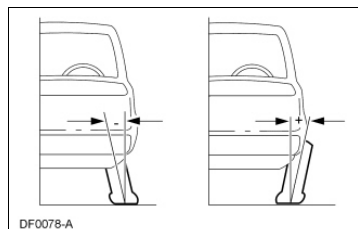


Wheel Alignment Angles

Camber

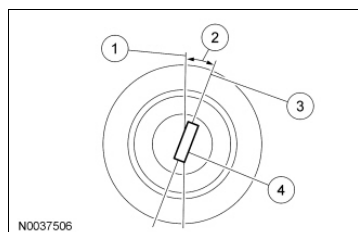
Negative and Positive Camber



Camber is the vertical tilt of the wheel when viewed from the front. Camber can be positive or negative and has a direct effect on tire wear.

Caster

Caster is the deviation from vertical of an imaginary line drawn through the pivot points (top of strut and lower ball joint), when viewed from the side. The caster specifications in this section will give the vehicle the best directional stability characteristics when loaded and driven. The caster setting is not related to tire wear. The caster setting is not adjustable.

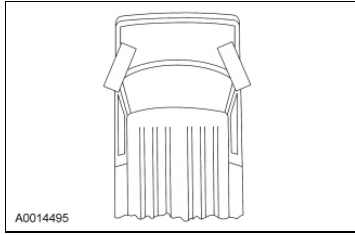


Item	Description
1	True vertical
2	Positive caster angle
3	Strut-to-ball joint centerline
4	Pivot centerline

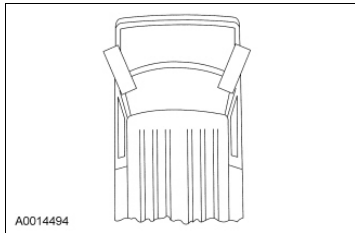
A backward tilt is positive (+) and a forward tilt is negative (-). Front caster adjustment is not a separate procedure on this vehicle. The vehicle will tend to drift/pull toward the side with the lowest caster.

Toe

Positive Toe (Toe In)

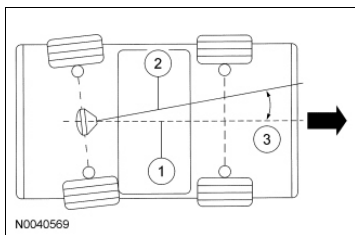


Negative Toe (Toe Out)



The vehicle toe setting affects tire wear and directional stability.

Incorrect Thrust Angle (Dogtracking)



Item	Description
1	Vehicle centerline
2	Axle centerline
3	Thrust angle

Incorrect thrust angle (also known as dogtracking) is the condition in which the rear axle is not square to the chassis. Heavily crowned roads can give the illusion of dogtracking.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel corrections to maintain a straight path down a level road.

Shimmy

Shimmy, as experienced by the driver, is large, consistent, rotational oscillations of the steering wheel resulting from large, side-to-side (lateral) tire/wheel movements.

Shimmy is usually experienced near 64 km/h (40 mph), and can begin or be amplified when the tire contacts pot holes or irregularities in the road surface.

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces and experienced by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

Poor returnability and sticky steering are used to describe the poor return of the steering wheel to center after a turn or steering correction.

Drift/Pull

Pull is a tugging sensation felt by the hands on the steering wheel that must be overcome to keep the vehicle going straight.

Drift describes what a vehicle with this condition does with the hands off the steering wheel.

- A vehicle-related drift/pull on a flat road causes a consistent deviation from the straight-ahead path and requires constant steering input in the opposite direction to counteract the effect.
- Drift/pull may be induced by conditions external to the vehicle (for example, wind or road crown).

Poor Groove Feel

Poor groove feel is characterized by little or no buildup of turning effort felt in the steering wheel as the wheel is rocked slowly left and right within very small turns around center or straight-ahead (under 20 degrees of steering wheel turn). Effort may be said to be "flat on-center."

- Under 20 degrees of turn, most of the turning effort that builds up comes from the mesh of the gear teeth in the steering gear. In this range, the steering wheel is not yet turned enough to feel the effort from the self-aligning forces at the road wheel or tire patch.
 - In the diagnosis of a driveability problem, it is important to understand the difference between wander and poor groove feel.
-

Suspension System

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Inspection and Verification

1. Road test the vehicle.
 - If any suspension alignment or ride height concerns are present, GO to Symptom Chart - Suspension System .
 - Verify the customer concern by carrying out a road test on a smooth road. If any vibrations are present, GO to Symptom Chart - NVH .
2. Inspect the tires.
 - Check the tire pressures 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 the chassis and underbody.
 - Remove any excessive accumulation of mud, dirt or road deposits from the chassis and underbody.
4. Inspect for aftermarket equipment.
 - Check for aftermarket changes to the steering, suspension, and wheel and tire components (such as competition or heavy duty). 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"> • Front or rear suspension components • Suspension fastener(s) • Incorrect spring usage • Spring(s) • Shock absorber(s) • Strut(s) • Suspension bushing(s) • Steering system components

- Wheel bearing and wheel hub(s)
- Non-OEM parts or modifications

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

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 from the front or rear suspension, occurs more in cold ambient temperatures. More noticeable over rough roads or when turning
- Front stabilizer bar insulators
- Under these conditions, the noise is acceptable.
- Clunk - noise from the front suspension, occurs in and out of turns
- Loose front suspension
- INSPECT for loose nuts or bolts. TIGHTEN to specifications. REFER to Section 204-01 for front suspension and Section 204-02 for rear suspension.
- Clunk - noise from the rear suspension, occurs when shifting from REVERSE to DRIVE
- Loose rear suspension components
- INSPECT for loose or damaged rear suspension components. REPAIR or INSTALL new components as necessary. REFER to Section 204-02 .
- Click or pop - noise from the front suspension. More noticeable over rough roads or over bumps

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- Worn or damaged ball joint(s)
- CARRY OUT a ball joint inspection. INSTALL new ball joint(s) or control arm(s) as necessary. REFER to Section 204-01 .
- Front strut jounce bumper(s) and dust shield(s)
- LUBRICATE the front strut rod(s) and the top and sides of the uppermost part of the dust shield(s) with the specified silicone brake grease.
- Squeak, creak or rattle noise. More noticeable over rough roads or over bumps
- Front or rear suspension components
- Loose or damaged front struts, shock absorber(s) or shock absorber bushing(s)
- Damaged spring or spring mount(s)
- Damaged or worn control/radius arm bushing(s)
- Worn or damaged stabilizer bar bushings or link(s)
- INSPECT the front and rear suspension. INSTALL new components as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.
- Front strut jounce bumper(s) and dust shield(s)
- LUBRICATE the front strut rod(s) and the top and sides of the uppermost part of the dust shield(s) with the specified silicone brake grease.
- Shudder - occurs during acceleration from a slow speed or stop
- Incorrect ride height causing incorrect driveline angle
- REFER to Section 205-00 for driveline angle diagnosis.
- Shimmy
- Loose wheel nut(s)
- TIGHTEN the nut(s) to specification. REFER to Section 204-04 .
- Loose front suspension fastener(s)
- TIGHTEN the fastener(s) to specification. REFER to Section 204-01 .
- Worn front wheel bearing(s)
- INSPECT the front wheel bearing(s). INSTALL new bearing(s) as necessary. REFER to Section 204-01 .
- Strut(s) or shock absorber(s)
- INSTALL new struts or shock absorbers as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.
- Shimmy - most noticeable on coast/deceleration. Also hard steering condition

- Excessive positive caster
- CHECK the wheel alignment. REFER to Camber Adjustment - Front or Camber Adjustment - Rear in this section. ADJUST as necessary.
- Rough/harsh ride
- Incorrect tire pressure
- ADJUST the tire pressure. REFER to the Vehicle Certification (VC) label.
- Strut(s) or shock absorber(s)
- INSTALL new struts or shock absorbers as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.
- Spring(s)
- INSPECT for broken springs. MEASURE the ride height. REFER to Ride Height Measurement in this section. INSTALL new springs as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.
- Damaged suspension component(s)
- INSTALL new suspension component(s) as necessary. REFER to Section 204-01 for front suspension or Section 204-02 for rear suspension.

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
A1 CHECK FOR UNEVENLY LOADED VEHICLE	
<ul style="list-style-type: none"> • Visually check the vehicle for an uneven loading condition. • Is the vehicle unevenly loaded? 	<p>Yes ADVISE the customer of uneven loading condition.</p> <p>No</p>

	GO to <u>A2</u> .
A2 CHECK THE TIRE PRESSURES AND TIRE CONDITIONS	
<ul style="list-style-type: none"> • Check the tire pressures. Refer to the Vehicle Certification (VC) label located on the driver door jamb. Check the tires for uneven/abnormal wear. Refer to Diagnosis and Testing - Wheels and Tires in <u>Section 204-04</u> . • Are the tire pressures and tire conditions OK? 	<p>Yes GO to <u>A3</u> .</p> <p>No ADJUST the tire pressures to the specified pressure or INSTALL new tires as necessary.</p>
A3 ISOLATE TIRE DRIFT/PULL CONDITION	
<ul style="list-style-type: none"> • Cross the front wheel and tire assemblies from left-to-right. Refer to <u>Section 204-04</u> . • Does the vehicle drift/pull? 	<p>Yes If the vehicle drifts/pulls in the opposite direction, tire forces are causing the drift/pull. REFER to <u>Section 204-04</u> to diagnose tire drift pull. If the vehicle drifts/pulls in the same direction, GO to <u>A4</u> .</p> <p>No Tire forces were causing the drift/pull and the concern has been corrected.</p>
A4 CHECK FOR BRAKE DRAG	
<ul style="list-style-type: none"> • Spin all 4 wheel and tire assemblies by hand and check for brake drag. • Do the wheels spin freely? 	<p>Yes GO to <u>A5</u> .</p> <p>No REFER to <u>Section 206-00</u> to diagnose brake drag condition.</p>
A5 CHECK THE WHEEL ALIGNMENT	
<ul style="list-style-type: none"> • Using alignment equipment and the manufacturer's instructions, check the wheel alignment. • Is the wheel alignment out of specification? 	<p>Yes ADJUST the alignment as necessary. REFER to General Procedures in this section.</p> <p>No REFER to <u>Section 211-00A</u> for Electronic Power Assist Steering (EPAS) or <u>Section 211-00B</u> for Hydraulic Power Assist Steering (HPAS) 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. Install a new wheel bearing as necessary. Refer to Section 204-01 .
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.

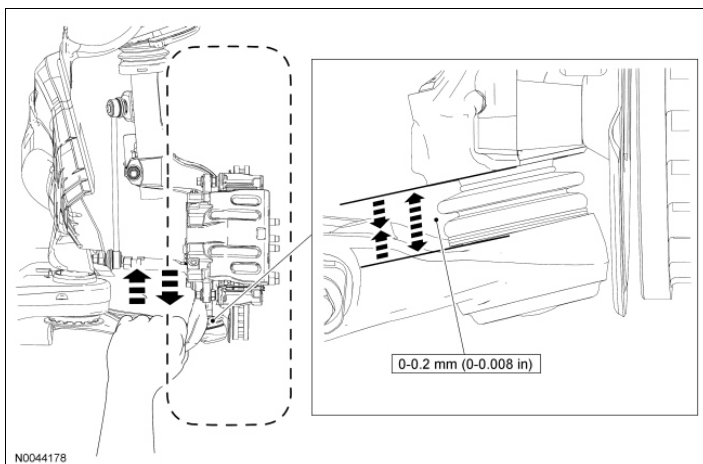
3. Inspect the ball joint and ball joint boot for damage.
 - If the ball joint or ball joint boot is damaged, install a new ball joint as necessary. Refer to [Section 204-01](#) .
4. **NOTICE:** Do not use any tools or equipment to move the wheel and tire assembly or suspension components while checking for relative movement. Suspension damage may 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 lower control arm 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 lower control arm, by hand.
 - If the deflection exceeds the specification, a new ball joint must be installed. Refer to [Section 204-01](#) .
 - If the deflection meets the specification, no further action is required.

