nut to 150 Nm (111 lb-ft).
11. **NOTE:** Do not damage the hub seal.

**NOTE:** Allow the steering knuckle to swing outboard while keeping the CV shaft pushed inboard.

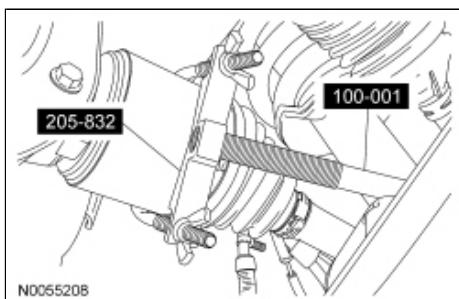
Once clearance is available, remove the CV shaft joint outboard end and IWE disconnect from the steering knuckle hub bearing.



12. Remove the IWE disconnect from the outboard CV joint housing.



13. Using the Halfshaft Remover and Slide Hammer, remove the halfshaft from the differential and the intermediate shaft.



14. Remove and discard the circlip and the stub shaft seal. For additional information, refer to [Section 205-03](#).
15. **NOTICE:** Verify the spline engagement by checking for spline lash before installing the halfshaft nut or component damage may occur.

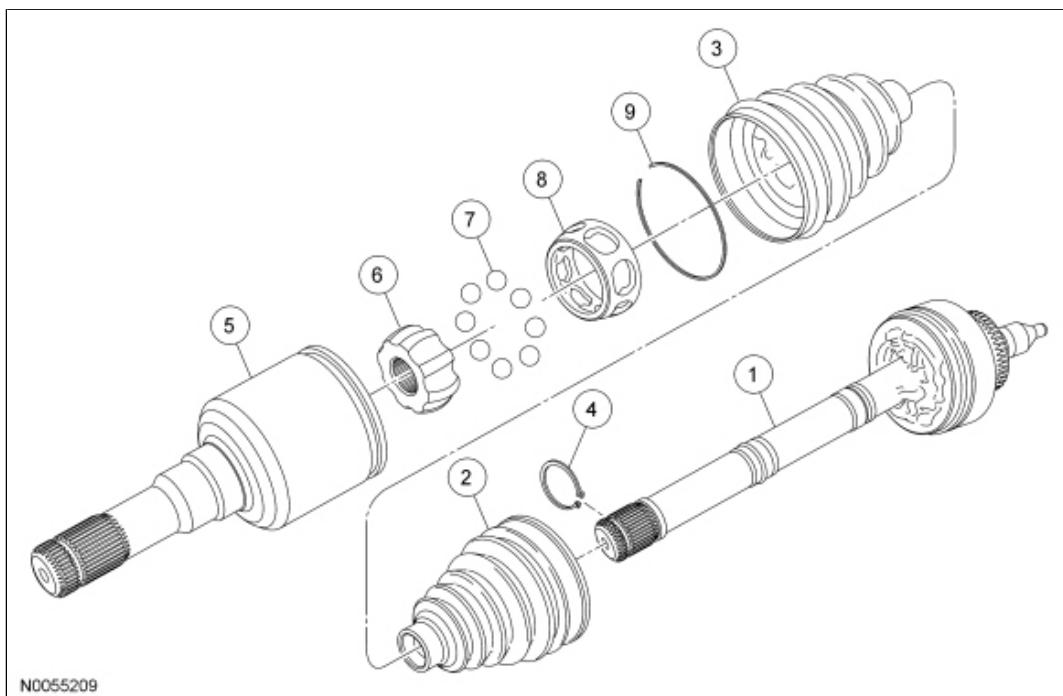
To install, reverse the removal procedure.



## Halfshaft

### Material

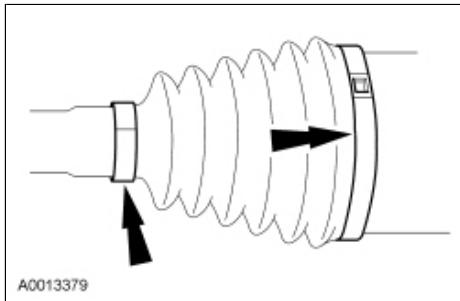
Item	Specification
Constant Velocity Joint Grease (High Temperature) XG-5	WSS-M1C258- A1



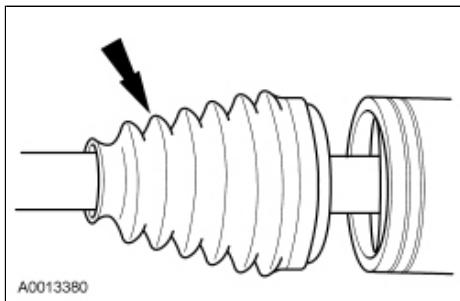
Item	Part Number	Description
1	3B436B	Outboard CV joint and interconnecting shaft assembly
2	3A331A	Outboard CV boot
3	3A331B	Inboard CV boot
4	4B422	Snap ring
5	3B414	Inboard CV joint housing
6	—	Inner race (part of 3B436 RH/ 3B437 LH)
7	—	Ball (8 required) (part of 3B436 RH/ 3B437 LH)
8	—	Ball cage (part of 3B436 RH/ 3B437 LH)
9	3B426	Retaining ring (part of 3B436 RH/ 3B437 LH)

## Disassembly

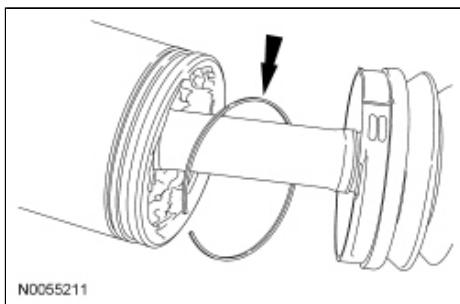
1. Remove the halfshaft from the vehicle. For additional information, refer to [Halfshaft](#) in the Removal and Installation portion of this section.
2. Remove the 2 boot clamps.



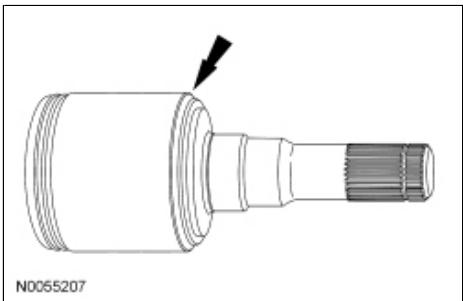
3. Separate the boot from the inboard CV joint housing.



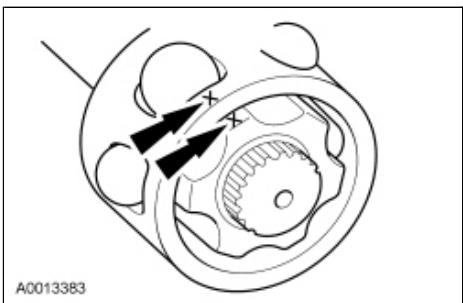
4. Remove the retaining ring.



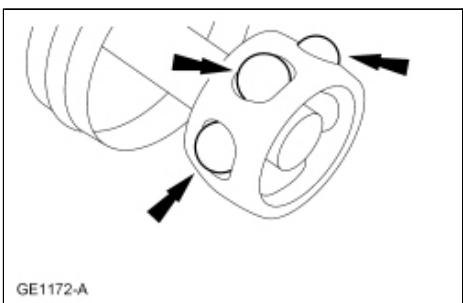
5. Remove the inboard CV joint housing.



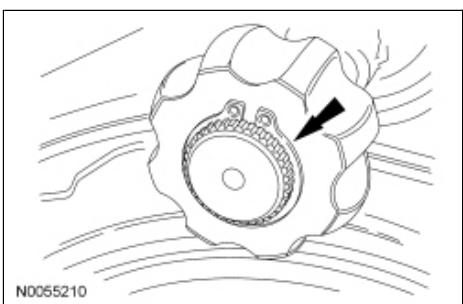
6. Index-mark the inner race and ball cage.



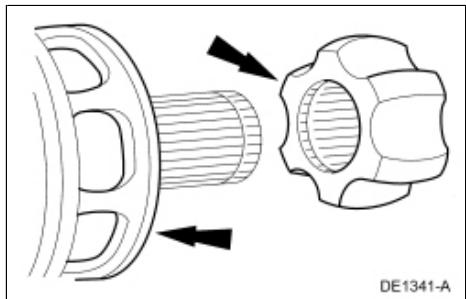
7. Remove the 6 balls.



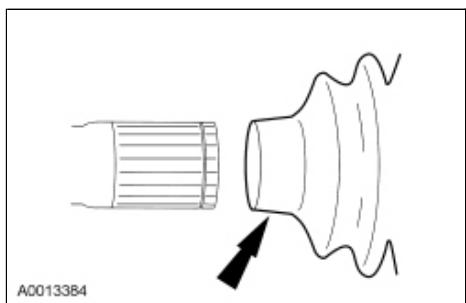
8. Remove the snap ring.



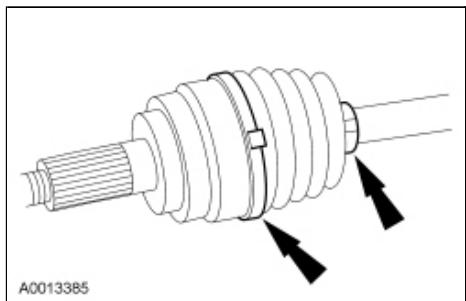
9. Remove the inner race and the ball cage.



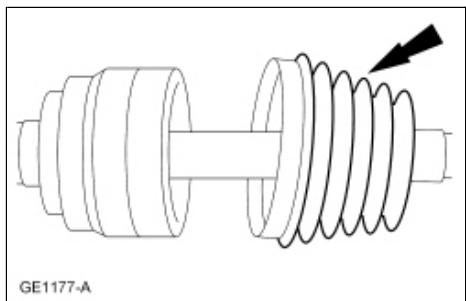
10. Remove the inboard boot.



11. Remove the 2 boot clamps.



12. Remove the outboard boot.

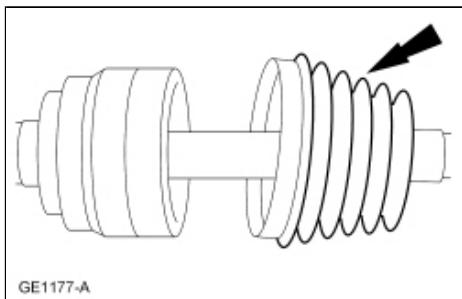


13. **NOTE:** If the grease is contaminated, clean and inspect the joint for wear. Install a new outboard CV joint and interconnecting shaft assembly if worn/damaged.

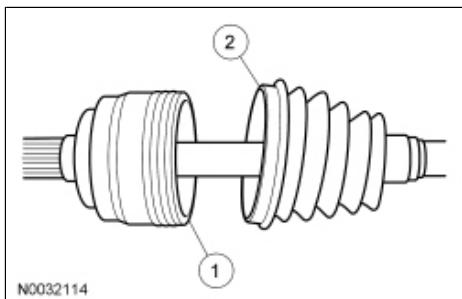
Check the CV joint grease for contamination.

## Assembly

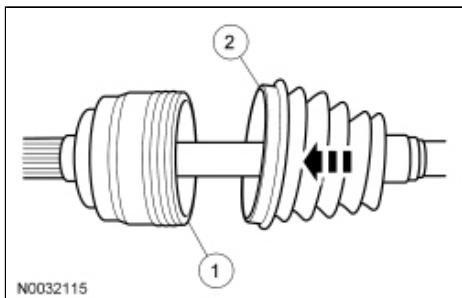
1. Position the outboard boot on the shaft.



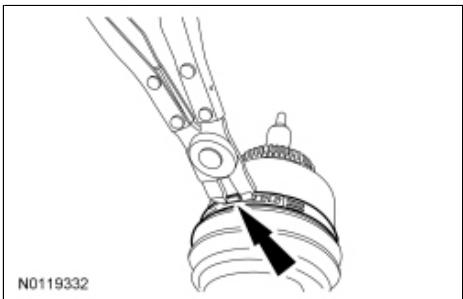
2. Pack the outboard CV joint with 165 g (5.82 oz) of grease.
  1. Use CV joint grease or equivalent provided in the boot kit.
  2. Spread any remaining grease from the kit evenly inside the boot.



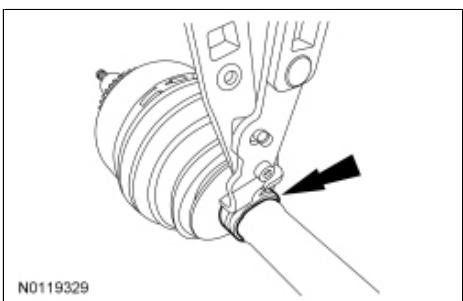
3. Install the outboard boot.
  1. Clean the boot mounting surface.
  2. Seat the boot in the joint boot groove.



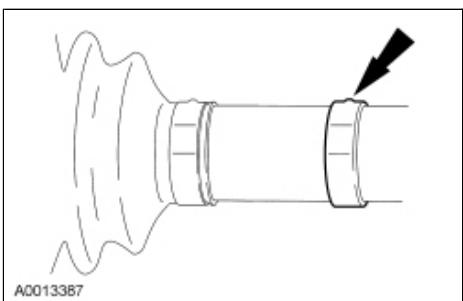
4. Using a suitable boot clamp installer (such as Snap-On® stock #YA3050 or equivalent) install the large boot clamp.



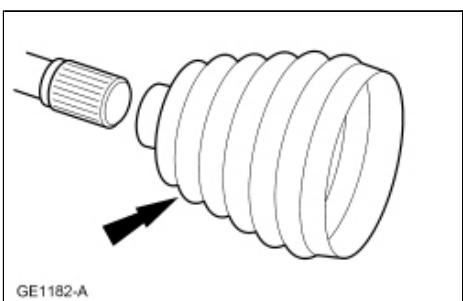
5. Using a suitable boot clamp installer (such as Snap-On® stock #YA3080 or equivalent) install the small boot clamp.



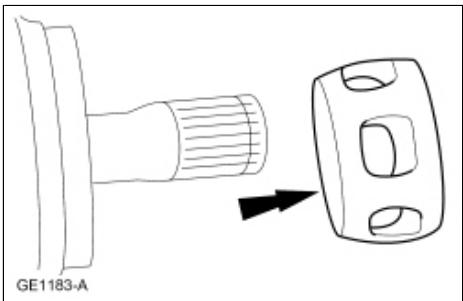
6. Position the boot clamp on the shaft.



7. Position the inboard boot on the shaft.

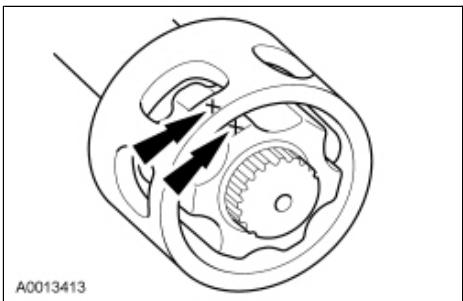


8. Position the ball cage on the shaft with the tapered end facing the boot.

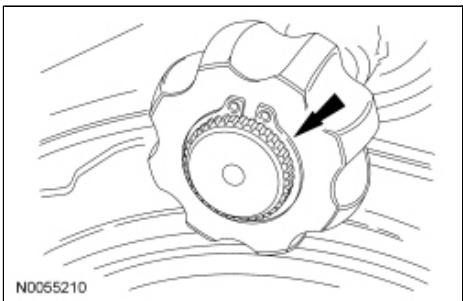


9. **NOTE:** Align the index marks.

Position the inner race on the shaft with the counterbored end facing the boot.

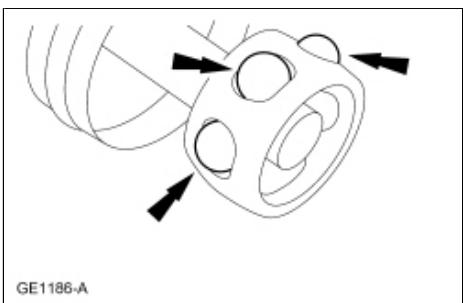


10. Install the snap ring.

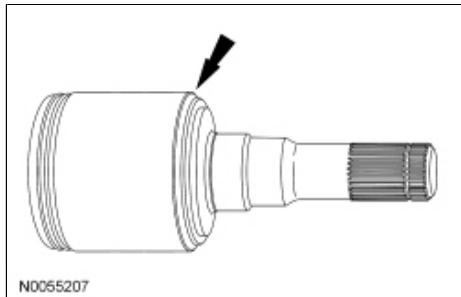


11. Lubricate and position the 6 balls.

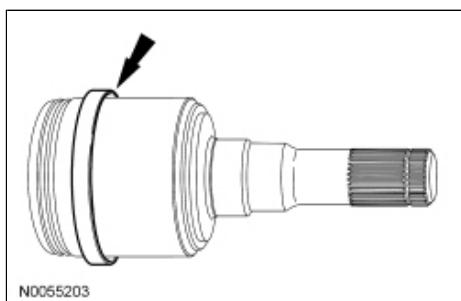
- Use CV joint grease or equivalent provided in the boot kit.



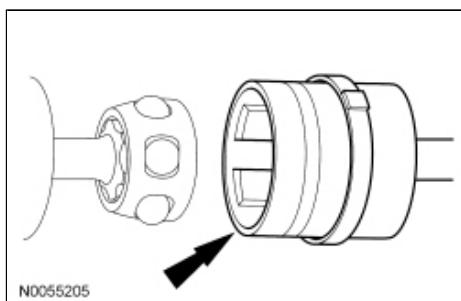
12. Fill the inboard CV joint housing with 235 g (8.29 oz) of grease.
  - Use CV joint grease or equivalent provided in the boot kit.



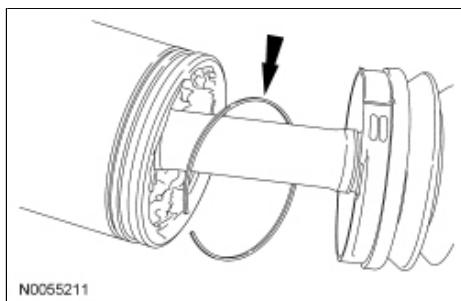
13. Position the boot clamp on the inboard CV joint housing.



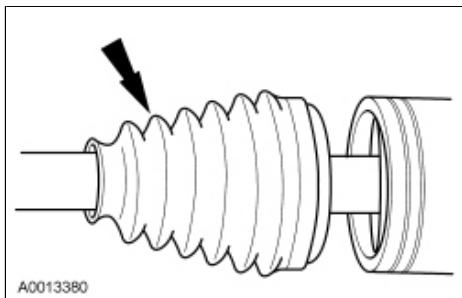
14. Position the inboard CV joint housing on the ball and race assembly.



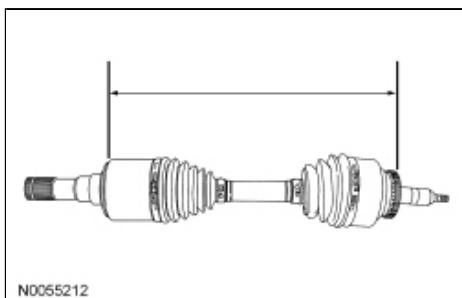
15. Install the retaining ring.



16. Remove any excess grease from the mating surface. Seat the boot in the joint boot groove.

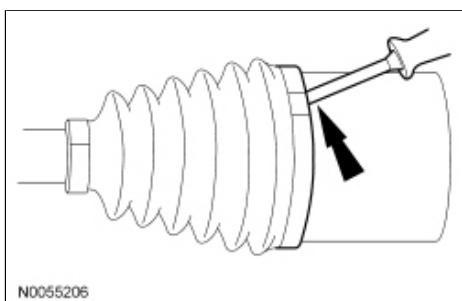


17. Set the halfshaft assembled length to specification. For additional information, refer to Specifications in this section.

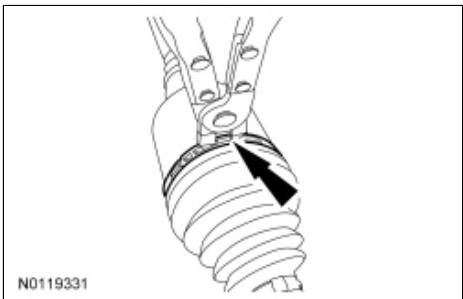


18. **NOTICE: Use care when inserting the screwdriver or damage to the boot may occur.**

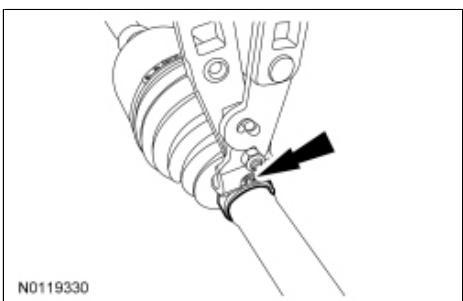
Insert a dull screwdriver blade under the boot to release the pressure.



19. Using a suitable boot clamp installer (such as Snap-On® stock #YA3050 or equivalent) install the large boot clamp.

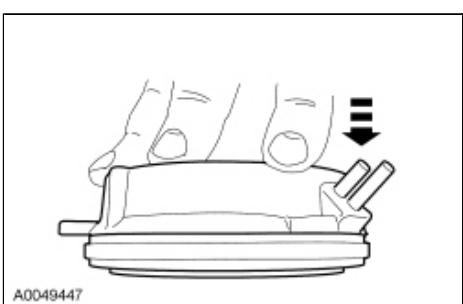


20. Using a suitable boot clamp installer (such as Snap-On® stock #YA3080 or equivalent) install the small boot clamp.

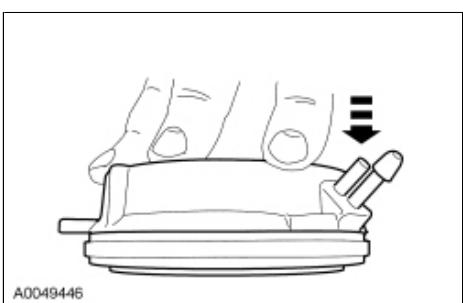


21. **NOTE:** Maintain a clean work surface.

Compress the Integrated Wheel End (IWE) disconnect on the bench to collapse the vacuum chamber.

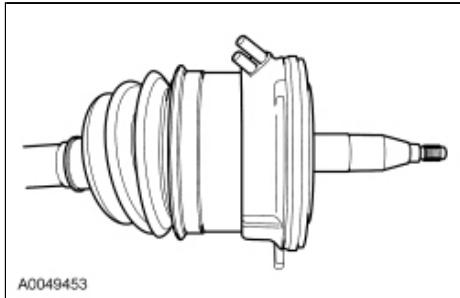


22. While the IWE disconnect is collapsed, install a vacuum cap on the vacuum port.



23. ***NOTICE:*** Do not install the Integrated Wheel End (IWE) end disconnect in the knuckle. It must be installed on the outer Constant Velocity (CV) joint housing or damage to the component may occur.

Install the IWE disconnect on the outer CV joint housing.



24. ***NOTICE:*** Verify the spline engagement by checking for spline lash before installing the halfshaft nut or damage to the component may occur.

Install the halfshaft in the vehicle. For additional information, refer to [Halfshaft](#) in the Removal and Installation portion of this section.

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**Material**

Item	Specification	Fill Capacity
Motorcraft® High Performance DOT 3 Motor Vehicle Brake Fluid (US) / Motorcraft® Brake Fluid - Heavy Duty DOT 3 (Canada) PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	1,420 ml (3.0 pt)
Motorcraft® Metal Brake Parts Cleaner (US) / Motorcraft® Brake Parts Cleaner (Canada) PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—
Motorcraft® Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—

**General Specifications**

Item	Specification
<b>Brake Disc</b>	
Front brake disc minimum thickness	32 mm (1.259 in)
Rear brake disc minimum thickness	23.0 mm (0.906 in)
<b>Brake Pads</b>	
Maximum brake pad taper wear (in any direction)	3.0 mm (0.118 in)
Minimum brake pad thickness	3.0 mm (0.118 in)

**Torque Specifications**

Description	Nm	lb-ft	lb-in
Brake caliper bleed screw	10	—	89
Master cylinder primary brake tube fittings	28	21	—
Master cylinder secondary brake tube fitting	20	—	177



## Brake System

The brake system consists of the following components:

- Front and rear disc brakes
- Cable/drum-in-hat actuated parking brake
- Brake master cylinder and fluid reservoir
- Vacuum-assisted power brake booster
- Four-wheel ABS
- Red brake warning indicator

The brake pedal is connected to the power brake booster, which is connected to the brake master cylinder. When the brake pedal is pressed, brake fluid is pushed through the double-walled steel tubes and flexible hoses to the front and rear disc brake calipers. The brake fluid enters the disc brake calipers, forcing the caliper pistons and brake pads outward against the brake disc friction surface, slowing or stopping rotation. When the brake pedal is released, brake fluid pressure is relieved, returning the front and rear disc brake caliper pistons and brake pads to the unapplied position.

For information on the following:

- Front disc brakes, refer to [Section 206-03](#).
  - Rear disc brakes, refer to [Section 206-04](#).
  - Parking brake actuation, refer to [Section 206-05](#).
  - Hydraulic brake actuation, refer to [Section 206-06](#).
  - Vacuum-assisted power brake booster, refer to [Section 206-07](#).
  - ABS, refer to [Section 206-09](#).
-



## Component Tests

### Brake Booster

1. Disconnect the brake booster vacuum sensor/check valve from the brake booster and connect a suitable vacuum/pressure tester to the booster side of the vacuum sensor/check valve.
2. Apply the parking brake, start the engine and place the transmission in NEUTRAL.
  - Allow the engine to reach normal operating temperature.
3. **NOTE:** Subtract approximately 3.38 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 ft) of elevation above sea level.

Verify that vacuum is available at the vacuum sensor/check valve with engine running at normal idle speed.

  - The vacuum gauge should read between 51-74 kPa (15-22 in-Hg).
  - If specified vacuum is available, stop the engine, connect the vacuum sensor/check valve and continue with Step 5.
  - If specified vacuum is not available, continue with Step 4.
4. Disconnect the vacuum sensor/check valve from the vacuum hose and verify that the specified vacuum is available at the hose with the engine at idle speed and the transmission in NEUTRAL.
  - If specified vacuum is available, stop the engine, install a new vacuum sensor/check valve and continue with Step 5.
  - If specified vacuum is not available, stop the engine, connect the vacuum hose to the vacuum sensor/check valve and refer to [Section 303-00](#) to diagnose the no/low vacuum condition.
  - On vehicles equipped with a brake vacuum pump, if specified vacuum is not available, inspect the vacuum hose and install new as necessary. If vacuum hose is OK, install a new brake vacuum pump. Refer to [Section 206-07](#).
5. Apply the brake pedal several times to exhaust all vacuum from the system.
6. Apply the brake pedal and hold it in the applied position. Start the engine and verify that the brake pedal moves downward after the engine starts.
  - If the brake pedal moves, the brake booster is operating correctly.
  - If the brake pedal does not move, install a new brake booster. Refer to [Section 206-07](#).
7. Operate the engine a minimum of 20 seconds at idle. Stop the engine and let the vehicle stand for 10 minutes, then apply the brake pedal. The brake pedal feel should be the same as that noted with the engine operating.
  - If the brake pedal feels hard (no power assist), install a new brake booster vacuum sensor/check valve and retest.
  - If condition still exists, install a new brake booster. Refer to [Section 206-07](#).
  - If the brake pedal feels the same as noted with the engine operating, the vacuum sensor/check valve is functioning properly.

### **Brake Master Cylinder — Bypass Condition**

1. Inspect the master cylinder. Refer to [Brake System Inspection](#) in this section.
2. Disconnect the brake tubes from the master cylinder.
3. Plug the outlet ports of the master cylinder.
4. **NOTE:** Make sure that the outlet port plugs do not show signs of leakage.  
  
Lightly apply the brakes and hold for 10 seconds. Release the brakes and then reapply with heavy force. If brake pedal height cannot be maintained, the brake master cylinder has an internal leak and a new brake master cylinder must be installed.
  - If brake pedal height is maintained, reinstall brake tubes and tighten to specifications. Refer to Specifications in this section. After installation, bleed the brake system. Refer to [Brake System Bleeding](#) in this section.

### **Brake Master Cylinder — Compensator Port**

1. Inspect the master cylinder. Refer to [Brake System Inspection](#) in this section.
  2. With the vehicle in NEUTRAL, position it on a hoist. Refer to [Section 100-02](#).
  3. Apply and release the brakes.
  4. With the brakes released, attempt to rotate each wheel and check for any brake drag.
    - If an excessive amount of brake drag exists at multiple wheels, continue to Step 5.
    - If an excessive amount of brake drag exists at only one wheel, it indicates a possible seized brake caliper, brake wheel cylinder or parking brake component. Repair or install new components as necessary.
  5. Check the brake stoplamp switch and the brake pedal free play to verify that the brake pedal is not partially applied.
  6. Loosen the brake master cylinder nuts and position the brake master cylinder away from the brake booster.
  7. With the brakes released, attempt to rotate each wheel and check for any brake drag.
    - If the brake drag is no longer present, install a new brake booster. Refer to [Section 206-07](#).
    - If the brake drag is still present, install a new master cylinder. Refer to [Section 206-06](#).
-



## Inspection And Verification

### Material

Item	Specification
Motorcraft® High Performance DOT 3 Motor Vehicle Brake Fluid (US) / Motorcraft® Brake Fluid - Heavy Duty DOT 3 (Canada) PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

 **WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

 **WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**NOTICE:** Blistering or swelling of rubber brake components can indicate contamination of the brake fluid by a petroleum-based substance. The entire hydraulic brake system must be flushed with clean, specified brake fluid and contaminated rubber components must be replaced to prevent recontamination.

**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

The first indication that something may be wrong in the brake system is a change in the feeling through the brake pedal. The brake warning indicator in the Instrument Cluster (IC) and the brake fluid level in the brake master cylinder reservoir are also indicators of system concerns.

If a wheel is locked and the vehicle must be moved, open a bleeder screw at the locked wheel to let out enough fluid to relieve the pressure. Close the bleeder screw. If multiple wheels are locked, check the brake pedal free play to verify brake pedal is not partially applied. These operations may release the brakes, but will not correct the concern. If this does not relieve the locked wheel condition, repair the locked components before proceeding.

1. Verify the customer concern.
  - For parking brake concerns, refer to [Section 206-05](#).
  - For ABS concerns, refer to [Section 206-09](#).
  - For adjustable pedal concerns, refer to [Section 206-06](#).
  - For all other concerns, continue with the next step.
2. Visually inspect for obvious signs of mechanical or electrical damage.

### Visual Inspection Chart

Mechanical	Electrical
<ul style="list-style-type: none"><li>• Brake fluid level and condition</li><li>• Brake master cylinder</li><li>• Brake master cylinder reservoir</li><li>• Brake booster</li><li>• Brake booster check valve</li><li>• Brake booster vacuum hose</li><li>• Brake hoses and tubes</li><li>• Brake caliper, guide pins and anchor plate</li><li>• Brake disc</li><li>• Brake pads</li><li>• Brake pedal, bracket and booster linkage</li><li>• Aftermarket modifications</li></ul>	<ul style="list-style-type: none"><li>• Parking brake switch</li><li>• Brake fluid level switch</li><li>• Wiring, terminals or connectors</li></ul>

3. Visually inspect the suspension system and tires for obvious signs of wear or damage.
    - For suspension system concerns, refer to [Section 204-00](#).
    - For tire concerns, refer to [Section 204-04](#).
  4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
  5. If the cause is not visually evident, GO to [Symptom Chart - Brake System](#) or GO to [Symptom Chart - NVH](#) in this section.
-

## Pinpoint Tests

### Pinpoint Test A: Vibration When the Brakes are Applied

#### Normal Operation

During moderate to heavy braking, noise from the Hydraulic Control Unit (HCU) and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct functioning of the ABS. Pedal pulsation or steering wheel nibble when the brakes are applied (frequency is proportioned to the vehicle speed) indicates a concern with a brake or suspension component.

#### PINPOINT TEST A: VIBRATION WHEN THE BRAKES ARE APPLIED

Test Step	Result / Action to Take
<b>A1 ROAD TEST THE VEHICLE — LIGHT BRAKING</b>	
<ul style="list-style-type: none"> <li>Road test the vehicle. Warm the brakes by slowing the vehicle from 80 to 32 km/h (50 to 20 mph) using light brake force. At highway speeds of 89-97 km/h (55-60 mph), apply the brake using light pedal force.</li> <li><b>Is there a vibration/shudder felt in the steering wheel, seat or brake pedal?</b></li> </ul>	<b>Yes</b> GO to <a href="#">A4</a> . <b>No</b> GO to <a href="#">A2</a> .
<b>A2 ROAD TEST THE VEHICLE — MODERATE TO HEAVY BRAKING</b>	
<ul style="list-style-type: none"> <li>Road test the vehicle. At highway speeds of 89-97 km/h (55-60 mph), apply the brake using a moderate to heavy pedal force.</li> <li><b>Is there a vibration/shudder?</b></li> </ul>	<b>Yes</b> GO to <a href="#">A3</a> . <b>No</b> The concern is not present at this time.
<b>A3 CHECK ABS OPERATION</b>	
<ul style="list-style-type: none"> <li><b>NOTE:</b> During moderate to heavy braking, noise from the HCU and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct operation of the ABS. Pedal pulsation or steering wheel nibble with the frequency proportional to vehicle speed indicates a concern with a brake or suspension component.</li> <li>Road test the vehicle and apply the brakes on a dry, firm surface, then apply the brakes on a wet, snowy or loose surface (such as gravel).</li> <li><b>Is the vibration/shudder only present on a wet, snowy or loose surface?</b></li> </ul>	<b>Yes</b> This is a normal operating condition of the ABS. <b>No</b> GO to <a href="#">A5</a> .
<b>A4 ISOLATE BRAKE VIBRATION</b>	
<ul style="list-style-type: none"> <li><b>NOTE:</b> This test is not applicable to vehicles with drum-in-hat type parking brakes. For vehicles with drum-in-hat parking brakes, proceed</li> </ul>	<b>Yes</b> GO to <a href="#">A7</a> .

<p>to the next test step. For all other vehicles, apply the parking brake to identify if the problem is in the front or rear brake.</p> <ul style="list-style-type: none"> <li>• Apply the parking brake to identify if the problem is in the front or rear brake. At highway speeds of 89-97 km/h (55-60 mph), lightly apply the parking brake until the vehicle slows down. Release the parking brake immediately after the test.</li> <li>• <b>Is there a vibration/shudder?</b></li> </ul>	<p><b>No</b> GO to <a href="#">A5</a>.</p>
<p><b>A5 CHECK THE FRONT SUSPENSION</b></p> <ul style="list-style-type: none"> <li>• Check the front suspension. Refer to <a href="#">Section 204-00</a>.</li> <li>• <b>Are all the suspension components in satisfactory condition?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">A6</a>.</p> <p><b>No</b> REPAIR or INSTALL new components as necessary. TEST the system for normal operation.</p>
<p><b>A6 CHECK THE FRONT BRAKE DISCS</b></p> <ul style="list-style-type: none"> <li>• Inspect the front brake discs. Refer to <a href="#">Brake System Inspection</a> in this section.</li> <li>• Road test the vehicle.</li> <li>• <b>Is the vibration/shudder present?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">A7</a>.</p> <p><b>No</b> The concern has been repaired.</p>
<p><b>A7 CHECK THE REAR SUSPENSION</b></p> <ul style="list-style-type: none"> <li>• Check the rear suspension. Refer to <a href="#">Section 204-00</a>.</li> <li>• <b>Are all the suspension components in satisfactory condition?</b></li> </ul>	<p><b>Yes</b> INSPECT the rear brake discs. REFER to <a href="#">Brake System Inspection</a> in this section.</p> <p><b>No</b> REPAIR or INSTALL new components as necessary. TEST the system for normal operation.</p>



## Principles of Operation

### Brake System

Applying the brake pedal uses lever action to push a rod into the brake booster, which through the use of vacuum, boosts the force of the rod and then transmits this force to the primary piston in the master cylinder. This produces hydraulic pressure in the master cylinder. This pressure builds in the master cylinder and brake tubes as the brake pedal is applied further. The pressure between the primary and secondary piston forces the secondary piston to compress, building pressure in its circuit. The hydraulic pressure is transmitted by brake fluid through the brake tubes to the ABS Hydraulic Control Unit (HCU), which then distributes that pressure to the individual brake calipers. The brake calipers use hydraulic pressure to apply the pads. The application of the brake pads will cause the rotation of the wheels to slow or stop, depending on how much brake pressure is applied. The parking brakes carry out the same function except that they are mechanically actuated by a cable that connects only to the rear brakes.

### Brake Master Cylinder Compensator Ports

The purpose of the compensator ports in the brake master cylinder is to supply additional brake fluid from the master cylinder reservoir when needed by the brake system due to brake lining wear and allow brake fluid to return to the master cylinder reservoir when the brakes are released. The returning brake fluid creates a slight turbulence in the master cylinder reservoir. This is a normal condition and indicates that the compensator ports are not clogged. Clogged compensator ports may cause the brakes to hang up or not fully release.

### Red Brake Warning Indicator

The red brake warning indicator alerts the driver to certain conditions that exist in the brake system. The Instrument Cluster (IC) performs a bulb check when the ignition key is turned to the RUN position. The conditions that cause the indicator to illuminate are low brake fluid level, the parking brake is applied or there is a fault in the ABS (if the yellow ABS warning indicator is also illuminated). To diagnose red brake warning indicator concerns, refer to [Section 413-01](#).



## Symptom Chart

### Symptom Chart — Brake System

#### Symptom Chart — Brake System

Condition	Possible Sources	Action
<ul style="list-style-type: none"><li>The red brake warning indicator and the yellow ABS warning indicator are illuminated</li></ul>	<ul style="list-style-type: none"><li>DTCs in the ABS module</li></ul>	<ul style="list-style-type: none"><li>REFER to <a href="#">Section 206-09</a> to diagnose the ABS.</li></ul>
<ul style="list-style-type: none"><li>The red brake warning indicator is always/never on</li></ul>	<ul style="list-style-type: none"><li>Brake fluid level switch</li><li>Parking brake switch</li><li>Wiring, terminals or connectors</li><li>Instrument Cluster (IC)</li><li>Smart Junction Box (SJB)</li><li>Vacuum sensor</li><li>Electronic Brake Distribution (EBD)</li></ul>	<ul style="list-style-type: none"><li>REFER to <a href="#">Section 413-01</a> to diagnose the red brake warning indicator.</li></ul>
<ul style="list-style-type: none"><li>Vehicle pulls or drifts during braking</li></ul>	<ul style="list-style-type: none"><li>Tires</li><li>Brake calipers and/or guide pins</li><li>Brake flexible hose</li><li>Brake pads</li><li>Brake discs</li><li>Suspension component(s) and/or wheel alignment</li></ul>	<ul style="list-style-type: none"><li>REFER to <a href="#">Section 204-04</a> to diagnose tire concerns.</li><li>INSPECT the brake system components. REFER to <a href="#">Brake System Inspection</a> in this section.</li><li>REFER to <a href="#">Section 204-00</a> to diagnose suspension system.</li></ul>
<ul style="list-style-type: none"><li>Brake pedal goes down fast or eases down slowly</li></ul>	<ul style="list-style-type: none"><li>Brake fluid leaks and/or air in the system</li><li>Brake master cylinder</li><li>Hydraulic Control Unit (HCU)</li></ul>	<ul style="list-style-type: none"><li>INSPECT the system for leaks. REPAIR as necessary. BLEED the system. REFER to <a href="#">Brake System Bleeding</a> in this section.</li><li>CARRY OUT the Brake Master Cylinder — Bypass Condition Component Test in this section.</li><li>REFER to <a href="#">Section 206-09</a> to diagnose the <a href="#">HCU</a>.</li></ul>
<ul style="list-style-type: none"><li>Brakes lock up</li></ul>	<ul style="list-style-type: none"><li>Brake pads</li></ul>	<ul style="list-style-type: none"><li>INSPECT the brake system</li></ul>

	<ul style="list-style-type: none"> <li>under light brake pedal force</li> </ul>	<ul style="list-style-type: none"> <li>Brake flexible hose</li> <li>Brake disc</li> <li>Brake calipers and/or guide pins</li> <li>ABS</li> </ul>	<p>components. REFER to <a href="#">Brake System Inspection</a> in this section.</p> <ul style="list-style-type: none"> <li>REFER to <a href="#">Section 206-09</a> to diagnose the ABS.</li> </ul>
	<ul style="list-style-type: none"> <li>Excessive brake pedal travel (low/spongy pedal)</li> </ul>	<ul style="list-style-type: none"> <li>Brake fluid leaks and/or air in the system</li> <li>Brake master cylinder</li> <li>Brake calipers and/or guide pins</li> <li>Brake flexible hose</li> <li><u>HCU</u></li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the system for leaks. REPAIR as necessary. BLEED the system. REFER to <a href="#">Brake System Bleeding</a> in this section.</li> <li>CARRY OUT the Brake Master Cylinder — Bypass Condition Component Test in this section.</li> <li>INSPECT the brake calipers and guide pins. REFER to <a href="#">Brake System Inspection</a> in this section.</li> <li>INSPECT the brake flexible hoses during brake application. REFER to <a href="#">Brake System Inspection</a> in this section.</li> <li>REFER to <a href="#">Section 206-09</a> to diagnose the <u>HCU</u>.</li> </ul>
	<ul style="list-style-type: none"> <li>Erratic brake pedal travel</li> </ul>	<ul style="list-style-type: none"> <li>Brake pedal</li> <li>ABS</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT the brake pedal for binding, obstructions and correct connection to booster rod. REPAIR as necessary. CHECK the brake pedal fasteners for correct torque. REFER to Specifications in <a href="#">Section 206-06</a>.</li> <li>REFER to <a href="#">Section 206-09</a> to diagnose the ABS.</li> </ul>
	<ul style="list-style-type: none"> <li>Brakes drag</li> </ul>	<ul style="list-style-type: none"> <li>Stoplamp switch</li> <li>Parking brake component</li> <li>Brake caliper and/or guide pins</li> <li>Brake booster/Master cylinder</li> <li><u>HCU</u></li> </ul>	<ul style="list-style-type: none"> <li>VERIFY correct installation of the stoplamp switch. REFER to <a href="#">Section 417-01</a>.</li> <li>REFER to <a href="#">Section 206-05</a> to diagnose the parking brake system.</li> <li>INSPECT the brake caliper and guide pins. REFER to <a href="#">Brake System Inspection</a> in this section.</li> <li>CARRY OUT the Brake Master Cylinder — Compensator Port Component Test in this section.</li> <li>REFER to <a href="#">Section 206-09</a> to diagnose the <u>HCU</u>.</li> </ul>
	<ul style="list-style-type: none"> <li>Excessive brake pedal effort</li> </ul>	<ul style="list-style-type: none"> <li>Insufficient engine vacuum for brake booster operation</li> <li>Brake booster manifold vacuum hose</li> <li>Brake booster</li> </ul>	<ul style="list-style-type: none"> <li>CARRY OUT the Brake Booster Component Test in this section.</li> <li>If any DTCs are retrieved for the brake vacuum pump, resolve them first before attempting any base brake repairs.</li> </ul>

	<ul style="list-style-type: none"> <li>• Brake booster vacuum sensor/check valve</li> <li>• Brake vacuum pump</li> <li>• Brake pads</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT the brake pads. REFER to <a href="#">Brake System Inspection</a> in this section.</li> </ul>
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## Symptom Chart — NVH

### Symptom Chart — NVH

**NOTE:** NVH symptoms should be identified using the diagnostic tools that are available. For a list of these tools, an explanation of their uses and a glossary of common terms, refer to [Section 100-04](#). Since it is possible any one of multiple systems may be the cause of a symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system. If this is not the causal system for the symptom, refer back to [Section 100-04](#) for the next likely system and continue diagnosis.

Condition	Possible Sources	Action
• Vibration when the brakes are applied	<ul style="list-style-type: none"> <li>• Brake disc(s)</li> <li>• Suspension components</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test A</a>.</li> </ul>
• Brake vibration/shudder — occurs when the brake pedal is released	<ul style="list-style-type: none"> <li>• Brake drag</li> </ul>	<ul style="list-style-type: none"> <li>• GO to <a href="#">Symptom Chart - Brake System</a>.</li> </ul>
• Rear brake noise — occurs when the brake pedal is unapplied	<ul style="list-style-type: none"> <li>• Parking brake component</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT the parking brake components. REFER to <a href="#">Section 206-05</a>.</li> </ul>
• Rattling noise	<ul style="list-style-type: none"> <li>• Caliper guide pins or guide pin bolts</li> <li>• Missing or damaged anti-rattle clips or springs</li> <li>• Loose brake disc shield</li> </ul>	<ul style="list-style-type: none"> <li>• CHECK the caliper guide pins and guide pin bolts. REFER to <a href="#">Brake System Inspection</a> in this section.</li> <li>• CHECK the brake pads for missing clips or broken springs. INSTALL new components as necessary. REFER to <a href="#">Section 206-03</a> for front disc brakes or <a href="#">Section 206-04</a> for rear disc brakes.</li> <li>• TIGHTEN the brake disc shield bolts to specification. REFER to <a href="#">Section 206-03</a> for front disc brakes or <a href="#">Section 206-04</a> for rear disc brakes.</li> </ul>
• Squealing noise — occurs on first (morning) brake application	<ul style="list-style-type: none"> <li>• Brake pads</li> </ul>	<ul style="list-style-type: none"> <li>• Acceptable condition. Caused by humidity and low brake pad temperature.</li> </ul>
• Squealing noise — a	<ul style="list-style-type: none"> <li>• Brake pads</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT the brake pads.</li> </ul>

continuous squeal		REFER to <a href="#">Brake System Inspection</a> in this section.
• Squealing noise — an intermittent squeal	• Brake pads	• Acceptable condition. Caused by cold, heat, water, mud or snow.
• Groaning noise — occurs at low speeds with brake lightly applied (creeping)	• Brake pads	• Acceptable condition.
• Grinding/moaning noise — continuous	• Brake pads • Brake disc	• INSPECT the brake pads, brake discs and attaching hardware. VERIFY brake components are within specifications. REFER to <a href="#">Brake System Inspection</a> in this section.

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## Brake Disc Machining

**NOTE:** Do not use a bench lathe to machine the brake discs. Use an on-vehicle brake lathe only. Read the entire operating manual and/or view the video shipped with the lathe before installing, operating or repairing the lathe.

**NOTE:** An on-vehicle brake lathe with an automatic runout adjustment feature is preferred. However, if the lathe is not self adjusting, the lathe oscillation must be adjusted using a dial indicator. The total indicated runout target is 0.000 mm (0.000 in). The maximum indicated runout should be no more than 0.050 mm (0.002 in). If the runout adjustment (automatic or manual) is carried out correctly prior to machining, then the final brake disc runout will be within specification and a runout measurement is not necessary after machining.

**NOTE:** Lateral runout and disc thickness variation measurements are not required because correct adjustment of the on-vehicle brake lathe will make sure that these dimensions are within specification.

1. Remove the wheel and tire. For additional information, refer to [Section 204-04](#).
2. **NOTICE:** Do not allow the caliper to hang from the brake hose or damage to the hose may occur.  
  
Remove the bolts and position the brake caliper or brake caliper and anchor plate assembly aside, as required.
  - Support the brake caliper using mechanic's wire.
3. Install the hub adapter using:
  - four wheel nuts on a 4-stud wheel hub.
  - five wheel nuts on a 5-stud wheel hub.
  - six wheel nuts on a 6-stud wheel hub.
  - four wheel nuts on a 7- or 8-stud wheel hub.
  - five wheel nuts on a 10-stud wheel hub.
4. Install the cutting lathe.
5. If the lathe is not self adjusting, adjust the lathe oscillation using a dial indicator. The total indicated runout target is 0.000 mm (0.000 in). The maximum indicated runout should be no more than 0.050 mm (0.002 in).
6. Center the cutting head, adjust the cutting bits and install the chip deflector/silencer.
7. **NOTE:** The depth of the cut should be between 0.10 and 0.40 mm (0.004 and 0.015 in). Lighter cuts will cause the bit to heat up and wear faster. Heavier cuts will cause poor brake disc surface finish.

Machine the brake disc.

8. Remove the lathe and the silencer.
9. Remove the wheel nuts and hub adapter.
10. Remove the metal shavings.

11. Measure the brake disc thickness.
    - If the measurement is below the minimum specification, install a new brake disc. For additional information, refer to [Section 206-03](#) for front disc brakes or [Section 206-04](#) for rear disc brakes.
  12. **NOTE:** It is not required to install new brake pads if friction material is within specifications. For additional information, refer to Specifications in this section.

Position the brake caliper or brake caliper and anchor plate assembly.

    - Install the bolts.
    - For fastener torque specifications, refer to [Section 206-03](#) for front disc brakes or [Section 206-04](#) for rear disc brakes.
  13. Install the wheel and tire. For additional information, refer to [Section 204-04](#).
-

## Brake System Bleeding

### General Equipment

Brake/Clutch System Pressure Bleeder/Filler
Fluid Container and Hose

### Pressure

**⚠ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

**⚠ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**⚠ WARNING:** Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

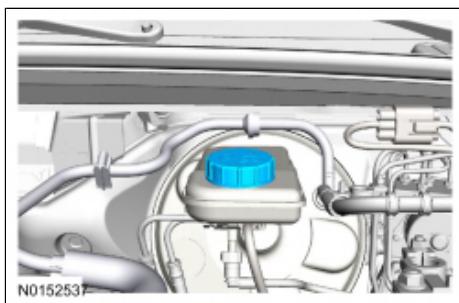
**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

**NOTE:** Pressure bleeding the brake system is preferred to manual bleeding.

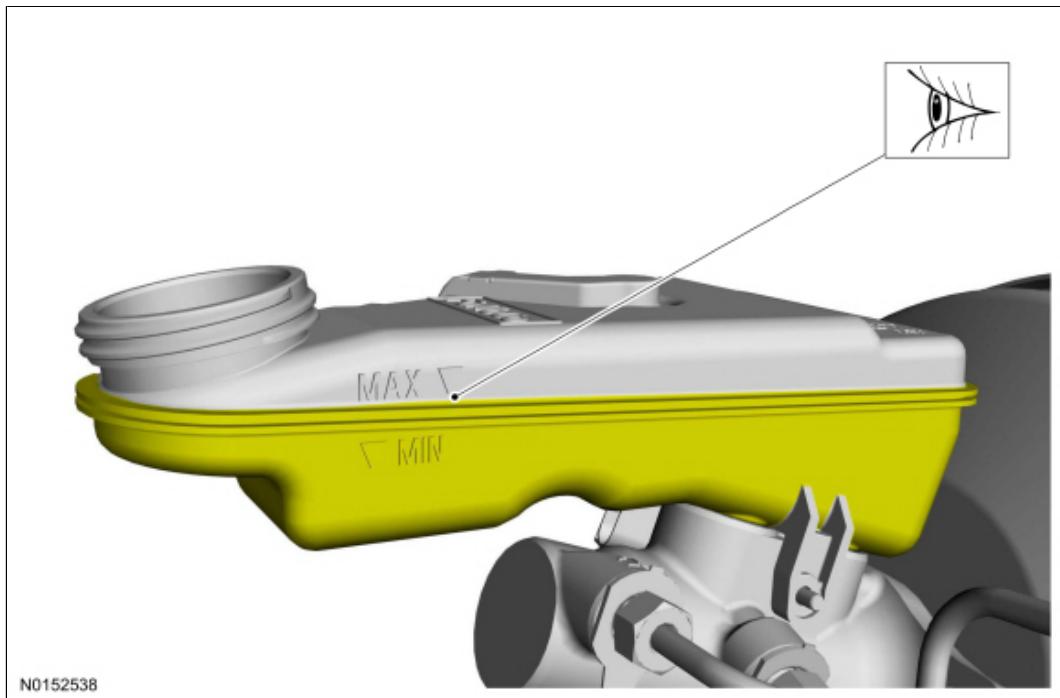
**NOTE:** The HCU bleeding procedure must be carried out if a new HCU has been installed.

### All Vehicles

- NOTE:** Make sure the area around the master cylinder cap is clean and free of foreign material.



2. Fill the reservoir with clean, specified brake fluid. Refer to Specifications in this section.



3. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

Install the bleeder adapter to the brake master cylinder reservoir and attach the bleeder tank hose to the fitting on the adapter.

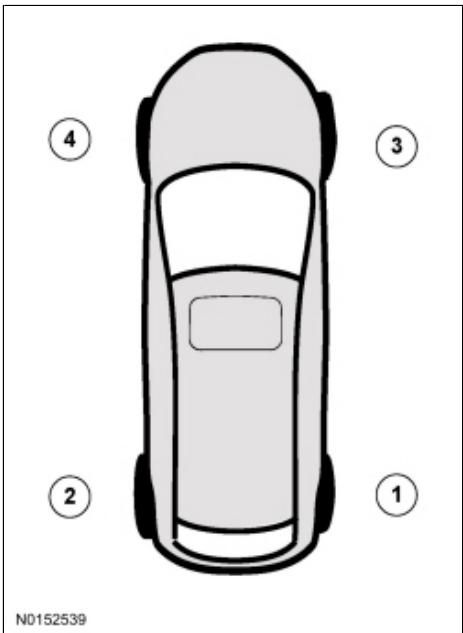
4. **NOTE:** Make sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation. Refer to Specifications in this section.

Open the valve on the bleeder tank.

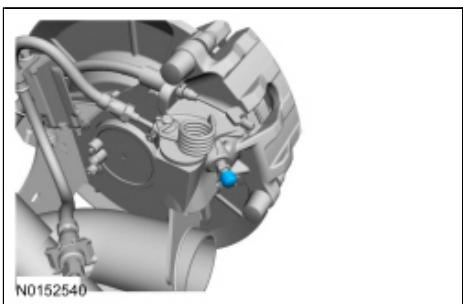
- Apply 207-345 kPa (30-50 psi) to the brake system.

5. With the vehicle in NEUTRAL, position it on a hoist. [Section 100-02](#).

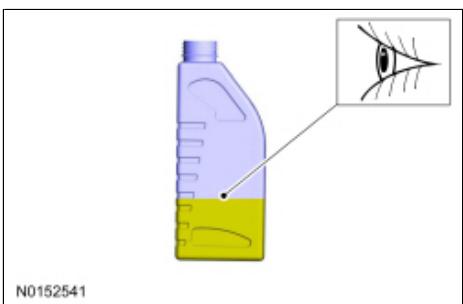
6. Bleeding steps must be followed in the order indicated in the graphic.



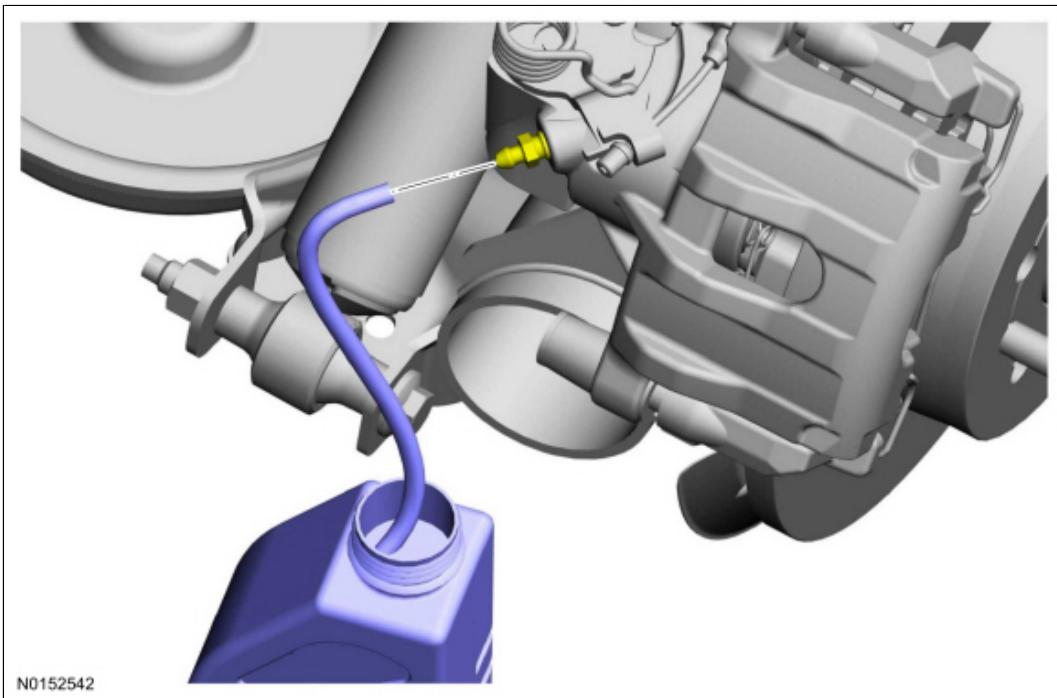
7.



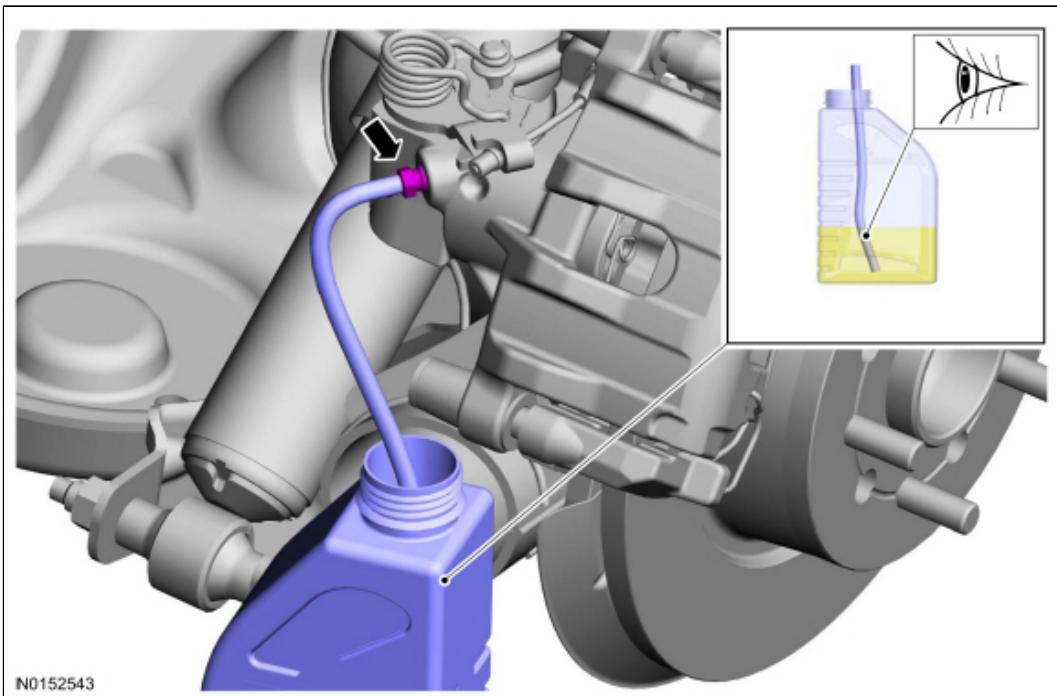
8.



9.



10. Loosen the bleeder screw  $180^\circ$  and leave open until clear bubble free brake fluid flows and then tighten the bleeder screw.

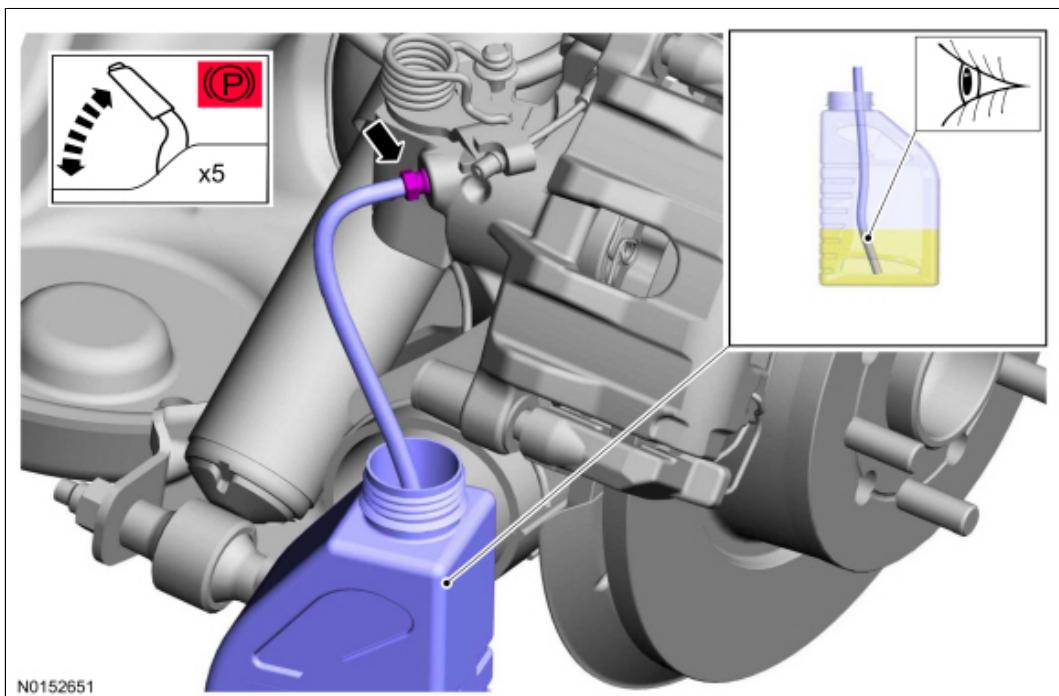


#### Vehicles with rear integral parking brake calipers

11. **NOTE:** Due to the complexity of the fluid path within the rear integral parking brake calipers, it is necessary to press and release the parking brake during the bleed procedure.

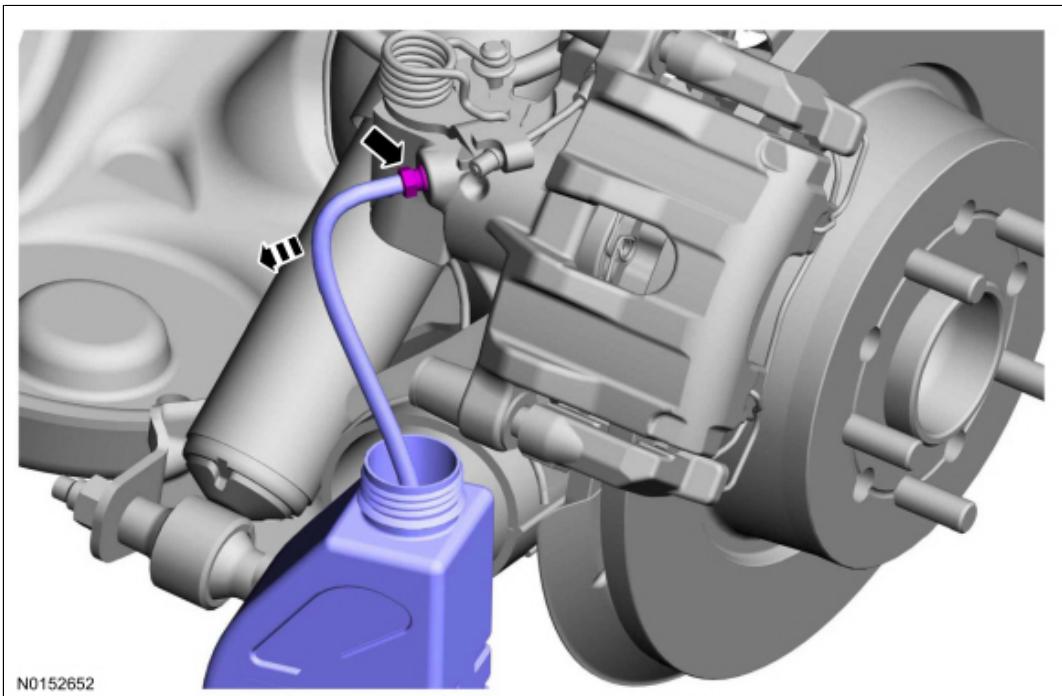
Apply and release the parking brake 5 times. Loosen the rear bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten the rear bleeder screw.

- Repeat until clear, bubble-free fluid comes out.

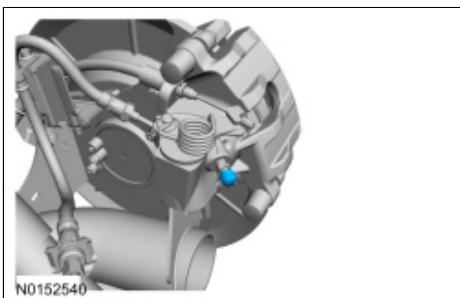


#### All vehicles

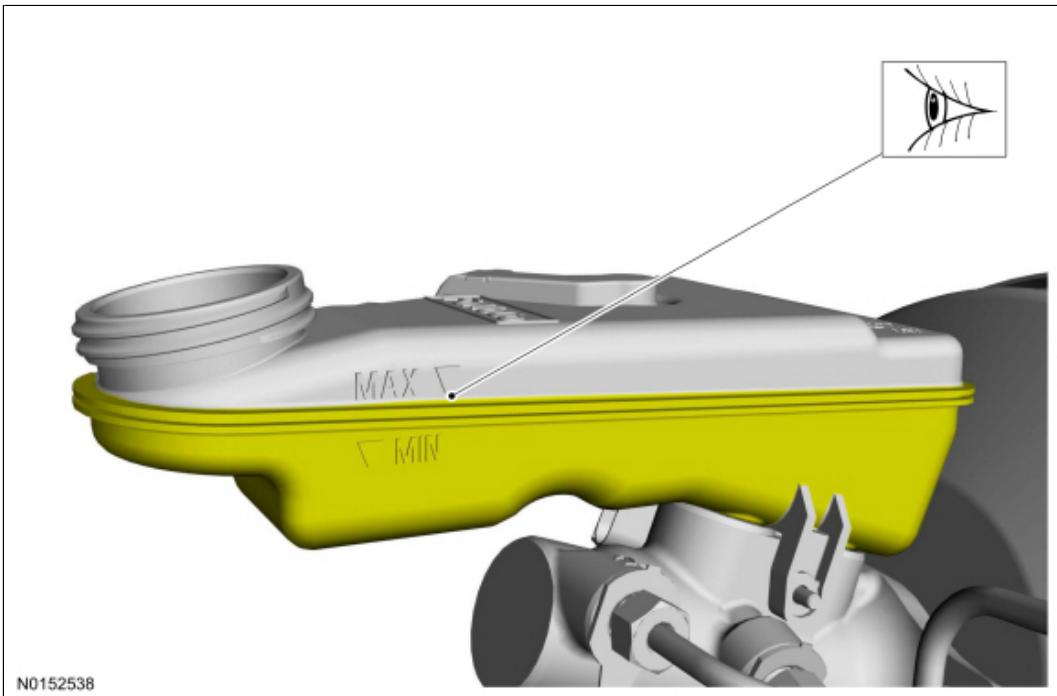
12. Tighten the bleeder screw to specification. Refer to Specifications in this section.
- Remove the fluid container and hose.



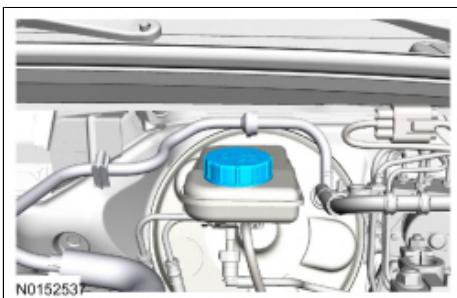
13.



14. Repeat steps 7-13 at the remaining wheel ends.
15. Close the bleeder tank valve and release the pressure. Remove the tank hose from the adapter and remove the adapter.
16. Fill the reservoir with clean, specified brake fluid. Refer to Specifications in this section.



17.



### Hydraulic Control Unit (HCU) Bleeding

**NOTE:** The HCU bleeding procedure must be carried out if a new HCU has been installed.

**NOTE:** Pressure bleeding the brake system is preferred to manual bleeding.

1. Follow the pressure bleeding or manual bleeding procedure steps to bleed the system.
2. Connect the diagnostic scan tool and follow the ABS Service Bleed instructions.
3. Repeat the pressure bleeding or manual bleeding procedure steps to bleed the system.



## Brake System Inspection

### Material

Item	Specification
Motorcraft® Metal Brake Parts Cleaner (US) / Motorcraft® Brake Parts Cleaner (Canada) PM-4-A or PM-4-B (US); CPM-4 (Canada)	—
Motorcraft® Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

### Brake Pads

**NOTE:** It is not required to install new brake pads when the brake discs are machined.

1. Inspect the brake pad friction material for contamination.
  - If the friction material shows evidence of contamination, install new brake pads. For additional information, refer to [Section 206-03](#) for front brake pads or [Section 206-04](#) for rear brake pads.
2. Inspect and measure the thickness of the brake pad friction material. For additional information, refer to Specifications in this section.
  - Minor surface cracks do not require pad replacement, however, if there are missing chunks or cracks in the lining through to the backing plate, install new brake pads. For additional information, refer to [Section 206-03](#) for front brake pads or [Section 206-04](#) for rear brake pads.
  - If the thickness of the friction material is less than the specified thickness, install new brake pads. For additional information, refer to [Section 206-03](#) for front brake pads or [Section 206-04](#) for rear brake pads.
  - If the friction material shows taper wear that is not within specifications, install new brake pads and verify the caliper guide pins are functioning correctly. For additional information, refer to Brake Caliper Guide Pins inspection.

### Brake Discs

**NOTICE:** Using an impact tool without a torque socket will lead to unevenly tightened wheel nuts. This causes brake disc on-vehicle lateral runout and brake roughness.

1. Inspect the brake discs and measure the brake disc thickness. Record the measurement. Refer to Specifications in this section.
  - If the brake disc is cracked or otherwise damaged, install a new brake disc. For additional information, refer to [Section 206-03](#) for front brakes or [Section 206-04](#) for rear brakes.
  - If the measurement is below the minimum thickness specification, install a new brake disc. For additional information, refer to [Section 206-03](#) for front brakes or [Section 206-04](#) for rear brakes.

- If the diagnosis has revealed vibration in the steering wheel, seat or pedal while braking that varies with vehicle speed, machine the brake disc. Heavily scored brake discs, similar to that caused by pads worn down to the backing plate, should also be machined. In order to machine, discs must be above the minimum thickness specification. For additional information, refer to Specifications and [Brake Disc Machining](#) in this section.

## **Brake Calipers**

1. Inspect the brake calipers for leaks, damage to seals and piston corrosion or binding.
  - If the brake caliper is leaking or otherwise damaged, install a new brake caliper. For additional information, refer to [Section 206-03](#) for front brake calipers or [Section 206-04](#) for rear brake calipers.

## **Brake Caliper Guide Pins**

1. The guide pins should slide with a reasonable amount of hand force. If the brake pads show taper wear or the guide pins are difficult to move, carry out the following steps.
  - Disassemble the brake caliper guide pins and inspect the guide pins and guide pin bores for wear, damage and corrosion. If the bore is worn or damaged, replace the damaged component.
  - Use a wire brush, rolled-up sandpaper or emery cloth to remove all corrosion and foreign material from the caliper guide pin bores. Clean any remaining foreign material from the bores with brake parts cleaner and compressed air.
  - Assemble the caliper seals, boots and guide pins. Use an ample amount of the specified grease to lubricate the bores and guide pins.
  - Inspect the brake pads. For additional information, refer to Brake Pads inspection in this section.

## **Brake Flexible Hoses and Tubes**

**NOTICE:** Never use copper tubing. It is subject to fatigue, cracking and corrosion, which may result in brake tube failure.

**NOTE:** Double-wall steel tubing is used throughout the brake hydraulic system. All brake tube fittings must be correctly double flared to provide strong, leakproof connections. When bending tubing to fit the underbody or rear axle contours, be careful not to kink or crack the tube.

1. Inspect brake tubes for corrosion, cracks, leaks or any other signs of damage.
  - If a section of the brake tube is damaged, the entire section must be installed with a new tube of the same type, size, shape and length.
  - When installing the hydraulic brake tubing, hoses or connectors, tighten all connections to specifications. After installation, bleed the brake system. For additional information, refer to [Brake System Bleeding](#) in this section.
2. Inspect the brake flexible hoses for cracks, leaks and swelling during brake application or any other signs of damage.
  - Install a new brake flexible hose if the hose shows signs of softening, cracking or other damage. For additional information, refer to [Section 206-03](#) for the front brake flexible hose or [Section 206-04](#) for the rear brake flexible hose.

## **Brake Master Cylinder**

**NOTE:** During normal operation of the brake master cylinder, the returning brake fluid creates a slight turbulence in the master cylinder reservoir. This is a normal condition and indicates that the compensator ports are not clogged. Clogged compensator ports may cause the brakes to hang up or not fully release. The net fluid level (such as after brake application and release) will remain unchanged. Fluid level will decrease with pad wear.

**NOTE:** A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

1. Inspect the brake master cylinder for fluid leaks.
  - Install a new master cylinder or brake fluid reservoir if signs of excessive leaking are present. For additional information, refer to [Section 206-06](#).
  - To check for correct brake master cylinder operation, refer to [Component Tests](#) in this section.

## **Brake Booster**

1. Inspect the brake booster for excessive corrosion or damage. Inspect the vacuum hoses for leaks and kinks.
    - Install a new brake booster if signs of excessive corrosion or damage is found. For additional information, refer to [Section 206-07](#).
    - Repair or replace vacuum hoses as necessary.
    - To check for correct brake booster operation, refer to [Component Tests](#) in this section.
-

## Component Bleeding

### General Equipment

Master Cylinder Bleeding Set

### Master Cylinder

**⚠️ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

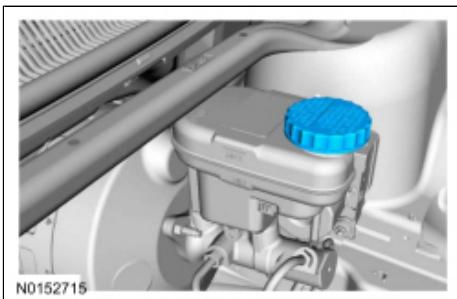
**⚠️ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**⚠️ WARNING:** Do not allow the brake master cylinder to run dry during the bleeding operation. Master cylinder may be damaged if operated without fluid, resulting in degraded braking performance. Failure to follow this instruction may result in serious personal injury.

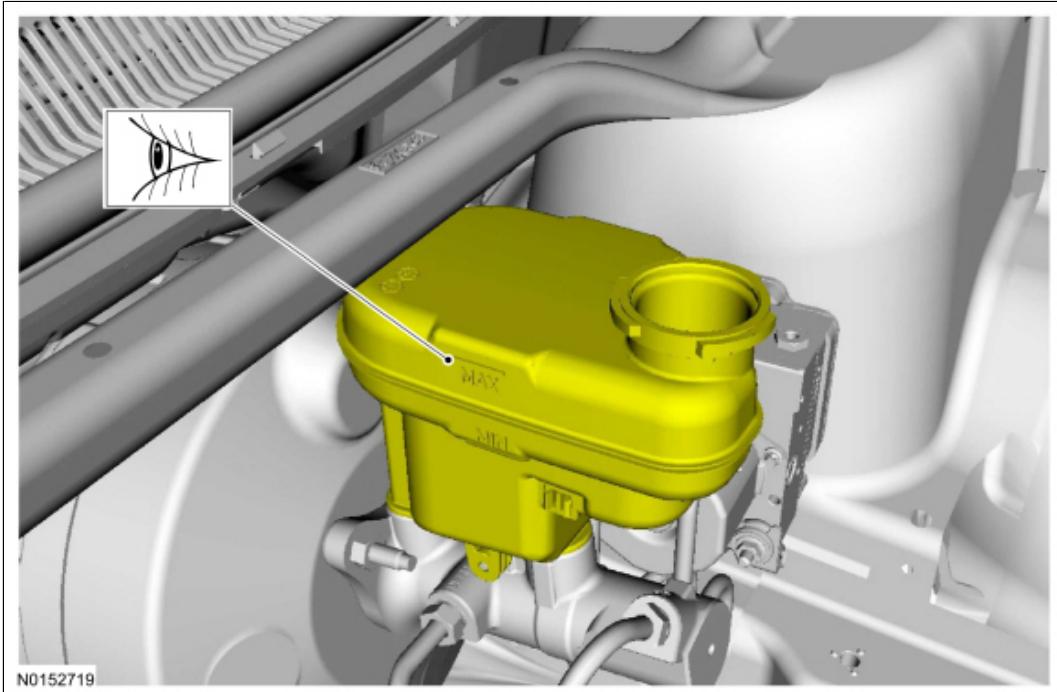
**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

**NOTE:** When a new brake master cylinder has been installed, it should be primed to prevent air from entering the system.

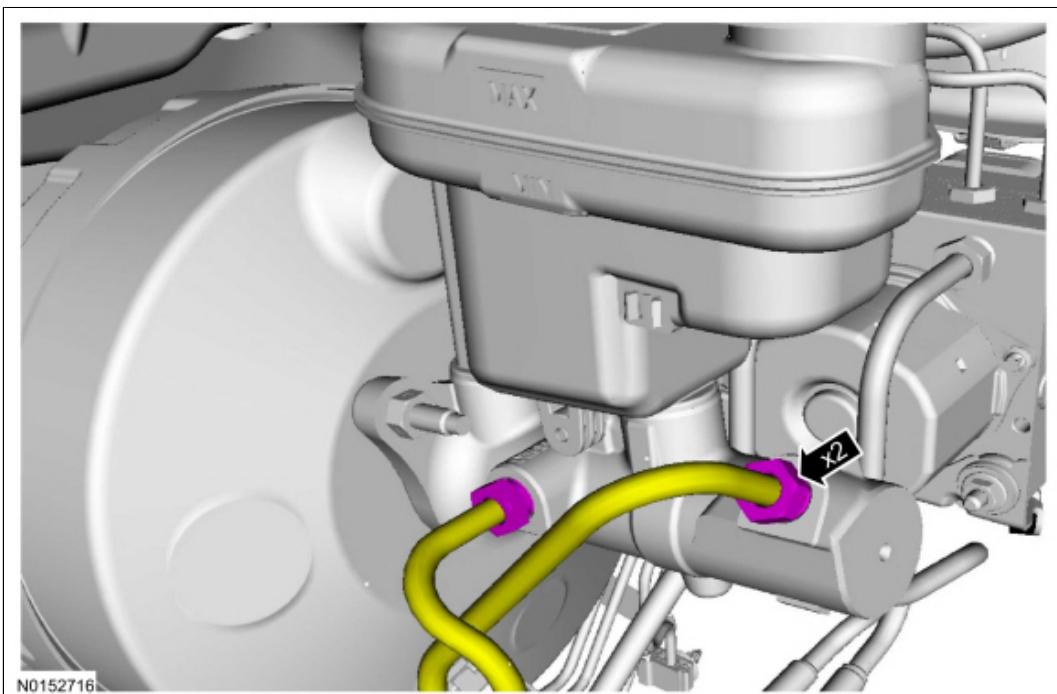
1.



2. Refer to Specifications in this section.



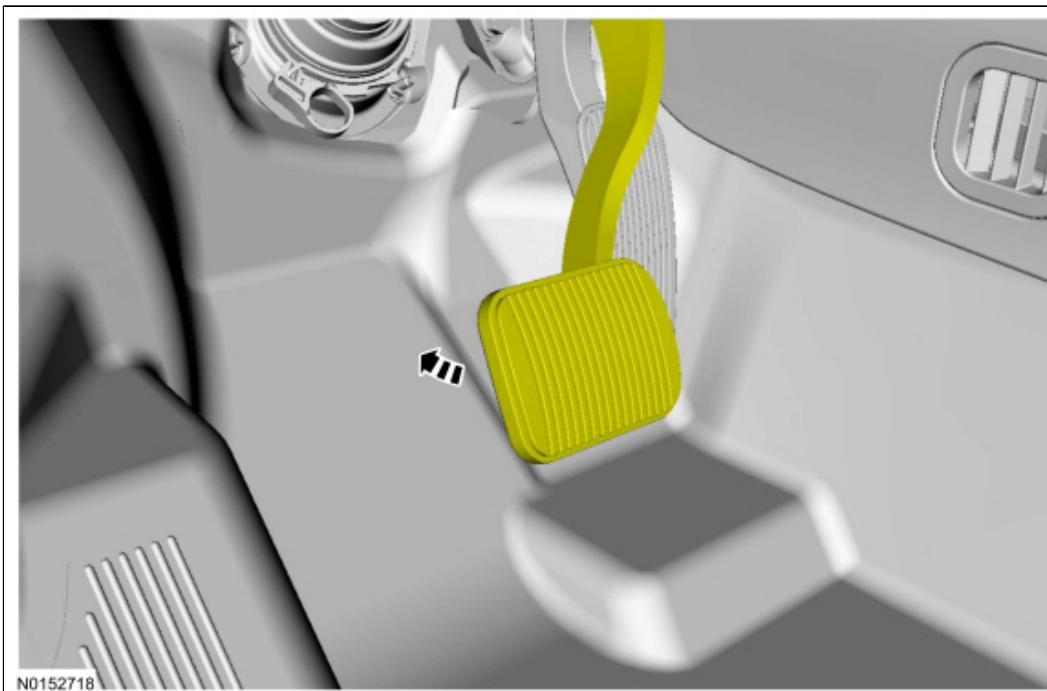
3.



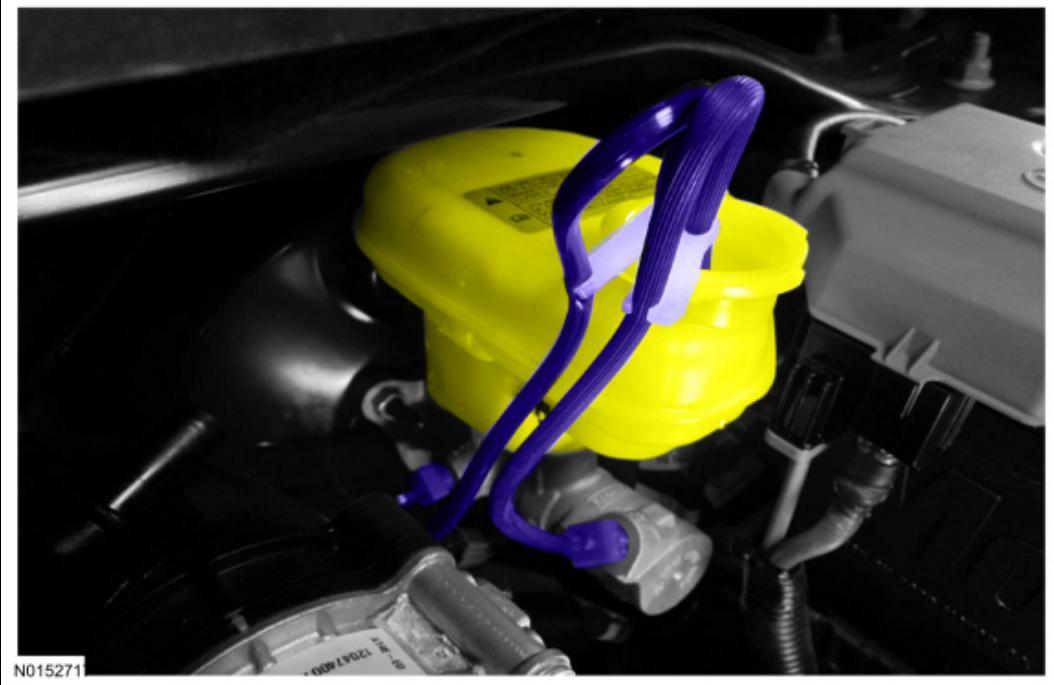
4. Use the General Equipment: Master Cylinder Bleeding Set



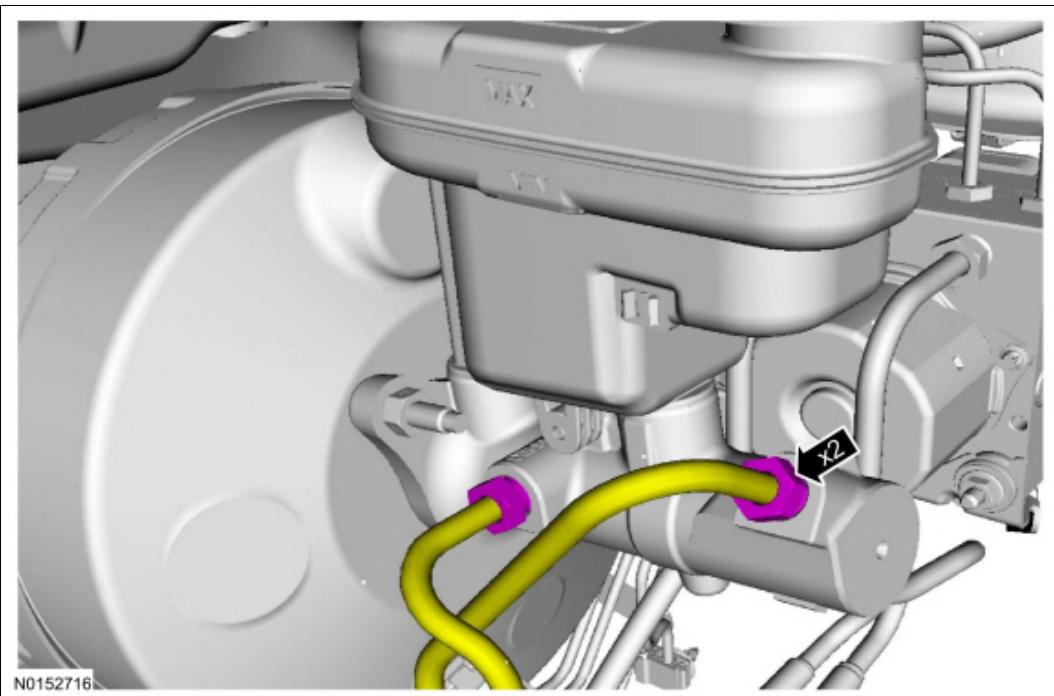
5. Have an assistant pump the brake pedal slowly until clear bubble free fluid flows from the brake tubes.



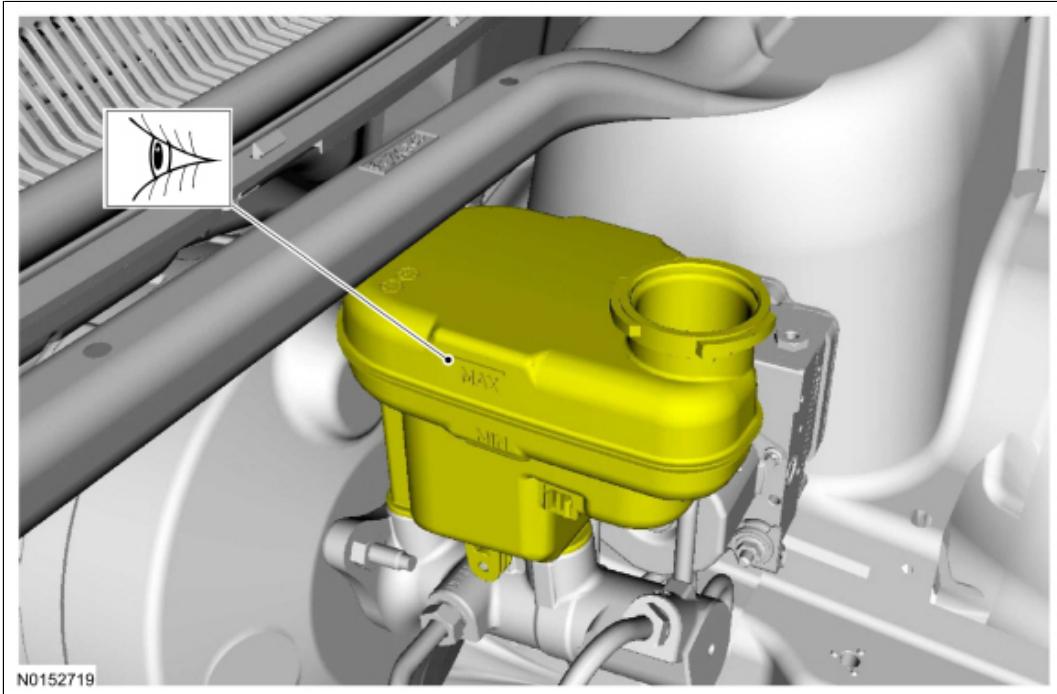
6. Remove the General Equipment: Master Cylinder Bleeding Set



7. Refer to Specifications in this section.



8. Refer to Specifications in this section.



9. Pressure bleed the brake system. Refer to [Brake System Bleeding](#).

#### **Brake Caliper, Wheel Cylinder, Brake Hose or Brake Tube**

1. **NOTE:** Pressure bleeding the brake system is required anytime a hydraulic brake system component has been disconnected.

Pressure bleed the brake system. Refer to [Brake System Bleeding](#).

---



**Material**

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	1,420 ml (3 pt)
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—

**General Specifications**

Item	Specification
<b>Brake Disc</b>	
Brake disc minimum thickness	32 mm (1.259 in)
<b>Brake Pads</b>	
Brake pad maximum taper wear (in any direction)	3.0 mm (0.118 in)
Brake pad minimum thickness	3.0 mm (0.118 in)

**Torque Specifications**

Description	Nm	lb-ft	lb-in
Brake caliper anchor plate bolts	250	184	—
Brake caliper flow bolt	35	26	—
Brake caliper guide pin bolts	37	27	—
Brake disc shield bolts	18	—	159
Brake flexible hose bracket-to-wheel knuckle bolt	30	22	—
Brake tube fitting	17	—	150



## **Front Disc Brake**

The front brake disc system consists of the following components:

- Brake pads
- Brake caliper anchor plate
- Brake caliper
- Brake disc
- Brake disc shield
- Brake flexible hose

When mechanical force is applied by the driver to the brake pedal, the force is converted into hydraulic pressure by the master cylinder. The hydraulic force is directed to the disc brake calipers and transferred to the brake pads. The brake pads are then forced against the brake friction surfaces by the brake caliper pistons. The friction of the brake pads on the brake disc causes the slowing of wheel rotation and the vehicle.

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## **Front Disc Brake**

Refer to [Section 206-00](#).

---

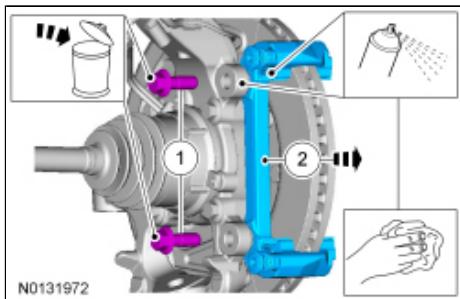
## Brake Caliper Anchor Plate

### Material

Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—

### Removal

1. Remove the brake pads. For additional information, refer to [Brake Pads](#) in this section.
2. Discard the specified component. Follow local disposal regulations.  
Apply the specified chemical with a spray can  
Clean the specified component with the specified material
  - To install, tighten the new bolts to 250 Nm (184 lb-ft).



### Installation

1. To install, reverse the removal procedure.



## Brake Caliper

### Removal

**⚠️ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

**⚠️ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

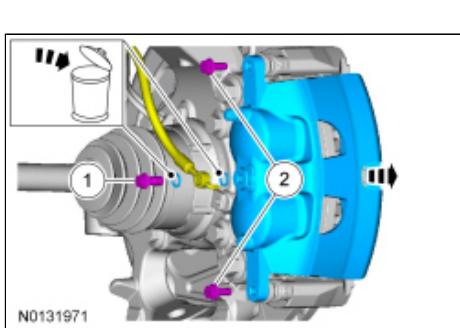
**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

**NOTE:** Removal steps in this procedure may contain installation details.

1. Remove the wheel and tire. For additional information, refer to [Section 204-04](#).
2. Discard the specified component. Follow local disposal regulations.
  1. **NOTE:** Use 2 new copper washers.

To install, tighten to 35 Nm (26 lb-ft).
  2. **NOTE:** Tighten the lower brake caliper guide pin bolt first.

To install, tighten to 37 Nm (27 lb-ft).



### Installation

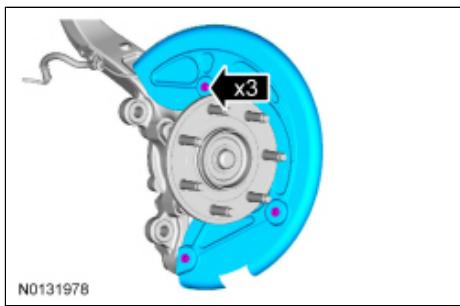
1. To install, reverse the removal procedure.
2. Bleed the brake caliper. For additional information, refer to Component Bleeding in [Section 206-00](#).



## Brake Disc Shield

### Removal

1. Remove the brake disc. For additional information, refer to [Brake Disc](#) in this section.
2.
  - To install, tighten to 18 Nm (159 lb-in).



### Installation

1. To install, reverse the removal procedure.

## Brake Disc

### Material

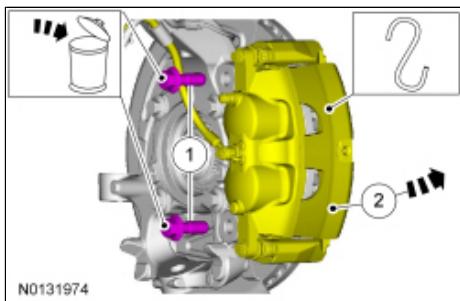
Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—

### Removal

1. Remove the wheel and tire. For additional information, refer to [Section 204-04](#).
2. **NOTICE:** Do not allow the caliper and anchor plate assembly to hang from the brake hose or damage to the hose can occur.

Discard the specified component. Follow local disposal regulations.  
Relocate and support the component.

- To install, tighten the 2 new bolts to 250 Nm (184 lb-ft).

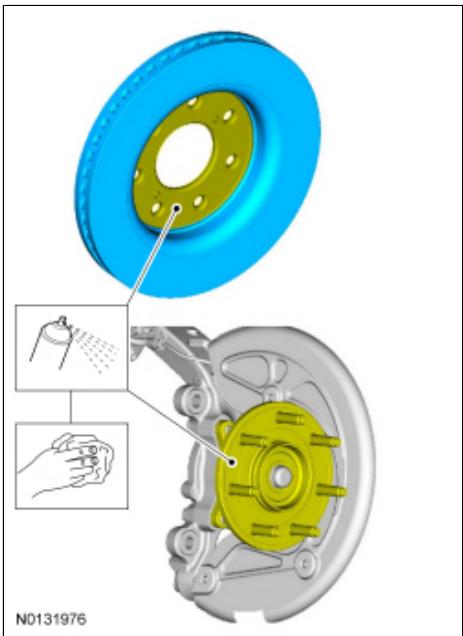


3.



### Installation

1. Apply the specified chemical with a spray can.  
Clean the specified component with the specified material.



- 
2. To install, reverse the removal procedure.

## Brake Flexible Hose

### Removal

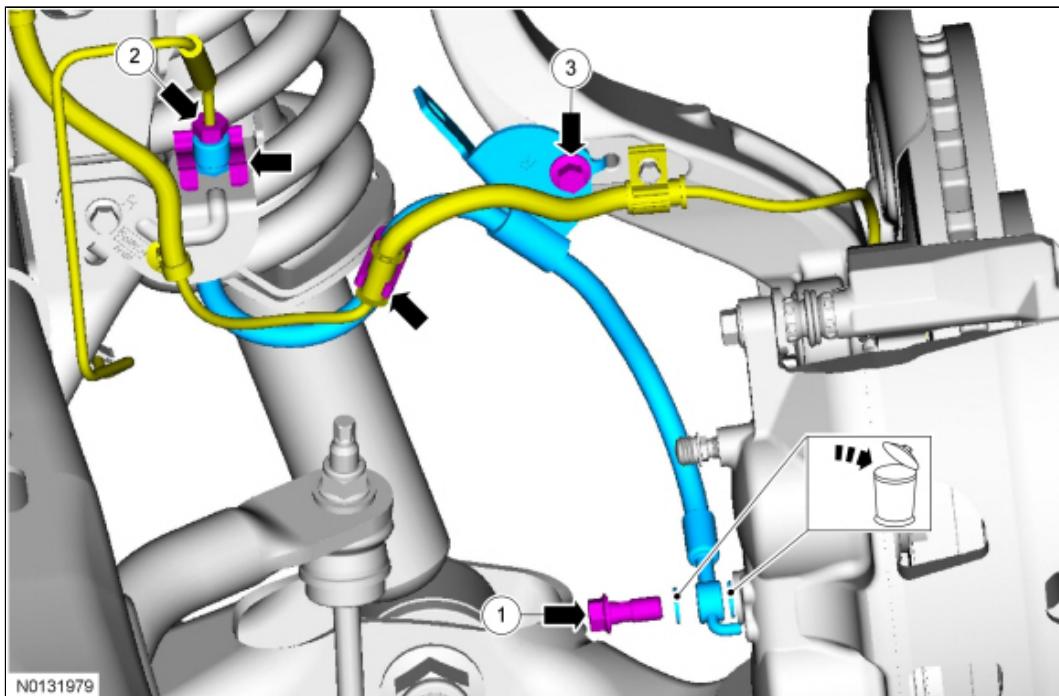
**⚠️ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

**⚠️ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

1. Discard the specified component. Follow local disposal regulations.
  1. **NOTE:** Use new copper washers.

2. To install, tighten to 35 Nm (26 lb-ft).
2. To install, tighten to 17 Nm (150 lb-in).
3. To install, tighten to 30 Nm (22 lb-ft).



## **Installation**

1. To install, reverse the removal procedure.
    - Bleed the brake caliper. For additional information, refer to Component Bleeding in [Section 206-00](#).
-

## Brake Pads

### Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

### Removal

**⚠ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

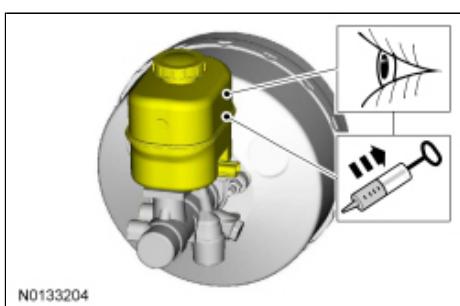
**⚠ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**⚠ WARNING:** Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.

**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

**NOTE:** Removal steps in this procedure may contain installation details.

1. Visual check. Extract the fluid with a syringe.  
If necessary, remove fluid until the brake master cylinder reservoir is half full.

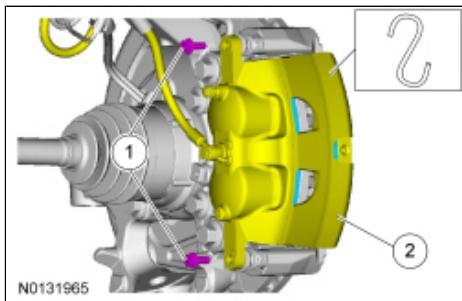


2. Remove the wheel and tire. For additional information, refer to [Section 204-04](#).

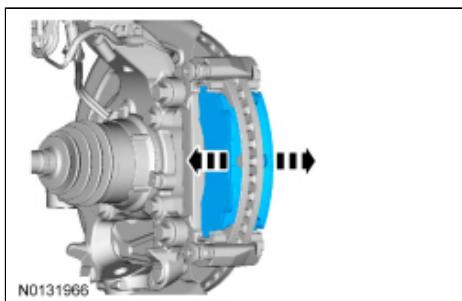
3. **NOTICE:** Do not allow the caliper to hang from the brake hose or damage to the hose can occur.

Relocate and support the component.

- To install, tighten to 37 Nm (27 lb-ft).

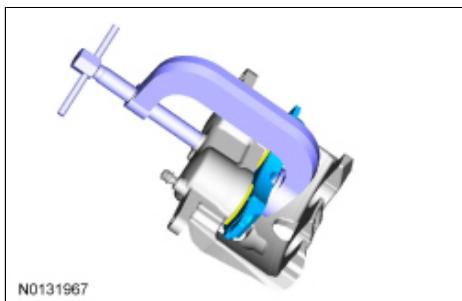


- 4.



5. **NOTE:** Protect the piston and boots when pushing the caliper piston into the caliper piston bores or damage to the piston or boots may occur.

If installing new brake pads, Use a C-clamp and a worn brake pad to compress the disc brake caliper pistons into the brake caliper bore.



## Installation

**NOTE:** If installing new brake pads, make sure to install all new hardware and specified lubricant supplied with the brake pad kit. Refer to the brake pad instruction sheet when applying lubricant.

1. To install, reverse the removal procedure.
  1. Fill the master cylinder with clean, specified brake fluid.

2. Apply brakes several times to verify correct brake operation.

---

**Material**

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	1,420 ml (3.0 pt)
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—

**General Specifications**

Item	Specification
<b>Brake Disc</b>	
Brake disc minimum thickness	23.0 mm (0.906 in)
<b>Brake Pads</b>	
Brake pad maximum taper wear (in any direction)	3.0 mm (0.118 in)
Brake pad minimum thickness	3.0 mm (0.118 in)

**Torque Specifications**

Description	Nm	lb-ft	lb-in
Axle vent valve	18	—	159
Brake caliper bleeder screw	10	—	89
Brake caliper flow bolt	35	26	—
Brake caliper guide pin bolts	33	24	—
Brake caliper support bracket bolts	150	111	—
Brake flexible hose bracket-to-axle bolt	30	22	—
Brake flexible hose bracket-to-frame bolt	17	—	150
Brake tube fitting	17	—	150



## **Rear Disc Brake**

The rear disc brake system consists of the following components:

- Brake caliper
- Brake caliper support bracket
- Brake disc
- Brake pads
- Inner brake flexible hose
- Outer brake flexible hose

When mechanical force is applied by the driver to the brake pedal, the force is converted into hydraulic pressure by the master cylinder. The hydraulic force is directed to the disc brake calipers and transferred to the brake pads. The brake pads are then forced against the brake friction surfaces by the brake caliper pistons. The friction of the brake pads on the brake disc causes the slowing or stopping of wheel rotation and the vehicle.

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## **Rear Disc Brake**

Refer to [Section 206-00](#).

---

## Brake Caliper

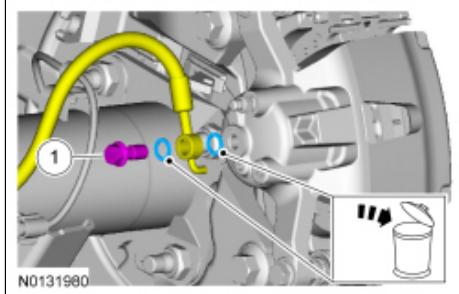
### Removal

**⚠️ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

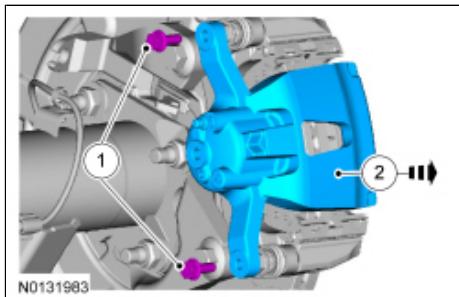
**⚠️ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

1. Remove the wheel and tire. For additional information, refer to [Section 204-04](#).
2. Discard the specified component. Follow local disposal regulations.



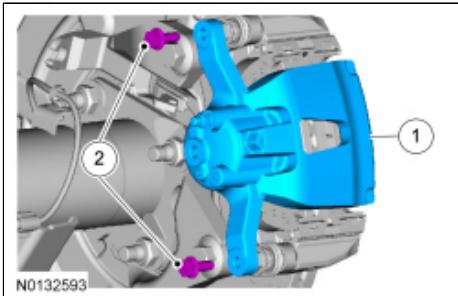
3.



### Installation

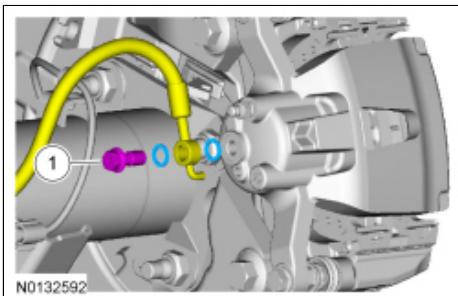
1.

- Tighten to 33 Nm (24 lb-ft).



2. **NOTE:** Use 2 new copper washers.

- Tighten to 35 Nm (26 lb-ft).



3. Bleed the brake caliper. For additional information, refer to Component Bleeding in [Section 206-00](#).

4. Install the wheel and tire. For additional information, refer to [Section 204-04](#).

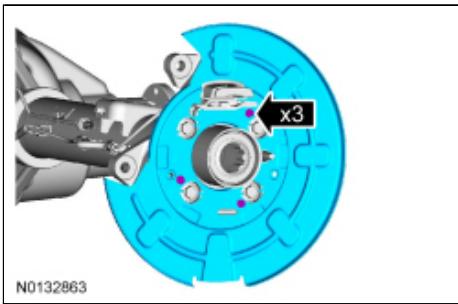


## Brake Disc Shield

### Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Remove the rear axle. For additional information, refer to [Section 205-02A](#) or [Section 205-02B](#).
2. Remove the parking brake shoes. For additional information, refer to [Section 206-05](#).
3. To install, tighten to 14 Nm (124 lb-in).



### Installation

1. To install, reverse the removal procedure.

## Brake Disc

### Material

Item	Specification
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—

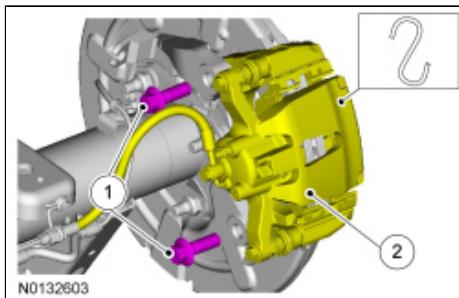
### Removal

**NOTE:** Removal steps in this procedure may contain installation details.

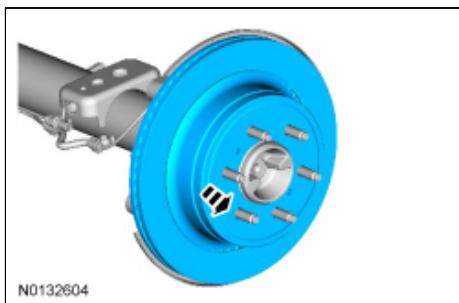
1. Remove the wheel and tire. For additional information, refer to [Section 204-04](#).
2. **NOTICE:** Do not allow the caliper assembly to hang from the brake hose or damage to the hose can occur.

Relocate and support the component.

- To install, tighten to 150 Nm (111 lb-ft).



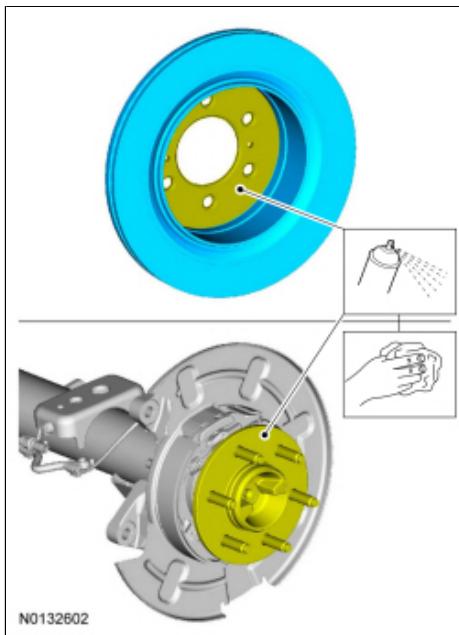
3.



### Installation

1. Apply the specified chemical with a spray can. Clean the specified component with the specified

material.



2. To install, reverse the removal procedure.
    - Apply brakes several times to verify correct brake operation.
-

## Brake Flexible Hose — Inner

### Removal

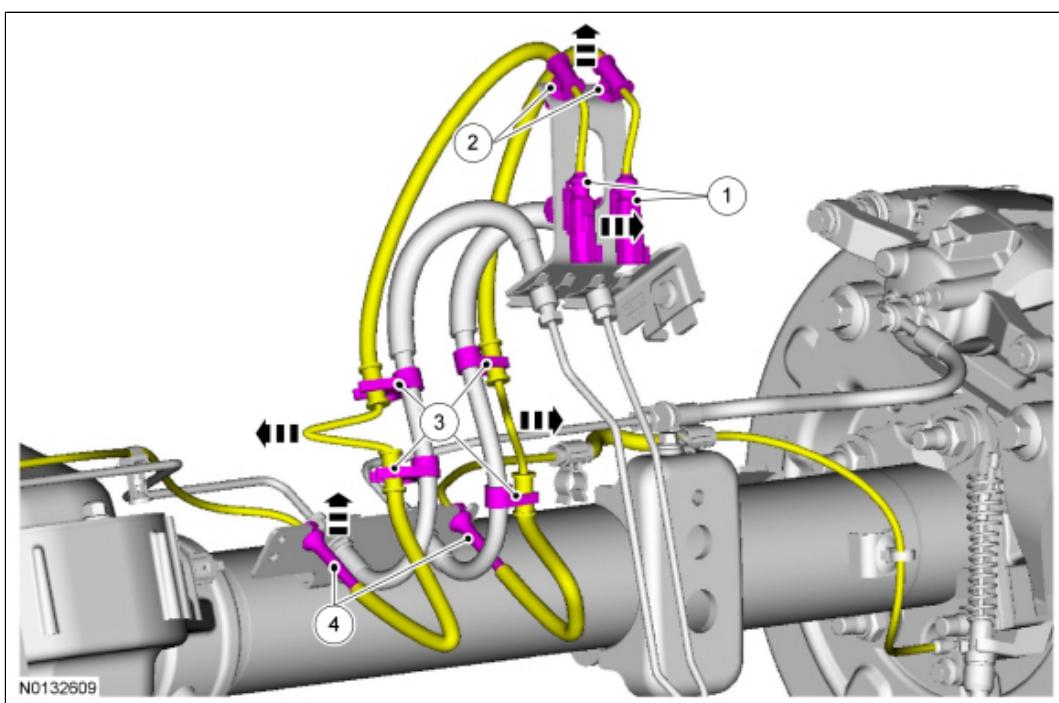
**⚠️ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

**⚠️ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

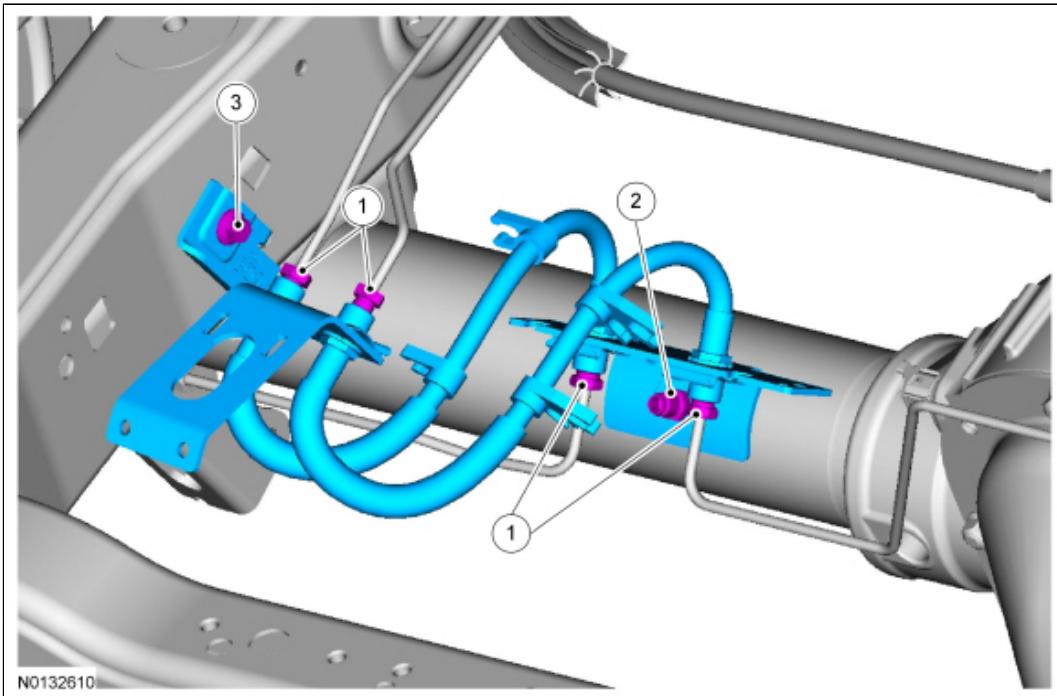
**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

**NOTE:** Removal steps in this procedure may contain installation details.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
- 2.



3.
  1. To install, tighten to 17 Nm (150 lb-in).
  2. To install, tighten to 18 Nm (159 lb-in).
  3. To install, tighten to 17 Nm (150 lb-in).



### Installation

1. To install, reverse the removal procedure.
  2. Bleed the brake calipers. For additional information, refer to Component Bleeding in [Section 206-00](#).
-



## Brake Flexible Hose — Outer

### Removal

 **WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

 **WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

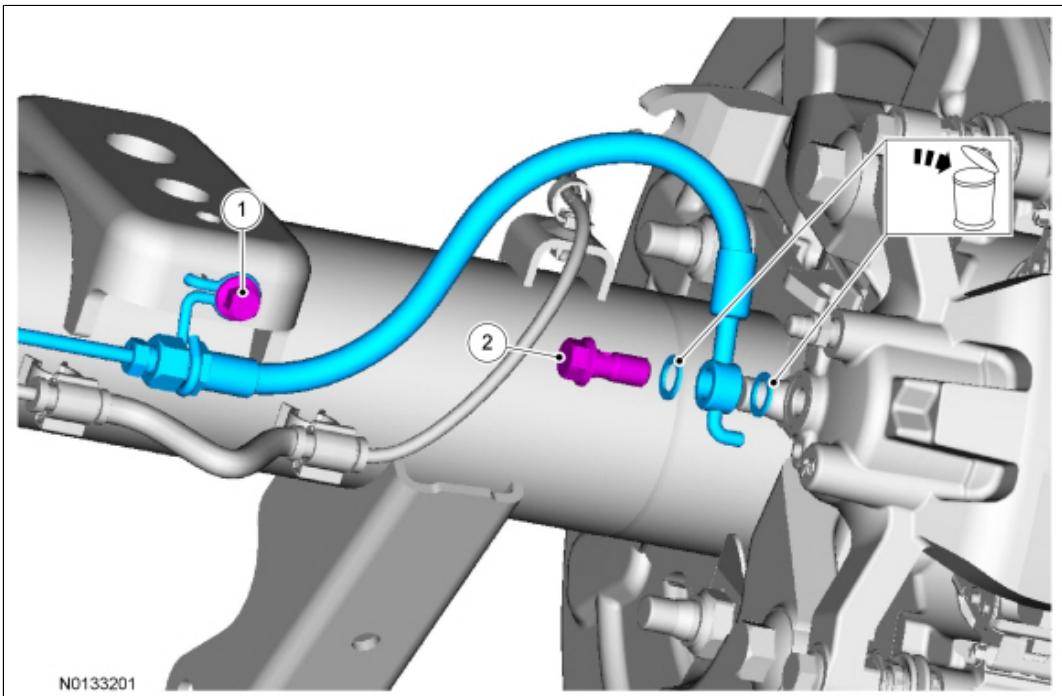
**NOTE:** Removal steps in this procedure may contain installation details.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. **NOTE:** RH shown LH similar.

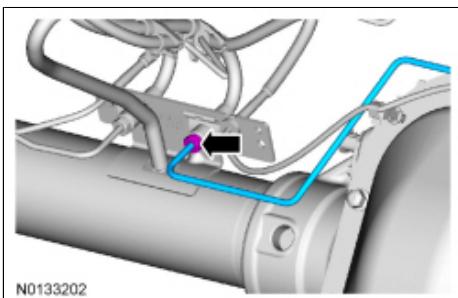
Discard the specified component. Follow local disposal regulations.

1. To install, tighten to 30 Nm (22 lb-ft).
2. **NOTE:** Use new copper washers.

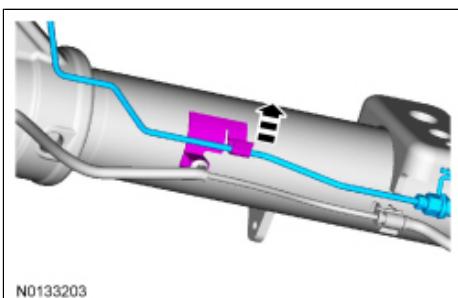
To install, tighten to 35 Nm (26 lb-ft).



3. To install, tighten to 17 Nm (150 lb-in).



- 4.



## Installation

1. To install, reverse the removal procedure.

2. Bleed the brake caliper. For additional information, refer to Component Bleeding in [Section 206-00](#).

---

## Brake Pads

### Material

Item	Specification
Molykote® M77 8U7Z-19A506-A	—

### Removal

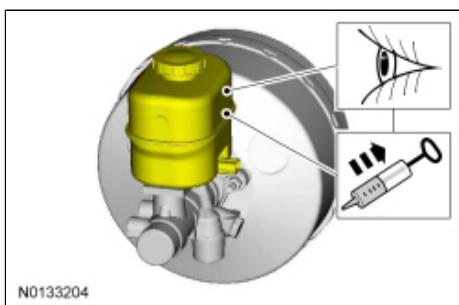
**⚠️ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

**⚠️ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**⚠️ WARNING:** Always install new brake shoes or pads at both ends of an axle to reduce the possibility of brakes pulling vehicle to one side. Failure to follow this instruction may result in uneven braking and serious personal injury.

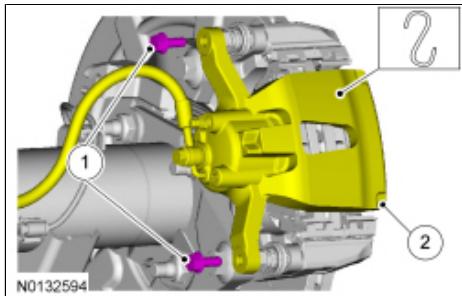
**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

1. Visual check. Extract the fluid with a syringe.  
If necessary, remove fluid until the brake master cylinder reservoir is half full.

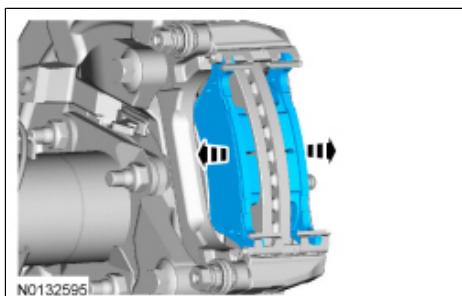


2. Remove the wheel and tire. For additional information, refer to [Section 204-04](#).
3. **NOTICE:** Do not allow the caliper to hang from the brake hose or damage to the hose can occur.

Relocate and support the component.

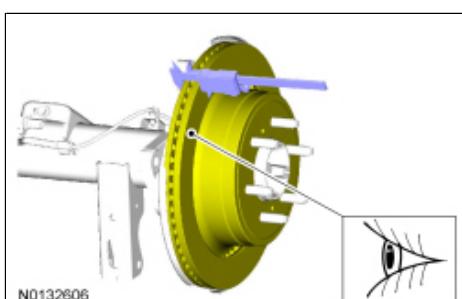


4.

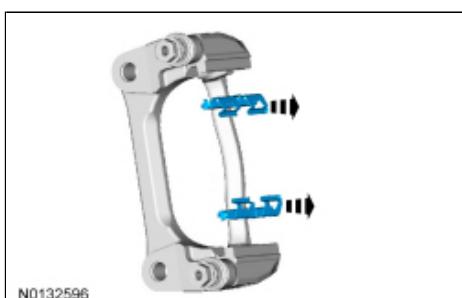


5. Visual check.

Measure the brake disc thickness and install a new brake disc if it is not within specification.



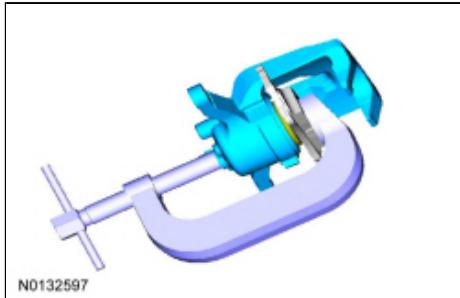
6.



## Installation

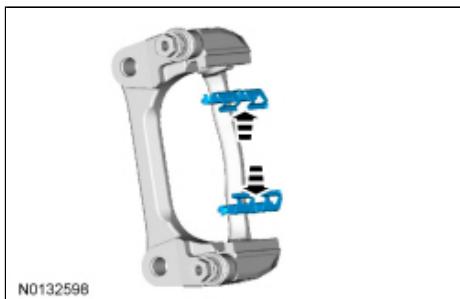
**NOTE:** If installing new brake pads, make sure to install all new hardware and specified lubricant supplied with the brake pad kit. Refer to the brake pad instruction sheet when applying lubricant.

1. **NOTICE:** Protect the caliper pistons and boots when pushing the caliper piston into the caliper piston bores or damage to components may occur.

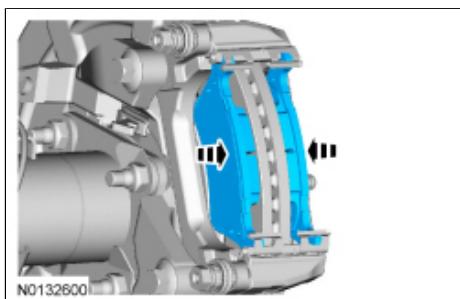


2. **NOTICE:** Do not allow grease, oil, brake fluid or other contaminants to contact the pad lining material or damage to components may occur. Do not install contaminated pads.

**NOTE:** Install all new hardware supplied with the pad kit.

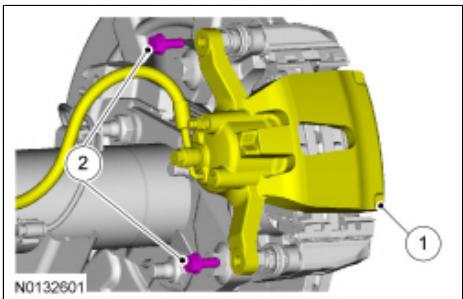


3.



4.

- Tighten to 33 Nm (24 lb-ft).



5. Fill the master cylinder with clean specified brake fluid.
    - Apply brakes several times to verify correct brake operation.
  6. Install the wheel and tire. For additional information, refer to [Section 204-04](#).
    - Apply brakes several times to verify correct brake operation.
-

**Material**

Item	Specification	Fill Capacity
Molykote® M77 8U7Z-19A506-A	—	—

**General Specifications**

Item	Specification
Parking brake shoe clearance	0.59 mm (0.023 in)

**Torque Specifications**

Description	Nm	lb-ft	lb-in
Parking brake cable bracket bolt (RH)	30	22	—
Parking brake control bolts	20	—	177

---

## **Parking Brake**

The parking brake and actuation system consists of the following components:

- Parking brake cables
- Parking brake control
- Parking brake shoes
- Red brake warning indicator

The parking brake system is a foot-operated/cable-actuated system that applies a drum-in-hat assembly within each rear brake disc. A red brake warning indicator is located in the instrument cluster and will illuminate when the system is actuated to alert the driver that the parking brakes are applied.

---

## Parking Brake

### Principles of Operation

### Parking Brake System

The parking brake system is an independent, cable-actuated system controlled by an foot-operated parking brake control that is self adjusting. The parking brake control applies tension to the front parking brake cable and conduit. The front parking brake cable is coupled to the LH rear parking brake cable and conduit which is coupled to the RH rear parking brake cable. The parking brake cable and conduits actuate the parking brake levers, engaging the parking brake shoes with the parking brake drum-in-hat assembly. The system is returned to the released position by pulling the parking brake control release handle. Springs in the parking brake system apply the necessary force to return the system to the unapplied position. The parking brake warning indicator is located in the instrument cluster. It illuminates to signal the driver that the parking brake is applied or to signal a low brake fluid condition. The warning indicator system is diagnosed in [Section 413-01](#).

### Inspection and Verification

**NOTE:** Prior to carrying out any diagnosis, make sure the red brake warning indicator is functional. Refer to [Section 413-01](#).

The first indication that something may be wrong in the brake system is a change in the feeling through the parking brake control. The parking brake not holding on an incline or dragging after being released are also indicators of system concerns.

Check the operation of the parking brake system with the vehicle on a hoist and the parking brake control fully released. Check for any damaged cables and install new components as necessary. Check the rear brake adjustment or carry out the brake system diagnosis.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage.

### Visual Inspection Chart

Mechanical
<ul style="list-style-type: none"><li>Parking brake cable(s)</li><li>Parking brake control</li><li>Parking brake control release handle</li><li>Parking brake shoes and hardware</li></ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and GO to [Symptom Chart](#).

## Symptom Chart

**Symptom Chart**

Condition	Possible Sources	Action
<ul style="list-style-type: none"> <li>• The red brake warning indicator is always/never on</li> </ul>	<ul style="list-style-type: none"> <li>• Brake fluid level switch</li> <li>• Parking brake switch</li> <li>• Wiring, terminals or connectors</li> <li>• Instrument cluster</li> <li>• Smart Junction Box (SJB)</li> <li>• Vacuum sensor</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to Diagnosis and Testing in <a href="#">Section 413-01</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• The parking brake does not apply</li> </ul>	<ul style="list-style-type: none"> <li>• Parking brake cable(s)</li> <li>• Parking brake control</li> <li>• Parking brake shoes and hardware</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test A</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• The parking brake does not release and/or parking brake shoes drag</li> </ul>	<ul style="list-style-type: none"> <li>• Parking brake cable(s)</li> <li>• Parking brake control</li> <li>• Parking brake shoes and hardware</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test B</a>.</li> </ul>

## Pinpoint Tests

### Pinpoint Test A: The Parking Brake Does Not Apply

#### Normal Operation

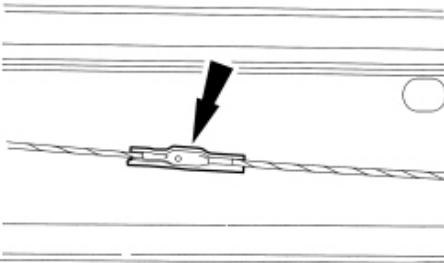
When the parking brake control is pressed, tension is applied to the front parking brake cable. This tension pulls on the RH rear parking brake cable, which is attached to the RH rear parking brake shoe actuator and applies the RH rear brake shoes. At the same time, the tension in the RH rear cable causes the RH rear conduit to attempt to straighten out. This straightening effect causes the RH rear conduit to pull on the LH rear parking brake cable, which is attached to the LH rear parking brake shoe actuator and applies the LH rear brake shoes.

**This pinpoint test is intended to diagnose the following:**

- Parking brake cable(s)
- Parking brake control
- Parking brake shoes and hardware

#### PINPOINT TEST A: THE PARKING BRAKE DOES NOT APPLY

Test Step	Result / Action to Take
<b>A1 CHECK THE PARKING BRAKE CONTROL</b>	
<ul style="list-style-type: none"> <li>• Press the parking brake control pedal.</li> <li>• <b>Does the parking brake control pedal move?</b></li> </ul>	<b>Yes</b> GO to <a href="#">A2</a> .  <b>No</b> GO to <a href="#">A5</a> .
<b>A2 CHECK FOR BROKEN CABLES</b>	
<ul style="list-style-type: none"> <li>• Have an assistant press and release the parking brake pedal to help isolate disconnected cables or cables that do not move.</li> <li>• Inspect the following items for damage and correct connections.           <ul style="list-style-type: none"> <li>■ Front cable and conduit</li> <li>■ LH rear cable and conduit</li> <li>■ RH rear cable and conduit</li> <li>■ Rear cable brackets</li> </ul> </li> <li>• <b>Are the cables in good condition?</b></li> </ul>	<b>Yes</b> GO to <a href="#">A3</a> .  <b>No</b> CONNECT the cable(s) or INSTALL new parking brake component(s) as necessary. TEST the system for normal operation.
<b>A3 CHECK THE PARKING BRAKE SHOES, ACTUATOR LEVERS AND HARDWARE</b>	
<ul style="list-style-type: none"> <li>• Remove the rear brake disc, refer to <a href="#">Section 206-04</a>. Inspect the parking brake shoes, actuator levers and hardware.</li> <li>• <b>Are the parking brake shoes, actuator levers and hardware in good condition?</b></li> </ul>	<b>Yes</b> GO to <a href="#">A4</a> .  <b>No</b> INSTALL new components as necessary. REFER to <a href="#">Parking Brake Shoes</a> in this section. TEST the system for normal operation.
<b>A4 CHECK THE PARKING BRAKE SHOE ADJUSTMENT</b>	
<ul style="list-style-type: none"> <li>• Check the parking brake shoe adjustment. Refer to <a href="#">Parking Brake Shoe Adjustment</a> in this section.</li> <li>• <b>Are the parking brake shoes adjusted to specification?</b></li> </ul>	<b>Yes</b> INSTALL a new parking brake control. REFER to <a href="#">Parking Brake Control</a> in this section. TEST the system for normal operation.  <b>No</b> ADJUST the rear parking brake shoes. REFER to <a href="#">Parking Brake Shoe Adjustment</a> in this section.
<b>A5 ISOLATE THE PARKING BRAKE CONTROL AND FRONT PARKING BRAKE CABLE</b>	
<ul style="list-style-type: none"> <li>• Disconnect the front parking brake cable from the RH rear parking brake cable at the cable union.</li> </ul>	<b>Yes</b> GO to <a href="#">A6</a> .  <b>No</b>

 <p>N0002007</p> <ul style="list-style-type: none"> <li>• Press the parking brake control pedal.</li> <li>• Does the parking brake control pedal move?</li> </ul>	<p>GO to <a href="#">A7</a>.</p>
<p><b>A6 ISOLATE THE REAR PARKING BRAKE CABLES</b></p> <ul style="list-style-type: none"> <li>• Disconnect the LH cable from the RH conduit equalizer.</li> <li>• Disconnect the rear parking brake cables from the parking brake actuating levers.</li> <li>• While holding the cable conduit, attempt to slide the cable inside the conduit.</li> <li>• Does the cable slide freely inside the conduit?</li> </ul>	<p><b>Yes</b> INSPECT the parking brake shoes, hardware and backing plate. INSTALL new components as necessary. REFER to <a href="#">Parking Brake Shoes</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> INSTALL new rear brake cable(s). REFER to <a href="#">Parking Brake Cable — Rear, LH</a> or <a href="#">Parking Brake Cable — Rear, RH</a> in this section. TEST the system for normal operation.</p>
<p><b>A7 ISOLATE THE FRONT PARKING BRAKE CABLE</b></p> <ul style="list-style-type: none"> <li>• <b>NOTE:</b> The parking brake control take-up spool tab may need to be bent aside to allow the cable to be removed.</li> <li>• Disconnect the front parking brake cable and conduit from the parking brake control.</li> </ul>  <p>A0056407</p> <ul style="list-style-type: none"> <li>• While holding the cable conduit, attempt to slide the cable inside the conduit.</li> <li>• Does the cable slide freely inside the conduit?</li> </ul>	<p><b>Yes</b> INSTALL a new parking brake control. REFER to <a href="#">Parking Brake Control</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> INSTALL a new front parking brake cable. REFER to <a href="#">Parking Brake Cable — Front</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test B: The Parking Brake Does Not Release and/or Parking Brake Shoes Drag

##### Normal Operation

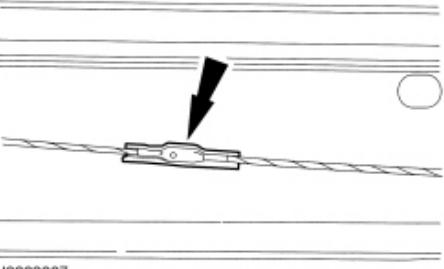
When the parking brake release handle is pulled, the ratchet mechanism and return spring in the parking

brake control release the tension on the parking brake cables and conduits. The cable conduits, cable springs and parking brake shoe springs provide the force necessary to return the parking brake system to the released position.

**This pinpoint test is intended to diagnose the following:**

- Parking brake cable(s)
- Parking brake control
- Parking brake control release handle
- Parking brake shoe actuators
- Parking brake shoes and hardware

#### PINPOINT TEST B: THE PARKING BRAKE DOES NOT RELEASE AND/OR PARKING BRAKE SHOES DRAG

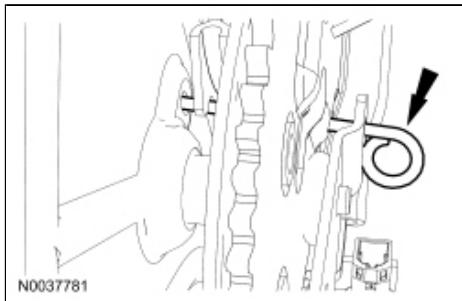
Test Step	Result / Action to Take
<b>B1 CHECK THE PARKING BRAKE CONTROL RELEASE HANDLE AND CABLE</b>	<p><b>Yes</b> GO to <a href="#">B2</a>.</p> <p><b>No</b> CONNECT the handle and cable. TEST the system for normal operation.</p>
<b>B2 CHECK THE REAR PARKING BRAKE CABLES</b>	<p><b>Yes</b> GO to <a href="#">B3</a>.</p> <p><b>No</b> INSTALL new rear brake cable(s). REFER to <a href="#">Parking Brake Cable — Rear, LH</a> or <a href="#">Parking Brake Cable — Rear, RH</a> in this section. TEST the system for normal operation.</p>
<ul style="list-style-type: none"> <li>• Disconnect the LH cable from the RH conduit equalizer.</li> <li>• Disconnect the front parking brake cable from the RH rear parking brake cable at the cable union.</li> </ul>  <small>N0002007</small> <ul style="list-style-type: none"> <li>• Disconnect the rear parking brake cables from the parking brake actuating levers.</li> <li>• While holding the rear cable conduit, attempt to slide the rear cable inside the conduit.</li> <li>• Does the cable slide freely inside the conduit?</li> </ul>	
<b>B3 CHECK THE REAR PARKING BRAKE SHOES AND HARDWARE</b>	<p><b>Yes</b> GO to <a href="#">B4</a>.</p> <p><b>No</b> INSTALL new components as</p>

	<p>necessary. REFER to <a href="#">Parking Brake Shoes</a> in this section. TEST the system for normal operation.</p>
<b>B4 ISOLATE THE FRONT PARKING BRAKE CABLE</b> <ul style="list-style-type: none"> <li><b>NOTE:</b> The parking brake control take-up spool tab may need to be bent aside to allow the cable to be removed.</li> <li>Disconnect the front parking brake cable and conduit from the parking brake control.</li> </ul>  <p>A0056407</p> <ul style="list-style-type: none"> <li>While holding the cable conduit, attempt to slide the cable inside the conduit.</li> <li><b>Does the cable slide freely inside the conduit?</b></li> </ul>	<p><b>Yes</b> INSTALL a new parking brake control. REFER to <a href="#">Parking Brake Control</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> INSTALL a new front cable. TEST the system for normal operation.</p>

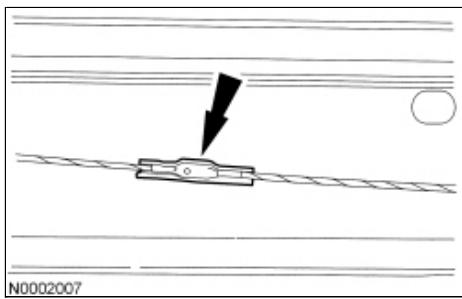
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## Parking Brake Cable Tension Release

1. Release the parking brake.
2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
3. With an assistant, release the parking brake cable tension by pulling down on the intermediate cable at the cable-to-cable union until the parking brake control sector rotates to its stop and a 4 mm (0.15 in) x 150 mm (5.9 in) retainer pin can be inserted.



4. Disconnect the cable at the cable-to-cable union.
5. To reload the tension on the parking brake cable, follow the release procedure in reverse.
  - Inspect the parking brake system for correct operation.





## Parking Brake Shoe Adjustment

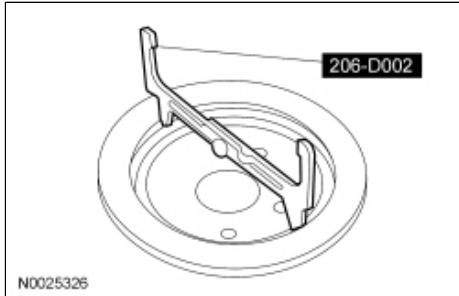
### Special Tool(s)

 ST1468-A	Brake Adjusting Gauge 206-D002 (D81L-1103-A) or equivalent
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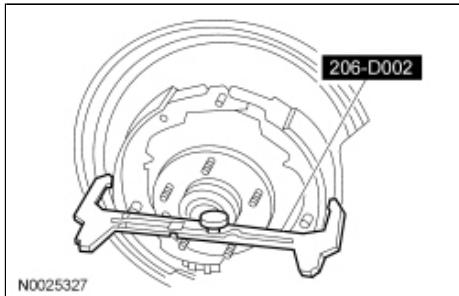
1. **NOTE:** Make sure the parking brake is fully released.

Using the release handle, release the parking brake control.

2. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
3. Using the Brake Adjusting Gauge, measure the ID of the drum portion of the rear brake disc and set the locking screw.
  - Record the measurement.



4. Place the Brake Adjusting Gauge over the widest diameter of the parking brake shoes.



5. Adjust the parking brake shoe clearance to 0.59 mm (0.023 in) less than the ID of the drum portion of the rear brake disc.
  - Rotate the parking brake shoe adjuster to achieve the correct parking brake shoe-to-brake disc

clearance.

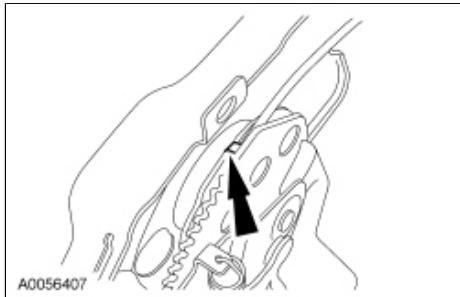
6. Install the rear brake disc. For additional information, refer to [Section 206-04](#).
  7. Test the parking brake for normal operation.
-

## Parking Brake Cable — Front

### Removal and Installation

1. Release the tension on the parking brake cable. For additional information, refer to [Parking Brake Cable Tension Release](#) in this section.
2. Remove the LH cowl side trim panel. For additional information, refer to [Section 501-05](#).
3. **NOTE:** The parking brake control take-up spool tab may need to be bent aside to allow the cable to be removed.

Disconnect the front parking brake cables from the parking brake control.



4. Release the front parking brake cable conduit from the parking brake control.
5. Detach the cable conduit grommet and remove the cable.
6. To install, reverse the removal procedure.
  - Inspect the parking brake system for correct operation.

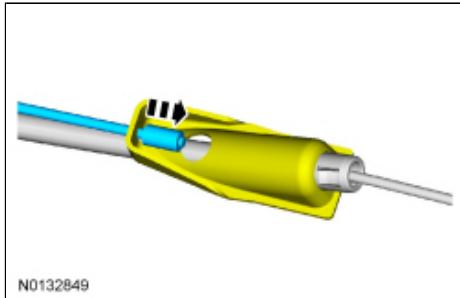


## Parking Brake Cable — Rear, LH

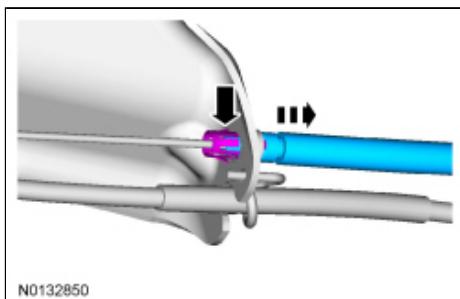
### Removal

**NOTE:** Removal steps in this procedure may contain installation details.

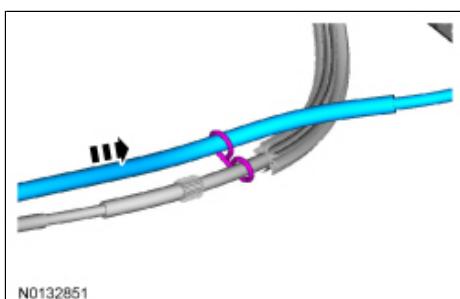
1. Release the parking brake cable tension. For additional information, refer to [Parking Brake Cable Tension Release](#) in this section.
- 2.



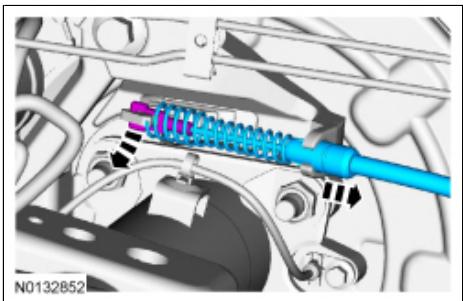
3.



4.



5.



### Installation

1. To install, reverse the removal procedure.
    - Inspect the parking brake system for correct operation.
-

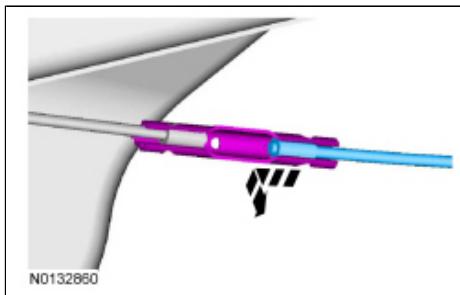
## Parking Brake Cable — Rear, RH

### Removal

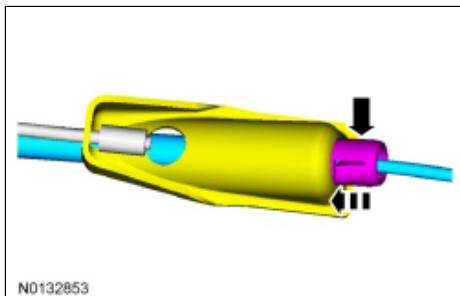
**NOTE:** Removal steps in this procedure may contain installation details.

1. Release the parking brake cable tension. For additional information, refer to [Parking Brake Cable Tension Release](#) in this section.

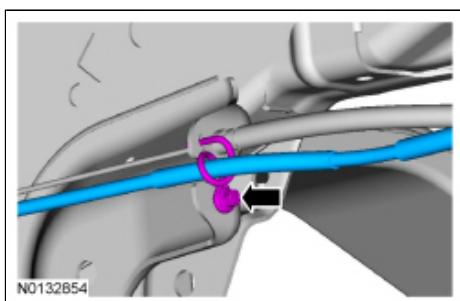
2.



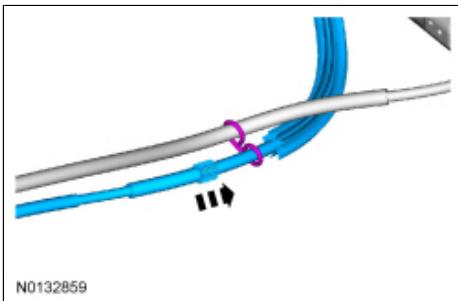
3.



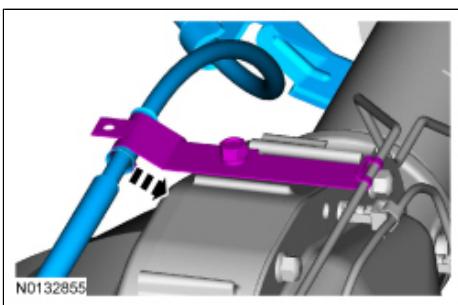
4. To install, tighten to 15 Nm (133 lb-in).



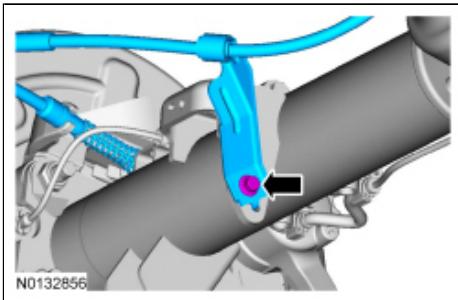
5.



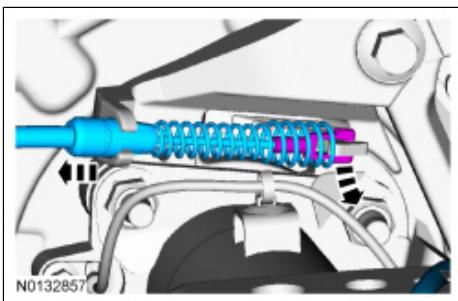
6.



7. To install, tighten to 30 Nm (22 lb-ft).



8.

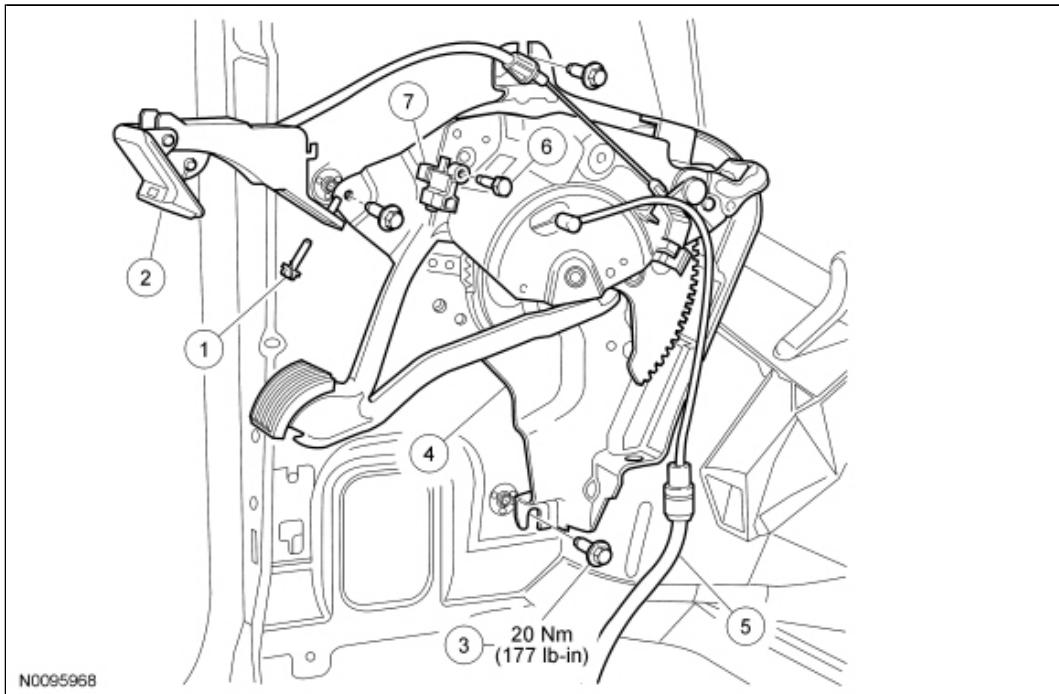


### Installation

1. To install, reverse the removal procedure.

- Inspect the parking brake system for correct operation.
-

## Parking Brake Control



Item	Part Number	Description
1	W707628	Parking brake release handle bolt
2	2783	Parking brake release handle
3	W704522	Parking brake control assembly bolt (3 required)
4	2780	Parking brake control
5	2853	Front parking brake cable
6	N807729	Parking brake warning indicator switch screw
7	15A851	Parking brake warning indicator switch

### Removal

**NOTE:** Removal steps in this procedure may contain installation details.

1. Remove the LH cowl side trim panel. For additional information, refer to [Section 501-05](#).
2. Release the tension on the parking brake cable. For additional information, refer to [Parking Brake Cable Tension Release](#) in this section.
3. Remove the parking brake release handle bolt and pull the handle assembly down to prevent breaking off the locator tabs.

4. Disconnect the parking brake release handle cable from the parking brake control.
5. Disconnect the parking brake switch electrical connector.
6. Remove the 3 bolts from the parking brake control.
  - To install, tighten to 20 Nm (177 lb-in).
7. Position the cable conduit grommet up through the floor.
  - Release the cable from the parking brake control.
8. Remove the parking brake control from the vehicle.

### **Installation**

1. To install, reverse the removal procedure.
    - Inspect the parking brake system for correct operation.
-

## Parking Brake Shoes

### Material

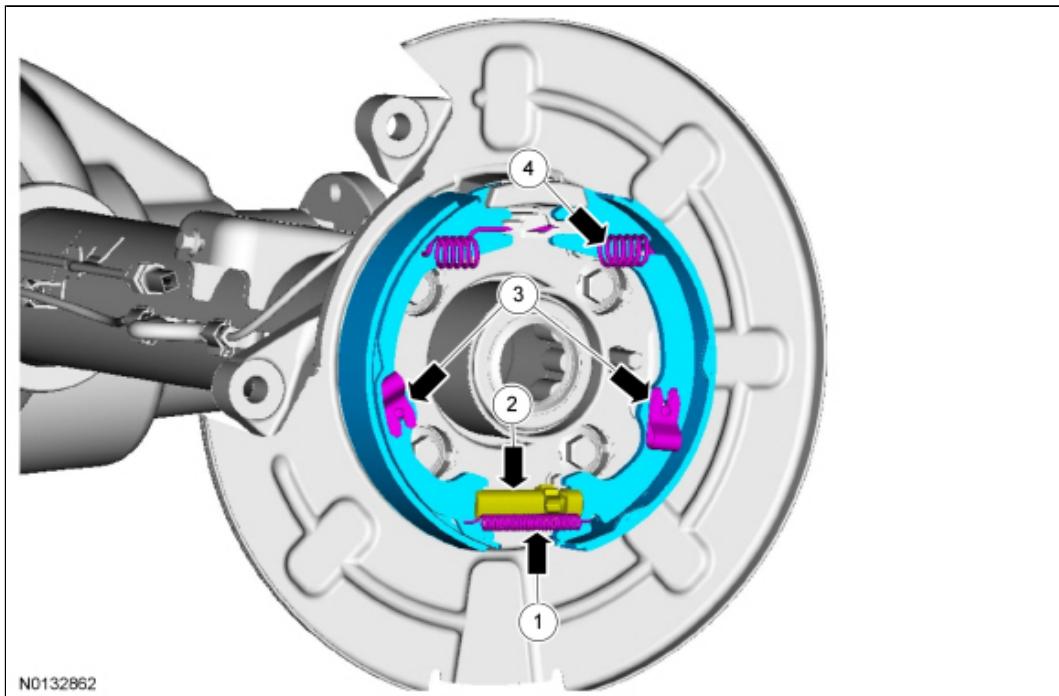
Item	Specification
Molykote® M77 8U7Z-19A506-A	—

### Removal

**NOTE:** Removal steps in this procedure may contain installation details.

**NOTE:** One parking brake shoe kit contains the linings required for both the LH and RH side.

1. Release the parking brake cable tension. For additional information, refer to [Parking Brake Cable Tension Release](#) in this section.
2. Remove the rear brake disc. For additional information, refer to [Section 206-04](#).
- 3.

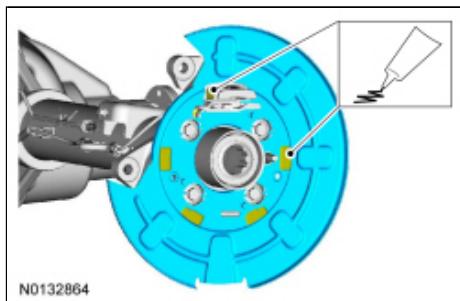


### Installation

1. **NOTE:** Using specified grease, lubricate the parking brake shoes where the shoe contacts the

actuator lever and the support bracket.

Apply the substance from the specified tube.



2. **NOTE:** Completely retract the parking brake adjusting screw before installation.

To install, reverse the removal procedure.

3. Adjust the parking brake shoe. For additional information, refer to [Parking Brake Shoe Adjustment](#) in this section.
  4. Reload the tension on the parking brake cable. For additional information, refer to [Parking Brake Cable Tension Release](#) in this section.
-

## **Parking Brake Warning Indicator Switch**

### **Removal and Installation**

1. Disconnect the parking brake warning indicator switch electrical connector.
  2. Remove the parking brake warning indicator switch screw and the switch.
  3. To install, reverse the removal procedure.
-

**Material**

Item	Specification	Fill Capacity
Motorcraft® High Performance DOT 3 Motor Vehicle Brake Fluid (US) / Motorcraft® Brake Fluid - Heavy Duty DOT 3 (Canada) PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	740 ml (1.56 pt)

**Torque Specifications**

Description	Nm	lb-ft	lb-in
Brake booster-to-pedal bracket nuts <sup>a</sup>	—	—	—
Brake master cylinder nuts	25	18	—
Brake pedal bracket bolts	25	18	—
Brake pedal control switch screw	3	—	27
Coolant expansion tank/lower Air Cleaner (ACL) housing assembly bolts	15	—	133
Hood switch and bracket nut	6	—	53
Primary brake tube fitting	28	21	—
Secondary brake tube fitting	20	—	177

<sup>a</sup> Refer to the procedure in this section.

## Hydraulic Brake Actuation

### Hydraulic Brakes

The hydraulic brake actuation system consists of the following components:

- Brake master cylinder and fluid reservoir
- Brake tubes and hoses
- Brake pedal and bracket
- Hydraulic Control Unit (HCU) (part of ABS)

### Adjustable Pedals

Adjustable pedals are available as an optional feature on this vehicle. Two systems are available, with or without memory and consist of the following components:

- Adjustable brake pedal and bracket
  - Adjustable accelerator pedal with motor and attached cable
  - Adjustable pedal switch
  - Steering Column Control Module (SCCM)
  - Memory SET switch (with memory feature only)
  - Driver Seat Module (DSM) (with memory feature only)
  - Body Control Module (BCM) (with memory feature only)
  - Remote Keyless Entry (RKE) (with memory feature only)
-



## Diagnostic Trouble Code (DTC) Charts

### Steering Column Control Module (SCCM) DTC Chart

DTC	Description	Action
B1368:11	Adjustable Pedal Position Feedback Sensor: Circuit Short To Ground	<a href="#">GO to Pinpoint Test C .</a>
B1368:12	Adjustable Pedal Position Feedback Sensor: Circuit Short To Battery	<a href="#">GO to Pinpoint Test C .</a>
B1369:09	Pedal Adjustment Switch: Component Failure	<p>INSTALL a new brake pedal control switch. REFER to <a href="#">Brake Pedal Control Switch</a> in this section.</p> <p>CLEAR the DTCs. REPEAT the self-test.</p> <p>If DTC B1369:09 returns, INSTALL a new Steering Column Control Module (SCCM). REFER to <a href="#">Section 211-05</a> .</p> <p>CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p>
B137D:18	Pedal Adjustment Motor: Circuit Current Below Threshold	<a href="#">GO to Pinpoint Test A .</a>
B137D:19	Pedal Adjustment Motor: Circuit Current Above Threshold	<a href="#">GO to Pinpoint Test A .</a>
B137D:71	Pedal Adjustment Motor: Actuator Stuck	<a href="#">GO to Pinpoint Test A .</a>
B1D36:09	Turn Indicator Switch: Component Failure	REFER to <a href="#">Section 417-01</a> .
All other SCCM DTCs	—	REFER to <a href="#">Section 211-05</a> .

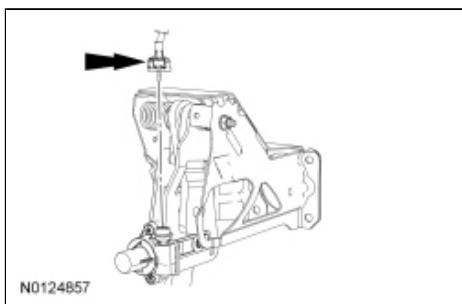


## Adjustable Pedal Indexing

**NOTICE:** The adjustable pedal system must be indexed whenever the brake pedal assembly or accelerator pedal assembly is installed or damage to the components may result.

1. **NOTE:** Make sure the electrical connector is connected to the adjustable pedal motor.

Disconnect the accelerator pedal-to-brake pedal cable from the adjustable brake pedal gear set.



2. Operate the accelerator pedal to the full rearward position.
3. Connect the adjustable pedal motor drive cable to the adjustable brake pedal drive.
4. Operate the adjustable pedals to the full forward position.
5. Disconnect the adjustable pedal motor drive cable from the adjustable brake pedal assembly.
6. Operate the adjustable accelerator pedal to the full forward position.
7. Connect the adjustable pedal motor drive cable to the adjustable brake pedal drive.
8. Check that the brake and accelerator pedals can be fully adjusted forward and rearward.



## Inspection And Verification

### Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
---	---

### Adjustable Pedals

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

### Visual Inspection Chart — Without Memory Feature

Mechanical	Electrical
<ul style="list-style-type: none"><li>• Adjustable accelerator pedal and motor with cable attached</li><li>• Adjustable brake pedal and bracket</li><li>• Foreign objects or material</li></ul>	<ul style="list-style-type: none"><li>• Wiring, terminals or connectors</li><li>• Body Control Module (BCM) fuse(s):<ul style="list-style-type: none"><li>■ 23 (15A)</li><li>■ 24 (15A)</li></ul></li><li>• Steering Column Control Module (SCCM)</li><li>• Brake pedal control switch</li></ul>

### Visual Inspection Chart — With Memory Feature

Mechanical	Electrical
<ul style="list-style-type: none"><li>• Adjustable accelerator pedal and motor with cable attached</li><li>• Adjustable brake pedal and bracket</li><li>• Foreign objects or material</li></ul>	<ul style="list-style-type: none"><li>• <u>BCM</u> fuse(s):<ul style="list-style-type: none"><li>■ 23 (15A)</li><li>■ 24 (15A)</li></ul></li><li>• Memory SET switch</li><li>• Remote Keyless Entry (RKE) transmitter</li><li>• <u>SCCM</u></li><li>• Wiring, terminals or connectors</li><li>• Brake pedal control switch</li></ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

5. **NOTE:** The Vehicle Communication Module (VCM) LED prove out confirms power and ground from the DLC are provided to the VCM.

If the scan tool does not communicate with the VCM:

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM.
- refer to [Section 418-00](#), No Power To The Scan Tool, to diagnose no power to the scan tool.

6. If the scan tool does not communicate with the vehicle:

- verify the ignition is ON.
- verify the scan tool operation with a known good vehicle.
- refer to [Section 418-00](#) to diagnose no response from the PCM.

7. Carry out the network test.

- If the scan tool responds with no communication for one or more modules, refer to [Section 418-00](#).
- If the network test passes, proceed with module self-test diagnostics.

8. Carry out the self-test diagnostics for the SCCM, BCM and Driver Seat Module (DSM).

9. If the DTCs retrieved are related to the concern, go to SCCM DTC Chart. For all other SCCM DTCs, refer to [Section 211-05](#). For DSM DTCs, refer to [Section 501-10](#). For BCM and all other DTCs, refer to [Section 419-10](#).

10. If no DTCs related to the concern are retrieved, GO to [Symptom Chart](#).

---

## Pinpoint Tests

### Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3094-A	Test Light SGT 27000 or equivalent 250-350 mA incandescent bulb test lamp SGT 27000
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

### Pinpoint Tests

#### Pinpoint Test A: The Adjustable Pedals Are Inoperative/Does Not Operate Correctly — Using the Brake Pedal Control Switch

Refer to Wiring Diagrams Cell [127](#), Adjustable Pedals for schematic and connector information.

##### Normal Operation

The Steering Column Control Module (SCCM) receives fused battery voltage from Body Control Module (BCM) fuses 23 (15A) and 24 (15A).

When the brake pedal control switch is pressed, the SCCM sends current to the adjustable pedals motor along one circuit and the current returns to the SCCM along another circuit, which is grounded through the SCCM to move the pedals in the desired direction.

- DTC B137D:18 (Pedal Adjustment Motor: Circuit Current Below Threshold) — This DTC sets if the SCCM senses current flow to the adjustable pedals motor below a preset limit while the brake pedal control switch is pressed, or if there is an open or high resistance in the adjustable pedals motor circuits when the ignition is ON.
- DTC B137D:19 (Pedal Adjustment Motor: Circuit Current Above Threshold) — This DTC sets if the SCCM senses current flow to the adjustable pedals motor above a preset limit while the brake pedal control switch is pressed, or if there is a short to ground in the adjustable pedals motor circuits when the ignition is ON.
- DTC B137D:71 (Pedal Adjustment Motor: Actuator Stuck) — This DTC sets if the SCCM senses current flow to the adjustable pedals motor within a specific range but above a preset limit while the brake pedal control switch is pressed when the ignition is ON.

**This pinpoint test is intended to diagnose the following:**

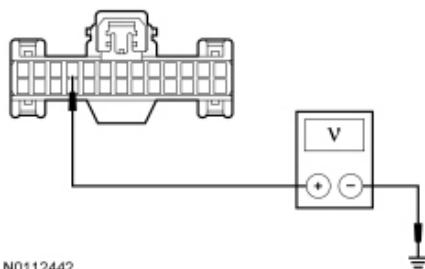
- Wiring, terminals or connectors
- Foreign objects or material
- Brake pedal control switch
- Adjustable accelerator pedal and motor with attached cable
- Adjustable brake pedal and bracket
- SCCM

#### **PINPOINT TEST A: THE ADJUSTABLE PEDALS ARE INOPERATIVE/DOES NOT OPERATE CORRECTLY — USING THE BRAKE PEDAL CONTROL SWITCH**

**NOTICE:** Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

Test Step	Result / Action to Take
<b>A1 CHECK THE ADJUSTABLE PEDALS MOTOR AND CABLE INSTALLATION</b>	<p><b>Yes</b> GO to <a href="#">A2</a>.</p> <p><b>No</b> CORRECT the adjustable pedals motor installation. REFER to <a href="#">Section 310-02</a>. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p>
<b>A2 INSPECT FOR FOREIGN MATERIAL</b>	<p><b>Yes</b> GO to <a href="#">A3</a>.</p> <p><b>No</b> REMOVE the foreign material. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p>
<b>A3 CHECK FOR VOLTAGE AT THE <u>SCCM</u></b>	<p><b>Yes</b></p>

- Measure the voltage between SCCM C2414A-10, circuit SBP23 (WH/RD), harness side and ground.

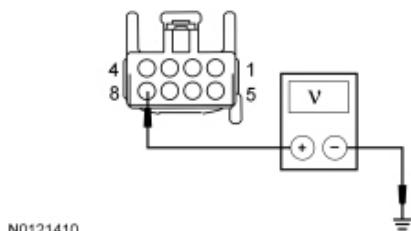


GO to [A4](#).

#### No

VERIFY BCM fuses 23 (15A) and 24 (15A) are OK. If OK, REPAIR the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify the cause for the circuit(s) short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

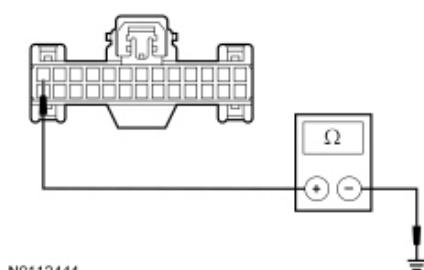
- Measure the voltage between SCCM C2414B-8, circuit SBP24 (VT/RD), harness side and ground.



- Is the voltage greater than 10 volts?

#### A4 CHECK THE SCCM GROUND CIRCUIT FOR AN OPEN

- Measure the resistance between SCCM C2414A-13, circuit GD133 (BK), harness side and ground.

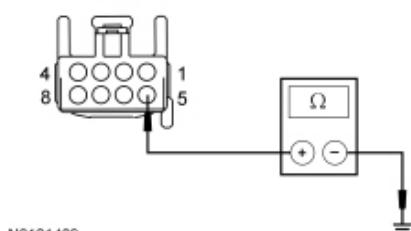


Yes  
GO to [A5](#).

#### No

REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

- Measure the resistance between SCCM C2414B-5, circuit GD138 (BK/WH), harness side and ground.



- Are the resistances less than 5 ohms?

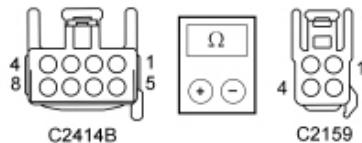
#### A5 CHECK THE ADJUSTABLE PEDALS MOTOR CIRCUITS FOR AN OPEN

- Disconnect: Adjustable Pedals Motor C2159 (vehicles with memory) or C2003 (vehicles without memory).
- Vehicles with memory, measure the resistance between SCCM C2414B, harness side and adjustable pedals motor C2159, harness side as follows:

<u>SCCM</u>	Circuit	Adjustable Pedals Motor
C2414B-4	CPP01 (WH/OG)	C2159-2
C2414B-7	CPP02 (BN)	C2159-1

**Yes**  
GO to [A6](#).

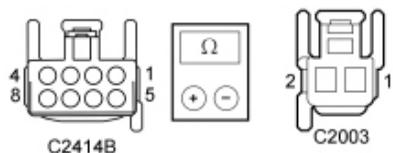
**No**  
REPAIR the affected circuit(s). CLEAR the DTCs.  
REPEAT the self-test. TEST the system for normal operation.



N0121359

- Vehicles without memory, measure the resistance between SCCM C2414B, harness side and adjustable pedal motor C2003, harness side as follows:

<u>SCCM</u>	Circuit	Adjustable Pedals Motor
C2414B-4	CPP01 (WH/OG)	C2003-2
C2414B-7	CPP02 (BN)	C2003-1



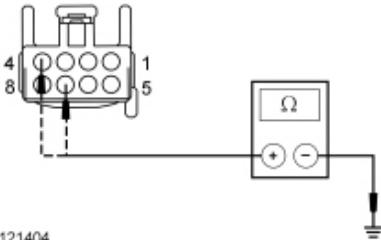
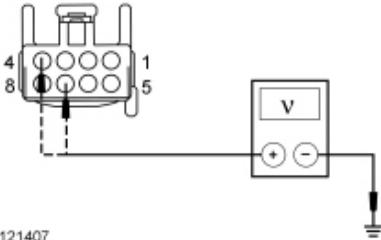
N0121408

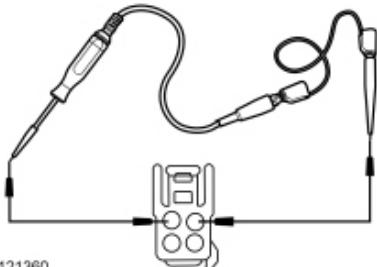
- Are the resistances less than 5 ohms?

#### A6 CHECK THE ADJUSTABLE PEDALS MOTOR CIRCUITS FOR A SHORT TO GROUND

- Measure the resistance between ground and:
  - SCCM C2414B-4, circuit CPP01 (WH/OG), harness side.
  - SCCM C2414B-7, circuit CPP02 (BN), harness side.

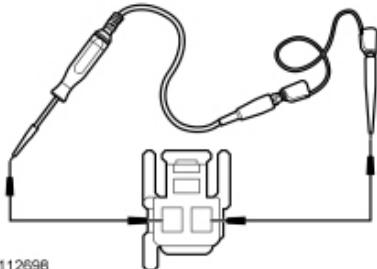
**Yes**  
GO to [A7](#).

	<p><b>No</b> REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p>
 N0121404	<ul style="list-style-type: none"> <li>Are the resistances greater than 10,000 ohms?</li> </ul>
<b>A7 CHECK THE ADJUSTABLE PEDALS MOTOR CIRCUITS FOR A SHORT TO VOLTAGE</b>	<p><b>Yes</b> REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p> <p><b>No</b> GO to <a href="#">A8</a>.</p>
 N0121407	<ul style="list-style-type: none"> <li>Is any voltage present?</li> </ul>
<b>A8 CHECK FOR SCCM OUTPUT</b>	<p><b>Yes</b> GO to <a href="#">A9</a>.</p> <p><b>No</b> GO to <a href="#">A10</a>.</p>



N0121360

- Vehicles without memory, connect the test light as follows:
  - Connect one lead on the test light to C2003-1, circuit CPP02 (BN), harness side.
  - Connect the other lead on the test light to C2003-2, circuit CPP01 (WH/OG), harness side.



N0112698

- Press the brake pedal control switch in the forward and rearward positions and verify the test light illuminates.
- **Does the test light illuminate when the brake pedal control switch is pressed in each direction?**

#### A9 CHECK THE ADJUSTABLE BRAKE PEDALS CABLE OPERATION

- Connect: Adjustable Pedals Motor C2159 (vehicles with memory feature) or C2003 (vehicles without memory feature).
- Disconnect the adjustable brake pedals cable from the adjustable brake pedal and bracket.
- Operate the brake pedal control switch and observe the cable in the conduit.
- **Does the adjustable brake pedals cable turn in the conduit?**

**Yes**

INSTALL a new brake pedal assembly. REFER to [Brake Pedal and Bracket](#) in this section. CLEAR the DTCs. REPEAT the self test. TEST the system for normal operation.

**No**

INSTALL a new adjustable accelerator pedal and motor with attached cable. REFER to Accelerator Pedal — Adjustable, Exploded View in [Section 310-02](#). CLEAR the DTCs. REPEAT the self test. TEST the system for normal operation.

#### A10 CHECK THE SCCM ADJUSTABLE PEDALS ACTIVE COMMANDS

- Select PARK.

**Yes**

<ul style="list-style-type: none"> <li>• Connect: Adjustable Pedals Motor C2159 (vehicles with memory feature) or C2003 (vehicles without memory feature).</li> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: DataLogger — <u>SCCM</u>.</li> <li>• <b>NOTE:</b> Toggling the active command ON causes the pedal to move in the commanded direction for 2 seconds and then the pedal stops.</li> <li>• Toggle the pedals forward (PEDAL_IN) active command ON.</li> <li>• Toggle the PEDAL_IN active command OFF.</li> <li>• Toggle the pedals rearward (PEDAL_OUT) active command ON.</li> <li>• Toggle the PEDAL_OUT active command OFF.</li> <li>• <b>Do the adjustable pedals respond correctly to the corresponding active commands?</b></li> </ul>	<p>INSTALL a new brake pedal control switch. REFER to <a href="#">Brake Pedal Control Switch</a> in this section. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p> <p><b>No</b> GO to <a href="#">A11</a>.</p>
<p><b>A11 CHECK THE <u>SCCM</u> FOR CORRECT OPERATION</b></p> <ul style="list-style-type: none"> <li>• Disconnect: <u>SCCM</u> C2414A and C2414B.</li> <li>• Check <u>SCCM</u> C2414A and <u>SCCM</u> C2414B for: <ul style="list-style-type: none"> <li>■ corrosion.</li> <li>■ pushed-out pins.</li> <li>■ spread terminals.</li> </ul> </li> <li>• Connect: <u>SCCM</u> C2414A and C2414B.</li> <li>• Connect: Adjustable Pedals Motor C2159 (vehicles with memory feature) or C2003 (vehicles without memory feature).</li> <li>• Make sure the connectors seat correctly, then operate the system and verify the concern is still present.</li> <li>• <b>Is the concern still present?</b></li> </ul>	<p><b>Yes</b> INSTALL a new <u>SCCM</u>. REFER to <a href="#">Section 211-05</a>. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p>

#### Pinpoint Test B: The Adjustable Pedals Are Inoperative/Does Not Operate Correctly — Using the Memory SET Switch or the Remote Keyless Entry (RKE) Transmitter

Refer to Wiring Diagrams Cell [127](#), Adjustable Pedals for schematic and connector information.

##### Normal Operation

When the desired memory position is selected using the memory SET switch or the Remote Keyless Entry (RKE) transmitter, the Driver Seat Module (DSM) communicates the desired pedals position in a message on the Medium Speed Controller Area Network (MS-CAN) bus to the Body Control Module (BCM). The BCM acts as a gateway module, relaying the message to the Steering Column Control Module (SCCM) over the High Speed Controller Area Network (HS-CAN) bus. The SCCM then sends current in one direction to the adjustable pedals motor to move the pedals forward and in another direction (reversed polarity) to move the pedals rearward.

The SCCM uses a Hall-effect sensor that is integral to the pedals motor to identify the current pedal position. The SCCM sends a reference voltage along one circuit, through the sensor and back to the SCCM along the signal return circuit.

If the vehicle is equipped with the memory feature but the SCCM is incorrectly configured, memory recall may not function correctly when the memory SET switch or the RKE transmitter is used to adjust the pedal position.

**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- Foreign objects or material
- Adjustable accelerator pedal and motor with attached cable
- Adjustable brake pedal and bracket
- RKE transmitter
- DSM
- SCCM
- Incorrect SCCM configuration
- BCM

**PINPOINT TEST B: THE ADJUSTABLE PEDALS ARE INOPERATIVE/DOES NOT OPERATE CORRECTLY — USING THE MEMORY SET SWITCH BUTTONS OR THE RKE TRANSMITTER**

**NOTICE:** Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

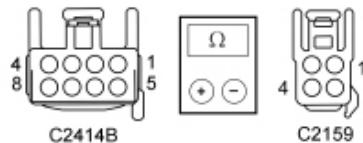
Test Step	Result / Action to Take
<b>B1 CHECK THE ADJUSTABLE PEDALS OPERATION WITH THE BRAKE PEDAL CONTROL SWITCH</b> <ul style="list-style-type: none"><li>• Press the brake pedal control switch in each direction for more than one second and observe the pedals.</li><li>• <b>Do the pedals operate for more than one second in the direction selected using the switch?</b></li></ul>	<p><b>Yes</b> GO to <a href="#">B2</a>.</p> <p><b>No</b> If the pedals do not move using the brake pedal control switch, <a href="#">GO to Pinpoint Test A</a>.</p> <p>If the pedals only move in one second intervals regardless of button operation, <a href="#">GO to Pinpoint Test C</a>.</p>
<b>B2 CHECK THE MEMORY SYSTEM OPERATION</b> <ul style="list-style-type: none"><li>• Set a memory position for the driver seat, exterior mirrors and adjustable pedals to memory SET switch button 1. Refer to Memory Position Programming in <a href="#">Section 501-10</a>.</li><li>• Select PARK.</li><li>• Press the memory SET switch button 1 and observe the following items:<ul style="list-style-type: none"><li>■ Driver seat</li><li>■ Exterior mirrors</li><li>■ Adjustable pedals</li></ul></li><li>• <b>Do all 3 items move when the button is pressed?</b></li></ul>	<p><b>Yes</b> GO to <a href="#">B3</a>.</p> <p><b>No</b> If all 3 items do not move, REFER to Diagnosis and Testing in <a href="#">Section 501-10</a> to diagnose the memory SET switch.</p> <p>If <b>only</b> the adjustable pedals do not move, GO to <a href="#">B4</a>.</p> <p>If <b>only</b> the driver seat does not move, REFER to Diagnosis and Testing in <a href="#">Section 501-10</a>.</p> <p>If <b>only</b> the exterior mirrors do not move, REFER to Diagnosis and Testing in <a href="#">Section 501-09</a>.</p>
<b>B3 CHECK THE <u>RKE TRANSMITTER</u> OPERATION</b>	

<ul style="list-style-type: none"> <li>• Set a memory position in the <u>RKE</u> transmitter for the driver seat, exterior mirrors and adjustable pedals. Refer to Remote Memory Activation in <a href="#">Section 501-14</a>.</li> <li>• Select PARK.</li> <li>• Press the unlock button on the <u>RKE</u> transmitter and observe the following items: <ul style="list-style-type: none"> <li>▪ Driver seat</li> <li>▪ Exterior mirrors</li> <li>▪ Adjustable pedals</li> </ul> </li> <li>• <b>Do all 3 items move when the button is pressed?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">B4</a>.</p> <p><b>No</b> If all 3 items do not move, REFER to Diagnosis and Testing in <a href="#">Section 501-14</a> to diagnose the <u>RKE</u> transmitter.</p> <p>If <b>only</b> the adjustable pedals do not move, GO to <a href="#">B4</a>.</p> <p>If <b>only</b> the driver seat does not move, REFER to Diagnosis and Testing in <a href="#">Section 501-10</a>.</p> <p>If <b>only</b> the exterior mirrors do not move, REFER to Diagnosis and Testing in <a href="#">Section 501-09</a>.</p>
<p><b>B4 CHECK THE ADJUSTABLE PEDALS MOTOR AND CABLE INSTALLATION</b></p> <ul style="list-style-type: none"> <li>• Check the adjustable pedals motor and cable for correct installation.</li> <li>• <b>Are the motor and cable correctly installed?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">B5</a>.</p> <p><b>No</b> CORRECT the adjustable pedals motor installation. REFER to <a href="#">Section 310-02</a>. TEST the system for normal operation.</p>
<p><b>B5 INSPECT FOR FOREIGN OBJECTS OR MATERIAL</b></p> <ul style="list-style-type: none"> <li>• Inspect the adjustable brake pedal and accelerator assemblies for foreign material causing a binding condition.</li> <li>• <b>Are the pedal assemblies free from foreign material?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">B6</a>.</p> <p><b>No</b> REMOVE the foreign material. TEST the system for normal operation.</p>
<p><b>B6 CHECK FOR DSM OR BCM DTCs</b></p> <ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Connect the scan tool.</li> <li>• Enter the following diagnostic mode on the scan tool: Self-Test — <u>DSM</u>.</li> <li>• Enter the following diagnostic mode on the scan tool: Self-Test — <u>BCM</u>.</li> <li>• Record any DTCs retrieved from the <u>DSM</u> or the <u>BCM</u>.</li> <li>• <b>Was DTC U0140 retrieved from the <u>DSM</u> or was DTC U0212:87 retrieved from the <u>BCM</u> ?</b></li> </ul>	<p><b>Yes</b> If DTC U0140 is retrieved from the <u>DSM</u>, REFER to <a href="#">Section 501-10</a> to diagnose the lost communication concern.</p> <p>If DTC U0212:87 is retrieved from the <u>BCM</u>, REFER to <a href="#">Section 419-10</a> to diagnose the lost communication concern.</p> <p><b>No</b> GO to <a href="#">B7</a>.</p>
<p><b>B7 CHECK THE ADJUSTABLE PEDALS MOTOR AND HALL-EFFECT SENSOR CIRCUITS FOR AN OPEN</b></p> <ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Disconnect: Adjustable Pedals Motor C2159.</li> <li>• Disconnect: <u>SCCM</u> C2414B.</li> <li>• Measure the resistance between <u>SCCM</u> C2414B,</li> </ul>	<p><b>Yes</b> GO to <a href="#">B8</a>.</p> <p><b>No</b></p>

harness side and adjustable pedals motor C2159, harness side as follows:

<b>SCCM</b>	<b>Circuit</b>	<b>Adjustable Pedals Motor</b>
C2414B-4	CPP01 (WH/OG)	C2159-2
C2414B-7	CPP02 (BN)	C2159-1

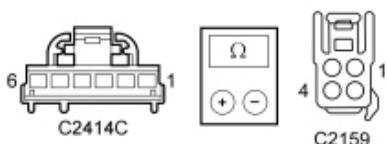
REPAIR the affected circuit(s). TEST the system for normal operation.



N0121359

- Disconnect: SCCM C2414C.
- Measure the resistance between SCCM C2414C, harness side and adjustable pedals motor C2159, harness side as follows

<b>SCCM</b>	<b>Circuit</b>	<b>Adjustable Pedals Motor</b>
C2414C-3	RPP06 (GN)	C2159-3
C2414C-6	LPP06 (YE/BU)	C2159-4



N0121358

- Are the resistances less than 5 ohms?

#### B8 CHECK THE ADJUSTABLE PEDALS MOTOR AND HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TO GROUND

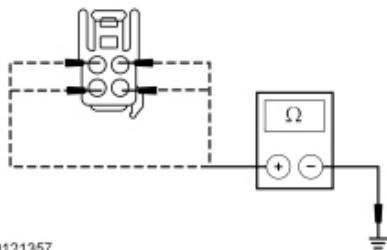
- Measure the resistance between ground and:
  - adjustable pedals motor C2159-1, circuit CPP02

Yes  
GO to [B9](#).

- (BN), harness side.
- adjustable pedals motor C2159-2, circuit CPP01 (WH/OG), harness side.
  - adjustable pedals motor C2159-4, circuit LPP06 (YE/BU), harness side.
  - adjustable pedals motor C2159-3, circuit RPP06 (GN), harness side.

**No**

REPAIR the affected circuit(s). TEST the system for normal operation.



- Are the resistances greater than 10,000 ohms?

#### B9 CHECK THE ADJUSTABLE PEDALS MOTOR AND HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TOGETHER

- Measure the resistance between adjustable pedals motor C2159, harness side as follows:

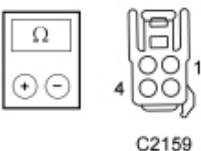
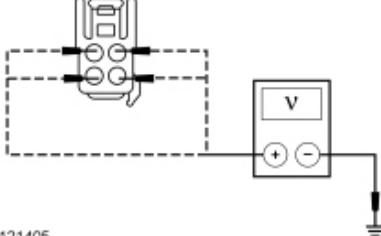
Adjustable Pedals Motor	Circuit	Adjustable Pedals Motor	Circuit
C2159-4	LPP06 (YE/BU)	C2159-2	CPP01 (WH/OG)
C2159-4	LPP06 (YE/BU)	C2159-3	RPP06 (GN)
C2159-4	LPP06 (YE/BU)	C2159-1	CPP02 (BN)
C2159-2	CPP01 (WH/OG)	C2159-3	RPP06 (GN)
C2159-2	CPP01 (WH/OG)	C2159-1	CPP02 (BN)
C2159-3	RPP06 (GN)	C2159-1	CPP02 (BN)

**Yes**

GO to [B10](#).

**No**

REPAIR the affected circuit(s). TEST the system for normal operation.

 <p>N0121355</p> <ul style="list-style-type: none"> <li>Are the resistance greater than 10,000 ohms?</li> </ul> <p><b>B10 CHECK THE ADJUSTABLE PEDALS MOTOR AND HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE</b></p> <ul style="list-style-type: none"> <li>Ignition ON.</li> <li>Measure the voltage between ground and: <ul style="list-style-type: none"> <li>adjustable pedals motor C2159-2, circuit CPP01 (WH/OG), harness side.</li> <li>adjustable pedals motor C2159-4, circuit LPP06 (YE/BU), harness side.</li> <li>adjustable pedals motor C2159-3, circuit RPP06 (GN), harness side.</li> <li>adjustable pedals motor C2159-1, circuit CPP02 (BN), harness side.</li> </ul> </li> </ul> <p>N0121405</p> <ul style="list-style-type: none"> <li>Is any voltage present?</li> </ul>	<p><b>Yes</b> REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p> <p><b>No</b> CONFIGURE the <u>SCCM</u> using As-Built data. TEST the system for normal operation. If the adjustable pedals do not operate correctly, INSTALL a new adjustable pedals motor and bracket assembly. REFER to Accelerator Pedal — Adjustable, Exploded View in <a href="#">Section 310-02</a>. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p> 
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#### Pinpoint Test C: The Adjustable Pedals Only Move in 1 Second Intervals

Refer to Wiring Diagrams Cell [127](#), Adjustable Pedals for schematic and connector information.

##### Normal Operation

The Steering Column Control Module (SCCM) uses a Hall-effect sensor integral to the motor to identify the current pedal position. The SCCM sends a reference voltage along the sensor feed circuit, through the Hall-effect sensor and back to the SCCM along the signal return circuit.

When the following DTCs are set, the adjustable pedals enters a "jog mode". When the pedals are in jog mode, the memory system recall does not function from either the Remote Keyless Entry (RKE) transmitter or memory SET switch. When the pedals are activated using the brake pedal control switch, the motor moves the pedals for one second regardless of the length of time the button is pressed.

If the vehicle is not equipped with memory and the SCCM is incorrectly configured, the SCCM expects to receive pedal position information when the vehicle is not equipped to provide it. If this happens, the adjustable pedals enters a "jog mode" similar to if a fault were present in the adjustable pedals position sensor circuits.

- DTC B1368:11 (Adjustable Pedal Position Feedback Sensor: Circuit Short to Ground) — This DTC sets if the SCCM detects a short to ground on the Hall-effect sensor feed and/or return circuits when the ignition is ON.
- DTC B1368:12 (Adjustable Pedal Position Feedback Sensor: Circuit Short to Battery) — This DTC sets if the SCCM detects a short to voltage on the Hall-effect sensor feed and/or return circuits when the ignition is ON.

**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- Adjustable accelerator pedal and motor with attached cable
- SCCM
- Incorrect SCCM configuration

#### PINPOINT TEST C: THE ADJUSTABLE PEDALS ONLY MOVE IN 1 SECOND INTERVALS

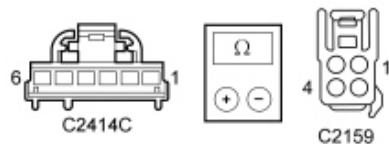
**NOTICE:** Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.

Test Step	Result / Action to Take
<b>C1 CHECK THE SCCM_DTCs</b>	<p><b>Yes</b> GO to <a href="#">C2</a>.</p> <p><b>No</b> If no DTCs were retrieved, CONFIGURE the <u>SCCM</u> using As-Built data. REPEAT the self-test. TEST the system for normal operation. If DTCs B1369:09, B137D:18, 19, or 71 were retrieved, REFER to DTC Charts in this section. For all other <u>SCCM</u> DTCs, REFER to the <u>SCCM</u> DTC Chart in <a href="#">Section 211-05</a>. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p>
<b>C2 CHECK THE SCCM HALL-EFFECT SENSOR CIRCUITS FOR AN OPEN</b>	<p><b>Yes</b> GO to <a href="#">C3</a>.</p> <p><b>No</b> REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.</p>

SCCM	Circuit	Adjustable Pedals Motor
C2414C-	RPP06 (GN)	C2159-3

3		
C2414C-6	LPP06 (YE/BU)	C2159-4



N0121358

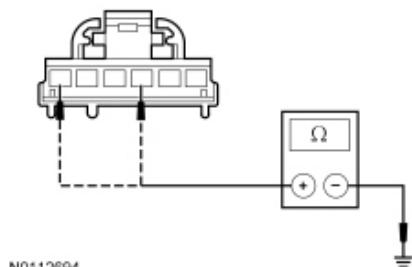
- Are the resistances less than 5 ohms?

#### C3 CHECK THE SCCM HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TO GROUND

- Measure the resistance between ground and:
  - SCCM C2414C-6, circuit LPP06 (YE/BU), harness side.
  - SCCM C2414C-3, circuit RPP06 (GN), harness side.

**Yes**  
GO to [C4](#).

**No**  
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.



N0112694

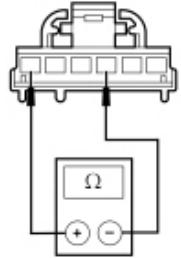
- Are the resistances greater than 10,000 ohms?

#### C4 CHECK THE SCCM HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TOGETHER

- Measure the resistance between SCCM C2414C-3, circuit RPP06 (GN), harness side and SCCM C2414C-6, circuit LPP06 (YE/BU), harness side.

**Yes**  
GO to [C5](#).

**No**  
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

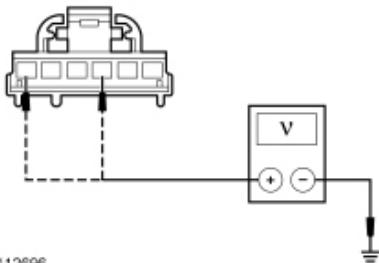


N0113510

- Is the resistance greater than 10,000 ohms?

#### C5 CHECK THE SCCM HALL-EFFECT SENSOR CIRCUITS FOR A SHORT TO VOLTAGE

- Ignition ON.
- Measure the voltage between ground and:
  - SCCM C2414C-6, circuit LPP06 (YE/BU), harness side.
  - SCCM C2414C-3, circuit RPP06 (GN), harness side.



N0112696

- Is any voltage present?

#### Yes

REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

#### No

INSTALL a new adjustable accelerator pedal and motor with attached cable. REFER to Accelerator Pedal — Adjustable, Exploded View in [Section 310-02](#). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation. If DTC B1368:11 or B1368:12 return, INSTALL a new SCCM. REFER to [Section 211-05](#). CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.



## Principles of Operation

### Hydraulic Brakes

The brake pedal is connected to the power brake booster, which is connected to the brake master cylinder. When the brake pedal is pressed, brake fluid is forced through the double-walled steel tubes and flexible hoses to the Hydraulic Control Unit (HCU). The brake fluid is then distributed to the front and rear brake calipers. The fluid enters the caliper, forcing the caliper pistons and brake pads outward against the brake disc friction surface, slowing or stopping rotation of the brake disc. When the brake pedal is released, brake fluid pressure is relieved, returning the front and rear brake caliper pistons and brake pads to the unapplied position.

To diagnose hydraulic brake concerns, refer to [Section 206-00](#).

For information on the HCU, refer to [Section 206-09](#).

### Adjustable Pedals Without Memory Feature

The adjustable pedals without memory are controlled by the brake pedal control switch and the Steering Column Control Module (SCCM). The adjustable pedals motor is attached to the accelerator pedal bracket and controls the accelerator pedals directly. It operates forward and rearward, depending on which direction the switch is pressed. The adjustable brake pedals is connected to the motor by a cable that rotates inside a sleeve. This allows both the brake and accelerator pedals to move together as an assembly. When the brake pedal control switch is pressed, voltage is applied from the SCCM to the adjustable pedals motor. The end of the motor that is attached to the accelerator pedal bracket rotates the pinion of a worm gear set and causes the accelerator pedal to move. At the same time, the other end of the motor rotates the cable inside the sleeve which causes the brake pedal adjuster to move through the use of a worm gear set. The pedals can be adjusted with the ignition switch in the OFF, ACC or RUN position, regardless of gear selector position.

The SCCM monitors the adjustable pedals motor and circuits for faults. If a fault is detected, the SCCM is capable of setting DTCs.

### Adjustable Pedals With Memory Feature

The adjustable pedals with memory are controlled by the SCCM, Body Control Module (BCM) and Driver Seat Module (DSM). The pedals can be adjusted in 3 different ways:

- Using the brake pedal control switch.
- Using the memory SET switch.
- Using the Remote Keyless Entry (RKE) transmitter.

The SCCM monitors the position of the pedals using a Hall-effect sensor that is integral to the adjustable pedals motor. When a memory position is recalled through either the memory SET switch or the RKE transmitter, the SCCM monitors the Hall-effect sensor and stops sending voltage to the motor once the

commanded memory position is reached. If the SCCM receives a pedals position input during a memory position recall function, the module stops the memory recall and responds to the new pedals position input.

When the RKE transmitter is activated, a message is sent over the Medium Speed Controller Area Network (MS-CAN) to the DSM. When the memory SET switch is pressed, the DSM senses continuity to ground on the switch circuit. When the DSM receives either the MS-CAN message or the ground input through the switch circuit, it sends a message over the MS-CAN to the BCM. The BCM acts as a gateway module, relaying the MS-CAN message that was received from the DSM to the SCCM over the High Speed Controller Area Network (HS-CAN). The SCCM then sends voltage over the appropriate circuit to the adjustable pedals motor to adjust the pedals.

The SCCM continuously monitors the adjustable pedals motor and circuits for faults. If a fault is detected, the SCCM is capable of setting DTCs.

The DSM also controls the driver seat and the exterior mirrors.

For information on setting and recalling a memory pedal position, refer to Memory Position Programming in [Section 501-10](#).

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## Symptom Charts

**Symptom Chart**

Condition	Possible Sources	Action
• No communication with the Steering Column Control Module (SCCM)	<ul style="list-style-type: none"> <li>• Fuse</li> <li>• Wiring, terminals or connectors</li> <li>• <u>SCCM</u></li> </ul>	<ul style="list-style-type: none"> <li>• REFER to <a href="#">Section 418-00</a>.</li> </ul>
• Adjustable pedals are inoperative/does not operate correctly — using the brake pedal control switch	<ul style="list-style-type: none"> <li>• Foreign objects or material</li> <li>• Fuse</li> <li>• Wiring, terminals or connectors</li> <li>• Brake pedal control switch</li> <li>• Adjustable accelerator pedal and motor with attached cable</li> <li>• Adjustable brake pedal and bracket</li> <li>• <u>SCCM</u></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test A</a>.</li> </ul>
• Adjustable pedals are inoperative/does not operate correctly — using the memory SET switch buttons	<ul style="list-style-type: none"> <li>• Foreign objects or material</li> <li>• Fuse</li> <li>• Wiring, terminals or connectors</li> <li>• Memory SET switch</li> <li>• Adjustable accelerator pedal and motor with attached cable</li> <li>• Adjustable brake pedal and bracket</li> <li>• Incorrect <u>SCCM</u> configuration</li> <li>• Driver Seat Module (DSM)</li> <li>• <u>SCCM</u></li> <li>• Body Control Module (BCM)</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test B</a>.</li> </ul>
• Adjustable pedals are inoperative/does not operate correctly — using the Remote Keyless Entry (RKE) transmitter	<ul style="list-style-type: none"> <li>• Foreign objects or material</li> <li>• Wiring, terminals or connectors</li> <li>• Adjustable accelerator pedal and motor with attached cable</li> <li>• Adjustable brake pedal and bracket</li> <li>• <u>RKE</u> transmitter</li> <li>• <u>DSM</u></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test B</a>.</li> </ul>

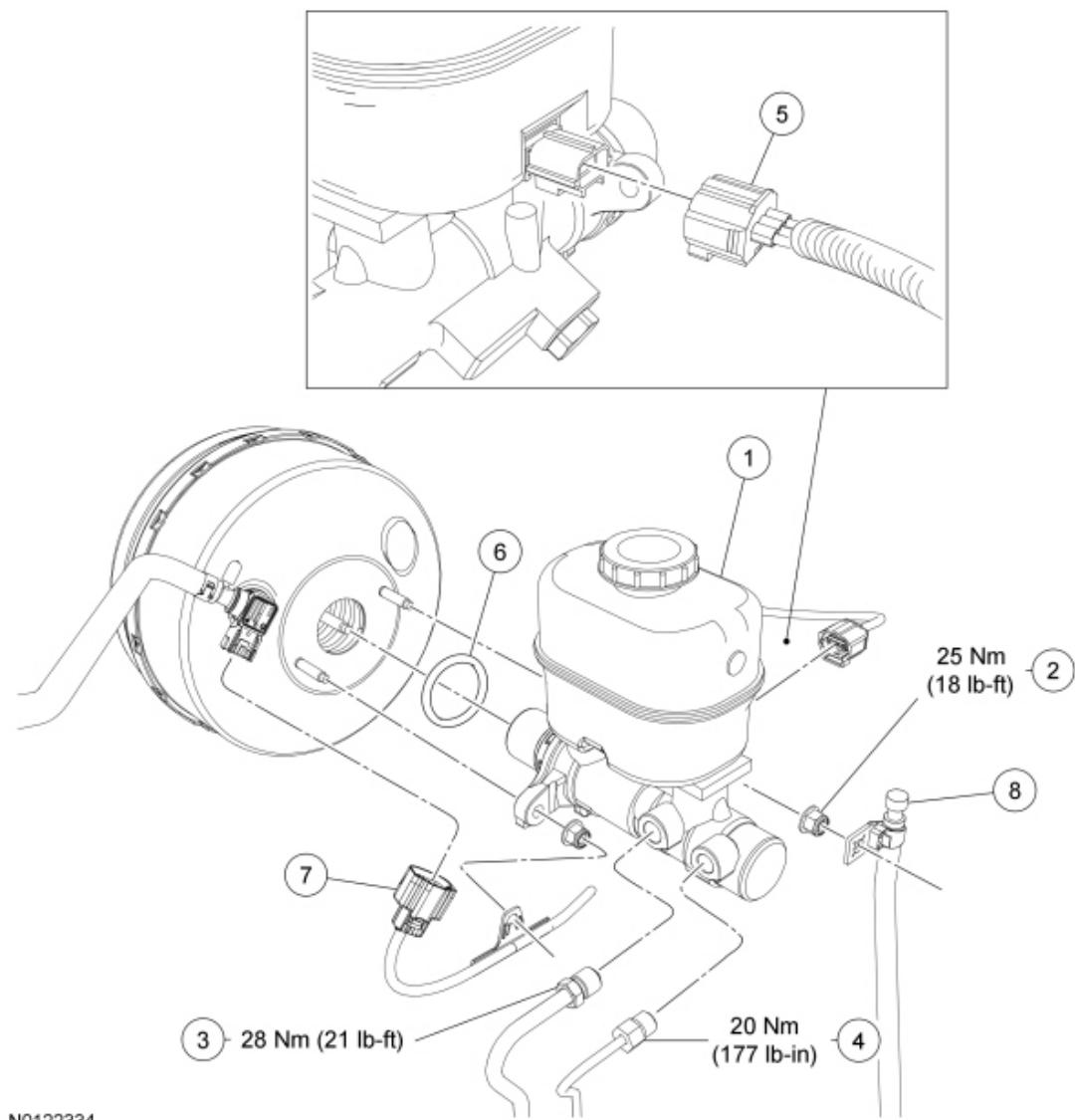
	<ul style="list-style-type: none"><li>• <u>SCCM</u></li><li>• <u>BCM</u></li></ul>	
<ul style="list-style-type: none"><li>• The adjustable pedals only move in 1 second intervals</li></ul>	<ul style="list-style-type: none"><li>• Wiring, terminals or connectors</li><li>• Adjustable accelerator pedal and motor with attached cable</li><li>• Incorrect <u>SCCM</u> configuration</li><li>• <u>SCCM</u></li></ul>	<ul style="list-style-type: none"><li>• <a href="#"><u>GO to Pinpoint Test C</u></a></li></ul>

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## **Brake Master Cylinder**

### **Material**

<b>Item</b>	<b>Specification</b>
Motorcraft® High Performance DOT 3 Motor Vehicle Brake Fluid (US) / Motorcraft® Brake Fluid - Heavy Duty DOT 3 (Canada) PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



N0122334

Item	Part Number	Description
1	2140	Brake master cylinder and reservoir assembly
2	W520212	Brake master cylinder nut (2 required)
3	—	Primary brake tube fitting (part of 2A040)
4	—	Secondary brake tube fitting (part of 2B253)
5	—	Brake fluid level switch electrical connector (part of 12A581)
6	2152	Brake master cylinder-to-booster seal
7	—	Vacuum sensor electrical connector (part of 12A581)
8	3B476	Front axle vent hose

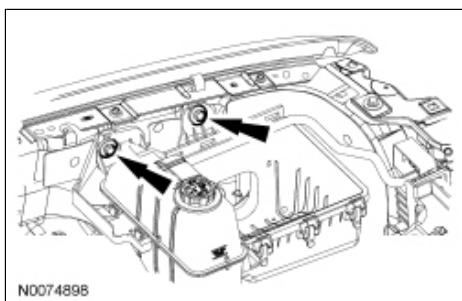
## Removal and Installation

**⚠️ WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

**⚠️ WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

1. Relieve the vacuum in the brake booster by pressing and releasing the brake pedal a minimum of 5 times with the engine not running.
2. Remove the Air Cleaner (ACL) element. For additional information, refer to Air Cleaner Element in [Section 303-12](#).
3. Remove the nut and position the hood switch and bracket aside.
  - To install, tighten nut to 6 Nm (53 lb-in).
4. Remove the 2 bolts and position the coolant expansion tank/lower ACL housing assembly aside.
  - To install, tighten bolts to 15 Nm (133 lb-in).



5. Disconnect the brake fluid level switch.
6. If equipped, position the vacuum sensor wiring harness and front axle vent hose aside.
7. Loosen the brake tube fittings and disconnect the brake tubes.
  - Plug the master cylinder ports.
  - To install, tighten primary brake tube fitting to 28 Nm (21 lb-ft).
  - To install, tighten secondary brake tube fitting to 20 Nm (177 lb-in).
8. **NOTICE:** When the master cylinder is removed, the piston will be exposed. Do not damage the piston or piston surface or a fluid leak may occur.

Remove the 2 brake master cylinder nuts and the brake master cylinder.

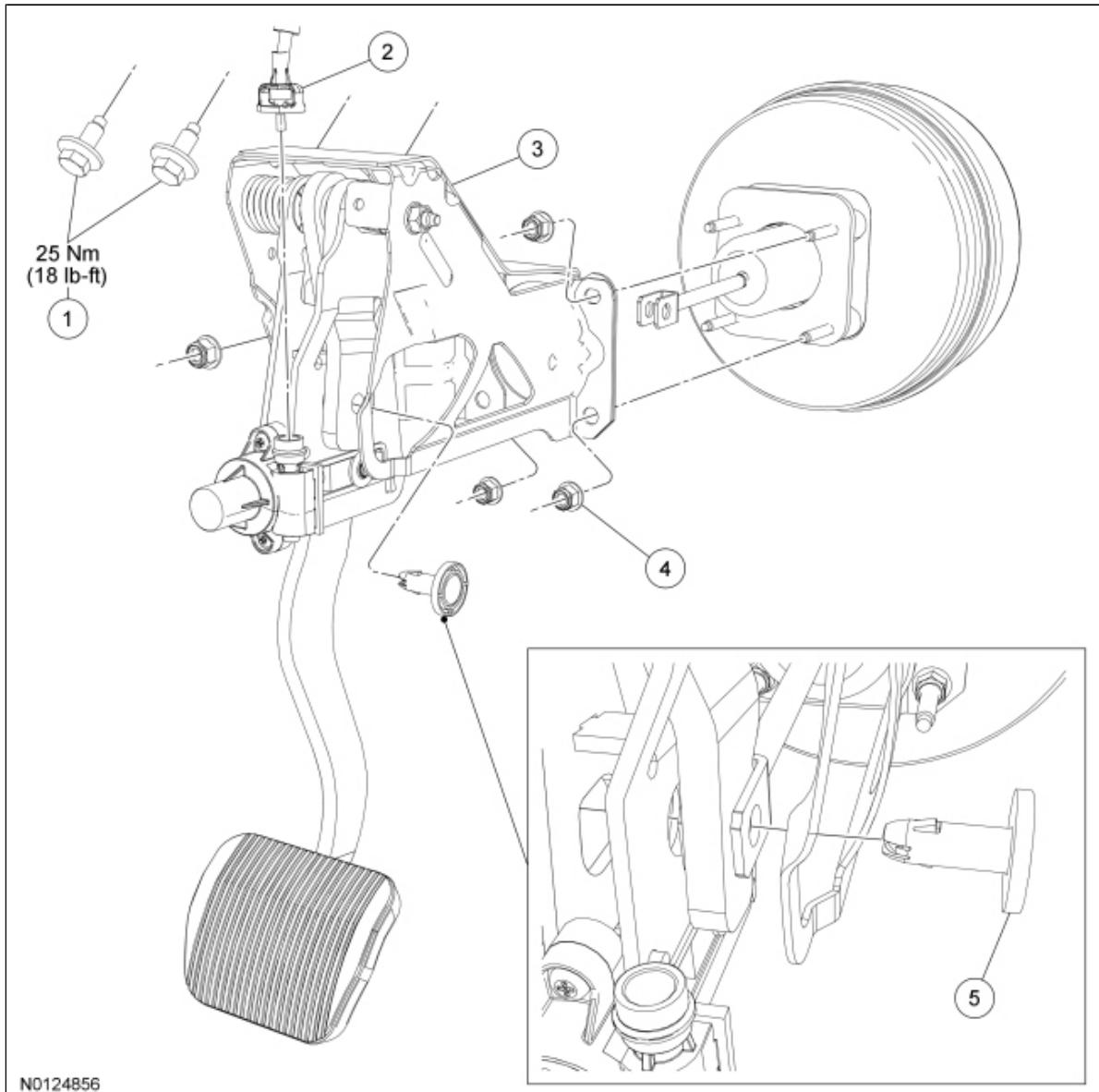
- To install, tighten to 25 Nm (18 lb-ft).

9. To install, reverse the removal procedure.

- If a new brake master cylinder has been installed, bleed the master cylinder. Refer to Component Bleeding in [Section 206-00](#).
  - If the brake master cylinder was removed to access other components, bleed the brake system. Refer to Brake System Bleeding in [Section 206-00](#).
-

## Brake Pedal and Bracket

**NOTE:** Adjustable brake pedal and bracket shown, fixed brake pedal and bracket similar.



N0124856

Item	Part Number	Description
1	W702368	Brake pedal bracket bolts
2	—	Accelerator pedal-to-brake pedal cable (part of 9F836)

3	2450	Brake pedal and bracket
4	W520212	Brake booster-to-pedal bracket nut (4 required)
5	2L523	Brake pedal pin

## Removal and Installation

### Vehicles equipped with adjustable pedals

1. **NOTICE:** The brake pedal and the accelerator pedal must be in the same position when installing a new cable or a new pedal. The pedals must be all the way forward or all the way rearward or damage to components may occur.

Move the pedals to the full forward (away from the driver) position.

2. Disconnect the accelerator pedal-to-brake pedal cable from the adjustable brake pedal gear set.

### All vehicles

3. **NOTICE:** Do not service the brake pedal without first removing the stoplamp switch. Remove this switch with the brake pedal in the at-rest position. Attempting to remove the switch when the plunger is extended (during pedal apply) results in damage to the switch.

Remove the stoplamp switch. For additional information, refer to [Section 417-01](#).

4. **NOTE:** Use an 11 mm, 12-point socket or wrench to compress the 2 tabs on the brake pedal arm pin.

Remove and discard the brake pedal pin, then disconnect the brake booster push rod from the brake pedal arm.

5. Remove the bulkhead sound insulator.

6. Remove the 4 brake booster-to-pedal bracket nuts.

- To install, tighten to 25 Nm (18 lb-ft) following a clockwise pattern starting with the upper left nut.

7. Remove the 2 brake pedal bracket bolts and remove the brake pedal and bracket.

- To install, tighten to 25 Nm (18 lb-ft).

8. **NOTICE:** Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch. Install this switch with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing this switch with the pedal in any other position results in incorrect adjustment and damages the switch.

To install, reverse the removal procedure.

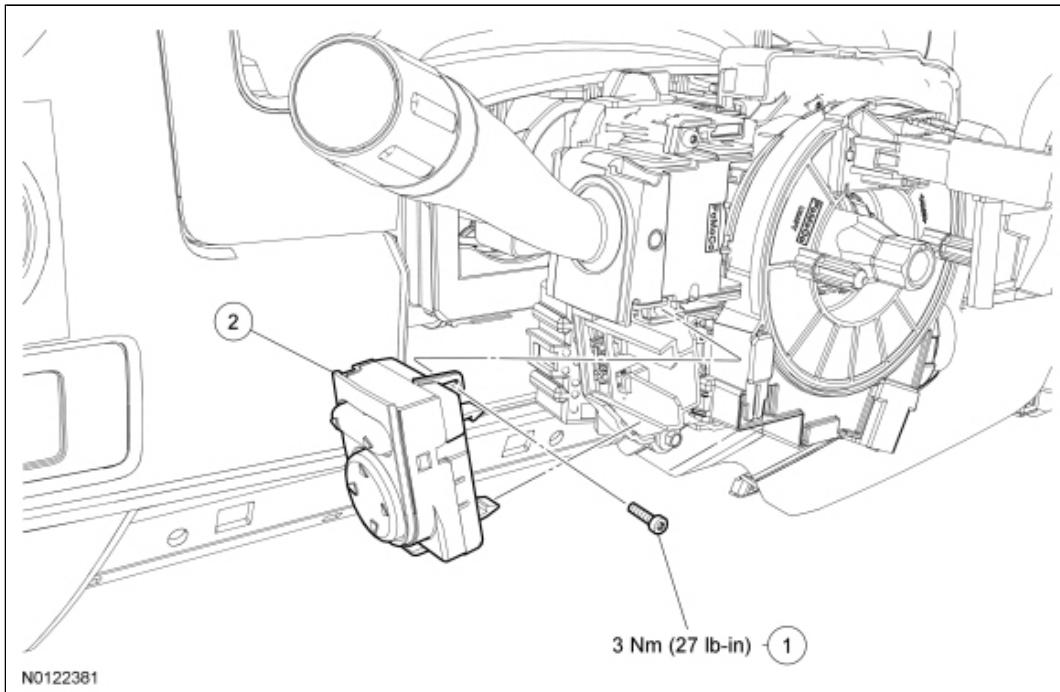
### Vehicles equipped with adjustable pedals

9. Index the pedal assemblies. For additional information, refer to [Adjustable Pedal Indexing](#) in this section.



## Brake Pedal Control Switch

**NOTE:** Steering wheel removed for clarity.



Item	Part Number	Description
1	W715057	Screw
2	9G604	Brake pedal control switch

### Removal and Installation

**NOTE:** Turn the steering wheel 90 degrees to the left to access the brake pedal control switch screws.

1. Remove the steering column shrouds. For additional information, refer to [Section 211-04](#).
2. Remove the screw.
  - To install, tighten to 3 Nm (27 lb-in).
3. Using a suitable tool (such as a pocket screwdriver), carefully disengage the control switch locking tabs one at a time, then remove the switch.
4. To install, reverse the removal procedure.



**Torque Specifications**

Description	Nm	lb-ft	lb-in
Brake booster nuts <sup>a</sup>	—	—	—
Brake master cylinder nuts	25	18	—
Brake vacuum pump bolts <sup>a</sup>	—	—	—
Coolant expansion tank/lower Air Cleaner (ACL) housing assembly bolts	15	—	133

<sup>a</sup> Refer to the procedure in this section.

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## Brake Booster

The power brake actuation system consists of the following components:

- Brake booster
- Brake booster check valve
- Brake booster vacuum sensor
- Brake booster vacuum supply hose
- Brake booster vacuum pump (3.5L GTDI engine only)

The brake booster uses vacuum from the intake manifold (3.7L and 5.0L) or an engine mounted vacuum pump (3.5L GTDI) to create a partial vacuum inside the vacuum booster on both sides of the diaphragm. When the brake pedal is pressed, the booster rod opens a valve, allowing air to enter the booster on one side of the diaphragm while sealing off the opposite side. This increases pressure on that side of the diaphragm so that it helps push the rod, which in turn pushes the piston in the master cylinder. As the brake pedal is released, the valve seals off the outside air supply while opening the vacuum valve. This restores vacuum to both sides of the diaphragm, allowing everything to return to its original position. The ABS module uses the signals produced by the vacuum sensor to verify the vacuum is maintained in the brake booster.

### Brake Booster Vacuum Pump

Vehicles equipped with a 3.5L GTDI engine are also equipped with an engine mounted/cam-driven brake booster vacuum pump. The brake vacuum pump is located on the backside of the RH cylinder head. Refer to [Brake Vacuum Pump](#).

- For vacuum sensor and vacuum pump diagnosis, refer to [Section 206-09](#).
-



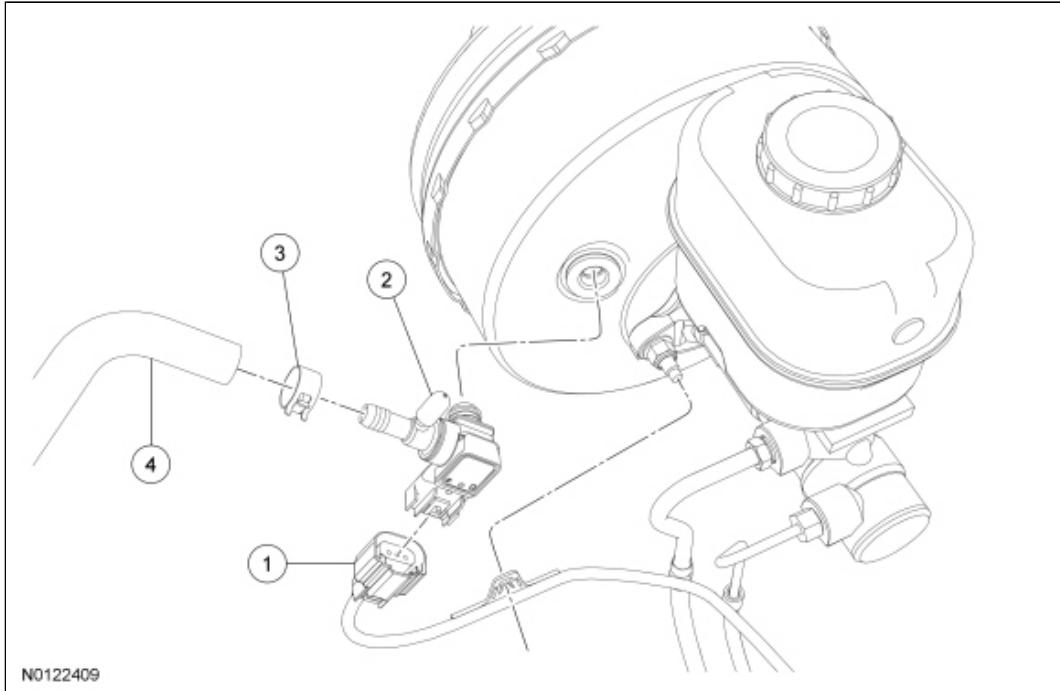
## **Power Brake System**

Refer to [Section 206-00](#).

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## Brake Booster Vacuum Sensor

**NOTE:** Rear Wheel Drive (RWD) shown, Four-Wheel Drive (4WD) similar.



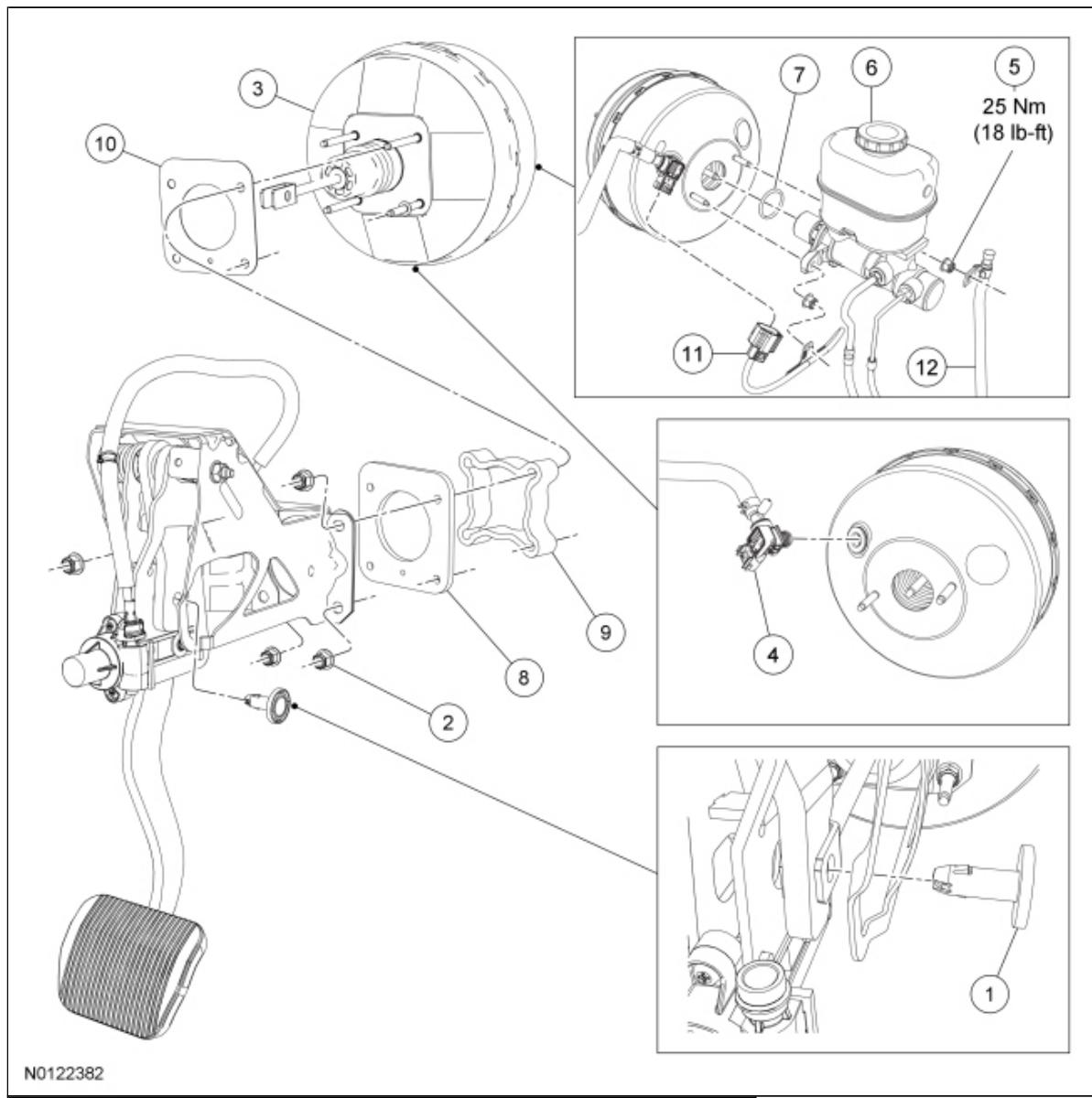
Item	Part Number	Description
1	—	Vacuum sensor electrical connector (part of 12A581)
2	2365	Brake booster vacuum sensor
3	—	Hose clamp (part of 9C490)
4	—	Vacuum supply hose (part of 9C490)

1. Relieve the vacuum in the brake booster by pressing and releasing the brake pedal a minimum of 5 times with the engine not running.
2. Disconnect the vacuum supply hose from the brake booster vacuum sensor.
3. If equipped, disconnect the Four-Wheel Drive (4WD) vacuum reservoir supply hose from the brake booster vacuum sensor.
4. Disconnect the vacuum sensor electrical connector and remove the vacuum sensor.
5. **NOTE:** To allow proper drainage of any moisture, the vacuum sensor must be installed in the same position and orientation as removed.

To install, reverse the removal procedure.



## Brake Booster

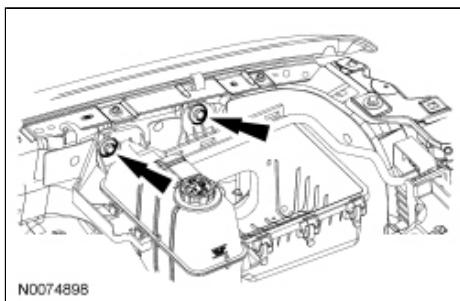


Item	Part Number	Description
1	2L523	Brake pedal pin
2	W520212	Brake booster nut (4 required)
3	2005	Brake booster
4	2365A	Vacuum sensor assembly

5	W520212	Brake master cylinder nut (2 required)
6	2140	Brake master cylinder assembly
7	2152	Brake master cylinder-to-booster seal
8	—	Gasket (part of 2B022)
9	—	Spacer
10	—	Gasket (part of 2B022)
11	—	Vacuum sensor electrical connector (part of 12A581)
12	3B476	Front axle vent hose

### Removal and Installation

1. Relieve the vacuum in the brake booster by pressing and releasing the brake pedal a minimum of 5 times with the engine not running.
2. Remove the Air Cleaner (ACL) element. For additional information, refer to Air Cleaner Element in [Section 303-12](#).
3. Remove the 2 bolts and position the coolant expansion tank/lower ACL housing assembly aside.
  - To install, tighten bolts to 15 Nm (133 lb-in).



4. Disconnect the brake fluid level switch.
5. If equipped, position the vacuum sensor wiring harness and front axle vent hose aside.
6. **NOTICE:** When the master cylinder is removed, the piston will be exposed. Do not damage the piston or piston surface or a fluid leak may occur.

Remove the 2 brake master cylinder nuts and position the master cylinder aside.

- Support the master cylinder with mechanic's wire.
- To install, tighten the nuts to 25 Nm (18 lb-ft).

7. **NOTE:** To allow proper drainage of any moisture, the vacuum sensor must be installed in the same position and orientation as removed.

Disconnect the vacuum sensor assembly from the brake booster.

8. **NOTICE:** Do not service the brake pedal or brake booster without first removing the stoplamp switch. This switch must be removed with the brake pedal in the at-rest position. The switch plunger must be compressed for the switch to rotate in the bracket. Attempting to remove the switch when the plunger is extended (during pedal apply) will result in damage to the switch.

Remove the stoplamp switch. For additional information, refer to [Section 417-01](#).

9. **NOTE:** The booster push rod clevis-locking pin is a one-time use only part. Any time the booster push rod clevis-locking pin is removed, a new booster push rod clevis-locking pin should be used.

**NOTE:** Remove the clevis-locking pin by squeezing the locking tabs and pulling outward on the opposite end.

Remove and discard the booster push rod clevis-locking pin.

10. Remove the 4 brake booster nuts and remove the brake booster.
  - To access the nuts, fold back the sound insulation.
  - To install, tighten the nuts to 25 Nm (18 lb-ft) following a clockwise pattern starting with the upper left nut.
11. **NOTICE:** Do not press, pull or otherwise move the brake pedal while installing the stoplamp switch. This switch must be installed with the booster push rod attached to the brake pedal and with the brake pedal in the at-rest position. Installing this switch with the brake pedal in any other position will result in incorrect adjustment and may damage the switch.

To install, reverse the removal procedure.

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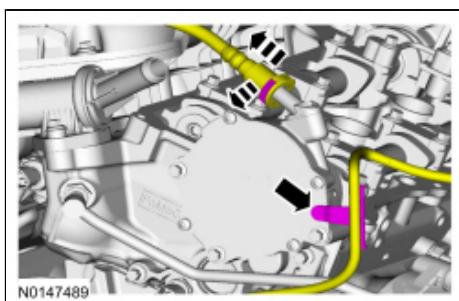
## Brake Vacuum Pump

### Material

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	—

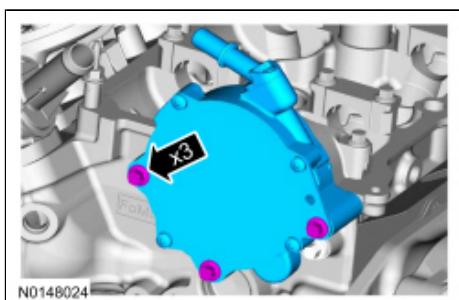
### Removal

1. Remove the RH front fender inner splash shield. Refer to [Section 501-02](#).
- 2.



3. **NOTICE:** Do not use excessive force when removing the vacuum pump or the vacuum pump oil tube may be dislodged from the pump causing internal oil seal damage to the pump. If the oil tube becomes dislodged from the pump, a new vacuum pump must be installed.

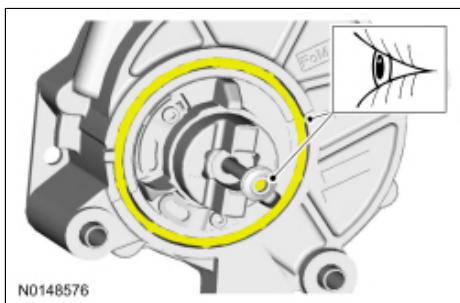
**NOTE:** The upper/inboard vacuum pump bolt will remain in the vacuum pump housing when removing the vacuum pump.



### Installation

- 1.
2. **NOTICE:** Make sure the oil tube filter screen is free of contaminants prior to the installation of the pump or damage to components may occur.

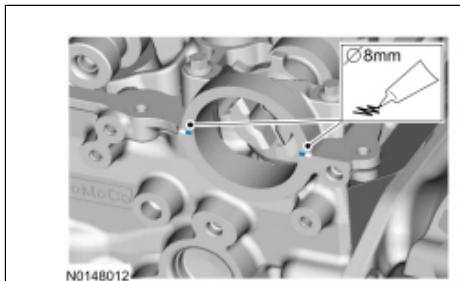
Visual check. Install a new gasket as necessary.



3. **NOTICE:** If the brake vacuum pump is not secured within 10 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Failure to follow this procedure can cause future oil leakage.

**NOTE:** Make sure the mating surfaces are clean and free of foreign material.

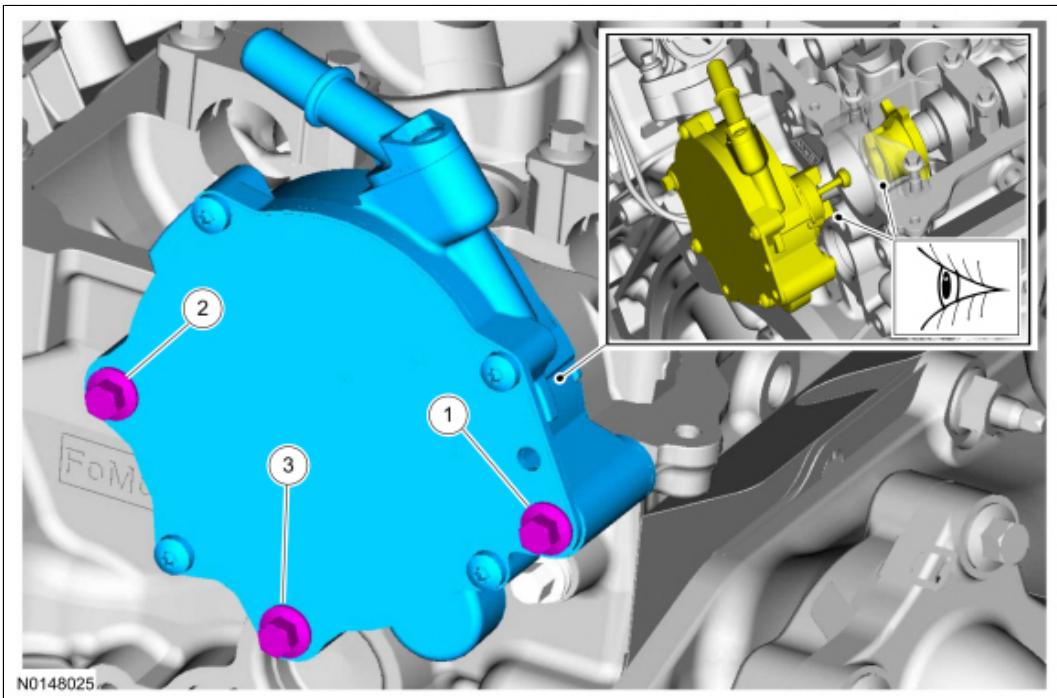
Apply a bead of the specified diameter from the specified tube.



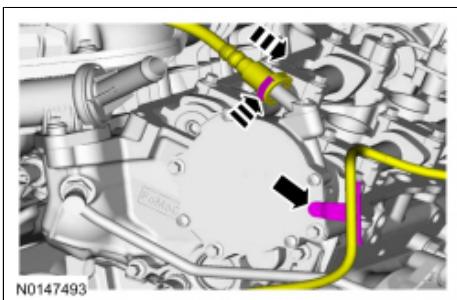
4. **NOTE:** Manually align the brake vacuum pump drive key with the camshaft slot before installation.

Visual check.

- Stage 1: Tighten in the sequence shown to 10 Nm (89 lb-in).
- Stage 2: Tighten an additional 45 degrees.



5.





**Material**

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	740 ml (1.56 pt)

**Torque Specifications**

Description	Nm	lb-ft	lb-in
ABS module screws	3	—	27
Brake tube-to-Hydraulic Control Unit (HCU) fittings	20	—	177
Front wheel speed sensor bolt	17	—	150
Front wheel speed sensor harness bolt	12	—	106
HCU-to-bracket nuts	8	—	71
HCU bracket bolts	20	—	177
Master cylinder primary brake tube-to- HCU fitting	28	21	—
Master cylinder secondary brake tube-to- HCU fitting	20	—	177
Rear wheel speed sensor bolt	15	—	133

## Anti-Lock Brake System (ABS) and Stability Control

### AdvanceTrac® With RSC®

The AdvanceTrac® system is made up of the following systems:

- Anti-lock braking
- Traction control
- ESC

The RSC® system is an optional feature that works in conjunction with AdvanceTrac® to aid in maintaining vehicle stability. AdvanceTrac® with RSC® system consists of the following components:

- ABS module — attached to the Hydraulic Control Unit (HCU), but can be serviced separately from the HCU.
- Front wheel speed sensors — one sensor is located in each front wheel knuckle. The sensors are serviced separately from the knuckle.
- Front wheel speed sensor encoders — one encoder strip is located in each wheel bearing and wheel hub assembly and is serviced with the wheel bearing.
- HCU — contains several valves (inlet, outlet, isolation and dump) and a hydraulic pump motor. It is mounted behind the radiator, below the air cleaner assembly. The HCU is replaced as a unit, including the ABS module.
- Rear wheel speed sensors — one sensor is located in each end of the rear axle housing. The sensors are serviced separately.
- Rear wheel speed sensor tone rings — one tone ring is located on each axle shaft.
- Stability control sensors — located inside the Restraints Control Module (RCM) and consist of the following sensors: yaw rate, roll rate, lateral and longitudinal accelerometers. The sensors are integral to the RCM and cannot be serviced separately.
- Steering wheel rotation sensor (6.2L) — located on the end of the steering column near the intermediate shaft. The sensor is serviced separately from the steering column but the sensor ring is replaced with the column. For all other applications, the steering wheel rotation sensor is part of the EPAS.
- Stability/traction control switch — located in the instrument panel finish panel and is serviced separately from the finish panel.
- Hill Descent Control™ switch — located in the auxiliary switch panel and is serviced separately.
- Brake vacuum pump (3.5L) — a mechanical pump located on the back of the RH cylinder head and driven by the RH exhaust cam shaft.

### Electronic Brake Distribution (EBD)

The ABS module and HCU incorporate a strategy called EBD. The EBD strategy uses the HCU as an electronic proportioning valve to create a balanced braking condition between the front and rear wheels and minimizes the chance of rear wheel lockup during hard braking.

A slight bump sensation may be felt in the brake pedal when EBD is active.

## **Anti-Lock Braking**

The conventional ABS aids in the prevention of wheel lock-up during braking events allowing the driver to maintain steering control and stop in the shortest distance possible under most conditions. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s).

When the ABS activates, both of the following can occur:

- A rumble or grinding sound may be heard
- If the driver's foot is on the brake pedal, a vibration may be felt in the brake pedal

## **Supplemental Braking Assist**

In addition to preventing wheel lock up during braking events, the ABS module also provides supplemental hydraulic brake assist through the use of the hydraulic pump motor and the HCU. This is done in the event of a severe vacuum loss at the brake booster.

## **AdvanceTrac® System**

### **Traction Control System**

The traction control system aids in the prevention of excessive wheel spin allowing the vehicle to maintain traction during acceleration. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s) and by the PCM modulating engine torque.

### **Electronic Stability Control (ESC) System**

The ESC system constantly monitors the vehicle's direction of travel relative to the driver's intended course, except when the vehicle is traveling in reverse, and aids in keeping the vehicle traveling along that course. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s) and by the PCM modulating engine torque.

When the AdvanceTrac® system activates, any of the following can occur:

- A rumble or grinding sound may be heard, much like ABS
- If the driver's foot is on the brake pedal, a vibration may be felt in the brake pedal, much like ABS
- A small deceleration or a reduction in the acceleration of the vehicle
- The stability/traction control indicator (sliding car icon) flashes

## **Roll Stability Control (RSC®) System**

The RSC® system constantly monitors vehicle roll motion, except when the vehicle is traveling in reverse, and aids in keeping the vehicle stable during sudden or abrupt maneuvers. This is accomplished by the ABS module and the HCU modulating brake fluid pressure to the affected brake caliper(s) and by the PCM modulating engine torque. The combination of reduced engine torque and modulated brake fluid pressure

aids in reducing the cornering forces and, therefore, the total roll momentum acting on the vehicle.

When the RSC® system activates, the vehicle produces the same noticeable symptoms as it does when the AdvanceTrac® system activates.

### **Trailer Sway Control**

Trailer sway control is a unique function in the AdvanceTrac® with RSC® system that recognizes and aids in reducing trailer sway. The trailer sway control function continually monitors the steering wheel rotation and yaw rate sensors to identify specific, increasing yaw oscillations that occur during a trailer sway event. If the trailer sway event exceeds programmed parameters, the ABS module and the HCU modulate brake fluid pressure to specific brake caliper(s) and the PCM modulates engine torque until the trailer sway is reduced below the programmed parameters.

For vehicles equipped with an optional TBC module, the trailer sway control system utilizes the module to apply the trailer brakes to quickly reduce trailer sway.

When the trailer sway control function activates, the vehicle produces the same noticeable symptoms as it does when the AdvanceTrac® system activates. In addition, the message center displays TRAILER SWAY, REDUCE SPEED and, if the vehicle is equipped with a TBC module, the module shows output to the trailer brakes.

The trailer sway control function only activates when the vehicle speed exceeds 64 km/h (40 mph). The system can be disabled during any key cycle. Refer to the Owner's Literature for information on disabling the system. The system is re-enabled when the ignition is turned to the OFF position and back to the RUN position.

### **MyKey® Interaction**

Through the MyKey® feature, the traction control function of the AdvanceTrac® system can be configured to be always on or to allow the driver to select the traction control function on or off.

When the traction control function is configured to be always on and a MyKey® restricted key is in use, the IPC will ignore any requests made by the driver to disable the traction control function and will not send any traction control disable messages to the ABS module. Refer to the Owner's Literature for additional information on the MyKey® feature and settings.

### **Hill Start Assist**

The hill start assist system is designed to assist the driver during hill-starts. Using the ABS, the hill start assist system holds the vehicle on an incline for a short time, allowing the driver to release the brake pedal and press the accelerator pedal without needing to use the parking brake.

### **Hill Descent Control™**

Hill Descent Control™ maintains vehicle speed on a downhill grade, operating at speeds between 3 km/h (2 mph) and 32 km/h (20 mph). If the vehicle is on flat or uphill terrain, the system goes into standby mode,

remaining activated up to 64 km/h (40 mph). At speeds greater than 64 km/h (40 mph), the Hill Descent Control™ system is deactivated. When Hill Descent Control™ is active, a rumble or grinding sound may be heard and/or felt.

### Traction Control Switch

The stability/traction control switch can be used by the driver to disable and enable the traction control, ESC and RSC® functions. Refer to the Owner's Literature for instructions on disabling and enabling the traction control, ESC and RSC® functions.

The conventional ABS cannot be disabled using the stability/traction control switch.

### Stability/Traction Control Indicators

The IPC message center is a reconfigurable telltale which is capable of displaying a variety of different messages and indicators such as the stability/traction control indicator (sliding car icon), stability/traction control disabled indicator (sliding car OFF icon), the 4WD mode/range or door open messages. For information about the IPC, refer to [Section 413-01](#).

There are 2 separate stability/traction control indicators, the sliding car icon and the sliding car OFF icon. Both icons are located in the IPC message center. The sliding car icon is used to alert the driver that a stability/traction event is taking place (flashes twice per second) and to alert the driver of potential concerns in the AdvanceTrac® system (illuminates continuously). The sliding car OFF icon is used to alert the driver that the traction control portion of the AdvanceTrac® system has been disabled by the driver. This icon only illuminates continuously and does not flash.

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## Anti-Lock Brake System (ABS) and Stability Control

### Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST3030-A	Rotunda Active Wheel Speed Sensor Tester 105-R0110
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

### Principles of Operations

#### Anti-Lock Braking

The ABS module continuously monitors brake pedal input, lateral vehicle motion and the rotational speed of each wheel. The PCM sends the brake pedal switch information to the ABS module over the HS-CAN while the RCM sends lateral acceleration sensor information to the ABS module over a private HS-CAN. Wheel speed information is retrieved by the ABS module using 4 active wheel speed sensors. When the ABS module detects an impending wheel lock during a braking event, the ABS module modulates brake pressure to the appropriate brake caliper(s) by opening and closing the appropriate solenoid valves inside the HCU while the hydraulic pump motor is activated. Once the affected wheel(s) return to the desired speed, the ABS module returns the solenoid valves in the HCU to their normal position.

The ABS module has 2 self-test options, one is carried out after the ignition is turned to the RUN position and the other is carried out after an ABS stop or after an AdvanceTrac® system activation. When the ignition is turned to the RUN position, the ABS module carries out a preliminary electrical check of the wheel speed

sensors and their circuits by sending voltage through the sensor and checking for the voltage to return. When the vehicle is traveling at speeds above 21 km/h (13 mph) and the brake pedal is not being pressed, the HCU pump motor is commanded on for approximately 0.5 second to check pump motor operation. Also, during all phases of operation while the vehicle is in motion, the ABS module checks for correct operation of the wheel speed sensors by comparing wheel speed input to other sensor input. Depending on the nature of the malfunction detected, the ABS module deactivates the anti-lock control system and sends a message over the HS-CAN to the IPC. When the IPC receives this message, it illuminates the yellow ABS warning indicator and the stability/traction control indicator (sliding car icon).

### **Electronic Brake Distribution (EBD)**

On initial application of the brake pedal, full pressure is applied to the rear brakes. The ABS module then uses wheel speed input to calculate an estimated rate of deceleration. Once vehicle deceleration exceeds a predetermined threshold, the ABS module commands the HCU to close the appropriate isolation valves to hold the rear brake pressure constant while allowing the front brake pressure to build. This creates a balanced braking condition between the front and rear wheels and minimizes the chance of rear wheel lockup during hard braking. As the vehicle decelerates, the valves are opened to increase the rear brake pressure in proportion to the front brake pressure.

If ABS is disabled due to DTCs being present in the ABS module, EBD continues to function unless the DTCs are for wheel speed sensors or the HCU. When EBD is disabled, the red brake warning light, the ABS warning indicator and the stability/traction control indicator (sliding car icon) illuminate.

### **Supplemental Braking Assist**

The ABS module uses the HCU and hydraulic pump motor to aid in bringing the vehicle to a safe, controlled stop in the event of severe vacuum loss at the brake booster. The ABS module continually monitors the vacuum in the brake booster through the use of a vacuum sensor. When the vacuum sensor indicates vacuum is below a predetermined level, a DTC is set in the ABS module. If this occurs during a braking event or if the driver attempts to stop the vehicle with a low vacuum condition in the brake booster, the ABS module activates the hydraulic pump motor in the HCU to assist with vehicle braking.

### **Traction Control Function**

The ABS module continuously monitors and compares the rotational speed of the drive wheels in relation to the non-driven wheels. When the drive wheels begin to spin faster than the non-driven wheels, the ABS module commands the HCU to modulate brake pressure to the appropriate brake caliper. This is accomplished by opening and closing the appropriate solenoid valves inside of the HCU while the hydraulic pump motor is activated. At the same time, the ABS module sends a message over the HS-CAN that a traction control event is taking place. When the IPC receives this message, it flashes the stability/traction control indicator (sliding car icon). If the event is severe enough, the ABS module sends a message to the PCM over the HS-CAN to assist with traction control. When the PCM receives this message, it adjusts engine timing and decreases fuel injector pulses. Once the affected wheel returns to normal speed, the ABS module returns the solenoid valves in the HCU to their normal position, deactivates the hydraulic pump motor and sends another message over the HS-CAN indicating that the traction event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC turns off the sliding car icon.

Once vehicle speed reaches or exceeds 144 km/h (89 mph), traction control is accomplished only through PCM intervention.

Certain DTCs in the ABS module disable the traction control system. Depending on the DTCs present, the

red brake warning light, the yellow ABS warning indicator and the sliding car icon illuminate.

### **Electronic Stability Control (ESC) and Roll Stability Control (RSC®) Functions**

The ESC and RSC® functions are controlled by the ABS module and use the same wheel speed sensors and tone rings used for anti-lock braking. The ESC and RSC® functions also use input from the steering wheel rotation sensor, the stability control sensors (yaw rate, roll rate, longitudinal and lateral accelerometers) which are internal to the RCM and information from other modules sent over the HS-CAN to help maintain vehicle stability.

The ABS module uses the various sensors to continuously monitor vehicle roll motion and direction of travel relative to the driver's intended course. If the ABS module determines from all these inputs that the vehicle is unable to travel in the intended direction or that a condition exists for a potential rollover event, it modulates brake pressure to the appropriate brake caliper(s) by opening and closing the appropriate solenoid valves inside the HCU while the hydraulic pump motor is activated. At the same time, the ABS module sends a message over the HS-CAN that a stability event is taking place. When the IPC receives this message, it flashes the stability/traction control indicator (sliding car icon). During a stability event, conditions may require the involvement of the PCM to limit engine torque like it does for traction control. Once the stability condition has been corrected, the ABS module sends another message over the HS-CAN indicating that the event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC turns off the sliding car icon.

Certain DTCs being present in the ABS module may disable the ESC and RSC® functions. Depending on the DTCs present, the yellow ABS warning indicator and/or the sliding car icon are illuminated.

### **Trailer Sway Control Function**

Trailer sway control is a unique function of the RSC® system that uses information from the steering wheel rotation sensor and the yaw information from the RCM to determine if a trailer sway event is taking place. Trailer sway is the undesirable yaw force a trailer can apply to the towing vehicle. If the ABS module determines that a trailer sway event is taking place, it takes action similar to the action taken for an ESC and an RSC® event. At the same time, the ABS module sends a message over the HS-CAN that a trailer sway event is taking place. When the IPC receives this message, it flashes the stability traction control indicator (sliding car icon) and displays TRAILER SWAY REDUCE SPEED in the message center. If necessary, the PCM reduces engine torque as it does for ESC and RSC®. Once the trailer sway has been corrected, the ABS module sends another message over the HS-CAN indicating that the event has ended. The PCM returns engine timing and fuel injectors to normal operation and the IPC turns off the stability traction control indicator (sliding car icon).

If the vehicle is also equipped with a TBC system, the TBC module receives the trailer sway message from the ABS module and takes appropriate action to assist in reducing the trailer sway. Refer to [Section 206-10](#) for information on the TBC system.

Trailer sway control only activates with vehicle speed greater than 64 km/h (40 mph). Any malfunction that disables the RSC® function also disables the trailer sway control function. Trailer sway control can also be disabled through the message center. Refer to the Owner's Literature for the disabling/enabling procedure. Regardless of the chosen state (enabled or disabled), trailer sway control is re-enabled at each ignition key cycle.

### **Hill Start Assist**

The hill start assist system engages automatically when the following conditions are met:

- The driver applies the vehicle brake and the vehicle is at a complete stop.
- Road inclination of approximately 4 degrees or more is detected (as indicated by the stability control sensor information).
- The vehicle transmission information indicates that the driver selects the correct gear, indicating the intention to drive up the hill.
- The parking brake is not engaged.

Once all the above criteria have been met and the driver releases the brake pedal, hill start assist utilizes the valves in the Hydraulic Control Unit (HCU) to hold the car stationary for up to 2 seconds giving the driver time to accelerate the vehicle. As the vehicle accelerates hill start assist gradually releases the brake pressure to make sure that the vehicle is neither rolling back nor driving off until there is sufficient driving torque to accelerate the vehicle forward. Hill start assist also functions if the vehicle is facing downhill if the reverse gear is selected.

### **Hill Descent Control™ and Hill Descent Control™ Switch**

Hill Descent Control™ uses the pump motor and HCU to provide vehicle speed control while descending a downhill grade, information from the RCM to determine whether or not the vehicle is on a downhill grade and wheel speed sensor information to determine vehicle speed. When the Hill Descent Control™ switch is pressed, a ground signal is sent to the IPC indicating that the driver has activated the system. The IPC then sends a message to the ABS module along the HS-CAN requesting system activation. The ABS module uses the input from the RCM and wheel speed sensors to determine the mode of operation (active, stand-by or deactivated). During a hill descent, while the Hill Descent Control™ system is activated, the driver sets vehicle speed through the use of the accelerator and brake pedals. Once the desired speed has been set, the system maintains that speed until one of the following occur:

- The vehicle is no longer on a downhill grade.
- The driver presses the switch again.
- Vehicle speed exceeds 64 km/h (40 mph).
- The system is disabled for cooling.

During periods of sustained use, the Hill Descent Control™ system automatically deactivates in order to cool the brake system. When this occurs, the system notifies the driver with a message in the message center and by sounding a warning chime. At this time the driver needs to provide brake and/or throttle control to maintain the desired descent speed. The system remains disabled until it has sufficiently cooled. The length of time needed for cooling varies depending on operating conditions.

### **Stability/Traction Control Switch**

Unlike conventional ABS, the individual functions of AdvanceTrac® with RSC® can be deactivated by the driver through the stability/traction control switch. The switch is hard-wired to the IPC and when pressed, sends a ground signal to the IPC.

If the stability/traction control switch is pressed and held for more than 30 seconds, a DTC sets in the ABS module.

Once disabled, the system remains in that state until the driver presses the switch again, the ignition is cycled or the vehicle speed reaches or exceeds 56 km/h (35 mph). Once the vehicle speed reaches or exceeds 56 km/h (35 mph), RSC® and ESC are reactivated. Once the vehicle speed drops below 48 km/h

(30 mph), traction control returns to the state the driver had originally selected, either on or off.

The functions cannot be disabled when a MyKey® restricted key is in use with the AdvanceTrac® always-on feature configured to on. If an attempt is made to disable the ESC system while a MyKey® restricted key is in use, ADVTRAC ON MY KEY SETTING displays in the IPC message center. For information about MyKey®, refer to [Section 419-01B](#).

### **Stability/Traction Control Indicators**

Both the stability/traction control indicator (sliding car icon) and the stability/traction control disabled indicator (sliding car OFF icon) alert the driver of stability/traction control system status.

When certain stability control system DTC(s) are present, the ABS module sends a message to the IPC over the HS-CAN. Depending on the nature of the DTC(s), the IPC responds by either solidly illuminating 1 or both icons or by flashing the icon(s) once every 2 seconds.

When a stability/traction control event is taking place, the ABS module sends a message to the IPC over the HS-CAN to flash the sliding car icon twice per second.

When the driver disables the stability/traction control system by using the traction control switch, the IPC receives a ground signal from the switch and then sends a message over the HS-CAN indicating that the driver has requested the system be deactivated and illuminates the sliding car OFF icon.

### **Stability Control Sensors**

The stability control sensors provide information to the ABS module for the operation of the ESC function, RSC® function (if equipped), hill start assist system and the Hill Descent Control™ system (if equipped). The stability control sensors are housed in the RCM and are serviced with the module. The sensors used for stability control include the yaw rate sensor, the lateral accelerometer, the longitudinal accelerometer and (if equipped with RSC®) the roll rate sensor. Sensor information is sent to the ABS module over a private HS-CAN.

### **Steering Wheel Sensor Information**

For the 6.2L engine, the steering wheel rotation sensor uses an optical sensor and a slotted wheel to measure the rate of rotation (angle) of the steering wheel. The steering wheel rotation sensor uses the HS-CAN to transmit information to the ABS module about steering wheel turning direction (left or right) and how far the steering wheel is being turned. The steering wheel rotation sensor does not indicate the absolute position of the steering wheel relative to straight-ahead. The ABS module learns this position by comparing the steering wheel position with other signals and storing the position it has learned. The module confirms this position and modifies it as necessary during every new driving cycle.

For all other applications, the steering wheel rotation sensor is part of the EPAS system and is located inside the PSCM. The sensor is serviced with the PSCM. The PSCM uses the HS-CAN to transmit information to the ABS module about steering wheel turning direction (left or right) and how far it is being turned. The PSCM does not indicate the absolute position of the steering wheel relative to straight-ahead. The ABS module learns this position by comparing the steering wheel position with other signals and storing the position it has learned. The ABS module confirms this position and modifies it as necessary during every new driving cycle.

## **ABS Module Configuration**

Module configuration is a scan tool process which configures specific vehicle settings in a new module. If installing a new ABS module and/or a new HCU, the ABS module must be configured. To configure the ABS module, refer to PMI in [Section 418-01](#).

## **Inspection and Verification**

1. Verify the customer concern.
2. Verify the stoplamps operate correctly by applying and releasing the brake pedal. If the stoplamps do not operate correctly, refer to [Section 417-01](#). If the stoplamps operate correctly, proceed to the next step.
3. Verify that the PRNDL operates correctly on the IPC. If the PRNDL does not operate correctly, refer to [Section 413-01](#). If the PRNDL operates correctly, proceed to the next step.
4. Visually inspect for obvious signs of mechanical or electrical damage.

## **Visual Inspection Chart**

Mechanical	Electrical
<ul style="list-style-type: none"><li>• Wheel speed sensor ring</li><li>• <u>HCU</u></li><li>• Tire pressure</li><li>• Mismatched wheels or tires on vehicle</li><li>• Base brake system</li><li>• Brake booster vacuum hose</li><li>• Steering components, suspension components and tire size</li></ul>	<ul style="list-style-type: none"><li>• BJB fuses:<ul style="list-style-type: none"><li>■ 36 (30A)</li><li>■ 47 (60A)</li><li>■ 54 (5A)</li></ul></li><li>• ABS module</li><li>• Wheel speed sensors</li><li>• Stoplamp switch</li><li>• Stability/traction control switch</li><li>• Hill Descent Control™ switch (if equipped)</li><li>• Brake fluid level switch</li><li>• Wiring, terminals or connectors</li><li>• Brake booster vacuum sensor</li></ul>

5. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
6. **NOTE:** Make sure to use the latest scan tool software release.

If the cause is not visually evident, connect the scan tool to the DLC.

7. **NOTE:** The VCM LED prove-out confirms power and ground from the DLC are provided to the VCM.

If the scan tool does not communicate with the VCM:

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM.
- refer to [Section 418-00](#), No Power To The Scan Tool, to diagnose no power to the scan tool.

8. If the scan tool does not communicate with the vehicle:

- verify the ignition is ON.
  - verify the scan tool operation with a known good vehicle.
  - refer to [Section 418-00](#) The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.
9. Carry out the network test.
    - If the scan tool responds with no communication for one or more modules, refer to [Section 418-00](#).
    - If the network test passes, retrieve and record [CMDTCs](#).
  10. Clear the continuous DTCs and carry out the self-test diagnostics for the ABS module.
  11. If the DTCs retrieved are related to the concern, go to ABS Module DTC Chart. For all other DTCs, refer to the Master DTC Chart in [Section 419-10](#).
  12. If no DTCs related to the concern are retrieved, GO to [Symptom Chart](#).

## DTC Charts

### ABS Module DTC Chart

**NOTE:** Always retrieve the continuous DTCs after running the self-test.

DTC	Description	Action
B1342	ECU is Defective	<p><b>NOTICE:</b> Do not power the Electronic Control Unit (ECU) while it is removed from the <a href="#">HCU</a>. Failure to do so could damage the <a href="#">ECU</a> or cause the <a href="#">ECU</a> to set unrelated DTCs.</p> <p><b>NOTE:</b> If other DTCs are present, repair them before installing a new component.</p> <p>CLEAR the DTCs. REPEAT the self-test. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. REPEAT the self-test.</p>
B1596	Service Continuous Codes	<p><b>NOTE:</b> This DTC does not indicate a malfunction of the ABS. If other DTCs are present, REPAIR them before addressing this DTC.</p> <p>Some DTCs cannot be detected by the ABS module until the ignition is cycled from ON to OFF and back to ON again. When DTCs are cleared using the scan tool, the ignition needs to be cycled in order to clear this DTC and have the ABS module check for other DTCs.</p> <p>DIAGNOSE all other DTCs. CLEAR the DTCs. CYCLE the ignition. RETRIEVE the DTCs. GO to the ABS Module DTC Chart.</p>
B1676	Battery Pack Voltage Out of Range	<a href="#">GO to Pinpoint Test A</a> .
B2477	Module Configuration Failure	CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in <a href="#">Section 418-01</a> . CLEAR the DTCs. REPEAT the self-test.
B2900	VIN Mismatch	<a href="#">GO to Pinpoint Test B</a> .

C109D	Low Vacuum Condition Detected	<a href="#">GO to Pinpoint Test I.</a>
C109E	Vacuum Sensor Circuit Fault	<a href="#">GO to Pinpoint Test I.</a>
C109F	Vacuum Sensor Signal Fault	<a href="#">GO to Pinpoint Test I.</a>
C1145	Wheel Speed Sensor RF Input Circuit Failure	<a href="#">GO to Pinpoint Test D.</a>
C1155	Wheel Speed Sensor LF Input Circuit Failure	<a href="#">GO to Pinpoint Test D.</a>
C1165	Wheel Speed Sensor RR Input Circuit Failure	<a href="#">GO to Pinpoint Test D.</a>
C1175	Wheel Speed Sensor LR Input Circuit Failure	<a href="#">GO to Pinpoint Test D.</a>
C116A	ABS Pressure Transducer / Brake Switch Mismatch	<a href="#">GO to Pinpoint Test G.</a>
C1222	Wheel Speed Mismatch	<a href="#">GO to Pinpoint Test E.</a>
C1266	ABS Valve Power Relay Circuit Failure	<a href="#">GO to Pinpoint Test F.</a>
C1278	Steering Wheel Angle 1 and 2 Signal Faulted	<p>This DTC sets when the steering wheel angle sensor data received over the <u>HS-CAN</u> is out of range and does not agree with other supporting sensor data.</p> <p>For the 6.2L engine, REFER to <a href="#">Section 211-05</a> to diagnose any <u>SCCM</u> DTCs.</p> <p>For all others, REFER to <a href="#">Section 211-05</a> to diagnose any <u>SCCM</u> DTCs. If no <u>SCCM</u> DTCs are present, REFER to <a href="#">Section 211-00A</a> to diagnose any <u>PSCM</u> DTCs.</p>
C1280	Yaw Rate Sensor Signal Fault	This DTC indicates a concern with the yaw rate sensor which is integral to the Restraints Control Module (RCM). REFER to <a href="#">Section 501-20B</a> to diagnose all the <u>RCM</u> DTCs. If no <u>RCM</u> DTCs are present, <a href="#">GO to Pinpoint Test P.</a>
C1282	Lateral Accelerometer Signal Fault	This DTC indicates a concern with the lateral accelerometer which is integral to the <u>RCM</u> . REFER to <a href="#">Section 501-20B</a> to diagnose all the <u>RCM</u> DTCs. If no <u>RCM</u> DTCs are present, <a href="#">GO to Pinpoint Test P.</a>
C1288	Pressure Transducer Main/Primary Input Circuit Failure	CLEAR the DTCs. REPEAT the self-test. RETRIEVE the DTCs. If DTC C1288 is retrieved, INSTALL a new Hydraulic Control Unit (HCU). REFER to <a href="#">Hydraulic Control Unit (HCU)</a> . CLEAR the DTCs. REPEAT the self-test.
C1296	Wheel Speed LF Signal Fault	<a href="#">GO to Pinpoint Test E.</a>
C1297	Wheel Speed RF Signal Fault	<a href="#">GO to Pinpoint Test E.</a>
C1298	Wheel Speed RR Signal Fault	<a href="#">GO to Pinpoint Test E.</a>
C1299	Wheel Speed LR Signal Fault	<a href="#">GO to Pinpoint Test E.</a>

C1300	ABS Pump Motor Circuit Failure	<a href="#">GO to Pinpoint Test C.</a>
C1440	Pressure Transducer Main/Primary Signal Faulted	<a href="#">GO to Pinpoint Test G.</a>
C1516	Roll Rate Sensor Signal Fault	This DTC indicates a concern with the roll rate sensor which is integral to the <u>RCM</u> . REFER to <a href="#">Section 501-20B</a> to diagnose all the <u>RCM</u> DTCs. If no <u>RCM</u> DTCs are present, <a href="#">GO to Pinpoint Test P.</a>
C1963	Stability Control Inhibit Warning	<a href="#">GO to Pinpoint Test P.</a>
C1975	IVD Plausibility Failure	<a href="#">GO to Pinpoint Test P.</a>
C2770	Longitudinal Acceleration Sensor Plausibility Failure	This DTC indicates a concern with the longitudinal accelerometer which is integral to the <u>RCM</u> . REFER to <a href="#">Section 501-20B</a> to diagnose all the <u>RCM</u> DTCs. If no <u>RCM</u> DTCs are present, <a href="#">GO to Pinpoint Test P.</a>
C2775	TC/AYC ON/OFF Switch Stuck Failure	<a href="#">GO to Pinpoint Test R.</a>
C2809	Hill Descent Control Switch Stuck	<a href="#">GO to Pinpoint Test J.</a>
U0073	Control Module Communication Bus A Off	REFER to <a href="#">Section 418-00</a> to diagnose the High Speed Controller Area Network (HS-CAN).
U0100	Loss of Communication with ECM/PCM	<a href="#">GO to Pinpoint Test K.</a>
U0114	Lost Communication With Four-Wheel Drive Clutch Control Module	<a href="#">GO to Pinpoint Test L.</a>
U0131	Lost Communication With Power Steering Control Module (VAPS)	<a href="#">GO to Pinpoint Test M.</a> For the 6.2L engine, <a href="#">GO to Pinpoint Test N.</a>
U0140	Lost Communication With Body Control Module (GEM)	<a href="#">GO to Pinpoint Test O.</a>
U0151	Lost Communication With Restraints Control Module	<a href="#">GO to Pinpoint Test P.</a>
U0155	Lost Communication With Instrument Panel Cluster (IC) Control Module	<a href="#">GO to Pinpoint Test Q.</a>
U0401	Invalid Data Received From ECM/PCM	This DTC sets when the ABS module receives invalid network data from the PCM. RETRIEVE and REPAIR all non-network DTCs in the PCM. REFER to <a href="#">Section 303-14</a> .
U0414	Invalid Data Received from Four-Wheel Drive Clutch Control Module	This DTC sets when the ABS module receives invalid network data from the Transfer Case Control Module (TCCM). RETRIEVE and REPAIR all non-network DTCs in the <u>TCCM</u> . REFER to <a href="#">Section 308-07A</a> .
U0423	Invalid Data Received From Instrument Panel Control Module	This DTC sets when the ABS module receives invalid network data from the Instrument Panel Cluster (IPC). RETRIEVE and REPAIR all non-network DTCs in the <u>IPC</u> . REFER to <a href="#">Section 413-01</a> .

U0428	Invalid Data Received from Steering Angle Sensor Module	<p>This DTC sets when the ABS module receives invalid steering angle network data.</p> <p>For vehicles equipped with Hydraulic Power Assist Steering (HPAS), this data is sent from the Steering Column Control Module (SCCM). RETRIEVE and REPAIR all non-network DTCs in the <u>SCCM</u>. REFER to <a href="#">Section 211-05</a>.</p> <p>For vehicles equipped with Electronic Power Assist Steering (EPAS), this data is sent from the Power Steering Control Module (PSCM). RETRIEVE and REPAIR all non-network DTCs in the <u>PSCM</u>. REFER to <a href="#">Section 211-00B</a>.</p>
U0452	Invalid Data Received From Restraints Control Module	<p>This DTC sets when the ABS module receives invalid network data from the <u>RCM</u>. RETRIEVE and REPAIR all non-network DTCs in the <u>RCM</u>. REFER to <a href="#">Section 501-20B</a>. If no <u>RCM</u> DTCs are present, <a href="#">GO to Pinpoint Test P</a>.</p>
U2050	No Application Present	<p>CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in <a href="#">Section 418-01</a>. CLEAR the DTCs. REPEAT the self test.</p>
U2051	One or More Calibration Files Missing /Corrupt	<p>CLEAR the DTC. CARRY OUT the ABS module self-test. If DTC U2051 returns, RECONFIGURE the ABS module using as-built data. REFER to <a href="#">PMI Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available</a> in <a href="#">Section 418-01</a>. CLEAR the DTC and REPEAT the self-test. If DTC U2051 returns, INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. CLEAR the DTC. REPEAT the self-test.</p>
U2152	SCP (J1850) Invalid Data from GEM	<p>This DTC sets when the ABS module receives invalid network data from the Body Control Module (BCM). RETRIEVE and REPAIR all non-network DTCs in the <u>BCM</u>. REFER to <a href="#">Section 419-10</a>.</p>

## Symptom Chart

### Symptom Chart

Condition	Possible Sources	Action
• No communication with the ABS module	<ul style="list-style-type: none"> <li>• Fuse</li> <li>• Wiring, terminals or connectors</li> <li>• ABS module</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to <a href="#">Section 418-00</a>.</li> </ul>
• The yellow ABS warning indicator is never on	<ul style="list-style-type: none"> <li>• Wiring, terminals or connectors</li> <li>• Instrument Panel Cluster (IPC)</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to <a href="#">Section 413-01</a>.</li> </ul>
• The stability/traction control indicator (sliding car icon) is never on	<ul style="list-style-type: none"> <li>• Stability/traction control system</li> <li>• ABS module</li> <li>• IPC</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to <a href="#">Section 413-01</a>.</li> </ul>
• Only the red brake warning indicator is always/never on	<ul style="list-style-type: none"> <li>• Wiring, terminals or connectors</li> <li>• Parking brake switch</li> <li>• Brake fluid level switch</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to <a href="#">Section 413-01</a>.</li> </ul>

	<ul style="list-style-type: none"> <li>• Body Control Module (BCM)</li> <li>• <u>IPC</u></li> </ul>	
<ul style="list-style-type: none"> <li>• The yellow ABS warning indicator is always on</li> </ul>	<ul style="list-style-type: none"> <li>• DTCs in the ABS module</li> <li>• ABS module</li> <li>• <u>IPC</u></li> </ul>	<ul style="list-style-type: none"> <li>• RETRIEVE and RECORD any ABS module DTCs. GO to the ABS Module DTC Chart.</li> <li>• If there are no DTCs present in the ABS module, REFER to <a href="#">Section 413-01</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• The sliding car icon is always on</li> </ul>	<ul style="list-style-type: none"> <li>• DTCs in the ABS module</li> <li>• Stability/traction control system</li> <li>• <u>IPC</u></li> </ul>	<ul style="list-style-type: none"> <li>• RETRIEVE and RECORD any ABS module DTCs. GO to the ABS Module DTC Chart.</li> <li>• If there are no DTCs present in the ABS module, REFER to <a href="#">Section 413-01</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• All 3 indicators (red brake warning light, yellow ABS warning indicator and the sliding car icon) are always on</li> </ul>	<ul style="list-style-type: none"> <li>• DTCs in the ABS module</li> <li>• Wiring, terminals or connectors</li> <li>• Parking brake switch</li> <li>• Brake fluid level switch</li> <li>• Stability/traction control system</li> <li>• <u>BCM</u></li> <li>• ABS module</li> <li>• <u>IPC</u></li> </ul>	<ul style="list-style-type: none"> <li>• RETRIEVE and RECORD any ABS module DTCs. GO to the ABS Module DTC Chart.</li> <li>• If there are no DTCs present in the ABS module, REFER to <a href="#">Section 413-01</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Spongy brake pedal with no warning indicator</li> </ul>	<ul style="list-style-type: none"> <li>• Air in the brake hydraulic system</li> <li>• Damaged or incorrectly installed brake components</li> </ul>	<ul style="list-style-type: none"> <li>• BLEED the brake system and the Hydraulic Control Unit (HCU). REFER to Brake System Bleeding in <a href="#">Section 206-00</a>.</li> <li>• INSPECT the brake pedal, brake booster and master cylinder for correct installation. REFER to <a href="#">Section 206-06</a> for the brake pedal and master cylinder or <a href="#">Section 206-07</a> for the brake booster. CORRECT the installation or INSTALL new as necessary. TEST the system for normal operation.</li> </ul>
<ul style="list-style-type: none"> <li>• Poor vehicle tracking during anti-lock function</li> </ul>	<ul style="list-style-type: none"> <li>• Air in the hydraulic brake system</li> <li>• Low tire pressure</li> <li>• <u>HCU</u></li> <li>• Base brake system concern</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test S</a>.</li> <li>• REFER to <a href="#">Section 206-00</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• The stability/traction</li> </ul>	<ul style="list-style-type: none"> <li>• Wiring, terminals or</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test R</a>.</li> </ul>

control system is inoperative	<ul style="list-style-type: none"> <li>connectors</li> <li>• Stability/traction control switch</li> <li>• ABS module</li> <li>• <u>IPC</u></li> </ul>	
• The stability/traction control system cannot be disabled	<ul style="list-style-type: none"> <li>• If a MyKey® restricted key is in use with the AdvanceTrac® always on feature configured to on, the traction control system cannot be disabled. An admin key must be used in order to enable and disable the traction control system</li> <li>• Wiring, terminals or connectors</li> <li>• Stability/traction control switch</li> <li>• <u>IPC</u></li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">GO to Pinpoint Test R.</a></li> </ul>
• The Hill Descent Control™ system (if equipped) is inoperative	<ul style="list-style-type: none"> <li>• ABS module DTCs present</li> <li>• Hill Descent Control™ switch</li> <li>• Wiring, terminals or connectors</li> </ul>	<ul style="list-style-type: none"> <li>• CARRY OUT a ABS module self-test.</li> <li>• <a href="#">GO to Pinpoint Test J.</a></li> </ul>

## Pinpoint Tests

### Pinpoint Test A: DTC B1676

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The voltage required for correct ABS operation is between 10 and 17 volts. Voltage outside of this range causes the ABS module to set DTC B1676.

- DTC B1676 (Battery Pack Voltage Out of Range) — this DTC sets in every ignition cycle if, with the ignition in the RUN position and vehicle speed greater than 6 km/h (4 mph), the battery voltage is less than 10 volts or more than 17 volts. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

**This pinpoint test is intended to diagnose the following:**

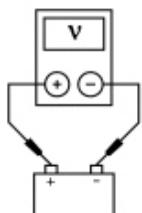
- Fuse
- Battery condition
- Wiring, terminals or connectors
- ABS module

## PINPOINT TEST A: DTC B1676

**NOTE:** DTC B1676 can be set if the vehicle has been recently jump started, the battery has been recently charged or the battery has been discharged. The battery may become discharged due to excessive load(s) on the charging system from aftermarket accessories or if the battery has been left unattended with the accessories on.

**NOTE:** Carry out a thorough inspection and verification before proceeding with the pinpoint test. Refer to Inspection and Verification in this section.

Test Step	Result / Action to Take
<b>A1 RETRIEVE ALL CMDTC IN ALL MODULES</b> <ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs.</li> <li>• Is DTC B1317, B1318 or B1676 present in one or more modules AND P0563, P0620, P0625, P0626 or P065B present in the PCM?</li> </ul>	<b>Yes</b> REFER to <a href="#">Section 414-00</a> for diagnosis of the battery and charging system.  <b>No</b> GO to <a href="#">A2</a> .
<b>A2 CHECK BATTERY CONDITION</b> <ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Carry out the Battery — Condition Test. Refer to <a href="#">Section 414-01</a>.</li> <li>• Does the battery pass the condition test?</li> </ul>	<b>Yes</b> If the battery passed the condition test but required a recharge, REFER to <a href="#">Section 414-00</a> to diagnose the charging system. CLEAR all CMDTCs. TEST the system for normal operation.  If the battery passed the condition test and did not require a recharge, GO to <a href="#">A3</a> .  <b>No</b> INSTALL a new battery. REFER to <a href="#">Section 414-01</a> . CLEAR all CMDTCs. TEST the system for normal operation.
<b>A3 CHECK CHARGING SYSTEM VOLTAGE</b> <p><b>NOTE:</b> Do not allow the engine speed to increase above 2,000 rpm while carrying out this step or the generator can self excite and result in default charging system output voltage. If engine speed goes above 2,000 rpm, shut the vehicle off and restart the engine before carrying out this step.</p> <ul style="list-style-type: none"> <li>• Start the engine.</li> <li>• Measure the voltage of the battery with and without a load on the charging system as follows:           <ul style="list-style-type: none"> <li>▪ Turn off all accessories and run the engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage.</li> <li>▪ Turn the headlights on and the HVAC fan on high and run engine at 1,500 rpm for a minimum of 2 minutes while measuring battery voltage.</li> </ul> </li> </ul>	<b>Yes</b> GO to <a href="#">A4</a> .  <b>No</b> REFER to <a href="#">Section 414-00</a> to diagnose the charging system. CLEAR all CMDTCs. TEST the system for normal operation.



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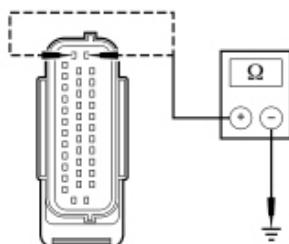
- Are the voltages between 13 and 15.2 volts?

#### A4 CHECK THE ABS MODULE GROUND CIRCUITS FOR AN OPEN

- Disconnect: Battery Negative Cable .
- Ignition OFF.
- Disconnect: ABS Module C135 .
- Measure the resistance between ground and:
  - ABS module C135-13, circuit GD121 (BK/YE), harness side.
  - ABS module C135-38, circuit GD121 (BK/YE), harness side.

**Yes**  
GO to [A5](#).

**No**  
REPAIR the affected circuit(s).  
CLEAR all CMDTCs. REPEAT  
the self-test.



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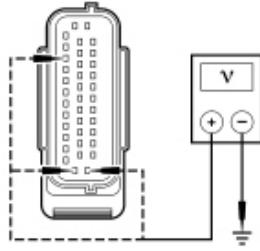
- Are the resistances less than 0.5 ohm?

#### A5 CHECK FOR VOLTAGE AT THE ABS MODULE

- Connect: Battery Negative Cable .
- Ignition ON.
- Measure the voltage between ground and:
  - ABS module C135-1, circuit SBB47 (WH/RD), harness side.
  - ABS module C135-25, circuit SBB36 (GN/RD), harness side.
  - ABS module C135-35, circuit CBB54 (VT/OG), harness side.

**Yes**  
GO to [A6](#).

**No**  
VERIFY that Battery Junction Box (BJB) fuses 36 (30A), 47 (60A), and 54 (5A) are OK. If OK, REPAIR the affected circuit(s). If not OK, REFER to the Wiring Diagrams manual to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test.



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- Are the voltages greater than 10 volts?

#### A6 CHECK FOR CORRECT ABS MODULE OPERATION

- Disconnect: ABS Module C135 .
- Check the connector for:
  - corrosion
  - damaged pins
  - pushed-out pins
- Connect: ABS Module C135 .
- Make sure the connector seats correctly, then operate the system and verify the concern is still present.
- **Is the concern still present?**

##### Yes

INSTALL a new ABS module. REFER to [Anti-Lock Brake System \(ABS\) Module](#) in this section. TEST the system for normal operation.

##### No

The system is operating correctly at this time. Concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

#### Pinpoint Test B: DTC B2900

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

##### Normal Operation

When the ignition is turned to the RUN position, the ABS module and the Body Control Module (BCM) share Vehicle Identification Number (VIN) information over the High Speed Controller Area Network (HS-CAN).

- DTC B2900 (VIN Mismatch) — this DTC sets in the ignition cycle if the VIN information stored in the ABS module does not match the information transmitted by the BCM. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

**This pinpoint test is intended to diagnose the following:**

- Module configuration (ABS and BCM)
- ABS module

#### PINPOINT TEST B: DTC B2900

Test Step	Result / Action to Take
B1 VERIFY <u>BCM VIN</u>	<ul style="list-style-type: none"> <li>• Connect the scan tool.</li> </ul> <b>Yes</b>

<ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Using the scan tool, carry out the network test.</li> <li>• Enter the following diagnostic mode on the scan tool: Log Viewer .</li> <li>• Compare the <u>VIN</u> in log viewer to the <u>VIN</u> plate.</li> <li>• <b>Does VIN in log viewer match the VIN plate?</b></li> </ul>	<p>GO to <a href="#">B2</a>.</p> <p><b>No</b> RECONFIGURE the <u>BCM</u>. FOLLOW the instructions on the scan tool. CLEAR the DTCs. CYCLE the ignition key. REPEAT the self-test.</p>
<p><b>B2 VERIFY ABS MODULE PART NUMBER</b></p> <ul style="list-style-type: none"> <li>• Retrieve and record the ABS module part number from log viewer and verify that the vehicle has the correct ABS module installed.</li> <li>• <b>Is the correct ABS module installed in the vehicle?</b></li> </ul>	<p><b>Yes</b> CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) Using the Integrated Diagnostic System (IDS) When the Original Module is NOT Available in <a href="#">Section 418-01</a>. CLEAR the DTC. CYCLE the ignition key. REPEAT the self-test.</p> <p><b>No</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. CLEAR the DTC. CYCLE the ignition key. TEST the system for normal operation.</p>

### Pinpoint Test C: DTC C1300

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The operating voltage required to run the hydraulic pump motor is between 10 and 17 volts. Fused battery voltage for the hydraulic pump motor is supplied to the ABS module from the Battery Junction Box (BJB). The hydraulic pump motor is internal to the Hydraulic Control Unit (HCU). If a new hydraulic pump motor is needed, a new HCU must be installed.

- DTC C1300 (ABS Pump Motor Circuit Failure) — this DTC sets every ignition cycle or in on-demand memory if there are circuit failures such as a short to ground, open, high circuit resistance, damaged motor, blown fuse. The module also checks the motor after every actuation. When the pump is shut off, the ABS module measures the output voltage of the motor. If the voltage drops too quickly, there may be a locked motor. DTC C1300 sets if this fault is detected 3 times. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

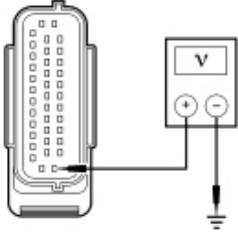
**This pinpoint test is intended to diagnose the following:**

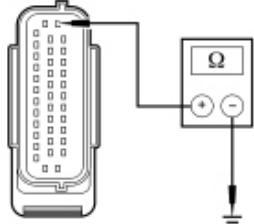
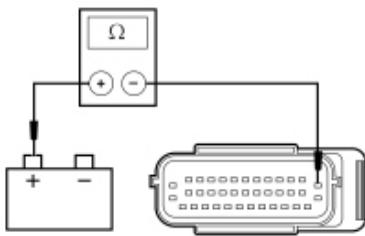
- Fuse
- Wiring, terminals or connectors
- HCU
- ABS module

### PINPOINT TEST C: DTC C1300

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct

probe adapter(s) may damage the connector.

Test Step	Result / Action to Take
<b>C1 CHECK THE ABS PUMP MOTOR</b>	
<ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Is the ABS pump motor running all the time?</li> </ul>	<b>Yes</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.  <b>No</b> GO to <a href="#">C2</a> .
<b>C2 CHECK THE ABS MODULE PUMP MOTOR (PMP_MOTOR) OUTPUT COMMAND</b>	
<ul style="list-style-type: none"> <li>• Connect the scan tool.</li> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module .</li> <li>• Toggle the PMP_MOTOR output command ON.</li> <li>• Does the ABS pump motor run for approximately 3 seconds?</li> </ul>	<b>Yes</b> TOGGLE the PMP_MOTOR output command OFF.  CLEAR the DTCs. CHECK the yellow ABS warning indicator while driving the vehicle (the brakes must not be applied) above 32 km/h (20 mph).  If the yellow ABS warning indicator illuminates, RETRIEVE the DTCs. If DTC C1300 is retrieved again, GO to <a href="#">C5</a> .  If the yellow ABS warning indicator does not illuminate, the system is OK.  <b>No</b> TOGGLE the PMP_MOTOR output command OFF. GO to <a href="#">C3</a> .
<b>C3 CHECK FOR VOLTAGE TO THE ABS MODULE</b>	
<ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Disconnect: ABS Module C135 .</li> <li>• Ignition ON.</li> <li>• Measure the voltage between ABS module C135-1, circuit SBB47 (WH/RD), harness side and ground.</li> </ul>  <small>N0058091</small> <ul style="list-style-type: none"> <li>• Is the voltage greater than 10 volts?</li> </ul>	<b>Yes</b> GO to <a href="#">C4</a> .  <b>No</b> VERIFY <u>BJB</u> fuse 47 (60A) is OK. If OK, REPAIR open in circuit SBB47 (WH/RD). If not OK, REPAIR the short circuit in circuit SBB47 (WH/RD). CLEAR the DTCs. REPEAT the self-test.
<b>C4 CHECK THE ABS MODULE GROUND CIRCUIT FOR AN OPEN OR EXCESSIVE RESISTANCE</b>	

<ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Disconnect: Battery Negative Cable .</li> <li>• Measure the resistance between ABS module C135-13, circuit GD121 (BK/YE), harness side and ground.</li> </ul> <p> N0055398</p> <p>• Is the resistance less than 0.5 ohm?</p>	<p><b>Yes</b> GO to <a href="#">C5</a>.</p> <p><b>No</b> REPAIR circuit GD121 (BK/YE). CLEAR the DTCs. REPEAT the self-test.</p>
<p><b>C5 CHECK THE ABS MODULE POWER CIRCUIT FOR CONTINUITY</b></p> <ul style="list-style-type: none"> <li>• Measure the resistance between the ABS module C135-1, circuit SBB47 (WH-RD), harness side and battery positive.</li> </ul> <p> N0117697</p> <p>• Is the resistance less than 0.5 ohms?</p>	<p><b>Yes</b> GO to <a href="#">C6</a>.</p> <p><b>No</b> REPAIR the open circuit SBB47 (WH/RD). CLEAR the DTCs. REPEAT the self-test.</p>
<p><b>C6 CHECK FOR CORRECT ABS MODULE OPERATION</b></p> <ul style="list-style-type: none"> <li>• Disconnect: ABS Module C135 .</li> <li>• Check the connector for: <ul style="list-style-type: none"> <li>■ corrosion</li> <li>■ damaged pins</li> <li>■ pushed-out pins</li> </ul> </li> <li>• Connect: ABS Module C135 .</li> <li>• Connect: Battery Negative Cable .</li> <li>• Make sure the connector seats correctly, then operate the system and verify the concern is still present.</li> <li>• Is the concern still present?</li> </ul>	<p><b>Yes</b> INSTALL a new HCU_. REFER to <a href="#">Hydraulic Control Unit (HCU)</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

#### Pinpoint Test D: DTCs C1145, C1155, C1165 and C1175

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

Active wheel speed sensors generate a square wave current signal that is sent to the ABS module. The wheel speed sensor circuitry connects to the ABS module through 2 wires and a connector at each wheel speed sensor. When the ignition switch is turned to the RUN position, the ABS module carries out a self-test by sending a reference voltage through the wheel speed sensors and their circuitry to determine if they are functional. The front wheel bearings contain a magnetic strip that replaces the tone ring. It functions the same but is not visible for inspection.

Battery voltage and ground are supplied to the active wheel speed sensors from the ABS module.

DTC Description	Fault Trigger Condition
<ul style="list-style-type: none"> <li>• C1145 — Speed Wheel Sensor RF Input Circuit Failure</li> <li>• C1155 — Speed Wheel Sensor LF Input Circuit Failure</li> <li>• C1165 — Speed Wheel Sensor RR Input Circuit Failure</li> <li>• C1175 — Speed Wheel Sensor LR Input Circuit Failure</li> </ul>	These DTCs set in continuous memory if the ABS module detects an open, short to ground or voltage or a damaged wheel speed sensor input circuit, the appropriate DTC sets when the vehicle speed exceeds 6 km/h (4 mph). DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected. DTCs C1165 and C1175 also set on-demand.

**This pinpoint test is intended to diagnose the following:**

- Wheel speed sensors
- Wheel bearing magnetic strips, rear tone rings
- Wiring, terminals or connectors
- ABS module

**PINPOINT TEST D: DTCs C1145, C1155, C1165 AND C1175**

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

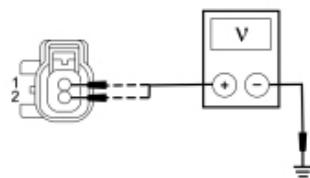
**NOTE:** If the ignition is turned to the ON position when a wheel speed sensor is disconnected, the ABS module disables the output to that sensor. Make sure all test connections are made at the wheel speed sensor connector before turning the ignition to the ON position.

Test Step	Result / Action to Take
<b>D1 CHECK FOR FAULT REPEATABILITY</b>	<p><b>Yes</b></p> <p>If the Rotunda Active Wheel Speed Sensor Tester is available, GO to <a href="#">D2</a>. If</p>

<ul style="list-style-type: none"> <li>Enter the following diagnostic mode on the scan tool: Clear the Continuous DTCs .</li> <li>Drive the vehicle at least 16 km/h (10 mph).</li> <li>Retrieve the Continuous Memory Diagnostic Trouble Codes (CMDTCs).</li> <li><b>Is DTC C1145, C1155, C1165 or C1175 retrieved?</b></li> </ul>	<p>the Rotunda Active Wheel Speed Sensor Tester is not available, GO to <a href="#">D4</a>.</p> <p><b>No</b> INSPECT the wheel speed sensors and wheel speed sensor wiring. REPAIR or INSTALL new as necessary. If any other DTCs are retrieved, GO to the ABS Module DTC Chart.</p>
<p><b>D2 CHECK THE ABS MODULE OUTPUT USING THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER</b></p> <ul style="list-style-type: none"> <li>Ignition OFF.</li> <li>Disconnect: Suspect Wheel Speed Sensor .</li> <li>Connect the Rotunda Active Wheel Speed Sensor Tester to the wheel speed sensor connectors.</li> <li>Select the correct system polarity on the tester and turn the tester power switch to the ON position.</li> <li>Ignition ON.</li> <li><b>Is the module output LED illuminated?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">D3</a> .</p> <p><b>No</b> GO to <a href="#">D6</a> .</p>
<p><b>D3 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER</b></p> <ul style="list-style-type: none"> <li>Raise the suspect wheel until it can spin freely. Refer to <a href="#">Section 100-02</a>.</li> <li>While monitoring the Rotunda Active Wheel Speed Sensor Tester, slowly spin the suspect wheel.</li> <li><b>Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?</b></li> </ul>	<p><b>Yes</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p> <p><b>No</b> If the current overload level LED is not illuminated and the sensor output LEDs do not illuminate or if the current overload level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to <a href="#">Wheel Speed Sensor — Front</a> or <a href="#">Wheel Speed Sensor — Rear</a> in this section. CLEAR the DTCs. REPEAT the self-test.</p> <p>If the current overload level LED is not illuminated and the sensor output LEDs illuminate green but do not flash, INSTALL a new wheel speed sensor. REFER to <a href="#">Wheel Speed Sensor — Front</a> or <a href="#">Wheel Speed Sensor — Rear</a> in this section. CLEAR the DTCs. REPEAT the self-test. If the outputs LEDs still do not flash when spinning the wheel, INSTALL a new wheel bearing magnetic strip or tone ring (rear). REFER to <a href="#">Section 204-01A</a>, <a href="#">Section 204-01B</a> or <a href="#">Wheel Speed Sensor Ring — Rear</a> in this section.</p>
<p><b>D4 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO VOLTAGE</b></p> <p><b>NOTE:</b> Check both circuits for each DTC.</p> <ul style="list-style-type: none"> <li>Ignition OFF.</li> </ul>	<p><b>Yes</b> REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.</p>

- Disconnect: ABS Module C135 .
- Disconnect: Suspect Wheel Speed Sensor .
- Ignition ON.
- Measure the voltage between the suspect wheel speed sensor connector, harness side and ground as follows:

Wheel Speed Sensor	Circuit
C150-1 (LF)	VCA03 (VT/WH)
C150-2 (LF)	RCA17 (YE)
C160-1 (RF)	VCA05 (GY/VT)
C160-2 (RF)	RCA19 (VT)
C426-1 (RR)	VCA06 (WH/OG)
C426-2 (RR)	RCA20 (BN)
C440-1 (LR)	VCA04 (BU/OG)
C440-2 (LR)	RCA18 (BN/GN)



N0120698

- Is any voltage present?

#### D5 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO GROUND

**NOTE:** Check both circuits for each DTC.

- Ignition OFF.
- Measure the resistance between the wheel speed sensor connector, harness side and ground as follows:

Wheel Speed Sensor	Circuit
C150-1 (LF)	VCA03 (VT/WH)
C150-2 (LF)	RCA17 (YE)
C160-1 (RF)	VCA05 (GY/VT)
C160-2 (RF)	RCA19 (VT)
C426-1 (RR)	VCA06 (WH/OG)
C426-2 (RR)	RCA20 (BN)
C440-1 (LR)	VCA04 (BU/OG)

**No**

GO to [D5](#).

**Yes**

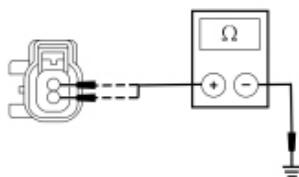
GO to [D6](#).

**No**

REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

C440-2 (LR)

| RCA18 (BN/GN) |



N0120699

- Are the resistances greater than 10,000 ohms?

#### D6 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN

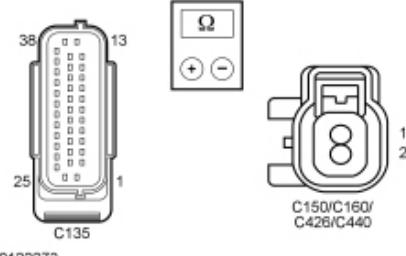
**NOTE:** Check both circuits for each DTC.

- Ignition OFF.
- Disconnect: ABS Module C135 .
- Disconnect: Suspect Wheel Speed Sensor .
- Measure the resistance between the ABS module connector, harness side and the suspect wheel speed sensor connector, harness side as follows:

ABS Module	Circuit	Wheel Speed Sensor
C135-21	VCA03 (VT/WH)	C150-1 (LF)
C135-34	RCA17 (YE)	C150-2 (LF)
C135-18	VCA05 (GY/VT)	C160-1 (RF)
C135-6	RCA19 (VT)	C160-2 (RF)
C135-19	VCA06 (WH/OG)	C426-1 (RR)
C135-31	RCA20 (BN)	C426-2 (RR)
C135-33	VCA04 (BU/OG)	C440-1 (LR)
C135-20	RCA18 (BN/GN)	C440-2 (LR)

Yes  
GO to [D7](#).

No  
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the ABS self-test.



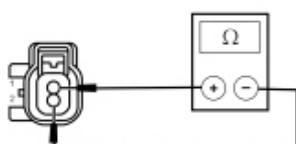
N0122273

- Are the resistances less than 5 ohms?

#### D7 CHECK SHORTED WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TOGETHER

- Measure the resistance between the suspect wheel speed sensor connector, harness side as follows:

ABS Module	Circuit	Wheel Speed Sensor
C135-21	VCA03 (VT/WH)	C150-1 (LF)
C135-34	RCA17 (YE)	C150-2 (LF)
C135-18	VCA05 (GY/VT)	C160-1 (RF)
C135-6	RCA19 (VT)	C160-2 (RF)
C135-19	VCA06 (WH/OG)	C426-1 (RR)
C135-31	RCA20 (BN)	C426-2 (RR)
C135-33	VCA04 (BU/OG)	C440-1 (LR)
C135-20	RCA18 (BN/GN)	C440-2 (LR)



N0120346

- Is the resistance greater than 10,000 ohms?

#### D8 CHECK THE ABS MODULE OUTPUT

**NOTE:** Make sure all test connections are made at the wheel speed sensor before the ignition key is turned to the ON position.

Yes  
GO to [D8](#).

No  
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

Yes  
INSTALL a new wheel speed sensor.  
REFER to [Wheel Speed Sensor — Front](#) or [Wheel Speed Sensor — Rear](#) in this

<p><b>NOTE:</b> Use a meter with a min/max feature and/or recording capabilities to obtain accurate measurements. The ABS module disables the voltage output immediately if the wheel speed sensor is not present.</p> <ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Connect: ABS Module C135 .</li> <li>• Connect the meter to the suspect wheel speed sensor electrical connector pins, harness side.</li> <li>• Set the meter to measure DC voltage.</li> <li>• Set the meter range to greater than 15 volts.</li> <li>• Enable the min/max or recording feature.</li> <li>• Ignition ON.</li> <li>• Check the maximum recorded voltage on the meter.</li> <li>• <b>Is the maximum recorded voltage greater than 10 volts?</b></li> </ul>	<p>section. CLEAR the DTCs. REPEAT the self-test.</p> <p><b>No</b> GO to <a href="#">D9</a>.</p>
<p><b>D9 CHECK FOR CORRECT ABS MODULE OPERATION</b></p> <ul style="list-style-type: none"> <li>• Disconnect: ABS Module C135 .</li> <li>• Check for: <ul style="list-style-type: none"> <li>■ corrosion</li> <li>■ damaged pins</li> <li>■ pushed-out pins</li> </ul> </li> <li>• Connect: ABS Module C135 .</li> <li>• Make sure the connector seats correctly, then operate the system and verify the concern is still present.</li> <li>• <b>Is the concern still present?</b></li> </ul>	<p><b>Yes</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. CLEAR the DTCs. REPEAT the self-test.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

#### Pinpoint Test E: DTCs C1222, C1296, C1297, C1298 and C1299

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The wheel speed sensor and tone ring generate a square wave current signal to the ABS module that is proportional to the wheel speed. The ABS module compares the wheel speed inputs from all the wheel speed sensors to determine an impending wheel lockup. Incorrect tire size or tire pressure can set these DTCs as well. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

DTC Description	Fault Trigger Condition
<ul style="list-style-type: none"> <li>• C1222 — Speed Wheel Mismatch</li> </ul>	<p>This DTC sets in the ignition cycle when the vehicle speed exceeds 20 km/h (12 mph) or the ABS module detects a difference between wheel speed sensor signals. This DTC can also be set by damaged tone rings, mismatched wheel and/or tire sizes or driving the vehicle on one or more deflated tires.</p>
<ul style="list-style-type: none"> <li>• C1296 — Wheel Speed LF Signal Fault</li> <li>• C1297 —</li> </ul>	<p>These DTCs set in the ignition cycle when the vehicle speed exceeds 20 km/h (12 mph). The appropriate DTC sets if the ABS module does not receive a signal from the wheel speed sensor. These DTCs can also be set by an excessive wheel speed sensor-to-tone ring air gap or a damaged tone ring, mismatched wheel</p>

Wheel Speed RF Signal Fault <ul style="list-style-type: none"> <li>• C1298 — Wheel Speed RR Signal Fault</li> <li>• C1299 — Wheel Speed LR Signal Fault</li> </ul>	and/or tire sizes or driving the vehicle on one or more deflated tires.
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**This pinpoint test is intended to diagnose the following:**

- ABS module
- Wheel speed sensor magnetic strip/tone ring
- Wheel speed sensor

#### PINPOINT TEST E: DTCs C1222, C1296, C1297, C1298 AND C1299

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

**NOTE:** If the ignition is turned to ON when one or more wheel speed sensors are disconnected, the ABS module disables the output to that sensor. Make sure all test connectors are made at the sensor before turning the ignition to ON.

Test Step	Result / Action to Take
<b>E1 CHECK THE ABS MODULE DTCs</b>	<p><b>Yes</b>  <a href="#">GO to Pinpoint Test D</a>.</p> <p><b>No</b>            GO to <a href="#">E2</a>.</p>
<b>E2 MONITOR THE WHEEL SPEED SENSOR PIDs</b>	<p><b>Yes</b>            CLEAR the DTCs. DRIVE the vehicle.            REPEAT the self-test. RETRIEVE and RECORD any ABS module DTCs.</p> <p>If DTC C1296, C1297, C1298 or C1299 returns, GO to <a href="#">E11</a>.</p> <p>If DTC C1222 is present, GO to <a href="#">E10</a>.</p> <p>For all other ABS module DTCs, GO to the ABS Module DTC Chart.</p> <p>If no DTCs return, INSPECT the ABS module and wheel speed sensor connectors for corrosion, pushed-out pins, or damaged pins and REPAIR if necessary. If all connectors are OK, GO to <a href="#">E7</a>.</p>

	<p><b>No</b> If the Rotunda Active Wheel Speed Sensor Tester is available, GO to <a href="#">E3</a>.  If the Rotunda Active Wheel Speed Sensor Tester is not available, GO to <a href="#">E5</a>.</p>
<b>E3 CHECK THE ABS MODULE OUTPUT USING THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER</b>	<p><b>Yes</b> GO to <a href="#">E4</a>.</p> <p><b>No</b> GO to <a href="#">E6</a>.</p>
<b>E4 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE ROTUNDA ACTIVE WHEEL SPEED SENSOR TESTER</b>	<p><b>Yes</b> INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, the concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p> <p><b>No</b> If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to <a href="#">Wheel Speed Sensor — Front</a> or <a href="#">Wheel Speed Sensor — Rear</a> in this section. CLEAR the DTCs. REPEAT the self-test.</p> <p>If the current level LED is not illuminated and the sensor output LEDs illuminate green but do not flash, INSPECT the wheel speed sensor tone ring and INSTALL new if necessary. If the tone ring is OK, INSTALL a new wheel speed sensor. REFER to <a href="#">Wheel Speed Sensor — Front</a> or <a href="#">Wheel Speed Sensor — Rear</a> in this section. CLEAR the DTCs. REPEAT the self-test.</p>
<b>E5 CHECK THE ABS MODULE OUTPUT</b>	<p><b>Yes</b> GO to <a href="#">E7</a>.</p> <p><b>No</b></p>

**NOTE:** Use a meter with a min/max feature and/or recording capabilities to obtain accurate measurements. The ABS module disables the voltage output immediately if the wheel speed sensor is not present.

- Ignition OFF.
- Connect the meter to the suspect wheel speed sensor electrical connector pins, harness side.
- Enable the min/max or recording feature.
- Ignition ON.
- Check the maximum recorded voltage on the meter.
- **Is the maximum recorded voltage greater than 10 volts?**

GO to [E6](#).

#### E6 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN

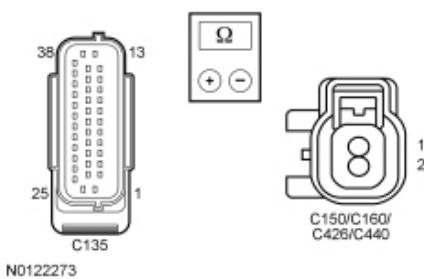
**NOTE:** Check both circuits for each DTC.

- Ignition OFF.
- Disconnect: ABS Module C135 .
- Disconnect: Suspect Wheel Speed Sensor .
- Measure the resistance between the ABS module connector, harness side and the suspect wheel speed sensor connector, harness side as follows:

**Yes**  
GO to [E11](#).

**No**  
REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

ABS Module	Circuit	Wheel Speed Sensor
C135-21	VCA03 (VT/WH)	C150-1 (LF)
C135-34	RCA17 (YE)	C150-2 (LF)
C135-18	VCA05 (GY/VT)	C160-1 (RF)
C135-6	RCA19 (VT)	C160-2 (RF)
C135-19	VCA06 (WH/OG)	C426-1 (RR)
C135-31	RCA20 (BN)	C426-2 (RR)
C135-33	VCA04 (BU/OG)	C440-1 (LR)
C135-20	RCA18 (BN/GN)	C440-2 (LR)



<ul style="list-style-type: none"> <li>Are the resistances less than 5 ohms?</li> </ul>	
<b>E7 CHECK THE WHEEL SPEED SENSOR AND MOUNTING</b>	<p><b>Yes</b> GO to <a href="#">E9</a>.</p> <p><b>No</b> TIGHTEN the wheel speed sensor to specification. REFER to Specifications in this section. CLEAR the DTCs. GO to <a href="#">E8</a>.</p>
<b>E8 RECHECK THE WHEEL SPEED SENSOR PIDs</b>	<p><b>Yes</b> The vehicle is OK. The concern may have been caused by a loose wheel speed sensor.</p> <p><b>No</b> GO to <a href="#">E9</a>.</p>
<b>E9 CHECK THE WHEEL SPEED SENSOR(S) FOR DAMAGE</b>	<p><b>Yes</b> For DTC C1296 or C1297, INSTALL a new wheel hub and bearing (wheel speed sensor tone rings are part of the wheel hub and bearing assembly). REFER to <a href="#">Section 204-01A</a> or <a href="#">Section 204-01B</a>. For DTC C1298 or C1299, INSTALL a new wheel speed sensor tone ring. REFER to <a href="#">Wheel Speed Sensor Ring — Rear</a> in this section. CLEAR the DTCs. REPEAT the self-test.</p> <p><b>No</b> INSTALL a new wheel speed sensor. REFER to <a href="#">Wheel Speed Sensor — Front</a> or <a href="#">Wheel Speed Sensor — Rear</a> in this section. CLEAR the DTC. REPEAT the self-test.</p>
<b>E10 CHECK THE ABS MODULE CONFIGURATION</b>	<p><b>Yes</b> GO to <a href="#">E11</a>.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by an incorrectly configured ABS module.</p>
<b>E11 CHECK FOR CORRECT ABS MODULE OPERATION</b>	

<ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Disconnect: ABS Module C135 .</li> <li>• Check ABS module connector for:           <ul style="list-style-type: none"> <li>■ corrosion</li> <li>■ damaged pins</li> <li>■ pushed-out pins</li> </ul> </li> <li>• Connect: ABS Module C135 .</li> <li>• Make sure the connector seats correctly, then operate the system and verify the concern is still present.</li> <li>• <b>Is the concern still present?</b></li> </ul>	<p><b>Yes</b> INSPECT the wheel speed sensor tone rings for damage. INSTALL new components as necessary. If the tone rings are OK, INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>
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### Pinpoint Test F: DTC C1266

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The operating voltage required for ABS module isolation valve operation is between 10 and 17 volts.

Fused battery voltage is supplied to the ABS module for the valves by the Battery Junction Box (BJB).

- DTC C1266 (ABS Valve Power Relay Circuit Failure) — this DTC sets in the ignition cycle if the ABS module detects an open or a short to ground on the valve power feed circuit. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

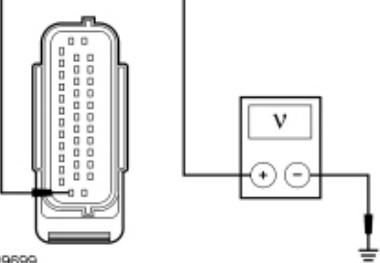
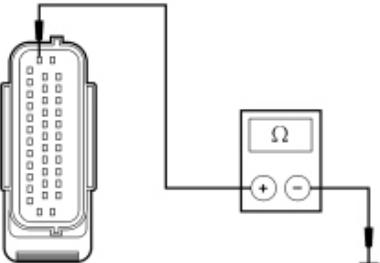
**This pinpoint test is intended to diagnose the following:**

- Fuse
- Wiring, terminals or connectors
- ABS module

### PINPOINT TEST F: DTC C1266

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

Test Step	Result / Action to Take
<b>F1 CHECK FOR VOLTAGE TO THE ABS MODULE</b>	<p><b>Yes</b> GO to <a href="#">F2</a>.</p> <p><b>No</b> VERIFY that Battery Junction Box (BJB) fuse 36 (30A) is OK. If OK, REPAIR circuit SBB36 (GN/RD). If not OK, REFER to the Wiring Diagrams manual to identify possible causes of the circuit short.</p>

		CLEAR the DTCs. REPEAT the self-test.
 N0009699	<ul style="list-style-type: none"> <li>Is the voltage greater than 10 volts?</li> </ul>	
<b>F2 CHECK THE ABS MODULE GROUND CIRCUIT FOR AN OPEN</b>	<ul style="list-style-type: none"> <li>Ignition OFF.</li> <li>Measure the resistance between ABS module C135-38, circuit GD121 (BK/YE), harness side and ground.</li> </ul>  N0012678	<p><b>Yes</b> GO to <a href="#">F3</a>.</p> <p><b>No</b> REPAIR circuit GD121 (BK/YE). CLEAR the DTCs. REPEAT the self-test.</p>
<b>F3 CHECK FOR CORRECT ABS MODULE OPERATION</b>	<ul style="list-style-type: none"> <li>Disconnect: ABS Module C135 .</li> <li>Check ABS module connector for:             <ul style="list-style-type: none"> <li>corrosion</li> <li>damaged pins</li> <li>pushed-out pins</li> </ul> </li> <li>Connect: ABS Module C135 .</li> <li>Is the concern still present?</li> </ul>	<p><b>Yes</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. CLEAR the DTCs. REPEAT the self-test.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

#### Pinpoint Test G: DTCs C116A, C1440

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The pressure transducer is integral to the Hydraulic Control Unit (HCU). The pressure transducer sends a signal to the ABS module that varies in relation to the amount of pressure applied to the brake pedal. The more pressure that is applied, the greater the signal sent to the ABS module. If a new pressure transducer is needed, then a new HCU must be installed.

When the brake pedal is pressed, the stoplamp switch closes and a voltage is sent to the PCM. The PCM then sends a message over the High Speed Controller Area Network (HS-CAN) to the ABS module indicating that the brake pedal has been pressed. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected.

- DTC C116A (ABS Pressure Transducer / Brake Switch Mismatch) — this DTC sets in every ignition cycle if, during normal operation, the stoplamp switch message does not match the HCU transducer, both signals have to agree about whether the brakes are being applied or not.
- DTC C1440 (Pressure Transducer Main/Primary Signal Faulted) — this DTC sets in every ignition cycle if the signal that the pressure transducer sends to the ABS module does not agree with the stoplamp switch position.

**This pinpoint test is intended to diagnose the following:**

- HCU
- ABS module

#### PINPOINT TEST G: DTCs C116A, C1440

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

Test Step	Result / Action to Take
<b>G1 MONITOR THE ABS MODULE BRAKE ON/OFF (BOO_ABS) PID</b>	<p><b>Yes</b> GO to <a href="#">G3</a>.</p> <p><b>No</b> GO to <a href="#">G2</a>.</p>
<b>G2 MONITOR THE PCM BRAKE ON/OFF (BOO1) PID</b>	<p><b>Yes</b> REFER to <a href="#">Section 418-00</a> to continue diagnosis of the <u>HS-CAN</u>.</p> <p><b>No</b> REFER to <a href="#">Section 417-01</a> to continue diagnosis of the stoplamp switch fault.</p>
<b>G3 MONITOR THE INITIAL (BRAKE PEDAL NOT APPLIED) BRAKE PRESSURE USING THE ABS MODULE BRAKE PRESSURE (BRAKPRES) PID</b>	<p><b>Yes</b> GO to <a href="#">G4</a>.</p> <p><b>No</b> INSTALL a new <u>HCU</u>. REFER to <a href="#">Hydraulic Control Unit (HCU)</a> in this section.</p>

#### G4 MONITOR THE BRAKPRES PID WHILE APPLYING THE BRAKE PEDAL

- Enter the following diagnostic mode on the scan tool:  
DataLogger — ABS Module .
- Firmly press and release the brake pedal while monitoring the BRAKPRES PID.
- **Does the PID increase with firm pressure on the brake pedal and then decrease with the brake pedal released?**

**Yes**

The system is operating correctly at this time. TEST the system for normal operation.

**No**

INSTALL a new HCU. REFER to [Hydraulic Control Unit \(HCU\)](#) in this section.

#### Pinpoint Test I: DTCs C109D, C109E and C109F

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

##### Normal Operation

The ABS module uses the vacuum sensor to determine if hydraulic pump intervention is necessary due to a severe loss of vacuum in the booster. The ABS module sends a 5-volt reference voltage to the sensor and the sensor compares the pressure in the booster to the ambient air pressure in the engine compartment and sends a varying voltage back to the ABS module based on the difference between the pressures. Normally, the pressure in the booster is much lower than ambient air pressure. As the pressure in the booster gets higher (closer to matching ambient air pressure), the lower the voltage sent back to the ABS module becomes.

- DTC C109D (Low Vacuum Condition Detected) — this DTC sets in continuous memory and every ignition cycle when the vacuum in the brake booster goes below a predetermined threshold and does not necessarily indicate a concern with the vacuum sensor, the related wiring or the ABS module. This DTC indicates a vacuum concern in the brake booster, engine and any related vacuum hoses/tubes. High altitude locations with low ambient air temperatures can cause a low vacuum condition to exist in the booster until the engine compartment warms up.
- DTC C109E (Vacuum Sensor Circuit Fault) — this DTC sets in continuous memory and every ignition cycle if during normal operation or the ABS module on-demand self-test, the ABS module detects an open circuit, a short to voltage or a short to ground on the vacuum sensor circuits or a failure of the vacuum sensor.
- DTC C109F (Vacuum Sensor Signal Fault) — this DTC sets in continuous memory and every ignition cycle if the vacuum sensor ambient air pressure inlet ports, or the vacuum sensor ports become restricted or clogged.

**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- Vacuum sensor
- ABS module

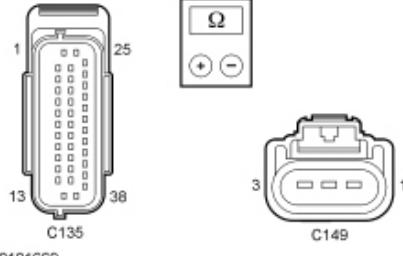
#### PINPOINT TEST I: DTCs C109D, C109E AND C109F

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

Test Step	Result / Action to Take
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<b>I1 CHECK THE ABS MODULE DTCs</b> <ul style="list-style-type: none"> <li>Review the DTCs recorded during Inspection and Verification.</li> <li><b>Was DTC C109D the only recorded DTC?</b></li> </ul>	<b>Yes</b> GO to <a href="#">I2</a> .  <b>No</b> If DTC C109E and/or C109F was retrieved, GO to <a href="#">I6</a> .  For all other DTCs, REFER to the ABS Module DTC Chart in this section.
<b>I2 CHECK DTC RETURNABILITY</b> <ul style="list-style-type: none"> <li>Using the scan tool, clear the ABS module DTCs.</li> <li>Ignition OFF.</li> <li>Disconnect the scan tool.</li> <li>Start the engine.</li> <li><b>NOTE:</b> It may take up to 3 minutes for DTC C109D to set.</li> <li>Allow the vehicle to idle for a minimum of 4 minutes. Apply and release the brake pedal for a minimum of 3 times per minute with normal pedal force for up to 3 minutes</li> <li>Ignition OFF.</li> <li>Connect the scan tool.</li> <li>Ignition ON.</li> <li>Enter the following diagnostic mode on the scan tool: Self Test — ABS Module .</li> <li><b>Is DTC C109D the only vacuum sensor DTC present?</b></li> </ul>	<b>Yes</b> GO to <a href="#">I3</a> .  <b>No</b> If DTC C109E and/or C109F was retrieved, GO to <a href="#">I6</a> .  For all other DTCs, REFER to the ABS Module DTC Chart in this section.  If no DTC is set, the system is operating correctly as this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTC. REPEAT the self-test.
<b>I3 CHECK THE ENGINE VACUUM</b> <ul style="list-style-type: none"> <li>Carry out the Intake Manifold Vacuum Test, refer to Diagnosis and Testing in <a href="#">Section 303-00</a>.</li> <li>Record the vacuum reading.</li> <li><b>Does the vacuum gauge indicate normal vacuum?</b></li> </ul>	<b>Yes</b> GO to <a href="#">I4</a> .  <b>No</b> FOLLOW the diagnostic procedure in <a href="#">Section 303-00</a> .
<b>I4 CHECK THE BRAKE BOOSTER</b> <ul style="list-style-type: none"> <li>Carry out the Brake Booster Component Test. Refer to <a href="#">Section 206-00</a>.</li> <li><b>Do the brake booster and check valve pass the component test?</b></li> </ul>	<b>Yes</b> GO to <a href="#">I5</a> .  <b>No</b> REPAIR or INSTALL new as necessary. CLEAR the DTC. REPEAT the self-test.
<b>I5 CHECK THE BRAKE BOOSTER VACUUM LEVEL (BBVACLVL) PID</b> <ul style="list-style-type: none"> <li>Connect the scan tool.</li> <li>Start the engine.</li> <li>Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module .</li> <li>Compare the recorded vacuum reading the brake booster vacuum level PID.</li> <li><b>Does the PID match the recorded vacuum reading of ±3.386 kPa (1 in-Hg)?</b></li> </ul>	<b>Yes</b> REPAIR any vacuum leaks at the vacuum system. For 4x4 vehicles, REPAIR any vacuum leaks from the vacuum hub lock system. REPEAT the ABS module self-test.

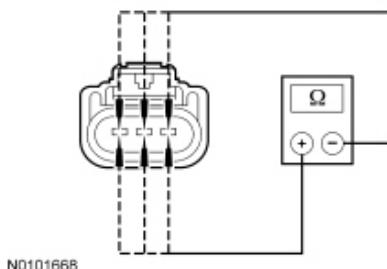
	<p><b>No</b> INSTALL a new brake booster vacuum sensor. REFER to <a href="#">Section 206-07</a>. CLEAR the DTCs. TEST the system for normal operation.</p>
<b>I6 CHECK THE BRAKE BOOSTER VACUUM SENSOR</b>	<p><b>Yes</b> GO to <a href="#">I7</a>.</p> <p><b>No</b> REPAIR or INSTALL a new vacuum sensor as necessary. REFER to <a href="#">Section 206-07</a>. CLEAR the DTCs. REPEAT the self-test.</p>
<b>I7 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR A SHORT TO GROUND</b>	<p><b>Yes</b> GO to <a href="#">I8</a>.</p> <p><b>No</b> REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.</p>
<ul style="list-style-type: none"> <li>Disconnect: ABS Module C135 .</li> <li>Disconnect: Brake Booster Vacuum Sensor C149 .</li> <li>Measure the resistance between ground and: <ul style="list-style-type: none"> <li>brake booster vacuum sensor C149-1, circuit VCA22 (GN/BN), harness side.</li> <li>brake booster vacuum sensor C149-2, circuit GD120 (BK/GN), harness side.</li> <li>brake booster vacuum sensor C149-3, circuit CCA22 (GY/YE), harness side.</li> </ul> </li> </ul> <p>N0101670</p> <ul style="list-style-type: none"> <li>Is the resistance greater than 10,000 ohms?</li> </ul>	
<b>I8 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR AN OPEN</b>	<p><b>Yes</b> GO to <a href="#">I9</a>.</p> <p><b>No</b> REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.</p>



- Are the resistances less than 5 ohms?

#### I9 CHECK THE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR A SHORT TOGETHER

- Measure the resistance between:
  - brake booster vacuum sensor C149-1, circuit VCA22 (GN/BN), harness side and brake booster vacuum sensor C149-2, circuit GD120 (BK/GN), harness side.
  - brake booster vacuum sensor C149-1, circuit VCA22 (GN/BN), harness side and brake booster vacuum sensor C149-3, circuit CCA22 (GY/YE), harness side.
  - brake booster vacuum sensor C149-2, circuit GD120 (BK/GN), harness side, and brake booster vacuum sensor C149-3, circuit CCA22 (GY/YE), harness side.



- Are the resistances greater than 10,000 ohms?

#### I10 CHECK THE ACTIVE BRAKE BOOSTER VACUUM SENSOR CIRCUITS FOR A SHORT TO VOLTAGE

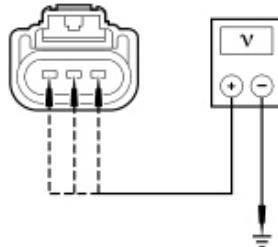
- Ignition ON.
- Measure the voltage between ground and:
  - brake booster vacuum sensor C149-1, circuit VCA22 (GN/BN), harness side.
  - brake booster vacuum sensor C149-2, circuit GD120 (BK/GN), harness side.
  - brake booster vacuum sensor C149-3, circuit CCA22 (GY/YE), harness side.

**Yes**  
GO to [I10](#).

**No**  
REPAIR the affected circuit(s).  
CLEAR the DTCs. REPEAT the self-test.

**Yes**  
REPAIR the affected circuit(s).  
CLEAR the DTCs. REPEAT the self-test.

**No**  
GO to [I11](#).

 N0101667	<ul style="list-style-type: none"> <li>Is any voltage present?</li> </ul>	
<b>I11 CHECK THE BRAKE BOOSTER VACUUM SENSOR CONNECTOR</b>	<ul style="list-style-type: none"> <li>Ignition OFF.</li> <li>Check brake booster vacuum sensor connector for:           <ul style="list-style-type: none"> <li>corrosion</li> <li>damaged pins</li> <li>pushed-out pins</li> </ul> </li> <li>Connect: Brake Booster Vacuum Sensor C149 .</li> <li>Make sure the connector seats correctly, then operate the system and verify the concern is still present.</li> <li>Is the concern still present?</li> </ul>	<p><b>Yes</b>          INSTALL a new vacuum sensor. REFER to <a href="#">Section 206-07</a>. CLEAR the DTCs. REPEAT the self-test.          If DTC C109E or C109F return, GO to <a href="#">I12</a>.</p> <p><b>No</b>          The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>
<b>I12 CHECK THE ABS MODULE CONNECTORS</b>	<ul style="list-style-type: none"> <li>Ignition OFF.</li> <li>Disconnect: ABS Module C135 .</li> <li>Check ABS module connector for:           <ul style="list-style-type: none"> <li>corrosion</li> <li>damaged pins</li> <li>pushed-out pins</li> </ul> </li> <li>Connect: ABS Module C135 .</li> <li>Make sure the connector seats correctly, then operate the system and verify the concern is still present.</li> <li>Is the concern still present?</li> </ul>	<p><b>Yes</b>          INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.</p> <p><b>No</b>          The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

#### Pinpoint Test J: The Hill Descent Control System Is Inoperative

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

##### Normal Operation

Hill Descent Control™ can be activated by momentarily pressing the Hill Descent Control™ switch at speeds from 3 km/h (2 mph) and 16 km/h (10 mph), but the system stays in control up to 32 km/h (20 mph). At speeds between 32 km/h (20 mph) and 64 km/h (40 mph), Hill Descent Control™ does not set or maintain speeds. Hill Descent Control™ automatically disables itself above 64 km/h (40 mph).

When the Hill Descent Control™ switch is pressed, a circuit inside of the switch is closed, ground is provided to the Instrument Panel Cluster (IPC) disabling or enabling the Hill Descent Control™.

DTC C2809 can be set by manually pressing and holding the Hill Descent Control™ switch for more than 30 seconds.

- DTC C2809 (Hill Descent Control Switch Stuck) — this DTC sets if the ABS module receives the HILL\_DESC\_SW message from the High Speed Controller Area Network (HS-CAN) for greater than 30 seconds.

**This pinpoint test is intended to diagnose the following:**

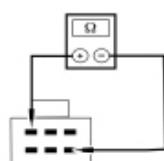
- Wiring, terminals or connectors
- Hill Descent Control™ switch
- ABS module

#### PINPOINT TEST J: THE HILL DESCENT CONTROL SYSTEM IS INOPERATIVE

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

Test Step	Result / Action to Take
<b>J1 CHECK FOR DTCs</b> <ul style="list-style-type: none"> <li>• Connect the scan tool.</li> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs.</li> <li>• <b>Are any ABS module, IPC or communication DTCs present?</b></li> </ul>	<b>Yes</b> For ABS module DTC C2809, GO to <a href="#">J2</a> .  For all other ABS module DTCs, REFER to the ABS Module DTC Chart.  For IPC DTCs, REFER to the <a href="#">Section 413-01</a> .  <b>No</b> System is operating correctly at this time.
<b>J2 VISUALLY INSPECT THE HILL DESCENT CONTROL™ SWITCH</b> <ul style="list-style-type: none"> <li>• Inspect the Hill Descent Control™ switch for damage.</li> <li>• Verify that the Hill Descent Control™ switch does not stick.</li> <li>• <b>Is the Hill Descent Control™ switch damaged or sticking?</b></li> </ul>	<b>Yes</b> INSTALL a new Hill Descent Control™ switch by removing the auxiliary switch assembly. REFER to the exploded view in <a href="#">Section 501-12</a> . PRESS the tab on each side of the switch to remove it from the bezel. After replacing the switch, CLEAR the DTCs and REPEAT the self-test. TEST the system for normal operation.  <b>No</b> GO to <a href="#">J3</a> .
<b>J3 ISOLATE THE HILL DESCENT CONTROL™ SWITCH</b>	

- Ignition OFF.
- Disconnect: Hill Descent Control™ Switch C3394 .
- Measure the resistance between Hill Descent Control™ switch pins 1 and 6, component side, while pressing and releasing the switch.



N0122269

- Is the resistance less than 5 ohms with the switch pressed and greater than 10,000 ohms with the switch released?

#### Yes

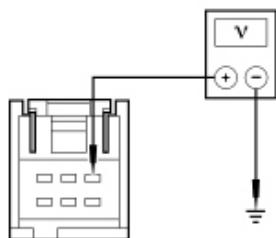
If DTC C2809 was recorded, GO to [J4](#).  
For all other conditions, GO to [J5](#).

#### No

INSTALL a new Hill Descent Control™ switch by removing the auxiliary switch assembly. REFER to the exploded view in [Section 501-12](#). PRESS the tab on each side of the switch to remove it from the bezel. After replacing the switch, CLEAR the DTCs and REPEAT the self-test. TEST the system for normal operation.

### J4 CHECK THE HILL DESCENT CONTROL™ SWITCH SIGNAL CIRCUIT FOR A SHORT TO VOLTAGE

- Disconnect: [IPC\\_C220](#) .
- Ignition ON.
- Measure the voltage between Hill Descent Control™ switch C3394-1, circuit CET59 (GY/VT), harness side and ground.



N0101067

- Is any voltage present?

#### Yes

REPAIR circuit CET59 (GY/VT).  
CLEAR the DTCs. REPEAT the self-test.

#### No

The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST for normal operation.

### J5 CHECK THE HILL DESCENT CONTROL™ SWITCH SIGNAL CIRCUIT FOR AN OPEN

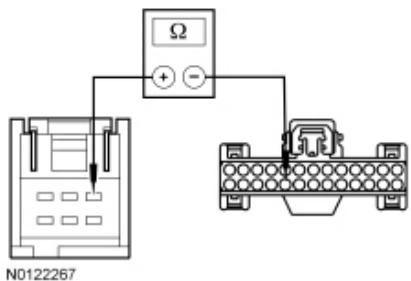
- Ignition OFF.
- Disconnect: [IPC\\_C220](#) .
- Measure the resistance between Hill Descent Control™ switch C3394-1, circuit CET59 (GY/VT), harness side and [IPC\\_C220-22](#), circuit CET59 (GY/VT), harness side.

#### Yes

GO to [J6](#).

#### No

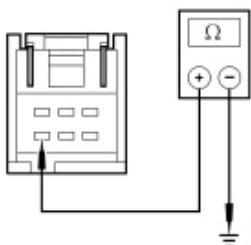
REPAIR circuit CET59 (GY/VT). TEST the system for normal operation.



- Is the resistance less than 5 ohms?

#### J6 CHECK THE HILL DESCENT CONTROL™ SWITCH GROUND CIRCUIT

- Ignition ON.
- Measure the resistance between Hill Descent Control™ switch C3394-6, circuit GD138 (BK/WH), harness side and ground.



- Is the resistance less than 5 ohms?

#### J7 CHECK FOR CORRECT IPC OPERATION

- Check IPC connector:
  - corrosion
  - damaged pins
  - pushed-out pins
- Connect the IPC connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- Is the concern still present?

**Yes**  
GO to [J7](#).

**No**  
REPAIR the open in circuit GD138 (BK/WH). CLEAR the DTCs. REPEAT the self-test.

**Yes**  
INSTALL a new IPC. REFER to [Section 413-01](#). TEST the system for normal operation.

**No**  
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

#### Pinpoint Test K: DTC U0100

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

##### Normal Operation

- DTC U0100 (Lost Communication With ECM/PCM) — this DTC sets in continuous memory if the brake pedal position switch, and traction control messages that should be received from the ECM/PCM are missing for 5 seconds or longer.

##### This pinpoint test is intended to diagnose the following:

- PCM

- ABS module

#### PINPOINT TEST K: DTC U0100

Test Step	Result / Action to Take
<b>K1 VERIFY THE SCAN TOOL COMMUNICATES WITH THE PCM</b>	<p><b>Yes</b> GO to <a href="#">K2</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a> to diagnose no communication with the PCM.</p>
<b>K2 CHECK THE ABS MODULE CONTINUOUS MEMORY DTCs</b>	<p><b>Yes</b> GO to <a href="#">K3</a>.</p> <p><b>No</b> The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>K3 RETRIEVE THE RECORDED DTCs FROM THE PCM KOEO SELF-TEST</b>	<p><b>Yes</b> For PCM DTCs, REFER to <a href="#">Section 303-14</a>.</p> <p><b>No</b> GO to <a href="#">K4</a>.</p>
<b>K4 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE SELF-TEST</b>	<p><b>Yes</b> <a href="#">GO to Pinpoint Test A</a>.</p> <p><b>No</b> GO to <a href="#">K5</a>.</p>
<b>K5 CHECK FOR DTC U0100 SET IN OTHER MODULES</b>	<p><b>Yes</b> INSTALL a new PCM. REFER to <a href="#">Section 303-14</a>. TEST the system for normal operation.</p> <p><b>No</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test L: DTC U0114

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### **Normal Operation**

- DTC U0114 (Lost Communication with Transfer Case Control Module (TCCM)) — this DTC sets in continuous memory if the Four-Wheel Drive (4WD) message that should be received from the Transfer Case Control Module (TCCM) is missing for 5 seconds or longer.

#### **This pinpoint test is intended to diagnose the following:**

- TCCM
- ABS module

#### **PINPOINT TEST L: DTC U0114**

Test Step	Result / Action to Take
<b>L1 VERIFY THE CUSTOMER CONCERN</b>	<p><b>Yes</b> GO to <a href="#">L2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>L2 CHECK THE COMMUNICATION NETWORK</b>	<p><b>Yes</b> GO to <a href="#">L3</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a>.</p>
<b>L3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND <u>TCCM</u> SELF-TESTS</b>	<p><b>Yes</b> For ABS module DTC B1676, <a href="#">GO to Pinpoint Test A</a>. For <u>TCCM</u> DTCs, REFER to <a href="#">Section 308-07A</a>.</p> <p><b>No</b> GO to <a href="#">L4</a>.</p>
<b>L4 RECHECK THE ABS MODULE DTCs</b>	<p><b>Yes</b> GO to <a href="#">L5</a>.</p> <p><b>No</b> The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>L5 CHECK FOR DTC U0114 SET IN OTHER MODULES</b>	

<ul style="list-style-type: none"> <li>Clear the DTCs.</li> <li>Ignition OFF.</li> <li>Ignition ON.</li> <li>Wait 10 seconds.</li> <li>Enter the following diagnostic mode on the scan tool: Self Test — All CMOTCs .</li> <li><b>Is DTC U0114 set in more than 1 module?</b></li> </ul>	<p><b>Yes</b> INSTALL a new TCCM. REFER to <a href="#">Section 308-07A</a>. CLEAR the DTCs. REPEAT the ABS module self-test.</p> <p><b>No</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.</p>
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### Pinpoint Test M: DTC U0131

#### Normal Operation

- DTC U0131 (Lost Communication With Power Steering Control Module (VAPS) — this DTC sets in continuous memory and on-demand if the steering sensor message that should be received from the Power Steering Control Module (PSCM) is missing for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- PSCM
- ABS module

### PINPOINT TEST M: DTC U0131

Test Step	Result / Action to Take
<b>M1 VERIFY THE CUSTOMER CONCERN</b>	<p><b>Yes</b> GO to <a href="#">M2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>M2 CHECK THE COMMUNICATION NETWORK</b>	<p><b>Yes</b> GO to <a href="#">M3</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a>.</p>
<b>M3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND PSCM SELF-TESTS</b>	<p><b>Yes</b> For ABS module DTC B1676, <a href="#">GO to Pinpoint Test A</a>. For PSCM DTCs, REFER to <a href="#">Section 211-00B</a>.</p> <p><b>No</b> GO to <a href="#">M4</a>.</p>
<b>M4 RECHECK THE ABS MODULE DTCs</b>	

<ul style="list-style-type: none"> <li>• Clear the DTCs.</li> <li>• Ignition OFF.</li> <li>• Wait 10 seconds.</li> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module .</li> <li>• <b>Is DTC U0131 still present?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">M5</a>.</p> <p><b>No</b> The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<p><b>M5 CHECK FOR DTC U0131 SET IN OTHER MODULES</b></p> <ul style="list-style-type: none"> <li>• Clear the DTCs.</li> <li>• Ignition OFF.</li> <li>• Ignition ON.</li> <li>• Wait 10 seconds.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — All CMOTCs.</li> <li>• <b>Is DTC U0131 set in more than 1 module?</b></li> </ul>	<p><b>Yes</b> INSTALL a new PSCM. REFER to <a href="#">Section 211-00B</a>. CLEAR the DTCs. REPEAT the ABS module self-test.</p> <p><b>No</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test N: DTC U0131

##### Normal Operation

- **NOTE:** Vehicles with a 6.2L engine are equipped with a Steering Column Control Module (SCCM).

DTC U0131 (Lost Communication With Power Steering Control Module (VAPS) — this DTC sets in continuous memory and on-demand if the steering sensor message that should be received from the SCCM is missing for 5 seconds or longer.

This pinpoint test is intended to diagnose the following:

- SCCM.
- ABS module

#### PINPOINT TEST N: DTC U0131

Test Step	Result / Action to Take
<p><b>N1 VERIFY THE CUSTOMER CONCERN</b></p> <ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Verify there is an observable symptom present.</li> <li>• <b>Is an observable symptom present?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">N2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<p><b>N2 CHECK THE COMMUNICATION NETWORK</b></p> <ul style="list-style-type: none"> <li>• Using a scan tool, carry out a Network Test.</li> <li>• <b>Does the <u>SCCM</u> pass the network test?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">N3</a>.</p> <p><b>No</b></p>

	REFER to <a href="#">Section 418-00</a> .
<b>N3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND <u>SCCM</u> SELF-TESTS</b>	<p><b>Yes</b> For ABS module DTC B1676, <a href="#">GO to Pinpoint Test A</a>. For <u>SCCM</u> DTCs, REFER to <a href="#">Section 211-05</a>.</p> <p><b>No</b> GO to <a href="#">N4</a>.</p>
<b>N4 RECHECK THE ABS MODULE DTCs</b>	<p><b>Yes</b> GO to <a href="#">N5</a>.</p> <p><b>No</b> The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>N5 CHECK FOR DTC U0131 SET IN OTHER MODULES</b>	<p><b>Yes</b> INSTALL a new <u>SCCM</u>. REFER to <a href="#">Section 211-00A</a>. CLEAR the DTCs. REPEAT the ABS module self-test.</p> <p><b>No</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test O: DTCs U0140

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

##### Normal Operation

- DTC U0140 (Lost Communication With Body Control Module (GEM)) — this DTC sets in the ABS module if it cannot transmit to or receive messages from the Body Control Module (BCM) over the High Speed Controller Area Network (HS-CAN) for 5 seconds or longer.

##### This pinpoint test is intended to diagnose the following:

- ABS module
- BCM

#### PINPOINT TEST O: DTC U0140

Test Step	Result / Action to Take
O1 VERIFY THE CUSTOMER CONCERN	

<ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Verify that there is an observable symptom present.</li> <li>• <b>Is an observable symptom present?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">O2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>O2 CHECK THE COMMUNICATION NETWORK</b>	<p><b>Yes</b> GO to <a href="#">O3</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a>.</p>
<b>O3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND <u>BCM</u> SELF-TESTS</b>	<p><b>Yes</b> For ABS module DTC B1676, <a href="#">GO to Pinpoint Test A</a>. For <u>BCM</u> DTCs, REFER to <a href="#">Section 419-10</a>.</p> <p><b>No</b> GO to <a href="#">O4</a>.</p>
<b>O4 CHECK FOR DTC U0140 OR U0140:00 SET IN OTHER MODULES</b>	<p><b>Yes</b> INSTALL a new <u>BCM</u>. REFER to <a href="#">Section 419-10</a>. TEST the system for normal operation. CLEAR the DTCs. REPEAT the ABS module self-test</p> <p><b>No</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test P: DTCs C1280, C1282, C1516, C1963, C1975, C2770, U0151 and U0452

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The ABS module uses information received from several sensors (wheel speed sensors, steering wheel rotation sensor, stability/traction control system sensors, etc.) to determine if vehicle stability, traction or roll warrants ESC or RSC® interaction. If an event is going to occur, the ABS module adjusts the brake torque at specific wheels and the PCM reduces engine torque to make the vehicle more stable. Once the ABS module has determined that the stability event has been corrected, it returns the brake and engine torque to normal and continues to monitor the vehicle. DTCs set in the ignition cycle can only be cleared by cycling the ignition off and on once the fault has been corrected. The Restraints Control Module (RCM) measures the yaw rate and vehicle acceleration, then sends the signal through a secondary, dedicated Controller Area Network (CAN) to the ABS module. The ABS module uses this information for AdvanceTrac® and RSC® system operation. The ABS module also compares this information to information it receives from other sensors (brake pedal input, steering wheel) to determine how valid the information is and to determine if an instability event is about to occur.

The RCM and the ABS module communicate along circuits VCA23 (BU/WH) and VCA24 (GN/OG). An open circuit or a short to power or ground on any one of these circuits causes the ABS module to set a DTC. Also, if the RCM is not mounted in the correct position, with the electrical connector facing the driver-side of the vehicle, the ABS module also sets DTCs.

DTC Description	Fault Trigger Condition
<ul style="list-style-type: none"> <li>C1280 — Yaw Rate Sensor Signal Fault</li> <li>C1282 — Lateral Accelerometer Signal Fault</li> <li>C1516 — Roll Rate Sensor Signal Fault</li> <li>C2770 — Longitudinal Acceleration Sensor Signal Fault</li> </ul>	If the ABS module receives a message from the <u>RCM</u> that is out of the normal operating range or one that does not agree with other sensor information, the appropriate signal fault DTC sets.
<ul style="list-style-type: none"> <li>C1963 — Stability Control Inhibit Warning</li> <li>C1975 — IVD Plausibility Failure</li> </ul>	If conditions or DTCs exist that prevent the AdvanceTrac® and RSC® systems from operating, DTCs C1963 and/or C1975 sets. This DTC is usually set due to the steering wheel rotation sensor or the <u>RCM</u> being damaged or installed incorrectly. If DTCs are present from the <u>RCM</u> or <u>PSCM</u> , diagnose these DTCs first.  a
<ul style="list-style-type: none"> <li>U0151 — Lost Communication with Restraints Control Module (RCM)</li> <li>U0452 — Invalid Data Received from RCM</li> </ul>	The <u>RCM</u> uses a dedicated communication bus to send information to the ABS module. If, during normal operation, the ABS module does not receive any information from the <u>RCM</u> for more than 250 milliseconds, DTC U0151 or U0452 sets. U0151 monitors both the <u>HS-CAN</u> and the dedicated <u>CAN</u> circuits. If the ABS module does not receive the <u>RCM</u> serial number, over the <u>HS-CAN</u> , DTC U0151 sets. It also sets if the sensor data is not received over the dedicated <u>CAN</u> from the <u>RCM</u> . These DTCs can also be caused by another module software update. CLEAR all module DTCs and carry out another self-test to recheck the system.

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**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- RCM
- ABS module

**PINPOINT TEST P: DTCs C1280, C1282, C1516, C1963, C1975, C2770, U0151 and U0452**

 **WARNING:** Do not handle, move or change the original horizontal mounting position of the restraints control module (RCM) while the RCM is connected and the ignition switch is ON. Failure to follow this instruction may result in the accidental deployment of the Safety Canopy and cause serious personal injury or death.

 **WARNING:** Never probe the electrical connectors on airbag, Safety Canopy or side air curtain assemblies. Failure to follow this instruction may result in the accidental deployment of these

assemblies, which increases the risk of serious personal injury or death.



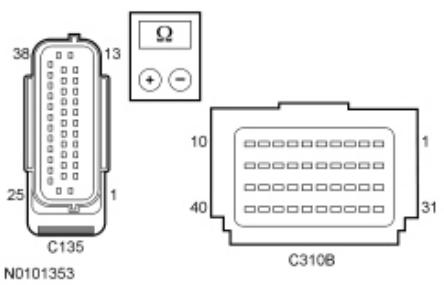
**WARNING:** Never disassemble or tamper with seat belt deployable components, including pretensioners, load limiters and inflators. Never back probe deployable device electrical connectors. Tampering or back probing may cause an accidental deployment and result in personal injury or death.

**NOTICE:** Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

**NOTE:** Supplemental Restraint System (SRS) components should only be disconnected or reconnected when instructed to do so within a pinpoint test step. Failure to follow this instruction may result in incorrect diagnosis of the SRS.

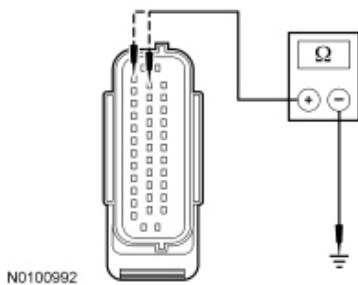
**NOTE:** The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

Test Step	Result / Action to Take
<b>P1 CHECK FOR A HS-CAN COMMUNICATION CONCERN WITH THE RCM OR PSCM</b>	<p><b>Yes</b> GO to <a href="#">P2</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a> to diagnose the High Speed Controller Area Network (HS-CAN) bus.</p>
<b>P2 CHECK FOR RCM AND PSCM DTCs</b>	<p><b>Yes</b> For <u>RCM</u> DTCs, REFER to <a href="#">Section 501-20B</a>. For <u>PSCM</u> DTCs, REFER to <a href="#">Section 211-00A</a>.</p> <p><b>No</b> If only one of the following ABS module DTCs C1280, C1282, C1516, C2770 was retrieved, GO to <a href="#">P3</a>. If more than one ABS module DTC C1280, C1282, C1516, C2770 was retrieved, GO to <a href="#">P7</a>. For DTCs U0151 and U0452, GO to <a href="#">P7</a>. For all other DTCs, GO to <a href="#">P3</a>.</p>
<b>P3 CHECK THE ABS MODULE YAW RATE (YAW_RATE_2) PID</b>	<p><b>Yes</b> GO to <a href="#">P4</a>.</p> <p><b>No</b> GO to <a href="#">P12</a>.</p>

<p><b>P4 CHECK THE ABS MODULE LATERAL ACCELERATION (LAT_ACCL_2) PID</b></p> <ul style="list-style-type: none"> <li>• <b>NOTE:</b> The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test.</li> <li>• Monitor the LAT_ACCL_2 PID.</li> <li>• <b>Is the LAT_ACCL_2 PID value between -0.125g and 0.125g?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">P5</a>.</p> <p><b>No</b> GO to <a href="#">P12</a>.</p>									
<p><b>P5 CHECK THE ABS MODULE LONGITUDINAL ACCELERATION (LONG_ACCL) PID</b></p> <ul style="list-style-type: none"> <li>• <b>NOTE:</b> The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test.</li> <li>• Monitor the LONG_ACCL PID.</li> <li>• <b>Is the LONG_ACCL PID value between -0.15g and 0.15g?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">P6</a>.</p> <p><b>No</b> GO to <a href="#">P12</a>.</p>									
<p><b>P6 CHECK THE ABS MODULE ROLL RATE (ROLLRAT) PID</b></p> <p><b>NOTE:</b> The vehicle must be on level ground and at a complete standstill. Any vehicle movement results in false values for this test.</p> <ul style="list-style-type: none"> <li>• Monitor the ROLLRAT PID.</li> <li>• <b>Is the ROLLRAT PID value between -3.5 and 3.5?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">P7</a>.</p> <p><b>No</b> GO to <a href="#">P12</a>.</p>									
<p><b>P7 CHECK THE DEDICATED CAN CIRCUITS FOR AN OPEN</b></p> <ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Depower the <u>SRS</u>. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in <a href="#">Section 501-20B</a>.</li> <li>• Disconnect: ABS Module C135 .</li> <li>• Disconnect: <u>RCM</u> C310A and C310B .</li> <li>• Measure the resistance between the ABS module C135, harness side and the <u>RCM</u> C310B, harness side as indicated in the following chart:</li> </ul>	<p><b>Yes</b> GO to <a href="#">P8</a>.</p> <p><b>No</b> REPAIR the affected circuit(s). REPOWER the <u>SRS</u>. REFER to Supplemental Restraint System (SRS) Depowering and Repowering in <a href="#">Section 501-20B</a>. CLEAR all CMDTCs. PERFORM a road test. REPEAT the self-test.</p>									
<table border="1"> <thead> <tr> <th>ABS Module</th> <th>Circuit</th> <th>RCM</th> </tr> </thead> <tbody> <tr> <td>C135-37</td> <td>VCA23 (BU/WH)</td> <td>C310B-20</td> </tr> <tr> <td>C135-24</td> <td>VCA24 (GN/OG)</td> <td>C310B-19</td> </tr> </tbody> </table>  <ul style="list-style-type: none"> <li>• <b>Are the resistances less than 5 ohms?</b></li> </ul>	ABS Module	Circuit	RCM	C135-37	VCA23 (BU/WH)	C310B-20	C135-24	VCA24 (GN/OG)	C310B-19	
ABS Module	Circuit	RCM								
C135-37	VCA23 (BU/WH)	C310B-20								
C135-24	VCA24 (GN/OG)	C310B-19								

**P8 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TO GROUND**

- Measure the resistance between ground and:
  - ABS module C135-24, circuit VCA24 (GN/OG), harness side.
  - ABS module C135-37, circuit VCA23 (BU/WH), harness side.



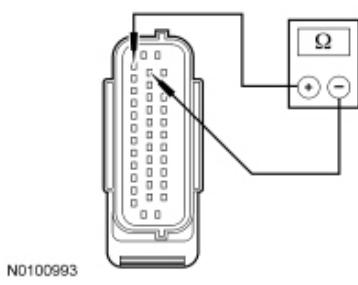
- Is the resistance greater than 10,000 ohms?

**Yes**  
GO to [P9](#).

**No**  
REPAIR the affected circuit(s). REPOWER the SRS. REFER to Supplemental Restraint System (SRS) Depowering and Repowering in [Section 501-20B](#). CLEAR all CMDTCs. PERFORM a road test. REPEAT the self test.

**P9 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TOGETHER**

- Measure the resistance between ABS module C135-24, circuit VCA24 (GN/OG), harness side and ABS module C135-37, circuit VCA23 (BU/WH), harness side.



- Is the resistance greater than 10,000 ohms?

**Yes**  
GO to [P10](#).

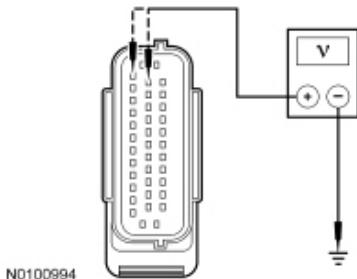
**No**  
REPAIR the affected circuit(s). REPOWER the SRS. REFER to Supplemental Restraint System (SRS) Depowering and Repowering in [Section 501-20B](#). CLEAR all CMDTCs. PERFORM a road test. REPEAT the self test.

**P10 CHECK THE DEDICATED CAN CIRCUITS FOR A SHORT TO VOLTAGE**

- Repower the SRS. **Do not** prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in [Section 501-20B](#).
- Ignition ON.
- Measure the voltage between ground and:
  - ABS module C135-24, circuit VCA24 (GN/OG), harness side.
  - ABS module C135-37, circuit VCA23 (BU/WH), harness side.

**Yes**  
REPAIR the affected circuit(s). CLEAR all CMDTCs. PERFORM a road test. REPEAT the self test.

**No**  
GO to [P11](#).



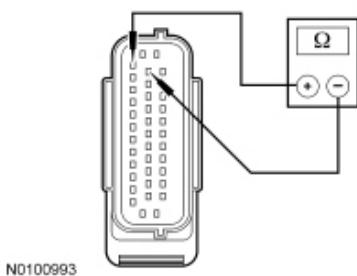
- Is any voltage present?

#### P11 CHECK RCM TERMINATING RESISTOR

- Ignition OFF.
- Depower the SRS. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in [Section 501-20B](#).
- Prior to reconnecting any previously disconnected SRS component:
  - inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.
  - inspect wire harness for any damage, pinched, cut or pierced wires.
  - inspect RCM C310A and C310B Connector Position Assurance (CPA) lever/lock for correct operation. Refer to RCM in [Section 501-20B](#).
  - repair any concerns found.

Refer to Wiring Diagrams Cell 5, Connector Repair Procedures for schematic and connector information.

- Connect: RCM C310A and C310B .
- Measure the resistance between ABS module C135-37, circuit VCA23 (BU/WH), harness side and C135-24, circuit VCA24 (GN/OG), harness side.



- Is the resistance between 108 and 132 ohms?

#### P12 CHECK THE RCM INSTALLATION AND MOUNTING SURFACE

- Ignition OFF.
- If not previously directed to do so, depower the Supplemental Restraint System (SRS). Refer to

**Yes**  
GO to [P12](#).

**No**  
INSTALL a new RCM. REFER to [Section 501-20B](#). CLEAR all CMDTCs . PERFORM a road test. REPEAT the self test. If the concern is still present, GO to [P14](#). If other DTCs are present, REFER to the appropriate DTC chart.

**Yes**  
GO to [P13](#).

<p>Supplemental Restraint System (SRS) Depowering and Repowering in <a href="#">Section 501-20B</a>.</p> <ul style="list-style-type: none"> <li>• Inspect the Restraints Control Module (RCM) installation and make sure that the fasteners are fully seated and tightened correctly. Refer to <a href="#">RCM</a> in <a href="#">Section 501-20B</a>.</li> <li>• Inspect the mounting surface for damage, corrosion or foreign material.</li> <li>• <b>Is the RCM installed correctly and is the mounting surface clean and free from damage?</b></li> </ul>	<p><b>No</b> REPAIR or INSTALL new as necessary. REPOWER the <a href="#">SRS</a>. REFER to Supplemental Restraint System (SRS) Depowering and Repowering in <a href="#">Section 501-20B</a>. CLEAR all <a href="#">CMDTCs</a>. PERFORM a road test. REPEAT the self test.</p>
<p><b>P13 CHECK FOR AN INTERMITTENT FAULT</b></p> <ul style="list-style-type: none"> <li>• Disconnect: <a href="#">RCM</a> C310A and C310B .</li> <li>• Disconnect: ABS module C135 . <ul style="list-style-type: none"> <li>▪ inspect connector(s) (including any in-line connectors) for corrosion, loose or spread terminals and loose or frayed wire connections at terminals.</li> <li>▪ inspect wire harness for any damage, pinched, cut or pierced wires.</li> <li>▪ repair any concerns found.</li> </ul> </li> </ul> <p>Refer to Wiring Diagrams Cell <a href="#">5</a>, Connector Repair Procedures for schematic and connector information.</p> <ul style="list-style-type: none"> <li>• Connect: All Previously Disconnected Component (s)/Connector(s) .</li> <li>• Repower the <a href="#">SRS</a>. <b>Do not</b> prove out the <a href="#">SRS</a> at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in <a href="#">Section 501-20B</a>.</li> <li>• Perform a road test.</li> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module .</li> <li>• <b>Is the concern still present?</b></li> </ul>	<p><b>Yes</b> INSTALL a new <a href="#">RCM</a>. REFER to <a href="#">Section 501-20B</a>. CLEAR all <a href="#">CMDTCs</a>. PERFORM a road test. REPEAT the self test. If the concern is still present, GO to <a href="#">P14</a>. If other DTCs are present, REFER to the appropriate DTC chart.</p> <p><b>No</b> The fault is not present and cannot be recreated at this time. <b>Do not install any new <a href="#">SRS</a> components at this time. <a href="#">SRS</a> components should only be installed when directed to do so in the pinpoint test.</b></p>
<p><b>P14 CHECK THE ABS MODULE FOR CORRECT OPERATION</b></p> <ul style="list-style-type: none"> <li>• Depower the <a href="#">SRS</a>. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in <a href="#">Section 501-20B</a>.</li> <li>• Prior to reconnecting any previously disconnected <a href="#">SRS</a> component: <ul style="list-style-type: none"> <li>▪ inspect connector(s) (including any in-line connectors) for pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.</li> <li>▪ inspect wire harness for any damage, pinched, cut or pierced wires.</li> <li>▪ inspect <a href="#">RCM</a> C310A and C310B <a href="#">CPA</a> lever/lock for correct operation. Refer to <a href="#">RCM</a> in <a href="#">Section 501-20B</a>.</li> <li>▪ inspect ABS module C135 for dirt, corrosion, water intrusion, pushed-out, loose or spread terminals and loose or frayed wire connections at terminals.</li> <li>▪ repair any concerns found.</li> </ul> </li> </ul>	<p><b>Yes</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.</p>

<p>Refer to Wiring Diagrams Cell <a href="#">5</a>, Connector Repair Procedures for schematic and connector information.</p> <ul style="list-style-type: none"> <li>• Connect All Previously Disconnected Component(s)/Connector(s).</li> <li>• Repower the <u>SRS</u>. <b>Do not</b> prove out the SRS at this time. Refer to Supplemental Restraint System (SRS) Depowering and Repowering in <a href="#">Section 501-20B</a>.</li> <li>• Perform a road test.</li> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module.</li> <li>• <b>Is the concern still present?</b></li> </ul>	
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#### Pinpoint Test Q: DTC U0155

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

##### Normal Operation

- DTC U0155 (Lost Communication With Instrument Panel Cluster (IC) Control Module) — this DTC sets in continuous memory and on-demand if the traction control switch information, or other sensor messages from the IPC are not received for 5 seconds or longer.

##### This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- IPC
- ABS module

#### PINPOINT TEST Q: DTC U0155

Test Step	Result / Action to Take
<b>Q1 VERIFY THE CUSTOMER CONCERN</b>	<p><b>Yes</b> GO to <a href="#">Q2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>Q2 CHECK THE COMMUNICATION NETWORK</b>	<p><b>Yes</b> GO to <a href="#">Q3</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a>.</p>
<b>Q3 RETRIEVE THE RECORDED DTCs FROM THE ABS MODULE AND <u>IPC</u> SELF-TESTS</b>	

<ul style="list-style-type: none"> <li>Enter the following diagnostic mode on the scan tool: Self Test — ABS Module .</li> <li>Enter the following diagnostic mode on the scan tool: Self Test — <u>IPC</u> .</li> <li><b>Is ABS module DTC B1676 or <u>IPC</u> DTC U3003:16 or DTC U3003:17 received?</b></li> </ul>	<p><b>Yes</b> For ABS module DTC B1676, <a href="#">GO to Pinpoint Test A</a> . For <u>IPC</u> DTCs, REFER to <a href="#">Section 413-01</a> .</p> <p><b>No</b> GO to <a href="#">Q4</a> .</p>
<b>Q4 RECHECK THE ABS MODULE DTCs</b> <ul style="list-style-type: none"> <li>Clear the DTCs.</li> <li>Ignition OFF.</li> <li>Wait 10 seconds.</li> <li>Ignition ON.</li> <li>Enter the following diagnostic mode on the scan tool: Self Test — ABS Module .</li> <li><b>Is DTC U0155 still present?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">Q5</a> .</p> <p><b>No</b> The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>Q5 CHECK FOR DTC U0155 OR U0155:00 SET IN OTHER MODULES</b> <ul style="list-style-type: none"> <li>Clear the DTCs.</li> <li>Ignition OFF.</li> <li>Ignition ON.</li> <li>Wait 10 seconds.</li> <li>Enter the following diagnostic mode on the scan tool: Self Test — All CMDTCs .</li> <li><b>Is DTC U0155:00 set in more than 1 module?</b></li> </ul>	<p><b>Yes</b> INSTALL a new <u>IPC</u> . REFER to <a href="#">Section 413-01</a> . CLEAR the DTCs. REPEAT the ABS module self-test.</p> <p><b>No</b> INSTALL a new ABS module. REFER to <a href="#">Anti-Lock Brake System (ABS) Module</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test R: The Stability/Traction Control System is Inoperative or Cannot be Disabled

Refer to Wiring Diagrams Cell [42](#) , Instrument Cluster for schematic and connector information.

##### Normal Operation

The stability/traction control switch is a normally open switch. When the switch is pressed, the Instrument Panel Cluster (IPC) senses ground through the switch and sends a message to the ABS module along the High Speed Controller Area Network (HS-CAN) to disable the stability/traction control system. The IPC also illuminates the traction control message center indicator.

**NOTE:** If a MyKey® restricted key is in use with the AdvanceTrac® always on feature configured to on, the traction control system cannot be disabled. An admin key must be used in order to enable and disable the traction control system .

- DTC C2775 (TC/AYC ON/OFF Switch Stuck Failure) — this DTC sets during the key cycle if the IPC senses a short to ground on stability/traction control switch circuit, if the stability/traction control switch is pressed for longer than 30 seconds, or if the stability/traction control switch is pressed during the on-demand self-test.

**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- MyKey® restricted key in use
- Stability/traction control switch

- IPC

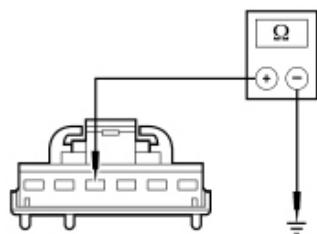
#### PINPOINT TEST R: THE STABILITY/TRACTION CONTROL SYSTEM IS INOPERATIVE OR CANNOT BE DISABLED

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

Test Step	Result / Action to Take
<b>R1 VERIFY THAT THE KEY IN USE IS NOT MYKEY® RESTRICTED</b>	<p><b>Yes</b> INFORM the customer that the key in use is MyKey® restricted. If necessary, REFER to the Owner's Literature for information regarding the programming of MyKey® features.</p> <p><b>No</b> GO to <a href="#">R2</a>.</p>
<b>R2 CHECK FOR ABS MODULE DTCs</b>	<p><b>Yes</b> For DTC U0073, REFER to <a href="#">Section 418-00</a> to diagnose the HS-CAN. For DTC U0155, <a href="#">GO to Pinpoint Test Q</a>. For DTC U0423, CARRY OUT a self-test of the <u>IPC</u>. REFER to <a href="#">Section 413-01</a> to diagnose the <u>IPC</u> concern.</p> <p><b>No</b> GO to <a href="#">R3</a>.</p>
<b>R3 ISOLATE THE STABILITY/TRACTION CONTROL SWITCH</b>	<p><b>Yes</b> GO to <a href="#">R4</a>.</p> <p><b>No</b> INSTALL a new stability/traction control switch. REFER to <a href="#">Stability/Traction Control Switch</a> in this section. TEST the system for normal operation.</p> <p>N0122274</p> <ul style="list-style-type: none"> <li>Is the resistance less than 5 ohms with the switch pressed and greater than 10,000 ohms with the switch released?</li> </ul>

**R4 CHECK THE SWITCH INPUT CIRCUIT FOR A SHORT TO GROUND**

- Disconnect: Battery Negative Cable .
- Disconnect: IPC C220 .
- Measure the resistance between stability/traction control switch C2355-4, circuit CCA15 (YE/GY), harness side and ground.



N0089363

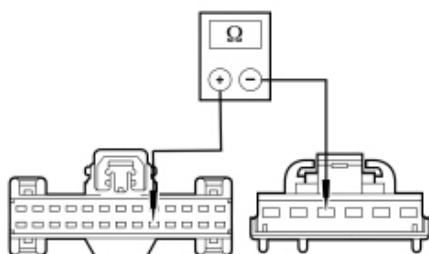
- Is the resistance greater than 10,000 ohms?

**Yes**  
GO to [R5](#) .

**No**  
REPAIR circuit CCA15 (YE/GY).  
TEST the system for normal operation.

**R5 CHECK THE SWITCH INPUT CIRCUIT FOR AN OPEN**

- Measure the resistance between stability/traction control switch C2355-4, circuit CCA15 (YE/GY), harness side and IPC C220-18, circuit CCA15 (YE/GY), harness side.



N0120950

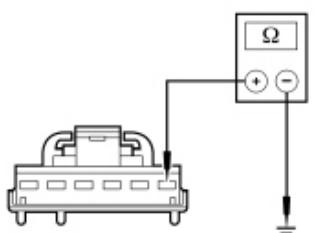
- Is the resistance less than 5 ohms?

**Yes**  
GO to [R6](#) .

**No**  
REPAIR circuit CCA15 (YE/GY).  
TEST the system for normal operation.

**R6 CHECK THE SWITCH GROUND CIRCUIT FOR AN OPEN**

- Measure the resistance between stability/traction control switch C2355-1, circuit GD133 (BK), harness side and ground.



N0106102

- Is the resistance less than 5 ohms?

**Yes**  
GO to [R7](#) .

**No**  
REPAIR circuit GD133 (BK). TEST the system for normal operation.

R7 CHECK FOR CORRECT <u>IPC</u> OPERATION	
<ul style="list-style-type: none"> <li>• Check <u>IPC</u> C220 for:           <ul style="list-style-type: none"> <li>■ corrosion</li> <li>■ damaged pins</li> <li>■ pushed-out pins</li> </ul> </li> <li>• Connect the <u>IPC</u> connector and make sure it seats correctly.</li> <li>• Operate the system and verify the concern is still present.</li> <li>• <b>Is the concern still present?</b></li> </ul>	<p><b>Yes</b> INSTALL a new <u>IPC</u>. REFER to <a href="#">Section 413-01</a>. CLEAR the DTCs. REPEAT the self-test.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.</p>

### Pinpoint Test S: Poor Vehicle Tracking During Anti-Lock Function

Refer to Wiring Diagrams Cell [42](#), Vehicle Dynamic Systems for schematic and connector information.

#### Normal Operation

The ABS module uses input from several different sensors (wheel speed sensors, Brake Pedal Position (BPP) switch, sensor cluster, etc.) to determine if an ABS event is necessary. If an ABS event is necessary, the ABS module commands the hydraulic pump motor on and the Hydraulic Control Unit (HCU) to actuate the appropriate solenoids. During an ABS event, the front and rear end of the vehicle should track true to the direction of travel along the vehicle centerline unless driver input dictates otherwise. Other items that could cause uneven braking during an ABS event are; an internal issue with the HCU, an issue with the base brake system (caliper, brake pads, etc.) or worn out suspension components.

The operating voltage required for ABS module, hydraulic pump and isolation valve operation is between 10 and 17 volts.

#### This pinpoint test is intended to diagnose the following:

- Air in hydraulic brake system
- Low tire pressure
- Base brake system
- HCU

### PINPOINT TEST S: POOR VEHICLE TRACKING DURING ANTI-LOCK FUNCTION

Test Step	Result / Action to Take
<b>S1 VERIFY VEHICLE TRACKING DURING NON-ABS BRAKING</b> <ul style="list-style-type: none"> <li>• <b>NOTE:</b> Before road testing the vehicle, check the tire pressure and confirm tire pressures are set to the pressure indicated on the <u>VC</u> label.</li> <li>• Test drive the vehicle and verify vehicle tracking during normal braking.</li> <li>• <b>Does the vehicle track correctly during normal braking?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">S2</a>.</p> <p><b>No</b> The condition can be caused by a base brake concern or vehicle alignment. REFER to <a href="#">Section 206-00</a> to verify the base brake system and REFER to <a href="#">Section 204-00</a> to verify suspension components.</p>

<p><b>S2 BLEED THE BRAKE SYSTEM</b></p> <ul style="list-style-type: none"> <li>• Bleed the HCU. Refer to <a href="#">Section 206-00</a>.</li> <li>• Test drive the vehicle and verify vehicle tracking during an ABS stop.</li> <li>• <b>Does the vehicle track correctly during an ABS stop?</b></li> </ul>	<p><b>Yes</b> The brake system is operating correctly. The concern may have been caused by air in the hydraulic system or a sticky valve.</p> <p><b>No</b> GO to <a href="#">S3</a>.</p>
<p><b>S3 CHECK THE ABS INLET VALVE (CLOSED POSITION)</b></p> <ul style="list-style-type: none"> <li>• Connect the scan tool.</li> <li>• Ignition ON.</li> <li>• With the vehicle in NEUTRAL, position it on a hoist. Refer to <a href="#">Section 100-02</a>.</li> <li>• Rotate all the wheels to make sure they rotate freely (the transmission must be in NEUTRAL).</li> <li>• Apply moderate brake pedal effort.</li> <li>• Enter the following diagnostic mode on the scan tool: DataLogger — ABS Module .</li> <li>• Toggle the left front inlet valve (LF_INLET) active command ON and at the same time, have an assistant attempt to rotate the LF wheel.</li> <li>• <b>Does the LF wheel rotate?</b></li> </ul>	<p><b>Yes</b> TOGGLE the LF_INLET active command OFF. INSTALL a new HCU. REFER to <a href="#">Hydraulic Control Unit (HCU)</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> TOGGLE the LF_INLET active command OFF. GO to <a href="#">S4</a>.</p>
<p><b>S4 CHECK THE ABS INLET VALVE (OPEN POSITION)</b></p> <ul style="list-style-type: none"> <li>• Apply moderate brake pedal effort.</li> <li>• Have an assistant attempt to rotate the LF wheel.</li> <li>• <b>Does the LF wheel rotate?</b></li> </ul>	<p><b>Yes</b> INSTALL a new HCU. REFER to <a href="#">Hydraulic Control Unit (HCU)</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> GO to <a href="#">S5</a>.</p>
<p><b>S5 CHECK THE ABS OUTPUT VALVE (OPEN POSITION)</b></p> <ul style="list-style-type: none"> <li>• Apply moderate brake pedal effort.</li> <li>• Toggle the left front outlet valve (LF_OUTLET) and the LF_INLET active commands ON and, at the same time, have an assistant attempt to rotate the LF wheel.</li> <li>• <b>Does the LF wheel rotate?</b></li> </ul>	<p><b>Yes</b> TOGGLE all active commands OFF. INSTALL a new HCU. REFER to <a href="#">Hydraulic Control Unit (HCU)</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> TOGGLE all active commands OFF. GO to <a href="#">S6</a>.</p>
<p><b>S6 CHECK THE ABS INLET AND OUTLET VALVE (CLOSED POSITION)</b></p> <ul style="list-style-type: none"> <li>• Apply moderate brake pedal effort.</li> <li>• Have an assistant attempt to rotate the LF wheel.</li> <li>• <b>Does the LF wheel rotate?</b></li> </ul>	<p><b>Yes</b> INSTALL a new HCU. REFER to <a href="#">Hydraulic Control Unit (HCU)</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> REPEAT this procedure (GO to <a href="#">S3</a>) for the RF, LR and RR wheels using the appropriate active</p>

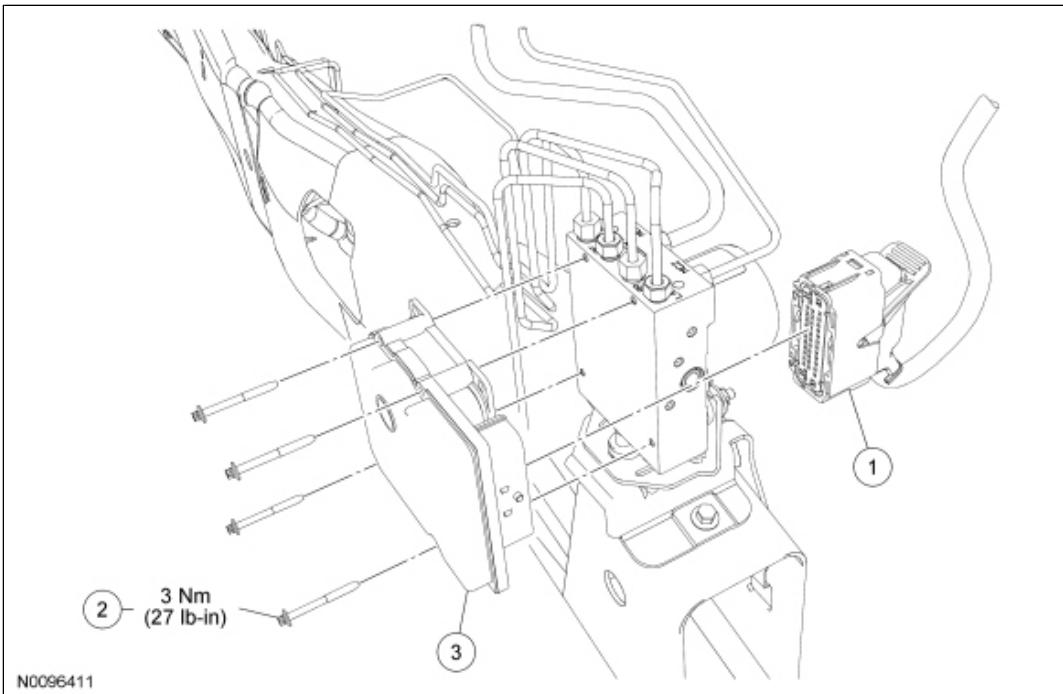
commands. If no failure occurs, the system is operating normally.

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## Anti-Lock Brake System (ABS) Module

### Special Tool(s)

 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
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Item	Part Number	Description
1	—	ABS module electrical connector (part of 12A581)
2	2M101	ABS module screw (also part of 2C219) (4 required)
3	2C219	ABS module

### Removal and Installation

**NOTICE:** Do not connect the wiring connector to the ABS module while it is separated from the HCU, doing so sets DTCs that cannot be cleared.

**NOTICE:** Electronic modules are sensitive to electrical charges. The ABS module can be damaged if exposed to these charges.

**NOTICE:** Do not swap ABS modules between vehicles. Brake fluid pressure sensor calibration varies depending on vehicle configuration. Swapping ABS modules between vehicles with different calibrations causes a DTC to set in the ABS module that cannot be cleared.

1. If a new ABS module is being installed, connect the scan tool and upload the module configuration information from the ABS module. For additional information on configuration, refer to Programmable Module Installation (PMI) in [Section 418-01](#).
2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to [Section 303-12](#).
3. Disconnect the ABS module electrical connector.
4. **NOTICE:** Pull the ABS module straight back until the coil packs and motor connector clear the Hydraulic Control Unit (HCU) or damage to the ABS module may result.

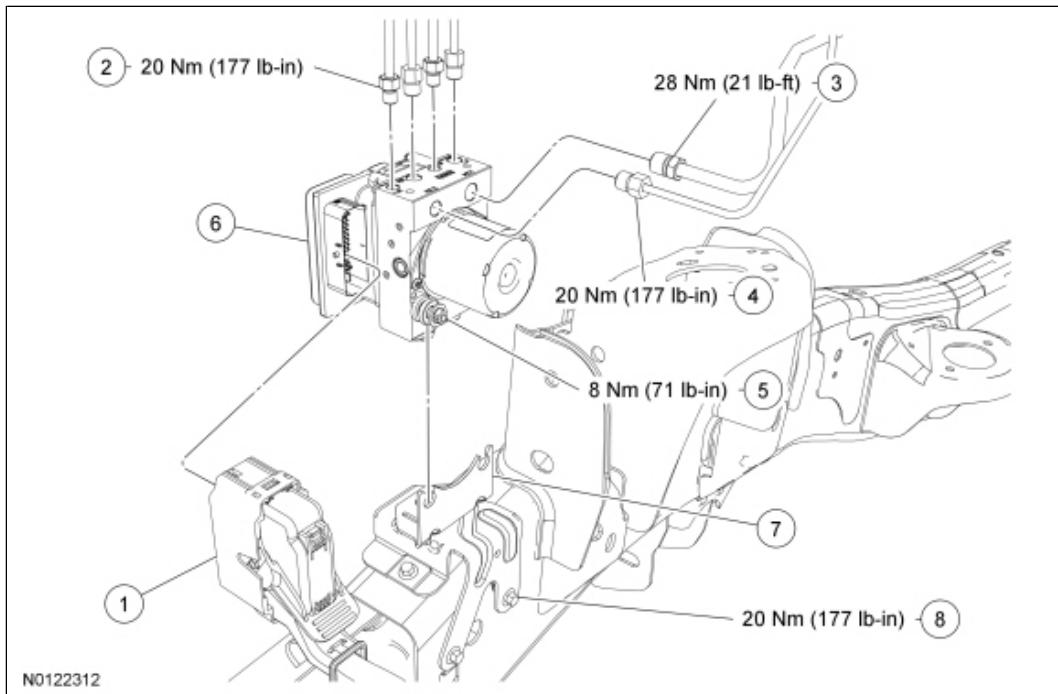
Remove the 4 ABS module screws and the ABS module.

- To install, tighten to 3 Nm (27 lb-in).
5. To install, reverse the removal procedure.
    - When installing a new ABS module, it must be configured (using vehicle as-built data or module configuration information retrieved earlier in this procedure). For additional information on configuration, refer to PMI in [Section 418-01](#).
-

## Hydraulic Control Unit (HCU)

### Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1



Item	Part Number	Description
1	—	ABS module electrical connector (part of 12A581)
2	—	Brake tube-to-Hydraulic Control Unit (HCU) fitting (4 required)
3	2A040	Master cylinder primary brake tube-to- <u>HCU</u> fitting
4	2B253	Master cylinder secondary brake tube-to- <u>HCU</u> fitting
5	—	<u>HCU</u> -to-bracket nut (part of kit 2C229) (2 required)
6	2C215	<u>HCU</u> _(also part of 2C405)
7	2C304	<u>HCU</u> bracket (also part of 2C405)
8	W506424	<u>HCU</u> bracket bolts (3 required)

## Removal and Installation



**WARNING:** Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.



**WARNING:** Carefully read cautionary information on product label. For emergency medical information seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

**NOTICE:** Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

**NOTICE:** Electronic modules are sensitive to electrical charges. The ABS module can be damaged if exposed to these charges.

**NOTICE:** Do not allow brake fluid or other contaminates to drip onto the ABS module or into the electrical connector. Contamination may cause a permanent failure to occur.

**NOTE:** The Hydraulic Control Unit (HCU) bracket does not have to be removed in order to complete this procedure.

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to [Section 303-12](#).
2. **NOTE:** The brake tubes must be installed in the same location as removed.  
Remove the 4 brake tube-to- HCU fittings.
  - To install, tighten to 20 Nm (177 lb-in).
3. Disconnect the master cylinder primary and secondary brake tube-to- HCU fittings.
  - To install, tighten the master cylinder primary brake tube-to- HCU fitting to 28 Nm (21 lb-ft).
  - To install, tighten the master cylinder secondary tube brake tube-to- HCU fitting to 20 Nm (177 lb-in).
4. Loosen the 2 HCU -to-bracket nuts and remove the HCU.
  - To install, tighten to 8 Nm (71 lb-in).
5. To install, reverse the removal procedure.
  - Bleed the brake system. For additional information, refer to [Section 206-00](#).

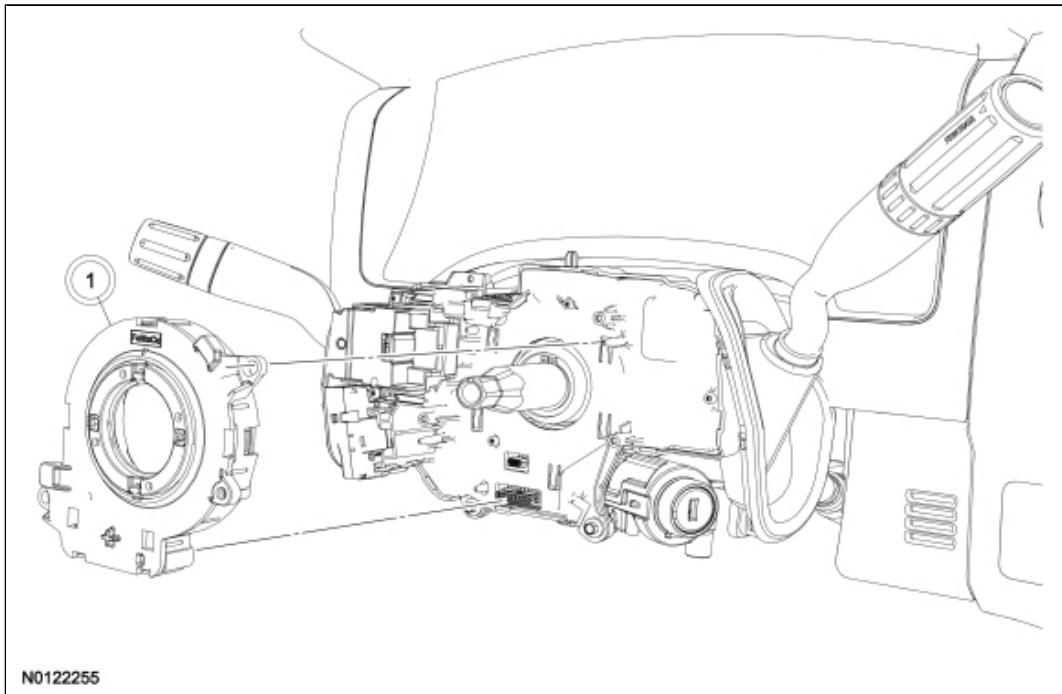


## **Stability/Traction Control Switch**

### **Removal and Installation**

1. Refer to Passenger Air Bag Deactivation (PAD) Indicator in [Section 501-20B](#).
-

## Steering Wheel Rotation Sensor



N0122255

Item	Part Number	Description
1	3F818	Steering wheel rotation sensor

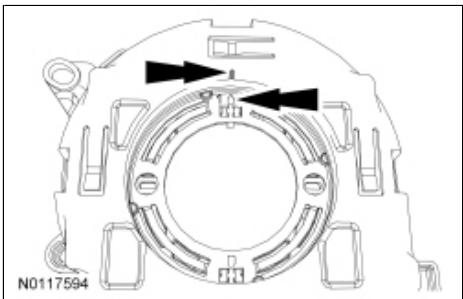
### Removal

**NOTE:** Only available on the 6.2L engine. For all other applications, the sensor is part of the Electronic Power Assist Steering (EPAS) and is not serviced separately.

1. Remove the clockspring. For additional information, refer to [Section 501-20B](#).
2. Remove the steering wheel rotation sensor.

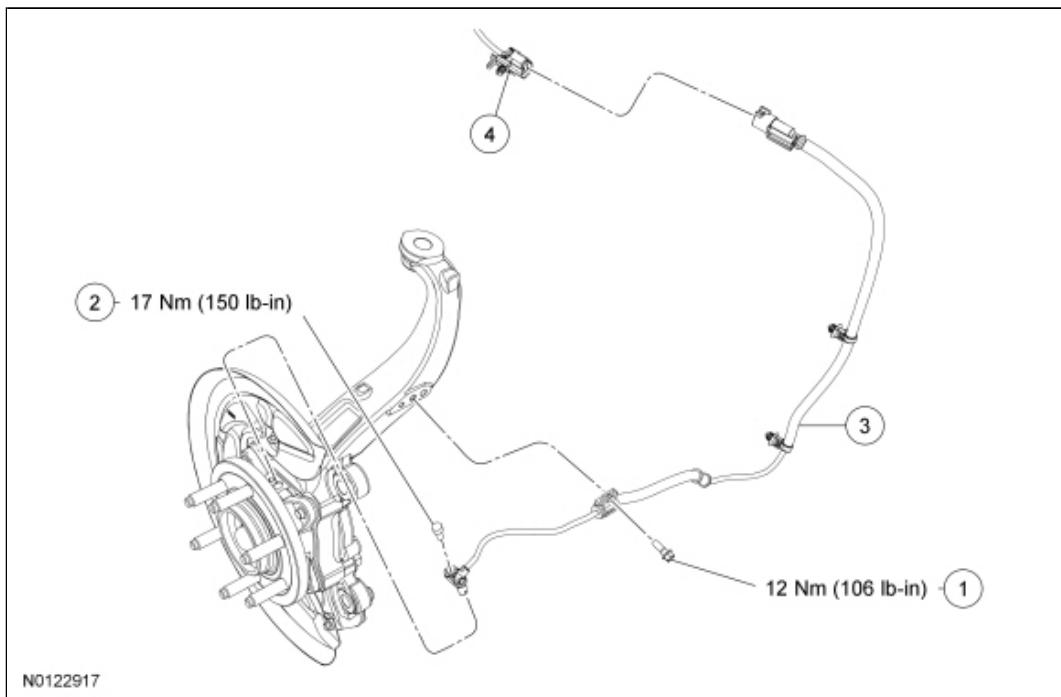
### Installation

1. Align the arrow on the inner ring of the sensor to the notch on the sensor body.



2. Position the sensor on the Steering Column Control Module (SCCM).
  3. Install the clockspring. For additional information, refer to [Section 501-20B](#).
-

## Wheel Speed Sensor — Front



Item	Part Number	Description
1	W710279	Wheel speed sensor harness bolt
2	—	Wheel speed sensor bolt (part of 2C204)
3	2C204	Wheel speed sensor
4	—	Wheel speed sensor electrical connector (part of 14250)

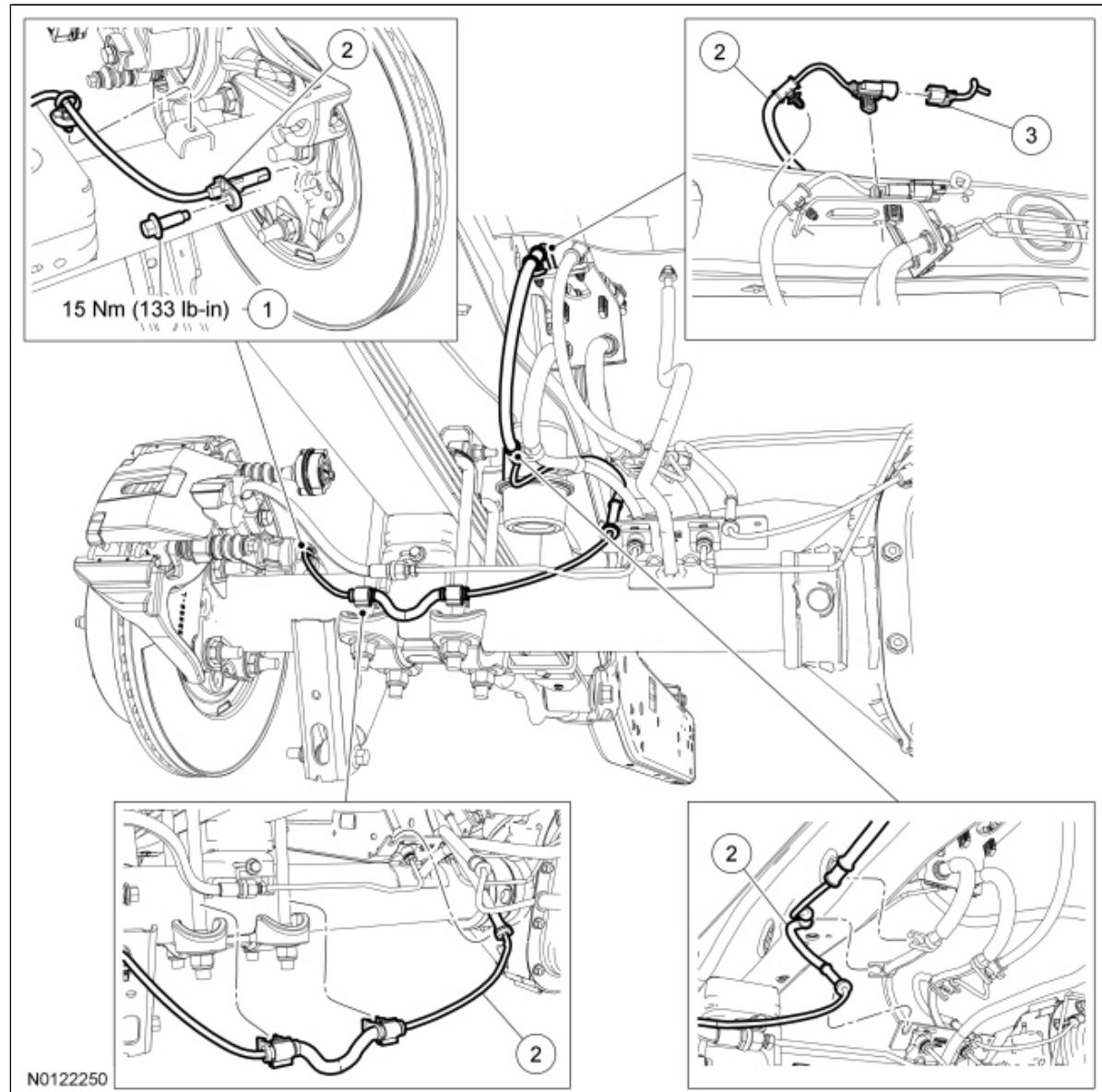
### Removal and Installation

1. Remove the brake disc. For additional information, refer to [Section 206-03](#).
2. **NOTE:** The wheel speed sensor harness electrical connector is located in the engine compartment secured to the fender apron.  
Disconnect the wheel speed sensor electrical connector.
3. Detach the 2 wheel speed sensor harness pushpin retainers.
4. Detach the wheel speed sensor harness retainer from the brake hose.
5. Remove the wheel speed sensor harness bolt.

- To install, tighten to 12 Nm (106 lb-in).
6. Remove the wheel speed sensor bolt and the wheel speed sensor.
    - To install, tighten to 17 Nm (150 lb-in).
  7. To install, reverse the removal procedure.
-

## Wheel Speed Sensor — Rear

### Left Rear Wheel Speed Sensor



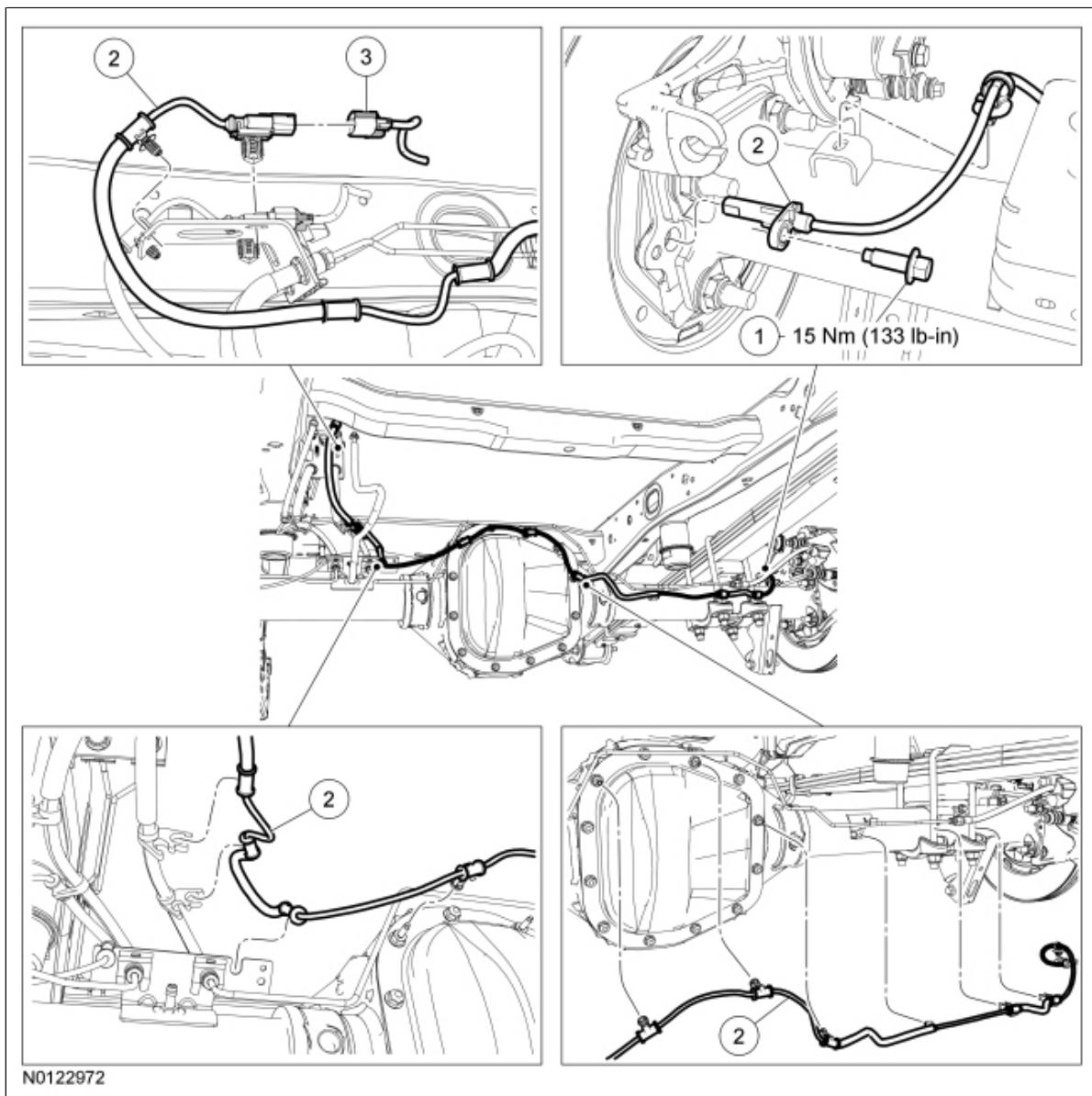
Item	Part Number	Description
1	W500223	Wheel speed sensor bolt
2	2C190	Wheel speed sensor

3

—

Wheel speed sensor electrical connector (part of  
14405)

### Right Rear Wheel Speed Sensor



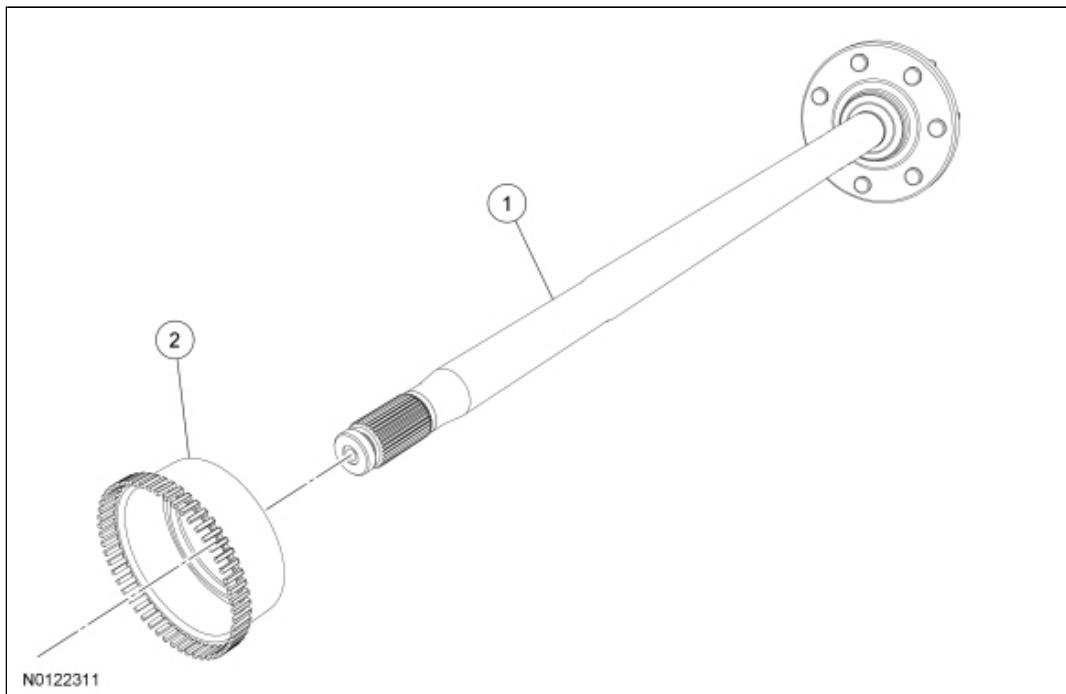
Item	Part Number	Description
1	W500223	Wheel speed sensor bolt
2	2C190	Wheel speed sensor
3	—	Wheel speed sensor electrical connector (part of 14405)

## **Removal and Installation**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02.](#)
  2. Disconnect the wheel speed sensor electrical connector.
  3. Detach the wheel speed sensor harness retainers and pushpin retainers.
  4. Remove the wheel speed sensor bolt and the wheel speed sensor.
    - To install, tighten to 15 Nm (133 lb-in).
  5. To install, reverse the removal procedure.
-

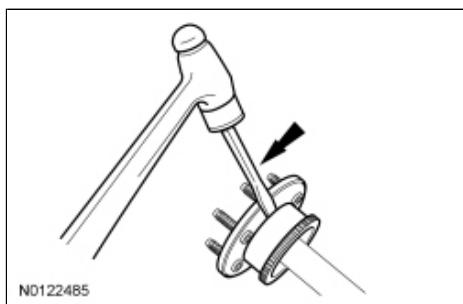
## Wheel Speed Sensor Ring — Rear

### Removal



Item	Part Number	Description
1	4234	Axle shaft
2	2C189	Wheel speed sensor ring

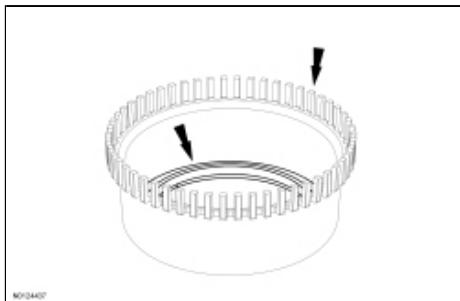
1. Remove the rear axle shaft. For additional information, refer to [Section 205-02A](#) or [Section 205-02B](#).
2. Using a suitable driver, remove the wheel speed sensor ring from the axle shaft and discard the ring.



### Installation

1. **NOTICE:** Do not apply any amount of force to the tooth area of the wheel speed sensor ring during installation, the sensor teeth are fragile and can be easily damaged. Apply force only to the inner lip area of the wheel speed sensor ring.

Using suitable adapters, press the wheel speed sensor ring onto the rear axle shaft.



2. Install the rear axle shaft. For additional information, refer to [Section 205-02A](#) or [Section 205-02B](#).
-

## Auxiliary Brake System — Trailer Brake Control (TBC) Module

### Trailer Brake Control System

The trailer brake control system consists of the following components:

- Trailer Brake Control (TBC) module, which is mounted in the center of the instrument panel just below the climate controls
- Trailer tow connector
- Instrument Panel Cluster (IPC)

The TBC module has the following driver inputs and outputs:

- Manual slider switch (input)
- Gain buttons (input)
- Gain setting display (output)
- Trailer connectivity icon (output)
- Output bar graph display (output)

The manual slider switch on the TBC module activates the trailer brakes independently from the vehicle brakes. The manual slider is used in conjunction with the gain buttons to adjust and set the trailer brakes. When the manual lever is activated with a trailer connected to the vehicle, the trailer stoplamps and the vehicle stoplamps illuminate. Activating the manual lever without a trailer connected to the vehicle still illuminates the vehicle stoplamps.

The gain buttons set the TBC system for specific towing conditions such as trailer load, vehicle load, road conditions and weather. The gain is normally set to provide maximum trailer braking while maintaining trailer stability. For information on setting the trailer brake gain, refer to the Owner's Literature.

The gain setting and output bar graph displays provide the driver with TBC system information. Trailer connectivity is provided through the trailer connector icon or message center depending on which IPC the vehicle is equipped with, the gain setting display provides the driver with the current gain setting and the output bar graph shows the amount of power going to the trailer brakes relative to brake pedal or manual lever input (only if a trailer is connected to the vehicle).

### TBC System Message Center Messages and Displays

The IPC message center displays the gain setting and relative braking power during a braking event. The message center also indicates trailer connectivity and trailer wiring faults. The following message center messages pertain to the TBC system:

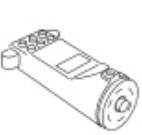
- **NO TRAILER** — This message is displayed whenever the ignition is cycled from OFF to RUN without a trailer connected to the 7-pin trailer connector.
- **TRAILER CONNECTED** — This message is displayed when a correct trailer connection at the 7-pin trailer connector has been made during a given ignition cycle.
- **OUTPUT** — When the vehicle brake pedal is applied, or when the manual control is activated, bar indicators illuminate in the message center to indicate the amount of power going to the trailer brakes

relative to the brake pedal or manual control input. One bar indicates the least amount of output with 6 bars indicating maximum output.

- **TRAILER DISCONNECTED** — This message is displayed and accompanied by a single chime when a correct trailer connection was made and then a disconnection has been sensed during a given ignition cycle. This message is also displayed if any of the following occur:
    - the 7-pin trailer connector becomes disconnected while driving
    - an intermittent open circuit occurs in the vehicle wiring from the TBC module to the 7-pin trailer connector or the trailer wiring
    - during manual activation using the manual control lever without a trailer connected (accompanied by a single chime)
  - **TRAILER BRAKE MODULE FAULT** — This message is displayed and a DTC is stored when a fault is detected by the TBC module.
  - **WIRING FAULT ON TRAILER** — This message is displayed when the trailer brake output circuit is shorted to ground or shorted to voltage. A DTC sets in the TBC module indicating which circuit fault was observed. It is important to determine if a trailer was connected when this message was displayed. If this message is only observed with a trailer connected, the concern is related to the trailer wiring and not the vehicle. If this message is observed without a trailer connected, the concern is with the vehicle wiring from the TBC module to the 7-pin trailer connector.
  - **TBC FAULT** — This message is displayed if the Instrument Panel Cluster (IPC) is receiving communications from the TBC module, but has not been configured for a trailer brake system. If the message center displays TBC FAULT and there are no DTCs stored in the TBC module, follow the steps in Programmable Parameters to verify and/or modify the TBC module programmable parameter in the IPC.
-

## Auxiliary Brake System — Trailer Brake Control (TBC) Module

### Special Tool(s)

 ST2574-A	Flex Probe Kit NUD105-R025D or equivalent
 ST3093-A	Fluke 77-IV Digital Multimeter FLU77-4 or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
 ST2954-A	7-Way Trailer Emulator TEK-6562A or equivalent

### Principles of Operation

**NOTE:** A trailer brake emulator tool is available to verify that the Trailer Brake Control (TBC) module and vehicle wiring are functioning correctly. The trailer emulator requires the trailer tow connector ground and 12 volt trailer tow charge circuit to be connected in order to check the electric brake circuit. Battery Junction Box (BJB) fuse 21 (30A) and the Trailer Tow/Battery Charge Relay must be installed for battery voltage to be supplied to the trailer tow connector. The fuse and relay are supplied as loose-shipped items with the vehicle and may not have been installed during Pre-Delivery Inspection (PDI).

The Trailer Brake Control (TBC) module is an integrated electronic control device designed to provide variable braking power to the electric-actuated drum brakes on a towed trailer (1 to 4 axles only). The braking energy provided to the trailer is varied with a Pulse Width Modulated (PWM) signal that switches between 0 volts and battery voltage, the higher the duty cycle the more braking power available.

The TBC module receives information from the stoplamp switch and the PCM. The brake pressure transducer is internal to the ABS module.

The stoplamp switch is mounted on the brake pedal bracket and switches on or off depending on the brake

pedal position. The TBC module receives the stoplamp switch and the brake torque information over the High Speed Controller Area Network (HS-CAN) from the PCM.

The TBC module receives information through the HS-CAN. These inputs are from the PCM, the Instrument Panel Cluster (IPC) and the ABS module. The Body Control Module (BCM) also sends ignition state, park lamp status and illumination dimming level data to the TBC module. The information sent from the TBC module is passed to the IPC and is displayed on the message center.

To adjust the gain setting up or down, the TBC module faceplate provides the driver with control buttons which determine the maximum power output. The TBC module faceplate also provides a manual control lever to manually apply the trailer brakes, independent of the vehicle brakes, to calibrate the gain setting to the specific trailer loading and road conditions. When the manual control lever is activated with a trailer connected to the vehicle, the trailer stoplamps and the vehicle stoplamps (except the center high mount stoplamp) illuminate. If a trailer is not connected and the manual control lever is activated, the vehicle still illuminates the vehicle stoplamps (except the center high mount stoplamp).

#### **Trailer Brake Control (TBC) Module Wake Up**

**NOTE:** These conditions require that a trailer **not** be connected to the trailer tow connector.

The following conditions describe the normal operation of the TBC module at start up.

When the ignition key is in the RUN position and the manual lever is set all the way to the left with a gain of 10, the message center should display TRAILER DISCONNECTED. At the same time, with the vehicle stationary, battery voltage should be present at pin 3 of the trailer tow connector.

When not braking the TBC module sends a voltage pulse every 4 seconds to pin 3 of the trailer tow connector to determine whether a trailer is connected to the trailer tow connector.

#### **Instrument Panel Cluster (IPC) Configuration For Trailer Brake Control (TBC) Functionality**

The same IPC is used for vehicles with and without the TBC option. TBC functionality is enabled or disabled using the scan tool. If the vehicle is equipped with a TBC module, but the IPC was not configured for TBC, the TBC module shuts down, no TBC information is displayed in the message center and DTC U2202 sets in the TBC module.

If the IPC is configured for TBC, but the vehicle is not equipped with a TBC module, TRAILER BRAKE MODULE FAULT is displayed in the message center. This symptom could occur if a replacement IPC was installed, but not configured correctly. For information on the TBC programmable parameter, refer to Programmable Parameters below.

#### **Programmable Parameters**

The message center displays TBC FAULT if it is receiving communications from the TBC module, but has not been configured for a trailer brake system. If the message center displays TBC FAULT and there are no DTCs stored in the TBC module, follow these steps to verify and/or modify the TBC module programmable parameter in the Instrument Panel Cluster (IPC).

1. Identify the vehicle using the normal Integrated Diagnostic System (IDS) process.
2. Select Programming and press the check box.

3. Select Module Programming and press the check box.
4. Select Programmable Parameters and press the check box.
5. Select Personality and press the check box.
6. Follow the on-screen directions.
7. **NOTE:** The scan tool displays either EQUIPPED or NOT EQUIPPED to the left of TBC - IPC.  
Highlight TBC - IPC.
8. If the IPC needs to be configured for a trailer brake system, choose EQUIPPED and press the check box.
9. Clear DTCs from the TBC module, then carry out a self-test on the TBC module. Refer to the Trailer Brake Control (TBC) Module DTC Chart for any DTCs retrieved.

### **Inspection and Verification**

**NOTE:** Carry out all pinpoint tests **without** a trailer connected to the vehicle.

**NOTE:** A trailer brake emulator tool is available to verify that the TBC module and vehicle wiring are functioning correctly. The trailer emulator requires the trailer tow connector ground and 12 volt trailer tow charge circuit to be connected in order to check the electric brake circuit.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

### **Visual Inspection Chart**

Mechanical	Electrical
<ul style="list-style-type: none"> <li>Base brake system</li> <li>Trailer</li> </ul>	<ul style="list-style-type: none"> <li>Battery Junction Box (BJB) fuse 17 (30A)</li> <li>Body Control Module (BCM) fuse 37 (10A)</li> <li>Wiring, terminals or connectors</li> <li>Trailer Brake Control (TBC) module</li> </ul>

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. **NOTE:** Make sure to use the latest scan tool software release.  
If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).
5. **NOTE:** The Vehicle Communication Module (VCM) LED prove-out confirms power and ground from the DLC are provided to the VCM.  
If the scan tool does not communicate with the VCM:
  - check the VCM connection to the vehicle.

- check the scan tool connection to the VCM.
  - refer to [Section 418-00](#), No Power To The Scan Tool, to diagnose no power to the scan tool.
6. If the scan tool does not communicate with the vehicle:
- verify the ignition is ON.
  - verify the scan tool operation with a known good vehicle.
  - refer to [Section 418-00](#), The PCM Does Not Respond To The Scan Tool, to diagnose no response from the PCM.
7. Carry out the network test.
- If the scan tool responds with no communication for one or more modules, refer to [Section 418-00](#).
  - If the network test passes, retrieve and record Continuous Memory Diagnostic Trouble Codes (CMDTCs).
8. Clear the [CMDTCs](#) and carry out the self-test diagnostics for the [TBC](#) module.
9. If the DTCs retrieved are related to the concern, go to the Trailer Brake Control (TBC) Module DTC Chart. For all other DTCs, refer to [Section 419-10](#).
10. If no DTCs related to the concern are retrieved, GO to [Symptom Chart](#).

## DTC Chart

**Trailer Brake Control (TBC) Module DTC Chart**

DTC	Description	Action
B1317	Battery Voltage High	<a href="#">GO to Pinpoint Test D</a> .
B1318	Battery Voltage Low	<a href="#">GO to Pinpoint Test E</a> .
B1342	<a href="#">ECU is Faulted</a>	<p>INSPECT for a stuck or damaged manual sliding lever and gain control buttons. REPAIR or CLEAR any obstructions or foreign material.</p> <p>REPAIR all other DTCs before repairing B1342. CLEAR the DTCs. TEST the system for normal operation.</p> <p><b>NOTE:</b> It takes 2 minutes for the Trailer Brake Control (TBC) module to set this DTC due to a stuck manual sliding lever or a stuck gain control button.</p> <p>If the DTC returns, INSTALL a new Trailer Brake Control (TBC) module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> in this section.</p>
B1863	<a href="#">TBC Ground Open Circuit</a>	<a href="#">GO to Pinpoint Test F</a> .
C2806	Trailer Brakes Wiring Circuit Short to Vbatt	<a href="#">GO to Pinpoint Test A</a> .
C2807	Trailer Brakes Wiring Circuit Short to Ground	<a href="#">GO to Pinpoint Test A</a> .
U0100	Lost Communication With <a href="#">ECM/PCM "B"</a>	<a href="#">GO to Pinpoint Test G</a> .

U0121	Lost Communication With Anti-Lock Brake System (ABS) Control Module	<a href="#">GO to Pinpoint Test H.</a>
U0140	Lost Communication With Body Control Module (GEM)	<a href="#">GO to Pinpoint Test I.</a>
U0155	Lost Communication With Instrument Panel Cluster (IC) Control Module	<a href="#">GO to Pinpoint Test J.</a>
U0415	Invalid Data Received from Anti-Lock Brake System (ABS) Control Module	This DTC indicates that the <u>TBC</u> module has received the brake pressure information sent from the ABS module, but that information does not agree with other sensor inputs. REFER to <a href="#">Section 206-09</a> to diagnose the ABS module.
U2202	Invalid Configuration Data Received	The Instrument Panel Cluster (IPC) is not configured for trailer brakes. REFER to Programmable Parameters in this section. CLEAR the DTCs. REPEAT the self-test.

## Symptom Chart

### Symptom Chart

Condition	Possible Sources	Action
<ul style="list-style-type: none"> <li>No communication with the Trailer Brake Control (TBC) module</li> </ul>	<ul style="list-style-type: none"> <li>Fuse(s)</li> <li>Wiring, terminals or connectors</li> <li><u>TBC</u> module</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 418-00</a>.</li> </ul>
<ul style="list-style-type: none"> <li>The trailer brakes are inoperative</li> </ul>	<ul style="list-style-type: none"> <li>Fuse(s)</li> <li>Wiring, terminals or connectors</li> <li>Trailer tow connector</li> <li><u>TBC</u> module</li> <li>Customer trailer</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">GO to Pinpoint Test B.</a></li> </ul>
<ul style="list-style-type: none"> <li>The trailer brakes are always engaged</li> </ul>	<ul style="list-style-type: none"> <li>Wiring, terminals or connectors</li> <li><u>TBC</u> module</li> <li>Customer trailer</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">GO to Pinpoint Test C.</a></li> </ul>
<ul style="list-style-type: none"> <li>The message center intermittently displays TRAILER DISCONNECTED or WIRING FAULT ON TRAILER while towing a trailer</li> </ul>	<ul style="list-style-type: none"> <li>Wiring, terminals or connectors</li> <li>Customer trailer</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">GO to Pinpoint Test A.</a></li> </ul>
<ul style="list-style-type: none"> <li>The message center displays <u>TBC</u> FAULT</li> </ul>	<ul style="list-style-type: none"> <li>DTCs present</li> </ul>	<ul style="list-style-type: none"> <li>RETRIEVE and RECORD the DTCs. REFER to the Trailer Brake Control (TBC)</li> </ul>

Module DTC Chart.		
<ul style="list-style-type: none"> <li>The message center displays TRAILER BRAKE MODULE FAULT when the vehicle is not equipped with a <u>TBC</u> module</li> </ul>	<ul style="list-style-type: none"> <li>Incorrect <u>IPC</u> configuration</li> </ul>	<ul style="list-style-type: none"> <li>CONFIGURE the <u>IPC</u>. REFER to Programmable Parameters in this section.</li> </ul>
<ul style="list-style-type: none"> <li>The message center displays WIRING FAULT ON TRAILER</li> </ul>	<ul style="list-style-type: none"> <li>Wiring, terminals or connectors</li> <li><u>TBC</u> module</li> <li>Customer trailer</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">GO to Pinpoint Test A.</a></li> </ul>

## Pinpoint Tests

### Pinpoint Test A: The Message Center Displays WIRING FAULT ON TRAILER

**NOTE:** Carry out all pinpoint tests **without** a trailer connected to the vehicle.

Refer to Wiring Diagrams Cell [95](#), Trailer/Camper Adapter for schematic and connector information.

#### Normal Operation

The braking energy provided to the trailer is varied with a Pulse Width Modulated (PWM) signal that switches between 0 volts and battery voltage, the higher the duty cycle the more braking power available. The Trailer Brake Control (TBC) module varies the PWM signal based on various inputs such as the brake torque message, the manual slider switch and the gain buttons. With the vehicle stationary and the manual slider switch fully to the left with a gain of 10, there should be more than 10-12 volts supplied to pin 3 of the 7-pin trailer tow connector. When the trailer is connected to the vehicle the Instrument Panel Cluster (IPC) should show the TRAILER CONNECTED message. If the WIRING FAULT ON TRAILER is only message displayed when the trailer is connected, the fault is with the trailer wiring.

Every 4 seconds (when not braking) the TBC module sends a voltage pulse to pin 3 of the 7-pin trailer tow connector to determine whether or not a trailer is connected.

- DTC C2806 (Trailer Brakes Wiring Circuit Short to Vbatt) — this DTC sets in continuous memory when the TBC module detects that the battery voltage is greater than 9 volts while not braking. The TBC module shuts off the trailer brake output and then shuts down.
- DTC C2807 (Trailer Brakes Wiring Circuit Short to Ground) — this DTC sets in continuous memory or on-demand when the TBC module detects that the battery voltage drops by more than 20 percent during a braking event or the trailer brakes are drawing more than 28 amps. The TBC module shuts off the trailer brake output and then shuts down.

**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- TBC module
- Customer trailer

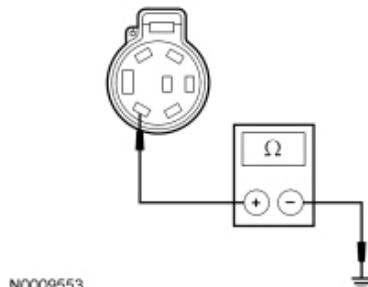
### PINPOINT TEST A: THE MESSAGE CENTER DISPLAYS WIRING FAULT ON TRAILER

**NOTICE:** Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals.  
Do not use standard multi-meter probes.

**NOTE:** Make sure the trailer brakes are electric-magnet actuated drum type brakes before proceeding with this pinpoint test.

Test Step	Result / Action to Take
<b>A1 VERIFY TBC MODULE DTCs</b> <ul style="list-style-type: none"> <li>• Verify a trailer is <b>not</b> connected to the trailer tow connector.</li> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: <u>TBC</u> Module Self-Test .</li> <li>• Clear the DTCs.</li> <li>• Test drive the vehicle in the following manner: <ul style="list-style-type: none"> <li>■ maintain a speed greater than 5 km/h (3 mph)</li> <li>■ turn the headlights ON</li> <li>■ lightly apply the brakes for more than 5 seconds</li> <li>■ activate the left and right turn signals</li> </ul> </li> <li>• Ignition OFF.</li> <li>• Ignition ON.</li> <li>• Wait at least 10 seconds for all modules to wake up and prove out.</li> <li>• Enter the following diagnostic mode on the scan tool: <u>TBC</u> Module Self-Test .</li> <li>• <b>Is DTC C2806 or C2807 present?</b></li> </ul>	<b>Yes</b> GO to <a href="#">A2</a> .  <b>No</b> For all other <u>TBC</u> module DTCs, GO to the <u>TBC</u> Module DTC Chart. If no DTCs return, the system is operating correctly at this time. INSPECT the 7-pin trailer tow connector for water intrusion, corrosion, pushed-out pins and spread terminals. REPAIR or INSTALL new as necessary. If the 7-pin trailer tow connector is OK, SEND the trailer to an authorized camper/trailer repair facility.
<b>A2 CHECK THE TRAILER TOW CONNECTOR</b> <ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Disconnect: Trailer Tow C439A .</li> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: <u>TBC</u> Module Self-Test .</li> <li>• Clear the DTCs.</li> <li>• Test drive the vehicle in the following manner: <ul style="list-style-type: none"> <li>■ maintain a speed greater than 5 km/h (3 mph)</li> <li>■ turn the headlights ON</li> <li>■ lightly apply the brakes for more than 5 seconds</li> <li>■ activate the left and right turn signals</li> </ul> </li> <li>• Ignition OFF.</li> <li>• Ignition ON.</li> <li>• Wait at least 10 seconds for all modules to wake up and prove out.</li> <li>• Enter the following diagnostic mode on the scan tool: <u>TBC</u> Module Self-Test .</li> <li>• <b>Is DTC C2806 or C2807 present?</b></li> </ul>	<b>Yes</b> For DTC C2806, GO to <a href="#">A4</a> . For DTC C2807, GO to <a href="#">A3</a> .  <b>No</b> INSTALL a new 7-pin trailer tow connector. CLEAR any DTCs present. TEST the system for normal operation.
<b>A3 CHECK THE <u>TBC</u> MODULE PWM OUTPUT CIRCUIT FOR A SHORT TO GROUND</b> <ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Connect: Trailer Tow C439A .</li> <li>• Disconnect: <u>TBC</u> Module C2142 .</li> <li>• Measure the resistance between C439A-3, circuit</li> </ul>	<b>Yes</b> GO to <a href="#">A5</a> .  <b>No</b>

CAT19 (BU), harness side and ground.



- Is the resistance greater than 10,000 ohms?

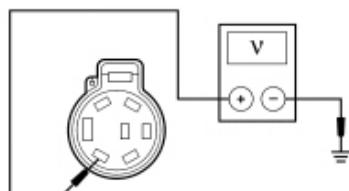
REPAIR circuit CAT19 (BU) for a short to ground. TEST the system for normal operation.

#### A4 CHECK THE TBC MODULE PWM OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Connect: Trailer Tow C439A .
- Disconnect: TBC Module C2142 .
- Ignition ON.
- Measure the voltage between C439A-3, circuit CAT19, (BU), harness side and ground while operating the following lamps in turn:
  - Parking lamps
  - Stop lamps
  - Reversing lamps

**Yes**  
REPAIR circuit CAT19 (BU) for a short to power. TEST the system for normal operation.

**No**  
GO to [A5](#).



- Is any voltage present?

#### A5 CHECK FOR CORRECT TBC MODULE OPERATION

- Ignition OFF.
- Inspect the TBC module connector.
- Repair:
  - corrosion (install a new connector or terminal - clean module pins)
  - damaged or bent pins - install new terminals or pins
  - pushed-out pins - install new pins as necessary
  - spread terminals - install new terminals as necessary
- Connect the TBC module connector and make sure that it seats correctly.
- Test drive the vehicle in the following manner:
  - maintain a speed greater than 5 km/h (3

**Yes**  
INSTALL a new TBC module. REFER to [Trailer Brake Control \(TBC\) Module](#) in this section. TEST the system for normal operation.

**No**  
The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

- mph)
- turn the headlights ON
  - lightly apply the brakes for more than 5 seconds
  - activate the left and right turn signals
  - Ignition OFF.
  - Ignition ON.
  - Wait at least 10 seconds for all modules to wake up and prove out.
  - Enter the following diagnostic mode on the scan tool: TBC Module Self-Test .
  - **Is DTC C2806 or C2807 present?**

### **Pinpoint Test B: The Trailer Brakes are Inoperative**

**NOTE:** Carry out all pinpoint tests **without** a trailer connected to the vehicle.

Refer to Wiring Diagrams Cell [95](#), Trailer/Camper Adapter for schematic and connector information.

#### **Normal Operation**

The braking energy provided to the trailer is varied with a Pulse Width Modulated (PWM) signal that switches between 0 volts and battery voltage, the higher the duty cycle the more braking power available. The Trailer Brake Control (TBC) module varies the PWM signal based on various inputs such as the brake torque message, the manual slider switch and the gain buttons. With the vehicle stationary and the manual slider switch fully to the left with a gain of 10, there should be more than 10-12 volts supplied to the trailer tow connector.

The TBC module receives stoplamp switch information from the PCM and information from the ABS module over the High Speed Controller Area Network (HS-CAN). If there is a problem in the ABS module that is preventing this information from being sent to the TBC module, the TBC module enters a limited operating mode. The TBC module receives fused battery voltage from Battery Junction Box (BJB) fuse 17 (30A) and fused ignition voltage from Body Control Module (BCM) fuse 37 (10A).

#### **This pinpoint test is intended to diagnose the following:**

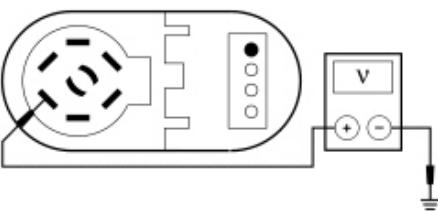
- Fuse(s)
- Wiring, terminals or connectors
- Trailer tow connector
- TBC module
- Customer trailer

### **PINPOINT TEST B: THE TRAILER BRAKES ARE INOPERATIVE**

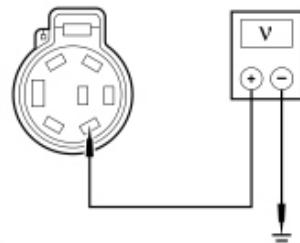
**NOTICE:** Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

**NOTE:** Make sure the trailer brakes are electric-magnet actuated drum-type brakes before proceeding with this pinpoint test.

Test Step	Result / Action to Take
<b>B1 CHECK FOR ANY PCM DTCs</b>	

<ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Allow at least 10 seconds for all modules to wake up and prove out.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — PCM Key ON Engine OFF (KOEO) .</li> <li>• Retrieve and record any PCM DTCs.</li> <li>• <b>Are any PCM DTCs retrieved?</b></li> </ul>	<b>Yes</b> REFER to <a href="#">Section 303-14</a> .  <b>No</b> GO to <a href="#">B2</a> .
<b>B2 CHECK FOR ANY ABS MODULE DTCs</b> <ul style="list-style-type: none"> <li>• Enter the following diagnostic mode on the scan tool: Self Test — ABS Module .</li> <li>• Retrieve and record any ABS module DTCs.</li> <li>• <b>Are any ABS module DTCs retrieved?</b></li> </ul>	<b>Yes</b> REFER to <a href="#">Section 206-09</a> .  <b>No</b> GO to <a href="#">B3</a> .
<b>B3 CHECK FOR SCAN TOOL COMMUNICATION WITH THE TBC MODULE</b> <ul style="list-style-type: none"> <li>• Using a scan tool, carry out the network test.</li> <li>• <b>Did the <u>TBC</u> module pass the network test?</b></li> </ul>	<b>Yes</b> GO to <a href="#">B4</a> .  <b>No</b> REFER to <a href="#">Section 418-00</a> .
<b>B4 CHECK FOR TBC MODULE DTCs</b> <ul style="list-style-type: none"> <li>• Review the DTCs retrieved and recorded during <u>TBC</u> module self-test.</li> <li>• <b>Are any <u>TBC</u> module DTCs present?</b></li> </ul>	<b>Yes</b> REFER to the Trailer Brake Control (TBC) Module DTC Chart.  <b>No</b> GO to <a href="#">B5</a> .
<b>B5 CHECK THE TBC MODULE FOR MAXIMUM OUTPUT</b> <p><b>NOTE:</b> Battery voltage must be greater than 10 volts.</p> <ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Set a gain of 10 in the <u>TBC</u> module.</li> <li>• <b>NOTE:</b> If the manual slider switch is held to the full left position for more than 5 to 20 minutes, the <u>TBC</u> module automatically shuts down.</li> <li>• Have an assistant press the manual slider switch fully to the left with a gain of 10 on the <u>TBC</u> module.</li> <li>• Measure the voltage between trailer tow 7-pin trailer tow connector electric brake supply pin, component side and ground.</li> </ul>  <p>N0084023</p> <ul style="list-style-type: none"> <li>• <b>Is the voltage greater than 10-12 volts?</b></li> </ul>	<b>Yes</b> The <u>TBC</u> module is operating correctly. SEND the trailer to an authorized camper/trailer repair center for an overload condition.  <b>No</b> GO to <a href="#">B6</a> .
<b>B6 CHECK THE TRAILER TOW CONNECTOR FOR AN OPEN</b>	

- Ignition OFF.
- Disconnect: Trailer Tow Connector C439A .
- Ignition ON.
- Have an assistant press the manual slider switch fully to the left with a gain of 10 on the TBC module.
- Measure the voltage between the trailer tow connector C439A-3, circuit CAT19 (BU), harness side and ground.



N0144814

- Is the voltage greater than 10 volts?

**Yes**

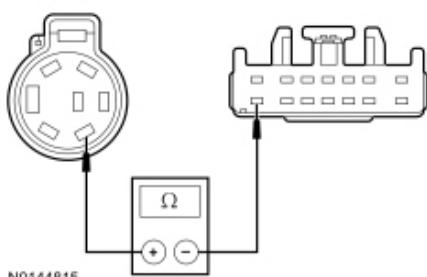
INSTALL a new trailer tow connector. CLEAR the DTCs. TEST the system for normal operation.

**No**

GO to [B7](#).

#### B7 CHECK THE TBC MODULE PWM OUTPUT CIRCUIT FOR AN OPEN

- Ignition OFF.
- Measure the resistance between the trailer tow connector C439A-3, circuit CAT19 (BU), harness side and TBC module C2142-14, circuit CAT19 (BU), harness side.



N0144815

- Is the resistance less than 5 ohms?

**Yes**

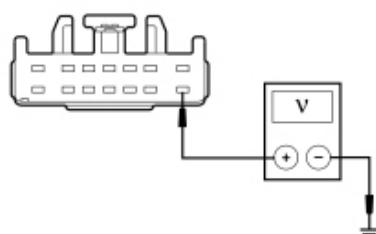
GO to [B8](#).

**No**

REPAIR the circuit. TEST the system for normal operation.

#### B8 CHECK THE BATTERY VOLTAGE TO THE TBC MODULE

- Ignition OFF.
- Measure the voltage between TBC module C2142-8, circuit SBB17 (RD), harness side and ground.



N0121967

- Is the voltage greater than 10 volts?

**Yes**

GO to [B9](#).

**No**

VERIFY the BBJ fuse 17 (30A) is OK. If OK, REPAIR circuit SBB17 (RD) for an open. TEST the system for normal operation.

**B9 CHECK FOR CORRECT TBC MODULE OPERATION**

- Disconnect the TBC module connector.
- Check for:
  - corrosion
  - damaged pins
  - pushed-out pins
- Connect the TBC module connector and make sure it seats correctly.
- Operate the system and verify the concern is still present.
- **Is the concern still present?**

**Yes**

INSTALL a new TBC module.  
REFER to [Trailer Brake Control \(TBC\) Module](#) in this section.  
TEST the system for normal operation.

**No**

The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

**Pinpoint Test C: The Trailer Brakes are Always Engaged**

**NOTE:** Carry out all pinpoint tests **without** a trailer connected to the vehicle.

Refer to Wiring Diagrams Cell [95](#), Trailer/Camper Adapter for schematic and connector information.

**Normal Operation**

The braking energy provided to the trailer is varied with a Pulse Width Modulated (PWM) signal that switches between 0 volts and battery voltage, the higher the duty cycle the more braking power available. With the vehicle stationary and the manual slider switch fully to the left with a gain of 10, there should be more than 10-12 volts supplied to pin 3 of the 7-pin trailer tow connector. The Trailer Brake Control (TBC) module also receives information from the brake pressure switch (also called the speed control deactivation switch) and the stoplamp switch from the PCM over the High Speed Controller Area Network (HS-CAN).

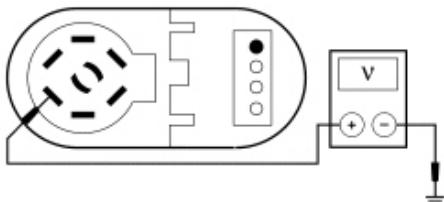
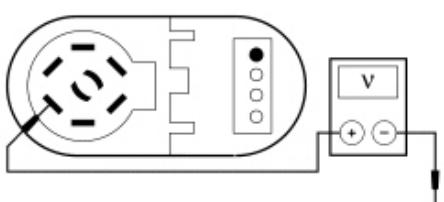
**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- TBC module
- Customer trailer

**PINPOINT TEST C: THE TRAILER BRAKES ARE ALWAYS ENGAGED**

**NOTICE:** Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals.  
Do not use standard multi-meter probes.

Test Step	Result / Action to Take
<b>C1 CHECK FOR ANY PCM DTCs</b>	<b>Yes</b> REFER to <a href="#">Section 303-14</a> . <b>No</b> GO to <a href="#">C2</a> .
<b>C2 CHECK FOR ANY <u>TBC</u> MODULE DTCs</b>	

<ul style="list-style-type: none"> <li>Enter the following diagnostic mode on the scan tool: Self Test — <u>TBC</u> Module .</li> <li>Retrieve and record any <u>TBC</u> module DTCs.</li> <li><b>Are any <u>TBC</u> module DTCs retrieved?</b></li> </ul>	<p><b>Yes</b> REFER to DTC Charts in this section.</p> <p><b>No</b> GO to <a href="#">C3</a>.</p>
<b>C3 OBSERVE THE VEHICLE STOPLAMP OPERATION</b> <ul style="list-style-type: none"> <li>Monitor the vehicle stoplamps while pressing and releasing the brake pedal.</li> <li><b>Do the vehicle stoplamps operate correctly?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">C4</a>.</p> <p><b>No</b> REFER to <a href="#">Section 417-01</a> to diagnose the stoplamp switch.</p>
<b>C4 CHECK THE <u>TBC</u> MODULE OUTPUT</b>	
<p><b>NOTE:</b> Every 4 seconds a voltage pulse is applied as a trailer connectivity test.</p> <ul style="list-style-type: none"> <li>Ignition ON.</li> <li>Make sure the brake pedal is not pressed and the manual slider switch is not being applied.</li> <li>Measure the voltage between 7-pin trailer tow connector electric brake supply pin, component side and ground.</li> </ul>	<p><b>Yes</b> The <u>TBC</u> module and vehicle wiring are operating correctly. SEND the trailer to an authorized camper/trailer repair center.</p> <p><b>No</b> GO to <a href="#">C5</a>.</p>
 N0084023 <ul style="list-style-type: none"> <li><b>Is the voltage approximately 0.3-0.4 volt?</b></li> </ul>	
<b>C5 CHECK THE <u>TBC</u> MODULE PWM OUTPUT CIRCUIT FOR A SHORT TO VOLTAGE</b>	
<ul style="list-style-type: none"> <li>Ignition OFF.</li> <li>Disconnect: <u>TBC</u> Module C2142 .</li> <li>Ignition ON.</li> <li>Measure the voltage between 7-pin trailer tow connector electric brake supply pin, component side and ground.</li> </ul>	<p><b>Yes</b> REPAIR the circuit. TEST the system for normal operation.</p> <p><b>No</b> GO to <a href="#">C6</a>.</p>
 N0084023 <ul style="list-style-type: none"> <li><b>Is any voltage present?</b></li> </ul>	

### C6 CHECK FOR CORRECT TBC MODULE OPERATION

<ul style="list-style-type: none"> <li>• Disconnect the <u>TBC</u> module connector.</li> <li>• Check for:           <ul style="list-style-type: none"> <li>■ corrosion</li> <li>■ damaged pins</li> <li>■ pushed-out pins</li> </ul> </li> <li>• Connect the <u>TBC</u> module connector and make sure it seats correctly.</li> <li>• Operate the system and verify the concern is still present.</li> <li>• <b>Is the concern still present?</b></li> </ul>	<p><b>Yes</b> INSTALL a new <u>TBC</u> module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.</p>
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### Pinpoint Test D: DTC B1317

Refer to Wiring Diagrams Cell [13](#), Power Distribution/BCM for schematic and connector information.

#### Normal Operation

- DTC B1317 (Battery Voltage High) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module when the TBC module detects that battery voltage has risen above 16 volts on the voltage supply circuit while not braking.

This pinpoint test is intended to diagnose the following:

- Charging system concern
- TBC module

### PINPOINT TEST D: DTC B1317

**NOTE:** DTC B1317 may be stored in the module memory due to previous battery charging or vehicle jump starting events.

Test Step	Result / Action to Take
<b>D1 CHECK FOR DTC B1317, B1676, P0563 (PCM) OR U3003:17 SET IN OTHER MODULES</b>	<p><b>Yes</b> REFER to <a href="#">Section 414-00</a> to diagnose an overcharging condition.</p> <p><b>No</b> GO to <a href="#">D2</a>.</p>
<b>D2 CHECK THE BATTERY VOLTAGE</b>	<p><b>Yes</b> REFER to <a href="#">Section 414-00</a> to diagnose an overcharging condition.</p>

<ul style="list-style-type: none"> <li>the battery voltage.</li> <li><b>Does the battery voltage rise to 16 volts or higher?</b></li> </ul>	<p><b>No</b> GO to <a href="#">D3</a>.</p>
<b>D3 RECHECK FOR DTC B1317</b> <ul style="list-style-type: none"> <li>Turn the engine off.</li> <li>Ignition ON.</li> <li>Allow at least 10 seconds for all modules to wake up and prove out.</li> <li>Enter the following diagnostic mode on the scan tool: Self Test — <u>TBC</u> Module .</li> <li>Clear the continuous memory DTCs.</li> <li>Carry out the <u>TBC</u> module self-test.</li> <li><b>Is DTC B1317 present?</b></li> </ul>	<p><b>Yes</b> INSTALL a new <u>TBC</u> module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> module in this section. TEST the system for normal operation.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set previously during battery charging or while jump starting the vehicle.</p>

#### Pinpoint Test E: DTC B1318

Refer to Wiring Diagrams Cell [13](#), Power Distribution/SJB for schematic and connector information.

##### Normal Operation

- DTC B1318 (Battery Voltage Low) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module when the TBC module detects that battery voltage has dropped below 9 volts on the voltage supply circuit while not braking.

This pinpoint test is intended to diagnose the following:

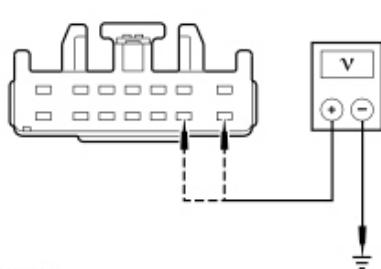
- Wiring, terminals or connectors
- Charging system concern
- TBC module

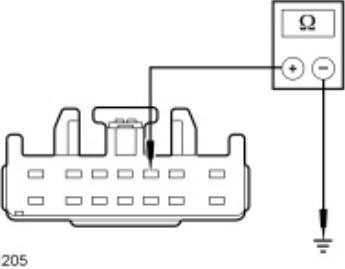
#### PINPOINT TEST E: DTC B1318

**NOTICE:** Use the correct probe adapter(s) when making measurements. Failure to use the correct probe adapter(s) may damage the connector.

**NOTE:** Failure to disconnect the battery when instructed results in false resistance readings. Refer to [Section 414-01](#).

Test Step	Result / Action to Take
<b>E1 RECHECK THE TBC MODULE DTCs</b> <ul style="list-style-type: none"> <li>Ignition ON.</li> <li>Allow at least 10 seconds for all modules to wake up and prove out.</li> <li>Enter the following diagnostic mode on the scan tool: Self Test — <u>TBC</u> Module .</li> <li>Clear the DTCs. Repeat the <u>TBC</u> module self-test.</li> <li><b>Is DTC B1318 still present?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">E2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to a previous low battery voltage condition.</p>
<b>E2 CHECK FOR CHARGING SYSTEM DTCs IN THE PCM</b>	

<ul style="list-style-type: none"> <li>Enter the following diagnostic mode on the scan tool: Self Test — PCM Key ON Engine OFF (KOEO) .</li> <li><b>Is DTC P0620, P0622, P0625, P0626 or P065B set in the PCM?</b></li> </ul>	<b>Yes</b> REFER to <a href="#">Section 414-01</a> . <b>No</b> GO to <a href="#">E3</a> .
<b>E3 CHECK THE BATTERY CONDITION AND STATE OF CHARGE</b> <ul style="list-style-type: none"> <li>Check the battery condition and verify the battery is fully charged. Refer to <a href="#">Section 414-01</a>.</li> <li><b>Is the battery OK and fully charged?</b></li> </ul>	<b>Yes</b> GO to <a href="#">E4</a> . <b>No</b> REFER to <a href="#">Section 414-00</a> .
<b>E4 CHECK THE TBC MODULE VOLTAGE (MODULE_VOLT) PID</b> <ul style="list-style-type: none"> <li>Ignition ON.</li> <li>Measure and record the voltage at the battery.</li> <li>Enter the following diagnostic mode on the scan tool: DataLogger — TBC Module .</li> <li>Monitor the TBC_MODULE_VOLT PID.</li> <li><b>Is the voltage within 0.2 volt of the recorded battery voltage?</b></li> </ul>	<b>Yes</b> GO to <a href="#">E7</a> . <b>No</b> GO to <a href="#">E5</a> .
<b>E5 CHECK THE TBC MODULE VOLTAGE SUPPLY</b> <ul style="list-style-type: none"> <li>Ignition OFF.</li> <li>Disconnect: <u>TBC</u> Module C2142 .</li> <li>Ignition ON.</li> <li>Measure the voltage between the <u>TBC</u> module C2142-8, circuit SBB17 (RD), harness side and ground; and between the <u>TBC</u> module C2142-9, circuit CBP37 (WH), harness side and ground.</li> </ul> <p>N0081204</p>  <ul style="list-style-type: none"> <li><b>Is the voltage within 0.2 volt of the recorded battery voltage?</b></li> </ul>	<b>Yes</b> GO to <a href="#">E6</a> . <b>No</b> REPAIR the circuit. TEST the system for normal operation.
<b>E6 CHECK THE TBC MODULE GROUND CIRCUIT FOR HIGH RESISTANCE</b> <ul style="list-style-type: none"> <li>Ignition OFF.</li> <li>Disconnect: Negative Battery Cable .</li> <li>Measure the resistance between the <u>TBC</u> module C2142-3, circuit GD138 (BK/WH), harness side and ground.</li> </ul>	<b>Yes</b> GO to <a href="#">E7</a> . <b>No</b> REPAIR the circuit. CLEAR the DTC. REPEAT the self-test.



N0091205

- Is the resistance less than 5 ohms?

<b>E7 CHECK FOR CORRECT <u>TBC</u> MODULE OPERATION</b>	
<ul style="list-style-type: none"> <li>• Disconnect the <u>TBC</u> module connector.</li> <li>• Check for: <ul style="list-style-type: none"> <li>■ corrosion</li> <li>■ damaged pins</li> <li>■ pushed-out pins</li> </ul> </li> <li>• Connect the <u>TBC</u> module connector and make sure it seats correctly.</li> <li>• Operate the system and verify the concern is still present.</li> <li>• <b>Is the concern still present?</b></li> </ul>	<p><b>Yes</b> INSTALL a new <u>TBC</u> module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> in this section. TEST the system for normal operation.</p> <p><b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.</p>

### Pinpoint Test F: DTC B1863

Refer to Wiring Diagrams Cell [95](#), Trailer/Camper Adapter for schematic and connector information.

#### Normal Operation

The Trailer Brake Control (TBC) module receives battery voltage from Battery Junction Box (BJB) fuse 17 (30A) and ignition voltage from Body Control Module (BCM) fuse 37 (10A).

- DTC B1863 (TBC Ground Open Circuit) — this DTC sets in continuous memory or on-demand when the TBC module detects an open circuit in the wiring, a connector condition causes an open in the ground circuit or if an internal failure of the TBC module causes an open in the ground circuit. The TBC module also disables trailer braking and sends a TRAILER BRAKE MODULE FAULT message to the message center. A trailer must be connected for this DTC to set.

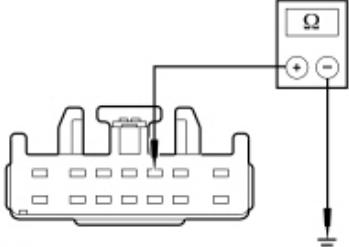
**This pinpoint test is intended to diagnose the following:**

- Wiring, terminals or connectors
- TBC module

### PINPOINT TEST F: DTC B1863

**NOTICE:** Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

**NOTE:** A trailer must be connected to the 7-pin trailer connector for DTC B1863 to set during the on-demand self-test.

Test Step	Result / Action to Take
<b>F1 CHECK THE TBC MODULE GROUND CIRCUIT FOR AN OPEN</b> <ul style="list-style-type: none"> <li>• Ignition OFF.</li> <li>• Disconnect: <u>TBC</u> Module C2142 .</li> <li>• Measure the resistance between <u>TBC</u> module C2142-3, circuit GD138 (BK/WH), harness side and ground.</li> </ul>  <p>N0091205</p> <ul style="list-style-type: none"> <li>• Is the resistance less than 5 ohms?</li> </ul>	<b>Yes</b> GO to <a href="#">F2</a> .  <b>No</b> REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test.
<b>F2 CHECK FOR CORRECT TBC MODULE OPERATION</b> <ul style="list-style-type: none"> <li>• Disconnect the <u>TBC</u> module connector.</li> <li>• Check for:               <ul style="list-style-type: none"> <li>■ corrosion</li> <li>■ damaged pins</li> <li>■ pushed-out pins</li> <li>■ broken harness wire</li> <li>■ broken connector</li> </ul> </li> <li>• Connect the <u>TBC</u> module connector and make sure it seats correctly.</li> <li>• Operate the system and verify the concern is still present.</li> <li>• Is the concern still present?</li> </ul>	<b>Yes</b> INSTALL a new <u>TBC</u> module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> in this section. TEST the system for normal operation.  <b>No</b> The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. TEST the system for normal operation.

#### Pinpoint Test G: DTC U0100

##### Normal Operation

- DTC U0100 (Lost Communication With ECM/PCM "B") — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module if data messages received (vehicle speed) from the PCM are missing for more than 5 seconds. For a complete list of all network messages, refer to [Section 418-00](#).

This pinpoint test is intended to diagnose the following:

- PCM
- TBC module

#### PINPOINT TEST G: DTC U0100

Test Step	Result / Action to Take
<b>G1 VERIFY THE SCAN TOOL CAN COMMUNICATE WITH THE PCM</b>	<p><b>Yes</b> GO to <a href="#">G2</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a> to diagnose no communication with the PCM.</p>
<ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Allow at least 10 seconds for all modules to wake up and prove out.</li> <li>• Verify that a vehicle session can be established with a scan tool.</li> <li>• <b>Can a vehicle session be established?</b></li> </ul>	
<b>G2 CHECK THE TBC MODULE CONTINUOUS MEMORY DTCs</b> <ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — <u>TBC</u> Module .</li> <li>• Clear the DTCs. Repeat the <u>TBC</u> module self-test. Record all <u>TBC</u> module DTCs.</li> <li>• <b>Is DTC U0100 retrieved again?</b></li> </ul>	<p><b>Yes</b> GO to <a href="#">G3</a>.</p> <p><b>No</b> The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>G3 RETRIEVE THE RECORDED DTCs FROM THE TBC MODULE SELF-TEST</b> <ul style="list-style-type: none"> <li>• Check for recorded <u>TBC</u> module DTCs from the previous self-test.</li> <li>• <b>Is DTC B1317 or DTC B1318 recorded?</b></li> </ul>	<p><b>Yes</b> For DTC B1317, <a href="#">GO to Pinpoint Test D</a>. For DTC B1318, <a href="#">GO to Pinpoint Test E</a>.</p> <p><b>No</b> GO to <a href="#">G4</a>.</p>
<b>G4 RETRIEVE THE RECORDED DTCs FROM THE PCM SELF-TEST</b> <ul style="list-style-type: none"> <li>• Enter the following diagnostic mode on the scan tool: Self Test — PCM Key ON Engine OFF (KOEO) .</li> <li>• <b>Is DTC P0562 or DTC P0563 recorded?</b></li> </ul>	<p><b>Yes</b> REFER to <a href="#">Section 303-14</a>.</p> <p><b>No</b> GO to <a href="#">G5</a>.</p>
<b>G5 CHECK FOR DTC U0100:00 SET IN OTHER MODULES</b> <ul style="list-style-type: none"> <li>• Using a scan tool, retrieve the continuous memory DTCs from the following modules: <ul style="list-style-type: none"> <li>■ Accessory Protocol Interface Module (APIM) (if equipped)</li> <li>■ <u>BCM</u></li> <li>■ Instrument Panel Cluster (IPC)</li> <li>■ Occupant Classification System Module (OCSM)</li> <li>■ Power Steering Control Module (PSCM) (if equipped)</li> <li>■ Restraints Control Module (RCM)</li> <li>■ Transfer Case Control Module (TCCM) (if equipped)</li> </ul> </li> <li>• <b>Is DTC U0100:00 set in any of these modules?</b></li> </ul>	<p><b>Yes</b> INSTALL a new PCM. REFER to <a href="#">Section 303-14</a>.</p> <p><b>No</b> INSTALL a new <u>TBC</u> module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test H: DTC U0121

### **Normal Operation**

- DTC U0121 (Lost Communication With Anti-Lock Brake System (ABS) Control Module) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module if data messages such as brake torque information are not received from the ABS module. For a complete list of all network messages, refer to [Section 418-00](#).

This pinpoint test is intended to diagnose the following:

- ABS module
- TBC module

### **PINPOINT TEST H: DTC U0121**

Test Step	Result / Action to Take
<b>H1 VERIFY THE CUSTOMER CONCERN</b> <ul style="list-style-type: none"> <li>• Ignition ON.</li> <li>• Allow at least 10 seconds for all modules to wake up and prove out.</li> <li>• Verify that there is an observable symptom present.</li> <li>• <b>Is an observable symptom present?</b></li> </ul>	<b>Yes</b> GO to <a href="#">H2</a> .  <b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.
<b>H2 CHECK THE COMMUNICATION NETWORK</b> <ul style="list-style-type: none"> <li>• Using a scan tool, carry out the network test.</li> <li>• <b>Does the ABS module pass the network test?</b></li> </ul>	<b>Yes</b> GO to <a href="#">H3</a> .  <b>No</b> REFER to <a href="#">Section 418-00</a> to diagnose the ABS module does not respond to the scan tool.
<b>H3 RETRIEVE ANY DTCs FROM THE <u>TBC</u> MODULE</b> <ul style="list-style-type: none"> <li>• Enter the following diagnostic mode on the scan tool: Self Test — <u>TBC</u> Module .</li> <li>• <b>Is DTC U3003:16 (or B1318) or DTC U3003:17 (or B1317) recorded?</b></li> </ul>	<b>Yes</b> For DTC B1317, <a href="#">GO to Pinpoint Test D</a> . For DTC B1318, <a href="#">GO to Pinpoint Test E</a> . For the ABS module, REFER to <a href="#">Section 206-09</a> .  <b>No</b> GO to <a href="#">H4</a> .
<b>H4 CHECK FOR DTC U0121:00 SET IN OTHER MODULES</b> <ul style="list-style-type: none"> <li>• Clear the DTCs.</li> <li>• Ignition OFF.</li> <li>• Wait at least 5 seconds to allow the <u>TBC</u> module to sleep (power down).</li> <li>• Ignition ON.</li> <li>• Allow at least 10 seconds for all modules to wake up and prove out.</li> <li>• Using a scan tool, retrieve the continuous memory DTCs from the following modules:</li> </ul>	<b>Yes</b> INSTALL a new ABS module. REFER to <a href="#">Section 206-09</a> . CLEAR the DTCs. REPEAT the ABS module self-test.  <b>No</b> INSTALL a new <u>TBC</u> module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> in this section. TEST the system for normal operation.

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|--|--|
| <ul style="list-style-type: none"> <li>■ Body Control Module (BCM)</li> <li>■ Instrument Panel Cluster (IPC)</li> <li>■ Power Steering Control Module (PSCM) (if equipped)</li> <li>■ Transfer Case Control Module (TCCM) (if equipped)</li> </ul> <p>• Is DTC U0121:00 set in any of these modules?</p> |  |
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#### **Pinpoint Test I: DTC U0140**

##### **Normal Operation**

- DTC U0140 (Lost Communication With Body Control Module (GEM)) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module if data messages such as ignition state, park lamp status and illumination dimming level data are not received from the Body Control Module (BCM). For a complete list of all network messages, refer to [Section 418-00](#).

This pinpoint test is intended to diagnose the following:

- BCM
- TBC module

#### **PINPOINT TEST I: DTC U0140**

<b>Test Step</b>	<b>Result / Action to Take</b>
<b>I1 VERIFY THE CUSTOMER CONCERN</b>	<p><b>Yes</b> GO to <a href="#">I2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>I2 CHECK THE COMMUNICATION NETWORK</b>	<p><b>Yes</b> GO to <a href="#">I3</a>.</p> <p><b>No</b> REFER to <a href="#">Section 418-00</a>.</p>
<b>I3 RETRIEVE ANY DTCs FROM THE <u>TBC</u> MODULE</b>	<p><b>Yes</b> For DTC B1317, <a href="#">GO to Pinpoint Test D</a>. For DTC B1318, <a href="#">GO to Pinpoint Test E</a>.</p> <p><b>No</b> GO to <a href="#">I4</a>.</p>
<b>I4 RETRIEVE ANY DTCs FROM THE <u>BCM</u></b>	

<ul style="list-style-type: none"> <li>Enter the following diagnostic mode on the scan tool: Self Test — <u>BCM</u>.</li> <li><b>Is DTC U3003:16 or DTC U3003:17 recorded?</b></li> </ul>	<p><b>Yes</b> REFER to <a href="#">Section 419-10</a>.</p> <p><b>No</b> GO to <a href="#">I5</a>.</p>
<b>I5 RECHECK THE TBC MODULE DTCs</b>	<p><b>Yes</b> GO to <a href="#">I6</a>.</p> <p><b>No</b> The system is operating correctly at this time. The DTC may have been set due to high network traffic or an intermittent fault condition.</p>
<b>I6 CHECK FOR DTC U0140 SET IN OTHER MODULES</b>	<p><b>Yes</b> INSTALL a new <u>BCM</u>. REFER to <a href="#">Section 419-10</a>. REPEAT the <u>BCM</u> self-test.</p> <p><b>No</b> INSTALL a new <u>TBC</u> module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> in this section. TEST the system for normal operation.</p>

#### Pinpoint Test J: DTC U0155

##### Normal Operation

- DTC U0155 (Lost Communication With Instrument Panel Cluster (IC) Control Module) — this DTC sets in continuous memory or on-demand in the Trailer Brake Control (TBC) module if data messages received from the Instrument Panel Cluster (IPC) are missing. The IPC sends a TRAILER BRAKE CONFIG message to the TBC module. For a complete list of all network messages, refer to [Section 413-01](#).

This pinpoint test is intended to diagnose the following:

- IPC
- TBC module

#### PINPOINT TEST J: DTC U0155

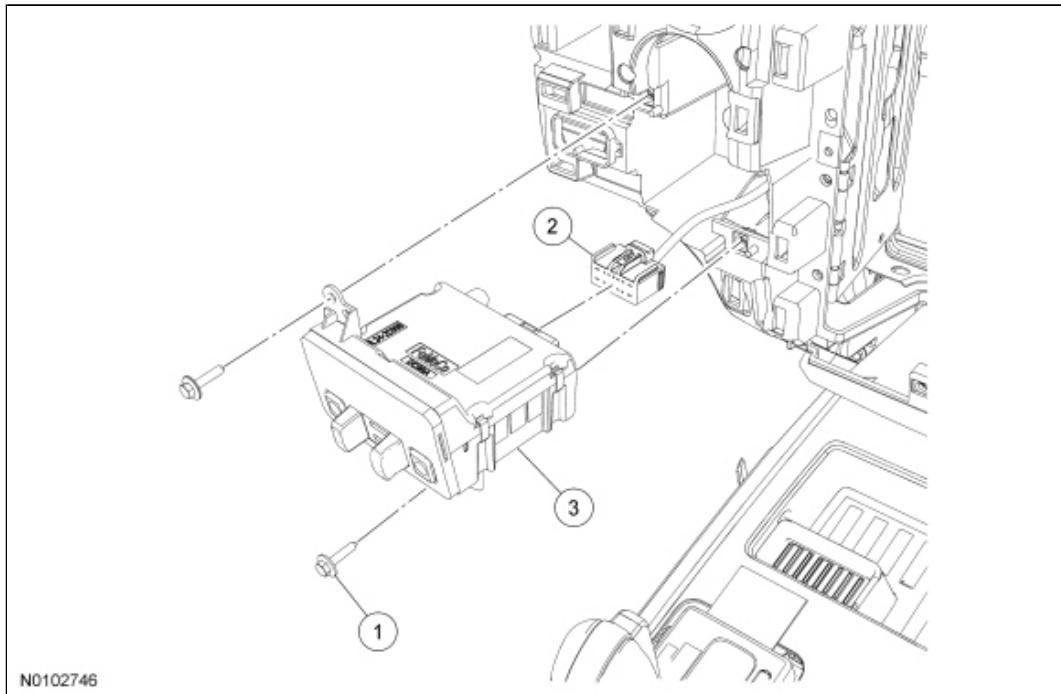
Test Step	Result / Action to Take
<b>J1 VERIFY THE CUSTOMER CONCERN</b>	<p><b>Yes</b> GO to <a href="#">J2</a>.</p> <p><b>No</b> The system is operating normally at this time. The DTC may have been set due to high network traffic or an</p>

present?	intermittent fault condition.
<b>J2 CHECK THE COMMUNICATION NETWORK</b>	
<ul style="list-style-type: none"> <li>• Using a scan tool, carry out the network test.</li> <li>• Does the <u>IPC</u> pass the network test?</li> </ul>	<b>Yes</b> GO to <a href="#">J3</a> .
	<b>No</b> REFER to <a href="#">Section 418-00</a> .
<b>J3 RETRIEVE THE RECORDED DTCs FROM THE <u>TBC</u> MODULE AND <u>IPC</u> SELF-TESTS</b>	
<ul style="list-style-type: none"> <li>• Enter the following diagnostic mode on the scan tool: Self Test — <u>TBC</u> Module .</li> <li>• Record the <u>TBC</u> module DTCs.</li> <li>• Enter the following diagnostic mode on the scan tool: Self Test — <u>IPC</u> .</li> <li>• Is DTC U3003:16 (or B1318) or DTC U3003:17 (or B1317) recorded?</li> </ul>	<b>Yes</b> For <u>TBC</u> module DTC B1317, <a href="#">GO to Pinpoint Test D</a> . For <u>TBC</u> module DTC B1318, <a href="#">GO to Pinpoint Test E</a> . For <u>IPC</u> DTCs, REFER to <a href="#">Section 413-01</a> .
	<b>No</b> GO to <a href="#">J4</a> .
<b>J4 CHECK FOR DTC U0155 SET IN OTHER MODULES</b>	
<ul style="list-style-type: none"> <li>• Clear the DTCs.</li> <li>• Ignition OFF.</li> <li>• Wait at least 5 seconds to allow the <u>TBC</u> module to sleep (power down).</li> <li>• Ignition ON.</li> <li>• Allow at least 10 seconds for all modules to wake up and prove out.</li> <li>• Retrieve the continuous memory DTCs from all modules.</li> <li>• Is DTC U0155:00 or DTC U0155 set in more than one module?</li> </ul>	<b>Yes</b> INSTALL a new <u>IPC</u> . REFER to <a href="#">Section 413-01</a> . CLEAR the DTCs. REPEAT the <u>IPC</u> self-test.
	<b>No</b> INSTALL a new <u>TBC</u> module. REFER to <a href="#">Trailer Brake Control (TBC) Module</a> in this section. TEST the system for normal operation.

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## Trailer Brake Control (TBC) Module



Item	Part Number	Description
1	W707628	Trailer Brake Control (TBC) module bolt (2 required)
2	—	TBC module electrical connector (part of 14401)
3	2C006	TBC module

### Removal and Installation

**NOTE:** The trailer brake system is normally installed at the assembly plant, however, the system can be installed at the dealership but only if the vehicle is equipped with the trailer tow option. This option can be confirmed by verifying the presence of both the 4-pin and the 7-pin connectors at the rear of the vehicle as well as a receiver hitch. If the vehicle is not equipped with these 3 items, then it is not equipped with trailer tow and cannot have the factory Trailer Brake Control (TBC) system installed.

On those vehicles equipped with the trailer tow option, the electrical connector for the TBC module is attached to the 14401 harness behind the steering column opening trim panel. If the system is installed at the dealership, the TBC module will be installed in place of the coin bin/storage tray and the Instrument Panel Cluster (IPC) must be configured to communicate with the TBC module. Refer to the Wiring Diagrams manual, Cell 95 Trailer/Camper Adapter and Cell 151 Component Location Views for connector and wiring information. Refer to Programmable Parameters in the Diagnosis and Testing portion of this section for information on IPC configuration.

1. Remove the LH center instrument panel trim panel. For additional information, refer to Center Instrument Panel Trim Panel in [Section 501-12](#).

2. Remove the 2 TBC module bolts.
  3. Remove the TBC module.
    - Disconnect the electrical connector.
  4. To install, reverse the removal procedure.
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