Steering Linkage

For additional information regarding power steering system concerns,
REFER to: Power Steering (211-02 Power Steering, Diagnosis and Testing).
For additional information regarding suspension system concerns, REFER to: Suspension System (204-00 Suspension System - General Information, Diagnosis and Testing).

Principles of Operation

Inspection and Verification

1. Road test.

- If any suspension alignment or ride height concerns are present, GO to Symptom Chart â€" 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. If aftermarket tires or wheels are installed, return the vehicle to the customer so the vehicle can be returned to factory trim.

- Check the tire pressure with all normal loads in the vehicle and with the tires cold. Refer to the VC label.
- Verify that all tires are sized to specification. If aftermarket tires or wheels are installed, return the vehicle to the customer so the vehicle can be returned to factory trim.
- Inspect the tires for incorrect wear and damage.
  REFER to: Wheels and Tires (204-04A Wheels and Tires, Diagnosis and Testing).

3. Inspect the chassis and underbody. If aftermarket steering or suspension components are installed, return the vehicle to the customer so the vehicle can be returned to factory trim.

- Remove any excessive accumulation of mud, dirt or road deposits from the chassis and underbody.

4. Inspect for aftermarket equipment. If aftermarket steering or suspension components are installed, return the vehicle to the customer so the vehicle can be returned to factory trim.

- 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
Damaged or leaking shock absorber(s)
Worn Ball joint(s)
Loose, worn or damaged steering system components
Loose or damaged front suspension components
Loose, damaged or missing fastener(s)

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 â€" Suspension System or GO to Symptom Chart â€" NVH.

Symptom Chart

Symptom	Possible Sources	Action

• Wheel Fight	• Normal operation.	• Wheel fight is a rotational steering wheel motion or feedback caused by irregularities in the road surface and can be considered a normal characteristic.
• Ring Down	• Normal operation.	• Ring down is feedback in the steering wheel over bumps or expansion joints that is temporary and damps out after a few seconds, and can be considered a normal characteristic.
• Abnormal Steering Wheel Oscillation	• Refer to pinpoint test.	• GO to Pinpoint Test A

Symptom Chart â€" NVH

Workshop Manual (WSM), Section 204-00 > Diagnosis and Testing > Suspension System Symptom Chart NVH Shimmy would also be recommended for this condition.

Symptom	Possible Sources	Action
• Shimmy	• Loose wheel nut(s)	• TIGHTEN nut(s) to specification. REFER to: Wheel and Tire - Vehicles With: Single Rear Wheels (204-04A Wheels and Tires, Removal and Installation). or REFER to: Wheel and Tire - Vehicles With: Dual Rear Wheels (204-04A Wheels and Tires, Removal and Installation).
• Shimmy â€" most noticeable on coast/deceleration. Also hard steering condition	• Excessive positive caster	• CHECK front caster and ADJUST as necessary. REFER to: Front Camber and Caster Adjustment - F-250/F-350, RWD (204-00 Suspension System - General Information, General Procedures). or REFER to: Front Camber and Caster Adjustment - F-250/F-350/F-450/F-550, 4WD (204-00 Suspension System - General Information, General Procedures).

Pinpoint Tests

Abnormal Steering Wheel Oscillation

Diagnostic Overview

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices.
REFER to: Diagnostic Methods (100-00 General Information, Description and Operation).

Possible Causes

- Aftermarket Equipment
- Tires (tread depth / air pressure / road force balance)
- Sealing Boots (torn / cut boots on track bar, steering linkage, knuckle ball joints)
- Steering Linkage Damper
- Track bar ball joint/ Bushing
- Sector Shaft Arm Drag Link
- Tie Rod
- Upper and lower knuckle ball joints
- Incorrect vehicle alignment
- Shock absorbers

PINPOINT TEST A : ABNORMAL STEERING WHEEL OSCILLATION

A1 CHECK AFTERMARKET EQUIPMENT

NOTE: *Inspect for aftermarket modifications to the wheels, tires, steering, suspension and chassis. Remove any oversized wheels and tires, lift kits, leveling kits, wheel spacers, steering kits or other non-OEM suspension components from the vehicle as these components can directly contribute to this condition.*

- Inspect for aftermarket modifications to the wheels, tires, steering, suspension and chassis.

Are any aftermarket components installed (Oversized wheels and tires, lift kits, leveling kits, wheel spacers, steering kits or other non-OEM suspension components)?

Yes	RETURN the vehicle to the customer and advise the vehicle needs to be returned to the factory configuration.
No	GO to A2

A2 CHECK THE TIRE PRESSURES AND TIRE CONDITIONS

- Check the tire pressures. Refer to Vehicle Certification (VC) Codes
  REFER to: Identification Codes (100-01 Identification Codes) .
  Check the tires for uneven/abnormal wear. Refer to Symptom Chart: Tire Wear REFER to: Wheels and Tires (204-04A Wheels and Tires, Diagnosis and Testing).

Are the tire pressures and tire conditions OK?

Yes	SWAP the tires and wheels from a known good unit and RETEST. If the concern is still present, GO to A3
No	ADJUST the tire pressures to the specified pressure or INSTALL new tires as necessary.

A3 ROAD FORCE BALANCE THE TIRES AND WHEELS

- Using the Hunter Road Force 9700 Series Wheel Balancer or equivalent, verify that each tire does not exceed more than 35lbs of road force with pressures at 60 to 65 psi or 45lbs of road force with pressures at 70 to 80 psi.
  REFER to: Wheels and Tires (204-04A Wheels and Tires, Diagnosis and Testing).

Does any tire and wheel assembly exceed the road force specification?

Yes	Use the match mounting process to help reduce excessive road force and retest. If the road force still can not be reduced by match mounting the tires, replaced the suspect tire and or wheel and RETEST. If the concern is still present, GO to A4 If the concern is resolved, RETURN the vehicle to the customer.
No	GO to A4

A4 CHECK FOR STEERING DAMPER LAG/LASH

- Inspect the steering damper for signs of fluid leakage.
- Remove the steering damper and place the steering damper in the vertical position so the tapered stud is at the top and the bushing is at the bottom.
- Place a socket extension or screw driver through the bushing of the steering damper and stand on it.
- By hand, slowly extend and compress the damper 2-3 cycles. Check for lag/lash at the fully extended position and the half damper travel position.

Is any leakage noted or lag/lash greater than 5mm is observed?

Yes	REPLACE the steering damper and RETEST. REFER to: Steering Linkage Damper - F-250/F-350/F-450/F-550, 4WD (211-03 Steering Linkage, Removal and Installation). If the concern is still present, GO to A5 If the concern is resolved, RETURN the vehicle to the customer.
No	GO to A5

A5 CHECK THE SEALING BOOTS

- Inspect the condition of all sealing boots on the steering linkages and track bar. Check for any components with signs of damage (tears, cuts, holes) to the sealing boots.

Is any component or sealing boot damage noted?

Yes	REPLACE the damaged component(s) as necessary and RETEST. If the concern is still present, GO to A6 If the concern is resolved, RETURN the vehicle to the customer.
No	GO to A6

A6 CHECK THE TRACK BAR BALL JOINT AND BUSHING

- Inspect the track bar ball joint and bushing for lash and any boot seal, cuts or tears.

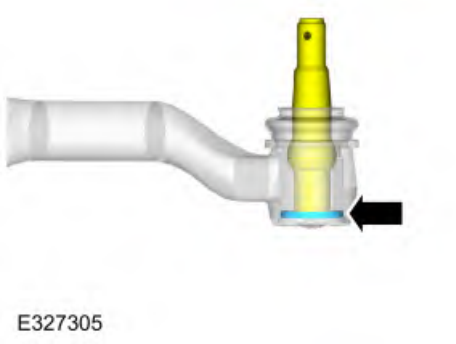
Is any lash or damage present?

Yes	REPLACE the track bar ball joint and/or bushing and RETEST. REFER to: Track Bar Ball Joint (204-01A Front Suspension - RWD, Removal and Installation). REFER to: Track Bar Ball Joint - Vehicles With: Integral Ball Joint (204-01A Front Suspension - RWD, Removal and Installation). . REFER to: Track Bar Bushing (204-01B Front Suspension - 4WD, Removal and Installation). If the concern is still present, GO to A7 If the concern is resolved, RETURN the vehicle to the customer.
No	If no damage is present, have an assistant turn the steering wheel left and right rapidly (Key On, Engine OFF) and inspect for side-to-side track bar ball joint and/or bushing movement. The full weight of the vehicle should be placed on the wheels when performing this procedure. Listen for any popping or knocking noise indicating end-play in the ball joint. Next inspect for vertical movement of the track bar relative to the axle as shown in the WSM, Section 204-01B under ball joint inspection > step 10 through step 12. Per the WSM, replace the ball joint if more than .025" of end-play is measured. REFER to: Track Bar Ball Joint (204-01A Front Suspension - RWD, Removal and Installation). REFER to: Track Bar Ball Joint - Vehicles With: Integral Ball Joint (204-01A Front Suspension - RWD, Removal and Installation). If no deflection is noted, remove the bolt securing the track bar to the frame-mounted bracket and inspect the bushing for cracking or damage. If any damage is noted, replace the bushing.REFER to: Track Bar Bushing (204-01B Front Suspension - 4WD, Removal and Installation). Verify the bolt is torqued to 550Nm with the vehicle at a curb position when reinstalled. RETEST. If the concern is still present, GO to A7 If the concern is resolved, RETURN the vehicle to the customer.

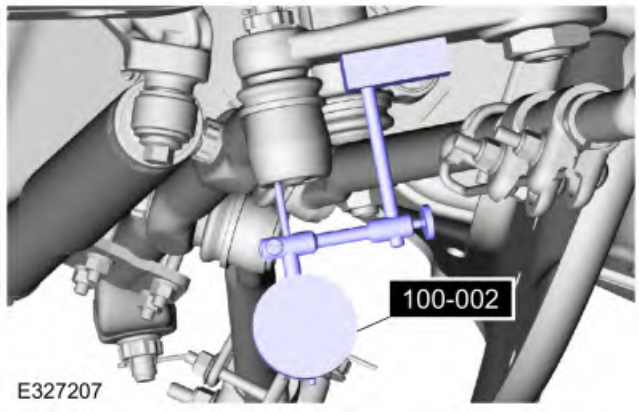
A7 CHECK THE SECTOR SHAFT ARM DRAG LINK

NOTE: *By design, there is a 1 to 2 degree rotational movement present in the drag link that will be observed as 1-2 mm of vertical movement when pushing on or rotating the tie rod offset (turnbuckle adjuster). This movement is characteristic due to the internal spring design (shown below) and should not be considered as a bad joint.*

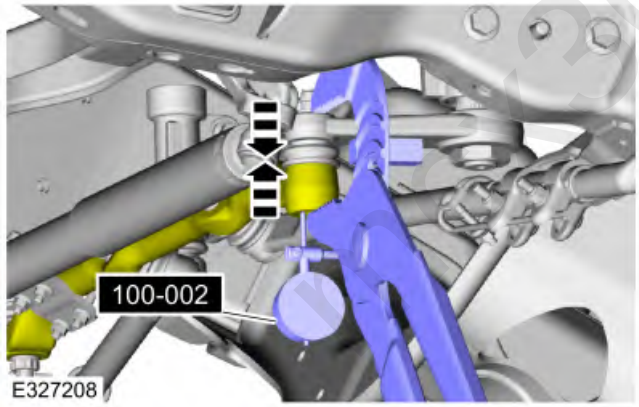
-



- Provide a solid mounting location for a dial indicator and using the dial indicator measure axial lash of the ball joint (Both axial and radial lash are related, a measurement of axial will also serve as a surrogate for radial lash).



- Compress the ball joint with a pair of adjustable pliers.

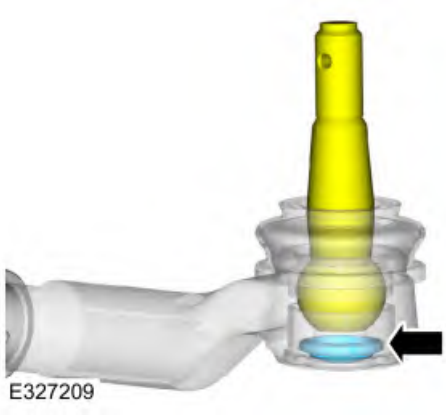


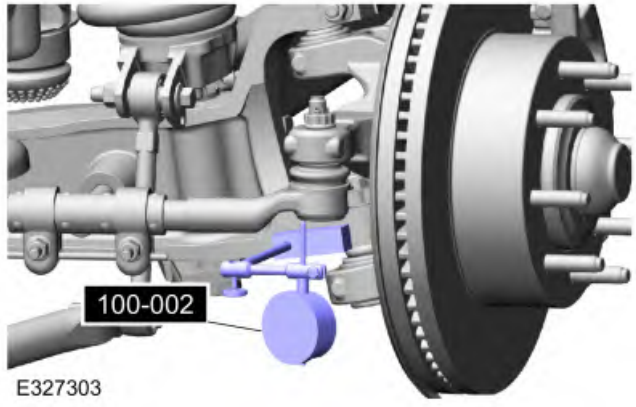
Is the axial lash greater than 0.025"?

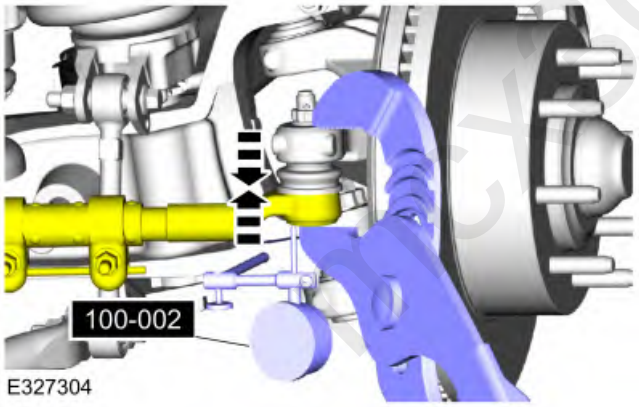
Yes	REPLACE the drag link. RETEST. REFER to: Sector Shaft Arm Drag Link - F-250/F-350/F-450/F-550 (211-03 Steering Linkage, Removal and Installation). If the concern is still present, GO to A8 If the concern is resolved, RETURN the vehicle to the customer.
No	REPEAT this test for the outer drag link ball joint. If the axial lash is greater than 0.025", replace the drag link outer. RETEST. REFER to: Front Suspension (204-01B Front Suspension - 4WD, Diagnosis and Testing). REFER to: Tie Rod End (211-03 Steering Linkage, Removal and Installation). If the concern is still present, GO to A8 If the concern is resolved, RETURN the vehicle to the customer.

A8 CHECK THE TIE ROD

NOTE: *By design, there is a 1 to 2 degree rotational free play present in the tie rod that will be observed as 1-2 mm of vertical movement when pushing on or pulling on the tie rod offset (turnbuckle adjuster). This movement is characteristic due to the internal spring design (shown below), and should not be considered as a bad joint.*

- 

- Provide a solid mounting location for a dial indicator and using the dial indicator, measure axial lash of the tie rod ball joint (Both axial and radial lash are related, a measurement of axial will also serve as a surrogate for radial lash).
- 

- Compress the ball joint with a pair of adjustable pliers.
- 

Is the axial lash greater than 0.025"?

Yes	REPLACE the tie rod. RETEST. REFER to: Tie Rod End (211-03 Steering Linkage, Removal and Installation). If the concern is still present, GO to A9 If the concern is resolved, RETURN the vehicle to the customer.
No	GO to A9

A9 CHECK THE BALL JOINTS FOR EXCESSIVE DEFLECTION.

- Inspect the upper and lower ball joints for excessive deflection.
  REFER to: Suspension System (204-00 Suspension System - General Information, Diagnosis and Testing).
- Provide a solid mounting location for a dial indicator and using the dial indicator, measure deflection of the ball joint(s) (Both axial and radial lash are related, a measurement of axial will also serve as a surrogate for radial lash).

Is the deflection greater than 0.025"?

Yes	REPLACE the ball joint(s). RETEST REFER to: Ball Joint (204-01B Front Suspension - 4WD, Removal and Installation). If the concern is still present,GO to A10
No	GO to A10

A10 CHECK THE SHOCK ABSORBERS

- Raise the vehicle on a frame lift (no weight on the wheels).
- Remove the lower shock mount attachment from the axle.
- Manually extend and compress the shock absorber with the upper mount still attached to the frame.

Is constant resistance felt during this test?

Yes	GO to A11
No	REPLACE the shock absorber(s) RETEST. REFER to: Front Shock Absorber (204-01B Front Suspension - 4WD, Removal and Installation). If the concern is still present, GO to A11

A11 CHECK THE WHEEL ALIGNMENT

- Using alignment equipment and the manufacturer's instructions, check the wheel alignment.
  REFER to: Front Camber and Caster Adjustment - F-250/F-350/F-450/F-550, 4WD (204-00 Suspension System - General Information, General Procedures).

Is the wheel alignment within specification?

Yes	If the alignment is within specification and the steering wheel oscillation concern is still present, utilize the appropriate alignment bushings to adjust the individual casters as low as possible while still remaining within specification and maintaining a cross-caster of .5 degree less on the left side. Toe in should be set to .05 degrees per side + /- .25 degree and RETEST. If the concern is resolved, RETURN the vehicle to the customer.
No	ADJUST the alignment as necessary. Utilize the appropriate alignment bushings to adjust the individual casters as low as possible while still remaining within specification and maintaining a cross-caster of .5 degree less on the left side. Toe in should be set to .05 degrees per side + /- .25 degree and RETEST. If the concern is resolved, RETURN the vehicle to the customer.