
Workshop Manual

1999

F-Super Duty 250-550

**1999 F-Super Duty 250-550
Workshop Manual**

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SECTION 100-01: Identification Codes

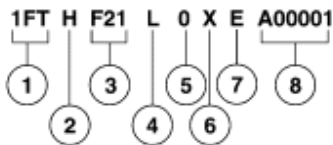
DESCRIPTION AND OPERATION

[Identification Codes](#)

SECTION 100-01: Identification Codes 1999 F-Super Duty 250-550 Workshop Manual
DESCRIPTION AND OPERATION [Procedure revision date: 01/26/2000](#)

Identification Codes

The vehicle identification number (VIN) is a 17-digit combination of letters and numbers. The VIN is stamped on a metal tab riveted on the instrument panel top upper left of the dash. The VIN number is also found on the vehicle certification (VC) label.




A0022945

Item	Description
1	World Manufacturer Identifier
2	Brake Type and Gross Vehicle Weight Rating (GVWR)

3	Vehicle Line, Series, Body Type
4	Engine Type
5	Check Digit
6	Model Year
7	Assembly Plant
8	Production Sequence Number

Vehicle Identification Number

1FT H F21 L O X E A00001




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The first three vehicle identification number (VIN) positions are the world manufacturer code.

- 1FT — Ford Motor Company, USA, truck, completed vehicle
- 1FD — Ford Motor Company, USA, incomplete vehicle
- 1FC — Ford Motor Company, USA, basic (stripped) chassis
- 1FF — Ford Motor Company, USA, motor vehicle equipment without engine/powertrain (Glider)
- 3FC — Ford Motor Company, Mexico, basic (stripped) chassis
- 3FE — Ford Motor Company, Mexico, incomplete vehicle
- 3FT — Ford Motor Company, Mexico, truck, completed vehicle

1FT H F21 L O X E A00001



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The fourth VIN position is the vehicle brake type and GVW code (all vehicles use hydraulic brakes).

- H — 8,501-9,000 pounds GVWR
- J — 9,001-10,000 pounds GVWR
- K — 10,001-14,000 pounds GVWR
- L — 14,001-16,000 pounds GVWR
- M — 16,001-19,501 pounds GVWR
- N — 19,501-26,000 pounds GVWR
- N — 8,501-9,000 pounds GVWR with second generation air bags
- S — 9,001-10,000 pounds GVWR with second generation air bags
- W — 10,001-14,000 pounds GVWR with second generation air bags
- X — 14,001-16,000 pounds GVWR with second generation air bags
- A — 16,001-19,500 pounds GVWR with second generation air bags

1FT H **F21** L O X E A00001



A0022948

Positions 5 through 7 indicate vehicle line, series and body type.

- F20 — F-250 Regular Cab, 4x2 (single rear wheels)
- F21 — F-250 Regular Cab, 4x4 (single rear wheels)
- X20 — F-250 SuperCab, 4x2 (single rear wheels)
- X21 — F-250 SuperCab, 4x4 (single rear wheels)
- W20 — F-250 Crew Cab, 4x2 (single rear wheels)
- W21 — F-250 Crew Cab, 4x4 (single rear wheels)
- F30 — F-350 Regular Cab, 4x2 (single rear wheels)
- F31 — F-350 Regular Cab, 4x4 (single rear wheels)
- X30 — F-350 SuperCab, 4x2 (single rear wheels)
- X31 — F-350 SuperCab, 4x4 (single rear wheels)
- W30 — F-350 Crew Cab, 4x2 (single rear wheels)
- W31 — F-350 Crew Cab, 4x4 (single rear wheels)
- F32 — F-350 Regular Cab, 4x2 (dual rear wheels)
- F33 — F-350 Regular Cab, 4x4 (dual rear wheels)
- X32 — F-350 SuperCab, 4x2 (dual rear wheels)
- X33 — F-350 SuperCab, 4x4 (dual rear wheels)
- W32 — F-350 Crew Cab, 4x2 (dual rear wheels)
- W33 — F-350 Crew Cab, 4x4 (dual rear wheels)
- F34 — F-350 Chassis Cab (Regular Cab), 4x2 (single rear wheels)
- F35 — F-350 Chassis Cab (Regular Cab), 4x4 (single rear wheels)
- X34 — F-350 Chassis Cab (SuperCab), 4x2 (single rear wheels)
- X35 — F-350 Chassis Cab (SuperCab), 4x4 (single rear wheels)
- W34 — F-350 Chassis Cab (Crew Cab), 4x2 (single rear wheels)

- W35 — F-350 Chassis Cab (Crew Cab), 4x4 (single rear wheels)
- F36 — F-350 Chassis Cab (Regular Cab), 4x2 (dual rear wheels)
- F37 — F-350 Chassis Cab (Regular Cab), 4x4 (dual rear wheels)
- X36 — F-350 Chassis Cab (SuperCab), 4x2 (dual rear wheels)
- X37 — F-350 Chassis Cab (SuperCab), 4x4 (dual rear wheels)
- W36 — F-350 Chassis Cab (Crew Cab), 4x2 (dual rear wheels)
- W37 — F-350 Chassis Cab (Crew Cab), 4x4 (dual rear wheels)
- F46 — F-450 Chassis Cab (Regular Cab), 4x2 (dual rear wheels)
- F47 — F-450 Chassis Cab (Regular Cab), 4x4 (dual rear wheels)
- W46 — F-450 Chassis Cab (Crew Cab), 4x2 (dual rear wheels)
- W47 — F-450 Chassis Cab (Crew Cab), 4x4 (dual rear wheels)
- F56 — F-550 Chassis Cab (Regular Cab), 4x2 (dual rear wheels)
- F57 — F-550 Chassis Cab (Regular Cab), 4x4 (dual rear wheels)
- W56 — F-550 Chassis Cab (Crew Cab), 4x2 (dual rear wheels)
- W57 — F-550 Chassis Cab (Crew Cab), 4x4 (dual rear wheels)
- F53 — Recreational Stripped Chassis (Motorhome)

1FT H F21 **L** 0 X E A00001



A0022949

The eighth VIN position is the engine displacement and number of cylinders.

- S — 6.8L SOHC, EFI, V10, Gas
- F — 7.3L OHV, DI Turbo, V8, Diesel
- 2 — 4.2L OHV, EFI, V6, Gas
- L — 5.4L, 2V, SOHC, EFI, V8, Gas

1FT H F21 L **0** X E A00001



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The ninth VIN position is a check digit.

1FT H F21 L 0 **X** E A00001



A0022951

The tenth VIN position is the model year code.

- X — 1999

1FT H F21 L 0 X **E** A00001



A0022952

The eleventh VIN position is the assembly plant code.

- S — Allen Park (Allen Park, Michigan)
- E — Kentucky Truck (Jefferson County, Kentucky)
- J — IMMSA (Monterrey, Mexico)
- M — Cuautitlan (Cuautitlan, Mexico)

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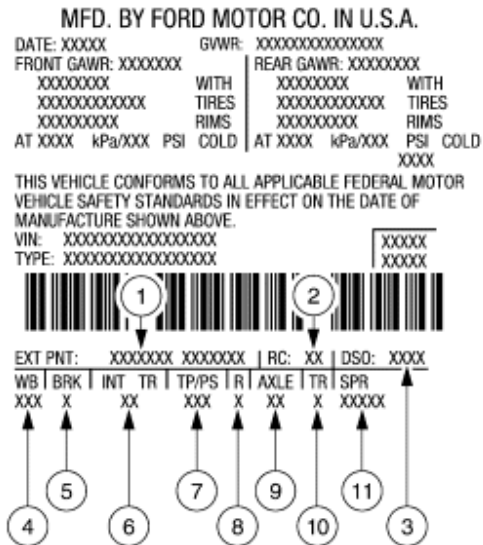


A0022953

The last six VIN positions are an alphanumeric code for the vehicle build sequence. This is also the vehicle serial and warranty number.

- A00001-E99999

Vehicle Certification (VC) Label



DY0168-B

Item	Description
1	Exterior Paint Code
2	Region Code
3	Domestic Special Order Code
4	Wheel Base Code
5	Brake Code
6	Interior Trim Code
7	Tape/Paint Pinstripe Code
8	Radio Code
9	Axle Code
10	Transmission Code
11	Spring Code

The vehicle certification (VC) label contains the manufacturer name, the month and year of manufacture, the certification statement, and the VIN. It also includes gross vehicle weight ratings (GVWR).

Vehicle Certification (VC) Label — Canada (Typical)

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: XXXXX GVWR/PBW: XXXXXXXXXXXXXXXX

FRONT GAWR: XXXXXXXX / REAR GAWR: XXXXXXXX

PNBE AV: XXXXXXXX PNBE AR: XXXXXXXX

WITH/AVEC: XXXXXXXX TIRES/PNEUS: XXXXXXXX

XXXXXXXXXXXXX / XXXXXXXX

XXXXXXXXXXXXX RIMS/JANTES: XXXXXXXX

AT/A kPa/PSI/LPC: XXXXX/XXX COLD/A FROID XXXX/XXX

XXXX/JUMELÉES: XXXX

VIN: XXXXXXXXXXXXXXXX XXXXX

TYPE: XXXXXXXXXXXXXXXX XXXXX

XXXXXXXXXXXXXXXXXXXX

EXT PNT: XXXXXX XXXXXX | RC: XX | DSO: XXXX

WB | BRK | INT | TR | TP/PS | R | AXLE | TR | SPR

XXX X XX XXX X XX X XXXX

DY0195-A

Vehicle Certification (VC) Label — Mexico (Typical)

MFD. BY FORD MOTOR COMPANY

DATE: XXXXX GVWR: XXXXXXXXXXXXXXXX

FRONT GAWR: XXXXXXXX REAR GAWR: XXXXXXXX

XXXXXXXX WITH XXXXXXXX WITH

XXXXXXXXXXXXX TIRES XXXXXXXX TIRES

XXXXXXXXXXXXX RIMS XXXXXXXX RIMS

AT XXXX kPa/XXX PSI COLD AT XXXX kPa/XXX PSI COLD

XXXX

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VIN: XXXXXXXXXXXXXXXX XXXXX

TYPE: XXXXXXXXXXXXXXXX XXXXX

XXXXXXXXXXXXXXXXXXXX

EXT PNT: XXXXXX XXXXXX | RC: XX | DSO: XXXX

WB | BRK | INT | TR | TP/PS | R | AXLE | TR | SPR

XXX X XX XXX X XX X XXXX

MADE IN MEXICO

DY0261-A

Vehicle Certification (VC) Label — Incomplete Vehicle (Typical)

INCOMPLETE VEHICLE MANUFACTURED BY

FORD MOTOR COMPANY

DATE: XXXXX GVWR: XXXXXXXXXXXXXXXX

FRONT GAWR: XXXXXXXX REAR GAWR: XXXXXXXX

XXXXXXXX WITH XXXXXXXX WITH

XXXXXXXXXXXXX TIRES XXXXXXXX TIRES

XXXXXXXXXXXXX RIMS XXXXXXXX RIMS

AT XXXX kPa/XXX PSI COLD AT XXXX kPa/XXX PSI COLD

XXXX

VIN: XXXXXXXXXXXXXXXX XXXXX

XXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXX

EXT PNT: XXXXXX XXXXXX | RC: XX | DSO: XXXX

WB | BRK | INT | TR | TP/PS | R | AXLE | TR | SPR

XXX X XX XXX X XX X XXXX

DY0196-A

Paint Codes

Refer to the paint manufacturer code book for information.

Radio Codes

- 7 — AM/FM stereo with clock
- 9 — AM/FM stereo cassette and clock
- K — AM /FM stereo cassette with CD player
- Y — Delete standard radio with clock
- G — Delete radio chassis only, AM/FM stereo, all other components installed
- R — Delete radio chassis only, AM/FM cassette, all other components installed
- E — Install Unique Gulf Coast Country Radio

Axle Codes

The following lists the gear ratios on rear axles.

- 31 — 3.73 non-limited slip, F-250, single rear wheels
- 32 — 4.10 non-limited slip, F-250, single rear wheels
- 33 — 4.30 non-limited slip, F-250, single rear wheels
- 36 — 4.56 non-limited slip, F-250, single rear wheels
- C1 — 3.73 limited slip, F-250, single rear wheels
- C2 — 4.10 limited slip, F-250, single rear wheels
- C3 — 4.30 limited slip, F-250, single rear wheels
- C6 — 4.56 limited slip, F-250, single rear wheels
- 41 — 3.73 non-limited slip, F-350, single rear wheels
- 42 — 4.10 non-limited slip, F-350, single rear wheels
- 43 — 4.30 non-limited slip, F-350, single rear wheels
- 46 — 4.56 non-limited slip, F-350, single rear wheels
- D1 — 3.73 limited slip, F-350, single rear wheels
- D2 — 4.10 limited slip, F-350, single rear wheels
- D3 — 4.30 limited slip, F-350, single rear wheels
- D6 — 4.56 limited slip, F-350, single rear wheels
- 61 — 3.73 non-limited slip, F-350, dual rear wheels
- 62 — 4.10 non-limited slip, F-350, dual rear wheels
- 63 — 4.30 non-limited slip, F-350, dual rear wheels
- 66 — 4.56 non-limited slip, F-350, dual rear wheels
- F1 — 3.73 limited slip, F-350, dual rear wheels
- F2 — 4.10 limited slip, F-350, dual rear wheels
- F3 — 4.30 limited slip, F-350, dual rear wheels
- F6 — 4.56 limited slip, F-350, dual rear wheels
- 81 — 3.73 non-limited slip, F-350, narrow frame, dual rear wheels
- 82 — 4.10 non-limited slip, F-350, narrow frame, dual rear wheels
- 83 — 4.30 non-limited slip, F-350, narrow frame, dual rear wheels
- 86 — 4.56 non-limited slip, F-350, narrow frame, dual rear wheels
- 88 — 4.88 non-limited slip, F-350, narrow frame, dual rear wheels
- E1 — 3.73 limited slip, F-350, narrow frame, dual rear wheels
- E2 — 4.10 limited slip, F-350, narrow frame, dual rear wheels
- EW — 4.10 limited slip, F-350, narrow frame, dual rear wheels
- E3 — 4.30 limited slip, F-350, narrow frame, dual rear wheels
- E6 — 4.56 limited slip, F-350, narrow frame, dual rear wheels

- 78 — 4.88 non-limited slip, F-450, Chassis Cab, dual rear wheels
- 75 — 5.38 non-limited slip, F-450, Chassis Cab, dual rear wheels
- G8 — 4.88 limited slip, F-450, Chassis Cab, dual rear wheels
- G5 — 5.38 limited slip, F-450, Chassis Cab, dual rear wheels
- GW — 4.10 limited slip, F-450, Chassis Cab, dual rear wheels
- 98 — 4.88 non-limited slip, F-550, Chassis Cab, dual rear wheels
- 95 — 5.38 non-limited slip, F-550, Chassis Cab, dual rear wheels
- K8 — 4.88 limited slip, F-550, Chassis Cab, dual rear wheels
- K5 — 5.38 limited slip, F-550, Chassis Cab, dual rear wheels
- KW — 4.10 limited slip, F-550, Chassis Cab, dual rear wheels
- 75 — Dana 80, 11,000 pounds GVWR, F53 Recreational Stripped Chassis, Motorhome
- 95 — Dana 135, 13,500 pounds GVWR, F53 Recreational Stripped Chassis, Motorhome

Transmission Codes

- B — Four-speed manual, T199, (Mexico)
- W — Five-speed manual, heavy-duty overdrive (Dana ZF)
- E — Four-speed automatic overdrive (4R100)
- 6 — Six-speed manual ZF (M6HD-6)
- M — Five-speed manual overdrive Mazda (M5R2-C)
- E — Automatic (4R100) Expedition/Navigator (5.4L engine), F53 Recreational Stripped Chassis, Motorhome

Spring Codes

The following lists available spring codes.

Front Springs

- Base part number — 5310 (RH/LH)

Rear Springs

- Base part number — 5560
- C — 5588, auxiliary rear spring
- D — 5588, auxiliary rear spring

Interior Trim Codes

The following lists the interior trim and interior color codes.

Interior Trim

- V — Vinyl bench
- K — Knitted vinyl bench
- C — Cloth bench
- F — Flight bench (Mexico only)
- M — Full bench (Mexico only)

- 3 — Cloth 40/20/40
- 8 — Leather 40/20/40
- 2 — Cloth captains chairs
- 4 — Leather captains chairs
- 5 — Leather quad captains chairs

Interior Color Codes

- X — Medium Prairie Tan
- 2 — Medium Graphite
- D — Denim Blue

Tape Stripe Codes

- S — Silver Metallic/Dark Violet/Bright Green (XLT)
 - V — Prairie Tan/Dark Violet/Burnt Orange (Lariat)
 - W — Cordovan (Super Crew Appearance Package)
 - X — Ebony/Dark Violet/Burnt Orange (Lariat)
 - D — Silver Metallic/Medium Platinum Metallic (XL and XLT)
-

SECTION 100-02: Jacking and Lifting

DESCRIPTION AND OPERATION

[Jacking](#)

[Lifting](#)

SECTION 100-02: Jacking and Lifting 1999 F-Super Duty 250-550 Workshop Manual
DESCRIPTION AND OPERATION [Procedure revision date: 01/26/2000](#)

Jacking

Jacking Points



WARNING: Do not run the engine when jacking the vehicle. The wheels contacting the ground could cause the vehicle to move.



WARNING: Make sure the jack is properly located to prevent the vehicle from falling.

Refer to the Owner Guide for additional information on vehicle jacking.

Lifting

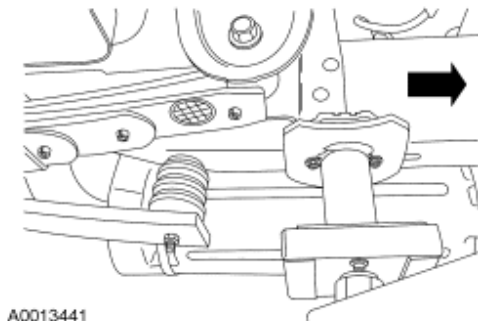
⚠ WARNING: When raising a vehicle on a twin-post hoist, use extreme care positioning the hoisting forks to avoid interference with the plastic midship fuel tank.

⚠ CAUTION: When raising a vehicle on a twin-post hoist, use care when positioning the vehicle so that the hoisting forks do not interfere with the shock absorber mounting brackets or stabilizer mounting brackets, if so equipped, or damage the axle carrier or rear cover.

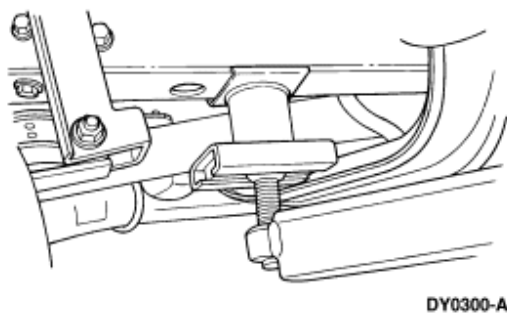
⚠ CAUTION: Damage to suspension, exhaust and steering linkage components can occur if care is not exercised when positioning the hoist adapters prior to lifting the vehicle.

Hoist adapters for heavy-duty hoists must be positioned according to the hoist manufacturer's recommendations. Be sure the hoist has an adequate lifting capacity for the vehicle being lifted.

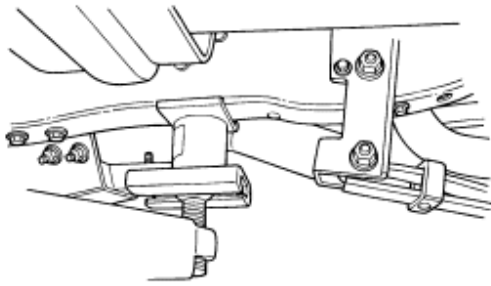
Frame — Right Rear



Frame — Right Front

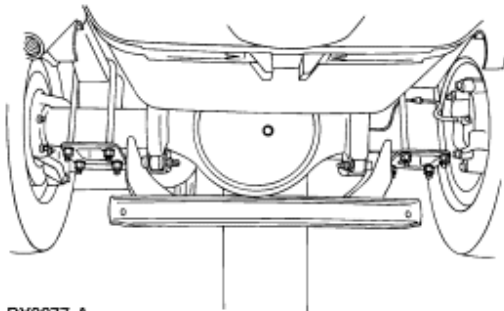


Frame — Left Front



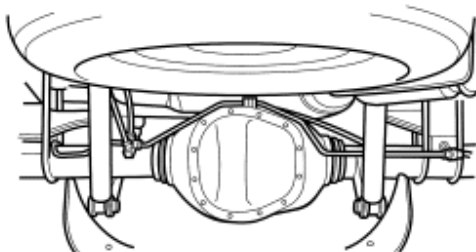
DY0301-A

Front Lifting Points — Motorhome



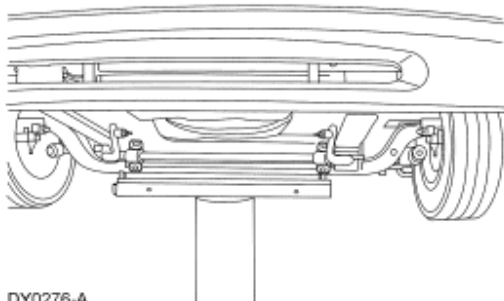
DY0277-A

Suspension — Rear



DY0302-A

Suspension — Rear, Motorhome



DY0276-A

Lifting Points



CAUTION: When raising a vehicle on a twin-post hoist, use care when positioning the vehicle so that the hoisting forks do not interfere with the shock absorber mounting brackets or stabilizer mounting brackets, if so equipped, or damage the axle carrier or rear cover.



CAUTION: Damage to suspension, exhaust and steering linkage components can occur if care is not exercised when positioning the hoist adapters prior to lifting the vehicle.

Hoist adapters for heavy-duty hoists must be positioned according to the hoist manufacturer's recommendations. Be sure the hoist has an adequate lifting capacity for the vehicle being lifted.

SECTION 100-04:
Noise, Vibration and Harshness

DESCRIPTION AND OPERATION

[Noise, Vibration and Harshness \(NVH\)](#)

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[Glossary of Terms](#)

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GENERAL PROCEDURES

[Powertrain/Drivetrain Mount Neutralizing](#)

[Exhaust System Neutralizing](#)

Noise, Vibration and Harshness (NVH)

Definitions

Noise is any unwanted sound, usually unpleasant in nature. Possible sources of noise are:

- the engine.
- the engine accessories.
- the intake and exhaust systems.
- the driveline.
- electric motors and pumps.
- the wind.
- mechanical pumps.
- the road surface.

Vibration is an unwanted periodic motion of a body or medium. It may be felt, heard, or seen. Possible sources of vibration include the:

- tires.
- engine.
- engine accessories.
- suspension.
- driveline.
- exhaust system.

Harshness refers to the ride quality and is very subjective. Reference to the previous conditions is usually the only way to identify harshness as a symptom.

Normal Noise, Vibration and Harshness

All internal combustion engines and drivelines produce some noise and vibration; operating in a real world environment adds noise and vibration that are not subject to control. Vibration isolators, mufflers and dampers are used to reduce these to acceptable levels.

A driver who is unfamiliar with a vehicle may think that some sounds are abnormal when actually the sounds are normal for the vehicle type. For example, four-wheel drive vehicles and vehicles with Traction-Lok® differentials produce noise when driven on hard surfaces that does not result on two-wheel drive vehicles or on surfaces where wheel slip can occur.

As a technician, it is very important to be familiar with vehicle features and know how they relate to NVH concerns and their diagnosis. If, for example, the vehicle has automatic overdrive, it is important to test drive in and out of overdrive mode.

Diagnostic Theory

The shortest route to an accurate diagnosis results from:

- system knowledge, including comparison with a known good system.
- system history, including repair history and usage patterns.
- condition history, especially any relationship to repairs or sudden change.
- knowledge of probable causes.
- using a systematic diagnostic method that divides the system into related areas.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- a road test to determine the exact nature of the concern.
- an analysis of the possible causes.
- testing to verify the cause.
- repairing any concerns found.
- a road test to make sure the concern has been corrected or brought back to within a normal range.

Glossary of Terms

Acceleration

The act or process of increasing speed. Acceleration occurs at light, medium, or wide-open throttle (WOT) conditions.

Light Acceleration

An increase in speed at less than half throttle.

Medium Acceleration

An increase in speed at half to nearly full throttle.

WOT Acceleration

An increase in speed at wide-open throttle.

Ambient Temperature

The surrounding or prevailing temperature.

Articulation

The relative movement of attached components.

Belt Chirp

A high-pitched short-duration noise usually caused by belt misalignment.

Belt Squeal

A high-pitched long-duration noise usually caused by belt slippage.

Boom

A low-frequency (sometimes cycling) noise, often felt as well as heard.

Bound Up

A stressed isolation mount or component that transmits vibration instead of dampening or isolating it.

Brakes Applied

The use of the brakes to keep the vehicle from moving.

Camber

The angle of the wheel in relation to the true vertical as measured looking from the front of the vehicle. Camber is positive when the wheel angle is offset so that the top of the wheel is positioned away from the vehicle.

Caster

The angle of the steering knuckle in relation to the true vertical as measured looking from the side of the vehicle.

Chuckle

The noise that occurs during the coast driving phase, usually caused by excessive clearance due to differential gear wear or by a damaged tooth on the coast side of the final drive ring gear.

Clunk

A short-duration, dull sound, usually associated with the transmission engaging in reverse or drive, or heard upon initial drive-away.

Coast/Deceleration

The vehicle is in motion and the transmission is engaged, but no pressure is applied to the accelerator pedal. Speed control, if equipped, is disengaged.

Coast/Neutral Coast

The vehicle is in motion with the transmission disengaged.

Controlled Rear Suspension Height

The height that a designated vehicle element must be at when driveline angle measurements are made.

Coupling Shaft

The front shaft in a two-piece driveline system.

CPS

Cycles per second.

Cruise

Constant speed on level ground; neither accelerating nor decelerating.

Deceleration

Slowing of the vehicle by releasing the accelerator pedal, but without using the brakes.

Drive Engine Run-Up Test

The operation of the engine through the normal rpm range with the vehicle standing still and the transmission engaged. This test is used for vibration checks.

Driveline Angles

The differences of alignment between the transmission output shaft, the driveshaft (4602), and the rear axle pinion centerline.

Driveshaft

The shaft that transmits power to the axle input shaft (pinion shaft). In a two-piece driveline, it is the rearmost shaft.

Drivetrain

All power transmitting components from the engine to the wheels; includes the clutch or torque converter, the transmission, the driveline, and the drive axle.

Drivetrain Damper

A weight attached to the engine, the transmission, the transfer case, or the axle. It is tuned by weight and placement to absorb vibration.

Dynamic Balance

The equal distribution of weight on each side of the centerline, so that when the wheel and tire assembly spins, there is no tendency for the assembly to move from side to side (wobble). Dynamically unbalanced wheel and tire assemblies can cause wheel shimmy. Refer to [Section 204-04](#) for the appropriate balancing procedures.

Engine Imbalance

An exaggerated engine movement or vibration that directly increases in frequency as the engine speed increases.

Engine Shake

A condition in which an engine's mass center is not concentric to the rotation center.

Engine Misfire

When ignition in one or more cylinders does not occur or occurs at the wrong time.

Flexible Coupling

A flexible joint in the exhaust pipe located between the catalytic converter and muffler, designed to eliminate binding conditions in the exhaust system and eliminate exhaust NVH.

Float

A drive mode on the dividing line between cruise and coast where the throttle setting matches the engine speed with the road speed.

Gravelly Feel

A grinding or growl in a component, similar to the feel experienced when driving on gravel.

Harshness

A firmer-than-usual response of a component.

Hose Clamp

A screw-type circular clamp.

Hz

Hertz; a frequency of one cycle per second.

Imbalance

Out of balance; heavier on one side than the other. In a rotating component, imbalance often causes vibration.

Inboard

Toward the vehicle centerline.

In-Phase

The in-line relationship between the forward coupling shaft yoke and the driveshaft centering socket yoke of a two-piece driveline.

Isolate

To separate from the influence of other components.

Knock

The noise caused by gear tooth damage on the drive side of the final drive ring gear, and also by the relative motion of components that are supported by bearings.

Neutral Engine Run-Up Test

The operation of the engine through the normal rpm range with the vehicle standing still and the transmission disengaged. This test is used to identify engine related vibrations.

Neutralize/Normalize

To relieve stress from possible bound-up components.

NVH

Noise, vibration and harshness.

Outboard

Away from the centerline of the vehicle.

Pinion Shaft

The input shaft in a driving axle that is usually a part of the smaller driving or input hypoid gear of a ring and pinion gearset.

Pumping Feel

A slow pulsing movement.

Radial/Lateral

Radial is in the plane of rotation; lateral is at 90 degrees to the plane of rotation.

Ring Gear

The large, circular, driven gear in a ring and pinion gearset.

Road Test

The operation of the vehicle under conditions intended to produce the concern under investigation.

Runout

Out of round or wobble.

Shake

Low frequency vibration, usually with visible movement.

Slip Yoke/Slip Spline

The driveshaft coupling that allows length changes to occur while the suspension articulates and while the driveshaft rotates.

Static Balance

The equal distribution of weight around the wheel. Statically unbalanced wheel and tire assemblies can cause a bouncing action called wheel tramp. This condition will eventually cause uneven tire wear. Refer to [Section 204-04](#) for the appropriate balancing procedures.

Tip-In Moan

A light moaning noise heard during light vehicle acceleration, usually between 40-100 km/h (25-65 mph).

TIR

Total indicated runout.

Tire Deflection

The change in tire diameter in the area where the tire contacts the ground.

Tire Force Vibration

A tire vibration caused by variations in the construction of the tire that is noticeable when the tire rotates against the pavement. This condition may be present on perfectly round tires because of variations in the inner tire construction.

Tire Flat Spots

A condition commonly caused by letting the vehicle stand when the tires are warm. It can be corrected by driving the vehicle until the tires are warm. This concern is more likely to occur with N, V and Z-speed rated tires.

Tire wear caused by wheel-locked skids.


Two-Plane Balance

Radial and lateral balance.

Vibration

An unwanted periodic motion of a body or medium. It can be felt, heard or seen.

Noise, Vibration and Harshness (NVH)

Special Tool(s)	
	ChassisEAR 107-R2102 or Equivalent

Inspection and Verification

This section provides a working knowledge of the process of diagnosing noise, vibration and harshness (NVH) conditions. The topics are based on the description of the condition. For example, if the condition is a shake that occurs at high speed, the most likely place to start is under High-Speed Shake in the symptom chart. The road test procedure will help you to sort the conditions into categories and distinguish a vibration from a shake. It also provides quick checks to help pinpoint or eliminate a cause.

How to Use the Diagnostic Procedure

Begin with the customer interview. Use the Glossary of Terms to find the descriptive name of conditions not encountered before. After naming it, identify the condition by performing a road test. Then, locate the proper diagnosis. Remember, by beginning at that point, most other systems in the vehicle have been eliminated; when the proper method of diagnosis is identified, the job is partly done. Follow the steps within the diagnostic procedure. Quick checks are described within the steps, while more involved procedures and adjustments are found in the General Procedures portion of this section. Always follow each step exactly and make notes along the way to recall important findings later.

Diagnostic Procedure

1: Customer Interview

It is important to interview the customer. Customer feedback can supply information that could be helpful in diagnosing the concern. Ask questions like:

- When is the concern present (at idle or while driving; at cold or warm operating temperatures; at high or low ambient temperatures)?
- Where does the concern appear to be coming from?
- How long has the concern been there? Has it steadily become worse?
- When did the concern start?
- Does the concern change with engine speed or with vehicle speed?

Use the customer concern evaluation form, shown following the last step of this procedure, to record customer concerns.

2: Duplicate the Noise Concern

Is the noise heard while bouncing the bumper of the vehicle, driving over rough road surfaces, braking, when driving, or while parked?

Typically, front underbody noise is heard while doing the static bounce test (bouncing the bumper or the vehicle). If the noise can not be duplicated with the static bounce test, or during low speed turning maneuvers, it is most likely not suspension related.

3: Isolate the Noise Concern

If the noise can be duplicated by the static bounce test, one of the following methods will help to locate the problem while doing the static bounce test.

- Use a stethoscope or ChassisEAR to determine the area of the chassis that the noise appears to be coming from.
- Place your hand on the coil spring, radius arm, or stabilizer bar. This method is sometimes misleading as the vibrations may carry from one suspension component to another.

4: Inspecting the Vehicle

While inspecting the vehicle in the general area of the source of the noise, look for the following:

- loose fasteners
- worn/broken parts
- excessive dirt/rust accumulation
- signs of leaking fluid
- debris wrapped around the driveshaft or the axle
- bound-up mounts and components
- mud packed behind the wheels

5: Repair of the Vehicle

Use the symptom chart to find which pinpoint test, actions or other section(s) to refer to. Also, check TSBs, OASIS/Hotline for recent techniques or known related systems concerns.

6: Test Drive the Vehicle

Repeat the method used to duplicate the problem to verify that the noise has been repaired.

7: Follow Up with the Customer

Follow up with the customer about two weeks after the repair is performed to ensure that the noise was correctly identified and repaired.

Customer Concern Evaluation Form

CUSTOMER CONCERN EVALUATION

Initial Write-Up Questions:

1. Did this condition exist when the vehicle was new?
Yes ☐
No ☐
2. How did the condition begin?
Explain: _____
3. Is the problem heard, felt, or both?
Heard ☐
Felt ☐
Both ☐
4. On what type of road surface can the problem be demonstrated?
Concrete ☐
Gravel ☐
Black Top ☐
Other _____
5. Is the problem temperature-dependent?
Hot ☐
Cold ☐
Both Hot and Cold ☐
6. Define the type of noise heard.
Boom ☐
Buzz ☐
Click ☐
Clunk ☐
Gear ☐
Grind ☐
Hum ☐
Knock ☐
Moan ☐
Pop ☐
Rumble ☐
Scrape ☐
Snap ☐
7. If the problem noise is boom, is it seat-dependent?
Yes ☐
No ☐
8. If the problem is vibration, where is it felt?
Seat ☐ Accelerator Pedal ☐
Steering Wheel ☐ Hood/Fenders ☐
Instrument Panel ☐ Rearview Mirror ☐
Floor ☐

Noise Diagnostic Procedure

Non-Axle Noise

There are some components, that when subject to certain conditions, can produce noise similar to axle noise and must be considered while performing a road test diagnosis. The seven most common are noise from the transmission, the exhaust system, the tires, roof racks, the power steering pump, the trim mouldings, and auxiliary fluid coolers.

Be sure that none of these components are the cause of the noise concern before proceeding with an axle teardown and diagnosis.

Noise Conditions

If noise is related to a specific component or system, refer to the appropriate workshop manual section for further diagnosis.

Vibration Conditions

Technically, vibration is a low- to high-frequency excitation, shaking or grounding condition, felt or heard, that is steady or variable in level and occurs during a portion of the total operating speed range. The types of vibrations that can be felt in the vehicle are divided into three groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Body and frame vibrations excited by powertrain, wind, or road inputs.
- Tip-in moans or resonance vibrations from stressed engine, exhaust system mounts, or driveline flexing modes.

These vehicle vibrations can also be subdivided into those that occur at low speeds and those that are most noticeable at higher speeds. Since the line between lower and higher speed vibrations is not clear, there will be vibrations that overlap the two ranges.

Typical Low-Speed Vibrations (Less Than 72 km/h [45 mph]):

- exhaust vibration
- engine harshness/vibration
- driveline vibration due to improper driveline angles or bad U-joints
- power steering pump vibrations
- drive belt vibrations
- engine cooling fan vibration
- take-off shudder (driveline concerns)
- brake roughness or harshness
- driveline roughness
- clutch torsion vibration
- excessive wheel runout

- tire flat spots
- driveline slip-yoke or companion flange
- components/material trapped between the body and the frame, the engine and the frame or the engine and the body
- automatic transmission clutch slippage

Typical High-Speed Vibrations (Above 72 km/h [45 mph]):

- axle and companion flange runout
- driveshaft imbalance
- excessive tire-wheel and rotor assembly imbalance
- tire roughness due to high non-uniformity (force variation) or out-of-balance condition
- rear axle pinion gear pitch line runout
- excessive tire and wheel runout
- components/material trapped between the body and the frame, the engine and the frame, or the engine and the body
- worn suspension components
- front end accessory vibrations
- exhaust vibration

Harshness is the term commonly used to describe the ride quality concern of the vehicle. A hard ride or harshness is usually caused by the tires or suspension system, namely:

- components/material trapped between the body and the frame
- overinflated, wrong size, or wrong type of tire installed on the vehicle
- suspension insufficiently lubricated
- worn suspension components
- suspension components installed with preload on the pivot point, the bearings, and the bushings
- vehicles equipped with tires that are not specified by the manufacturer (different brand tires often give different ride qualities to the vehicle)
- bent, bound-up or worn shock absorbers or shock isolators
- heavy-duty components installed on the vehicle
- load distribution

Other harshness conditions that effect ride quality are summarized as follows:

- Vehicle bounce — the vertical motion of a vehicle on its suspension system, front, and rear in phase. A low frequency "float"; an intermediate frequency "kick."
- Vehicle pitch — the out-of-phase vertical motion of the front and rear of the vehicle. A flat ride is considered the opposite of a pitch ride.
- Vehicle roll — the side-to-side rotation of the vehicle body about the front and the rear axles.

Weight Distribution

Weight properly distributed to front and rear axles gives the best ride and steerability, and eliminates premature failures due to overloaded axles, springs, tires, etc.

Payload distribution has a definite influence on vehicle performance. Even if the total vehicle is not loaded beyond the recommended maximum gross vehicle weight, this does not mean that individual components are not overloaded.

Overloading can be due to the improper positioning of heavy materials so that the load is centered over one rear tire or so far forward in the body that the front axle and tires are overloaded.

Unloaded or diminishing load type operations also affect the ride characteristics of a vehicle. Road vibrations and shock, for example, are not dampened in a light vehicle to the extent that they are under heavily loaded conditions.

Road Test

Noise, vibration and harshness (NVH) diagnosis must start with the customer interview and be followed by a road test.

NVH usually occurs in five areas:

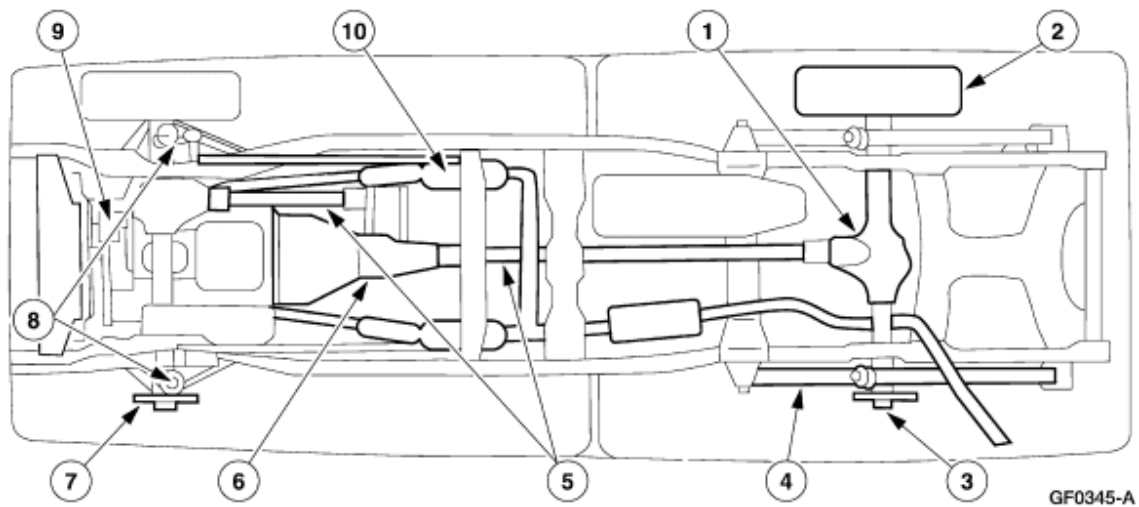
- tires
- engine accessories
- suspension
- **NOTE:** A gear-driven unit will produce a certain amount of noise. Some noise audible at certain speeds or under various driving conditions is acceptable. Slight noise is not detrimental and must be considered normal.

drivetrain

- body and interior trim panels

It is important that an NVH concern be isolated into its specific area as soon as possible. The easiest and quickest way to do this is to perform a road test.

NVH Diagnostic Locator





Item	Condition	Possible Source
1	Noise, Driveline Vibration	Ring Gear Runout, Excessive Backlash Variation, Companion Flange Runout, Driveshaft Runout, Pinion Runout
2	Noise, High-Speed Shake	Wheel and Tire Imbalance, Runout, Non-Uniformity, Inflation, Force Variations, Flat Spots
3	Noise, High-Speed Shake	Wheel Bearing Roughness, Rotor Balance
4	Noise, Harshness	Rear Suspension Wear, Damage, Misalignment, Binding, Worn/Hard Bushings
5	Vibration	Driveshaft Runout, Balance, Angle, U-Joint Seizure, Wear
6	Noise, Vibration	Transmission Gear Wear or Damage, Torque Converter Balance, Output Shaft Straightness, Transfer Case (4x4)
7	Noise, High-Speed Shake, Harshness	Wheel Bearing Roughness, Misadjustment, U-Joint Binding (4x4), Rotor Balance, Ball Joints
8	Noise, Harshness	Front Suspension Wear, Damage, Misalignment, Steering Intermediate Shaft, Poor Sealing of Components Passing from Interior to Exterior
9	Tip-In Moan, Boom, Vibration	Engine, Mounts, Accessories, Air Cleaner, Torque Converter, Belts Binding, Loose, Misaligned, Worn or Damaged
10	Tip-In Moan, Noise	Exhaust System Grounding, Binding, Bound Up Hangers, Damaged/Bent Components

1. Use the Vehicle Road Test Evaluation form shown following the last step of this procedure. Make notes on the backside of the form throughout the diagnostic routine.
2. **NOTE:** Do not make adjustments until a road test and a thorough visual inspection of the vehicle is performed. Do not change the tire pressure or the vehicle load. This may

reduce the condition's intensity to a point at which it cannot be identified clearly. It may also inject a new condition into the concern, preventing proper diagnosis.

Make a visual inspection as part of the preliminary diagnostic routine, writing down anything that does not look right. Note the tire pressures, but do not adjust them yet. Note leaking fluids, loose nuts/bolts, or bright spots where components are rubbing against each other. Check the cargo area for unusual loads.

3. Perform the neutral engine run-up (NERU) test. It identifies engine or exhaust-related vibrations and helps in sorting out vibrations that are found in the road test.
 - a. If the vehicle is equipped with a tachometer, it can be used. Otherwise, a tach must be connected.
 - b. Locate the vehicle away from other vehicles and walls which may reflect sound differently than a road.
 - c. Put the vehicle in N (neutral) or P (park) and do not set the parking brake or press on the service brake since these are not engaged in a road test.
 - d. Run the engine rpm up from an idle to approximately 4000 rpm and note any moans, vibrations, noises, etc., and the rpm at which they occur. Sometimes it is possible to "tune in" on these conditions by running the rpm up and down to determine a precise rpm at which they occur; in other cases they will fall over a broad range of rpm. This establishes a baseline against which driving vibrations can be measured.
 - e. If you suspect that the exhaust system is vibrating, hang a ring of keys or something similar from the tailpipe and listen for the rattling of the keys as the engine is run up and down.
 - f. When conducting the road test, refer to the results of the NERU test to distinguish vibrations and noises caused by the engine from those caused by the transmission, the driveshaft (4602), or the axle. If a vibration or noise occurs at a particular speed, try operating in another gear at the same speed. This changes the engine rpm and helps to distinguish engine induced vibrations and noises. If it occurs at a particular rpm, use different gears to test at the same rpm at different road speeds.
4.  **WARNING: Set both the parking brake and service brake and make sure to perform the test with enough space ahead of the vehicle to eliminate the possibility of an accident should the vehicle unintentionally lurch forward.**

 **CAUTION: Do not conduct this test for over 30 seconds, or without periodic driving or shifting to neutral to circulate transmission lubricant; otherwise the transmission will overheat causing severe damage to the automatic transmission.**

Perform the drive engine run-up (DERU) test.

Run the engine rpm up and down between an idle and approximately 2000 rpm with the transmission in D (drive). Note the nature of any vibrations and noises and when these concerns occur in relation to engine rpm.

Road Test Form

VEHICLE ROAD TEST EVALUATION

Road Test Evaluations:

1. Does the problem occur with engine, driveshaft, or wheel speed?
Engine ☐
Driveshaft ☐
Wheel ☐
2. Is the problem road speed dependent? (Occurs at the same vehicle speed independent of transmission gear).
Yes ☐
No ☐
3. Is the problem engine speed dependent? (Occurs at the same engine rpm. independent of transmission gear).
Yes ☐
No ☐
4. If the problem is engine speed dependent, perform a neutral engine runup (NERU), and compare rpm's to road rpm's.
Same as NERU ☐
Different than NERU ☐
5. Is the problem drive mode dependent? (Occurs in drive, cruise, coast/float).
Drive ☐ Speed
Cruise ☐ Speed
Coast ☐ Speed
Float ☐ Speed
6. Is the problem acceleration rate dependent? (Light, Medium or heavy throttle).
Light ☐
Medium ☐
Heavy ☐
7. Does the problem occur from a stop?
Yes ☐
No ☐
8. Is the problem transmission gear dependent? (Occurs in overdrive, but not direct drive).
Yes ☐
No ☐
9. Does the problem occur on turns?
Yes ☐
No ☐
10. Does the problem only occur when going from reverse to drive or drive to reverse?
Yes ☐
No ☐

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5. **NOTE:** The type of road and its surface condition are important factors in the road test. A smooth asphalt road that allows driving over a range of speeds is best. The brushed concrete road surface found on many expressways and the coarse aggregate sometimes found in concrete can mask many vehicle noises and make NVH diagnosis difficult.

Road test the vehicle and define the condition by reproducing it several times during the road test.

- a. A tachometer must be used.
 - b. Note the fuel level. Some vehicles change in their response to various excitations when the fuel level changes.
 - c. Try to duplicate the conditions with the customer present, particularly the speed and throttle operation.
 - d. Find the speed where the concern is most severe.
 - e. Accelerate gently through this speed to a few mph above it and then coast back down a few mph below it and note if the concern changes.
 - f. Repeat this procedure, if necessary, to get a feeling for the behavior. Then drive about five mph above the speed, put the transmission in NEUTRAL, and coast down. Note any change in behavior.
 - g. Try "floating" the driveline by backing off slightly on the throttle at the speed at which the condition occurs. The idea is to unload the axle gears and the universal joints as much as possible. If the concern does not change in all these modes of operation, the cause may be driveline imbalance since the imbalance is not changed by the throttle position.
6. Perform the road test quick checks as soon as the condition is reproduced. This will identify the proper method of diagnosis. Run through the quick checks more than once to make sure you are getting a usable result.

Road Test Quick Checks

1. 24-80 km/h (15-50 mph): With light acceleration, a moaning noise is heard and possibly a vibration is felt in the floorpan. It is usually worse at a particular engine speed and at a particular throttle setting during acceleration at that speed. It may also produce a moaning sound, depending on what component is causing it.
Refer to Tip-In Moan in the symptom chart.
2. 40-72 km/h (25-45 mph): With steady to heavy acceleration or deceleration, a rumble-type noise is heard. It is very intense during heavy acceleration or deceleration and very light during cruise or neutral coast. The vibration is hard to duplicate with vehicle supported on a hoist, since the wheels are coasting free.
Refer to Driveshaft Vibration in the symptom chart.
3. High Speed: With slow acceleration and deceleration or at constant speed, a shake is sometimes noticed in the steering wheel/column, seats, floorpan, trim panels or front end sheet metal. It is a low frequency vibration (around 9-15 cycles per second). It may increase when applying the brakes lightly.
Refer to High-Speed Shake in the symptom chart.
4. High Speed: A vibration is felt in the floorpan or seats, with no visible shake, but with an accompanying sound or rumble, buzz, hum, drone or booming noise.
It will exist in all drive modes, but may vary somewhat in acceleration, deceleration, float or coast modes. In some cases, the driveline vibration is eliminated in the float mode.
Refer to Driveshaft Vibration in the symptom chart.
5. Neutral Engine Run-Up: A vibration is felt whenever the engine reaches a particular rpm either with the vehicle in motion or while the vehicle is sitting still. It can be caused by

any component from the fan back to the clutch or torque converter (7902) and by anything that turns at engine speed when the vehicle is stopped. Refer to Engine Accessory Vibration in the symptom chart.

Hoist Test



WARNING: If only one drive wheel is allowed to rotate, the speed must be limited to a maximum speedometer reading of 55 km/h (34 mph) since the actual wheel speed will be twice that indicated on the speedometer. Exceeding a speed of 55 km/h (34 mph) or allowing the drive wheel to hang unsupported can result in tire disintegration/differential failure, which can cause serious personal injury/extensive vehicle damage.

After a road test, it is sometimes useful to do a similar test on a hoist. (Use an axle hoist, not a frame hoist. An axle hoist will not change the driveline angles. If only a frame hoist is available, axle stands must be used.) Make sure the 4x4 selector is in the 2WD mode on a 4x4 vehicle.



1. **WARNING:** A vehicle equipped with a traction-lok® differential will always have both wheels driving. If only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Be sure both rear wheels are off the floor.

Elevate the rear wheels slightly. Check to make sure both wheels will turn.

2. Start the engine and shift the transmission into DRIVE (D). Explore the speed range of interest using the drive/cruise/float tests; refer to Road Test in this section.
3. A coast down in NEUTRAL must also be conducted. If the vehicle is free of vibration when operating at a steady indicated speed and behaves very differently in DRIVE and coast, an axle concern is likely.

Accessories Mounting Inspection

Inspect the drive belt accessories mounting brackets and hardware for loose fasteners or bad belt alignment; for additional information, refer to [Section 303-05](#).

Axle Inspection

Check for low differential lubricant; for additional information, refer to [Section 205-00](#), [Section 205-02A](#), [Section 205-02B](#), [Section 205-02D](#) or [Section 205-03](#) for more information. During turns, the rear axle may have a chattering noise (Traction-Lok® axles only). Slight chatter noise

on slow turns after extended highway driving is considered acceptable and has no detrimental effect on the Traction-Lok® axle functions.

Drive Belt Inspection

Inspect the drive belt (8620) and pulleys for wear or damage. The automatic tensioners have belt wear indicator marks. If the indicator mark is not between the MIN and MAX marks, the drive belt is worn or an incorrect drive belt is installed. With the engine idling, check for irregular motion of the drive belt ; refer to [Section 303-05](#) for more information.

Driveshaft Inspection

Inspect the driveshaft for any undercoating, physical damage and missing balance weights. Check for index marks (yellow paint daub marks) on the rear of the driveshaft and the axle companion flange. The paint daubs must be less than 22-1/2 degrees apart.

Driveshaft U-Joint Inspection

Place the vehicle on a frame hoist and rotate the driveshaft by hand. Check for rough operation or seized U-joints. Replace the U-joint if it shows signs of seizure, excessive wear, or improper seating; for additional information, refer to [Section 205-01](#).

Exhaust System Inspection

Raise the vehicle on a hoist and check for broken and loose clamps and brackets. Check for damaged and bent exhaust components and for exhaust components touching the body and the frame. For additional information, refer to [Section 309-00](#).

Tire/Wheel Inspection

Inspect the tires and the wheels for wear and damage. Check the tires for cupping and flat spots. Verify that the correct tire size and wheel rim are used. If a tire/wheel is damaged, the suspension components can suffer misalignment, abnormal wear/damage that contribute to the tire/wheel damage. For additional information, refer to [Section 204-00](#) or [Section 204-04](#).

Transfer Case Inspection

Inspect the transfer case for proper operation. For additional information, refer to [Section 308-07A](#) or [Section 308-07B](#).

Symptom Chart

SYMPTOM CHART		
Condition	Possible Sources	Action
<ul style="list-style-type: none"> High-Speed Shake 	<ul style="list-style-type: none"> Tires/wheels. Wheel bearings. Suspension/steering linkage. Engine. Transmission. 	<ul style="list-style-type: none"> GO to Pinpoint Test A.
	<ul style="list-style-type: none"> Brake rotors imbalance. 	<ul style="list-style-type: none"> INSPECT for damage; for additional information, REFER to Section 206-00.
<ul style="list-style-type: none"> Tip-In Moan 	<ul style="list-style-type: none"> Air cleaner (ACL). Engine mounts. Exhaust. 	<ul style="list-style-type: none"> GO to Pinpoint Test B.
<ul style="list-style-type: none"> Idle Boom/Shake/Vibration 	<ul style="list-style-type: none"> Engine compartment component grounding. Engine mounts. Exhaust. Drive belt and pulleys. 	<ul style="list-style-type: none"> GO to Pinpoint Test C.
<ul style="list-style-type: none"> Engine Accessory Vibration 	<ul style="list-style-type: none"> Drive belt and pulleys. Mounting hardware. Accessories. 	<ul style="list-style-type: none"> For additional information, REFER to Section 303-05.
<ul style="list-style-type: none"> Driveshaft Vibration 	<ul style="list-style-type: none"> Driveshaft — runout indexing (axle/transmission), companion flange, U-joints and balance. 	<ul style="list-style-type: none"> For additional information, REFER to driveline vibration in Section 205-00.

<ul style="list-style-type: none"> • Tire/Wheel Runout 	<ul style="list-style-type: none"> • Imbalanced tires. • Damaged tire/wheel. 	<ul style="list-style-type: none"> • GO to Pinpoint Test A.
<ul style="list-style-type: none"> • Brakes — Vibration/Shudder 	<ul style="list-style-type: none"> • Brake pads. • Front disc brake hub and rotors. • Brake calipers. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 206-00.
<ul style="list-style-type: none"> • Axle Noise 	<ul style="list-style-type: none"> • Improper axle lubricant level. • Axle housing damage. • Axle shaft/splines/bearings. • Differential gears/bearings. • Broken ring gear bolts. • Broken gear teeth. • Incorrect clearance between axle gears (ring and pinion). • Pinion gear/bearings. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 205-00, Section 205-02A, Section 205-02B, Section 205-02C, Section 205-02D, Section 205-02E or Section 205-03.
<ul style="list-style-type: none"> • Noise or Vibration — 4WD Vehicles 	<ul style="list-style-type: none"> • Tires/wheels. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 204-04.
	<ul style="list-style-type: none"> • Wheel bearings. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 204-01B.
	<ul style="list-style-type: none"> • Driveshafts/U-joints/front axle companion shaft runout. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 205-00.
	<ul style="list-style-type: none"> • Engine/transmission mounts. 	<ul style="list-style-type: none"> • GO to Pinpoint Test C.
	<ul style="list-style-type: none"> • Transfer case. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 308-07A or Section

		308-07B.
	<ul style="list-style-type: none"> • Engine. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 303-00.
	<ul style="list-style-type: none"> • Transmission. 	<ul style="list-style-type: none"> • REFER to the appropriate transmission section.
<ul style="list-style-type: none"> • Driveshaft Joint Noise and Vibration 	<ul style="list-style-type: none"> • Worn U-joints. • Center bearing support driveshaft. • Worn slip yoke. • Worn/damaged driveshaft. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 205-00.
<ul style="list-style-type: none"> • Non-Axle Noise 	<ul style="list-style-type: none"> • Grille whistle. • Trim moulding. • Aftermarket add-ons (running boards, grounding body-to-frame, antennas, visors, bug deflectors, etc.). 	<ul style="list-style-type: none"> • GO to Pinpoint Test E.
	<ul style="list-style-type: none"> • Drive belt squeal or chirp. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 303-05.
	<ul style="list-style-type: none"> • Tires. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 204-04.
	<ul style="list-style-type: none"> • Exhaust. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 309-00.
	<ul style="list-style-type: none"> • Transmission. 	<ul style="list-style-type: none"> • REFER to the appropriate

		transmission section.
	<ul style="list-style-type: none"> • Speed control system. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 310-03.
	<ul style="list-style-type: none"> • Power steering system. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 211-00.
	<ul style="list-style-type: none"> • Auxiliary transmission fluid cooler. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 307-02.
<ul style="list-style-type: none"> • Wheel End Vibration 	<ul style="list-style-type: none"> • Tires/wheels. • Wheel bearing. • Brake drum/rotor imbalance. • Engine or transmission mounts. 	<ul style="list-style-type: none"> • GO to Pinpoint Test D.
<ul style="list-style-type: none"> • Engine Run-Up Vibration 	<ul style="list-style-type: none"> • Engine, Transmission, Exhaust. 	<ul style="list-style-type: none"> • PERFORM the NERU and DERU tests; refer to Road Test in this section.
	<ul style="list-style-type: none"> • Engine. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 303-00.
	<ul style="list-style-type: none"> • Transmission. 	<ul style="list-style-type: none"> • REFER to the appropriate transmission section.
	<ul style="list-style-type: none"> • Exhaust. 	<ul style="list-style-type: none"> • For additional information, REFER to Section


		309-00.
<ul style="list-style-type: none"> Noise and Vibration While Turning; Clicking, Popping or Grinding 	<ul style="list-style-type: none"> Wheel bearings. 	<ul style="list-style-type: none"> For additional information, REFER to Section 204-01B (4x4) or Section 206-03 (4x2).
	<ul style="list-style-type: none"> Brake components. 	<ul style="list-style-type: none"> For additional information, REFER to Section 206-00.
	<ul style="list-style-type: none"> Suspension components. 	<ul style="list-style-type: none"> For additional information, REFER to Section 204-00.
	<ul style="list-style-type: none"> Steering components. 	<ul style="list-style-type: none"> For additional information, REFER to Section 211-00.
<ul style="list-style-type: none"> Shudder, Vibration During Acceleration 	<ul style="list-style-type: none"> Driveline angles out of specification. 	<ul style="list-style-type: none"> CHECK the driveline angles; for additional information, REFER to Section 205-00. CORRECT as necessary.
	<ul style="list-style-type: none"> Binding, damaged or galled splines on the slip yoke. 	<ul style="list-style-type: none"> CHECK the transmission for proper lubricant. CLEAN and lap the splines. LUBRICATE the splines with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

	<ul style="list-style-type: none"> • U-joints binding or seized. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 205-01.
	<ul style="list-style-type: none"> • Rear spring U-bolt. Axle assembly mispositioned. 	<ul style="list-style-type: none"> • CHECK the U-bolts for proper torque. CHECK the axle mounts for damage and wear. REPAIR as necessary.
	<ul style="list-style-type: none"> • Front suspension components. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 204-00.
<ul style="list-style-type: none"> • Whistle 	<ul style="list-style-type: none"> • Body system. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 501-00.
<ul style="list-style-type: none"> • Wind Noise or Rattle 	<ul style="list-style-type: none"> • Body system. • Exterior trim/ornamentation. • Interior trim/ornamentation. • Instrument panel. • Door. 	<ul style="list-style-type: none"> • For additional information, REFER to the appropriate section in Group 5.

Pinpoint Tests

These pinpoint tests are designed to take the technician through a step-by-step diagnosis procedure to determine the cause of a condition. It may not always be necessary to follow a chart to its conclusion. Perform only the steps necessary to correct the condition. Then check the operation of the system to make sure the condition has been corrected. It is sometimes necessary to remove various vehicle components to gain access to the component to be tested. Refer to the applicable section for removal and installation of components. After verifying that the condition has been corrected, make sure all components removed have been installed.

PINPOINT TEST A: HIGH-SPEED SHAKE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 ROAD TEST FOR SHAKE/VIBRATION	
	<ol style="list-style-type: none"> 1 Accelerate the vehicle to the speed at which the shake/vibration occurred.
	<ol style="list-style-type: none"> 2 Record the critical vehicle speed and engine rpm.
	<ol style="list-style-type: none"> 3 Place the transmission in neutral and allow the engine to return to idle.
	<ul style="list-style-type: none"> • Does the shake/vibration disappear during the neutral coast? <p>→ Yes PERFORM the neutral engine run-up (NERU) test and the Drive Engine Run-Up (DERU) test; for additional information, REFER to Road Test in this section.</p> <p>→ No GO to A2.</p>
A2 INSPECT THE TIRES AND THE WHEELS	
	<ol style="list-style-type: none"> 1 Raise and support the vehicle; for additional information, refer to Section 100-02.
<ol style="list-style-type: none"> 2 	<ol style="list-style-type: none"> 2. Inspect the tires and the wheels for extreme wear and damage. Inspect the tires for cupping and flat spots.
	<ul style="list-style-type: none"> • Is the condition of the tires and the wheels OK? <p>→ Yes GO to A3.</p> <p>→ No</p>

	CHECK the suspension components for misalignment, abnormal wear and damage; for additional information, REFER to Section 204-00 . CORRECT the suspension concerns and REPLACE the worn/damaged tires and wheels. PERFORM a road test.
A3 CHECK THE WHEEL BEARINGS	
	1. Spin the tires by hand to check for wheel bearing roughness. Check wheel bearing end play.
	<ul style="list-style-type: none"> Are the wheel bearings OK? <p>→ Yes GO to A4.</p> <p>→ No REPLACE the wheel bearings as required; for additional information, REFER to Section 204-01B (4x4) or Section 206-03 (4x2). PERFORM a road test.</p>
A4 CHECK THE TIRE AND WHEEL BALANCE	
	1 Check the tire and wheel balance.
	<ul style="list-style-type: none"> Are the tires and wheels balanced? <p>→ Yes GO to A5.</p> <p>→ No BALANCE the tires and wheels; for additional information, REFER to Section 204-04. PERFORM a road test.</p>
A5 MEASURE RUNOUTS	
1	1 For each wheel position measure, locate and mark: <ul style="list-style-type: none"> high point of tire and wheel assembly total radial runout. high point of wheel radial runout. high point of wheel lateral runout.



DF0065-A

2. Record all measurements in the chart.

Assembly Position	Tire/Wheel Assembly Total Radial Runout	Wheel Radial Runout	Wheel Lateral Runout
Left Front			
Right Front			
Left Rear			
Right Rear			
Example	1.52 mm (0.060 Inch)	0.50 mm (0.020 Inch)	0.63 mm (0.025 Inch)

- Have all the tire and wheel assemblies been measured?

→ Yes

GO to [A6](#).

→ No

COMPLETE Step A5.

A6 ANALYZE THE RUNOUT MEASUREMENTS

1. Measurements obtained in Step A5 must fall within the specifications listed in Condition 1 in the following chart.

Condition	Assembly Total Radial Runout	Wheel Radial Runout	Wheel Lateral Runout
-----------	------------------------------	---------------------	----------------------




		1	Less Than 1.02 mm (0.04 Inch)	Less Than 1.14 mm (0.045 Inch)	Less Than 1.14 mm (0.045 Inch)
		2	Less Than 1.02 mm (0.04 Inch)	More Than 1.14 mm (0.045 Inch)	Less Than 1.14 mm (0.045 Inch)
		3	Less Than 1.02 mm (0.04 Inch)	Less Than 1.14 mm (0.045 Inch)	More Than 1.14 mm (0.045 Inch)
		4	More Than 1.02 mm (0.04 Inch)	Less Than 1.14 mm (0.045 Inch)	Less Than 1.14 mm (0.045 Inch)
	<ul style="list-style-type: none">Do the measurements obtained in A5 fall within the specifications listed in Condition 1 in the chart? <p>→ Yes Condition 1: Good assembly. GO to A11 .</p> <p>→ No If Condition 2 or 3, GO to A7 . If Condition 4, GO to A8 .</p>				
A7 REPLACE THE WHEEL					
	1. Measure the runout on the new tire and wheel assembly.				
	<ul style="list-style-type: none">Is the assembly within specification from A6?				

	<p>→ Yes GO to A10.</p> <p>→ No If Condition 2 or 3, REPLACE the wheel and RECHECK. If Condition 4, GO to A8 .</p>
A8 INDEX THE TIRE AND WHEEL ASSEMBLY	
	1. Align the high point of total assembly radial runout 180 degrees away from the high point of the wheel radial runout.
	2. Measure the total assembly radial runout.
	<ul style="list-style-type: none"> • Is the total radial runout less than 1.02 mm (0.04 inch)? <p>→ Yes GO to A10.</p> <p>→ No GO to A9.</p>
A9 REPLACE THE TIRE	
	1. Measure the total assembly radial runout on the new tire assembly.
	<ul style="list-style-type: none"> • Is the total radial runout less than 1.02 mm (0.04 inch)? <p>→ Yes GO to A10.</p> <p>→ No INDEX the tire and wheel assembly as in A8. If the new assembly is now within specification GO to A10 . If the new assembly is still not within specification, GO to A11 .</p>
A10 ROAD TEST	
	1. Balance the new tire and wheel assembly.
	2. After all assemblies have been checked and corrected, road test the vehicle.

	<ul style="list-style-type: none"> • Is the vehicle operating correctly? <p>→ Yes Vehicle is OK.</p> <p>→ No GO to A11.</p>
A11 SUBSTITUTE WHEELS AND TIRES	
	1. Substitute a known good set of wheels and tires.
	2. Road test the vehicle.
	3. If the vehicle exhibits a shake or vibration, note the vehicle speed and engine rpm at which it occurs.
	<ul style="list-style-type: none"> • Is the vibration present? <p>→ Yes For additional information, REFER to driveline vibration in Section 205-00.</p> <p>→ No INSTALL the original tire and wheel assemblies one by one, road testing at each step until the damaged tire(s) is identified. REPLACE tire(s) as necessary and RETEST.</p>




PINPOINT TEST B: TIP-IN MOAN

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK THE ENGINE AIR CLEANER INSTALLATION	
	1. For additional information, refer to Section 303-12 for proper installation of the engine air cleaner.
	<ul style="list-style-type: none"> • Is the engine air cleaner properly installed? <p>→ Yes GO to B2.</p> <p>→ No CORRECT the condition and PERFORM a road test. If the moan persists,</p>

	GO to B2 .
B2 INSPECT THE ENGINE, THE TRANSMISSION MOUNTS, AND THE EXHAUST SYSTEM	
	WARNING: Exhaust gases contain carbon monoxide, which is harmful to health and potentially lethal. Exhaust system leaks must be repaired immediately. Never operate the engine in an enclosed area.
	WARNING: Exhaust system components are hot.
	1. Inspect and replace the engine and transmission mounts as necessary.
	2.  CAUTION: You must neutralize the exhaust system after neutralizing the engine and transmission mounts to prevent the exhaust components from binding and introducing additional NVH into the vehicle. Neutralize the mounts; for additional information, refer to Engine/Transmission Mount Neutralizing in this section.
	3. Inspect and replace the exhaust components as necessary; for additional information, refer to Section 309-00 .
	4. Neutralize the exhaust system; for additional information, refer to Exhaust System Neutralizing in this section.
	5. Perform a road test.
	<ul style="list-style-type: none"> • Is moan eliminated? → Yes The vehicle is OK. → No For additional information, REFER to Section 303-05 for diagnosis and testing of the accessory drive system.


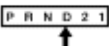

PINPOINT TEST C: IDLE BOOM/SHAKE/VIBRATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK FOR ENGINE COMPARTMENT COMPONENT GROUNDING	
	1. Check the engine compartment for any component that is grounding between the engine and the body or chassis.
	<ul style="list-style-type: none"> • Are all components OK?

	<p>→ Yes GO to C2.</p> <p>→ No CORRECT the condition and PERFORM a road test. If the boom/shake/vibration is still present, GO to C2 .</p>
C2 INSPECT THE ENGINE, THE TRANSMISSION MOUNTS, AND THE EXHAUST SYSTEM	
 WARNING: Exhaust gases contain carbon monoxide, which is harmful to health and potentially lethal. Exhaust system leaks must be repaired immediately. Never operate the engine in an enclosed area.	
 WARNING: Exhaust system components are hot.	
NOTE: Disregard this step if it has already been performed in Step B2. GO to Section 303-05 for diagnosis and testing of the accessory drive system.	
	1. Inspect and replace the engine and the transmission mounts as necessary.
	2.  CAUTION: You must neutralize the exhaust system after neutralizing the engine and transmission mounts to prevent the exhaust components from binding and introducing additional NVH into the vehicle. Neutralize the mounts; for additional information, refer to Engine/Transmission Mount Neutralizing in this section.
	3. Inspect and replace the exhaust components as necessary; for additional information, refer to Section 309-00 .
	4. Neutralize the exhaust system; for additional information, refer to Exhaust System Neutralizing in this section.
	5. Perform a road test.
	<ul style="list-style-type: none"> • Is the condition corrected? <p>→ Yes The vehicle is OK.</p> <p>→ No For additional information, REFER to Section 303-05 for diagnosis and testing of the accessory drive system.</p>

PINPOINT TEST D: WHEEL END VIBRATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 ROAD TEST FOR VIBRATION/SHUDDER	

	1. Determine if the vibration/shudder is induced when making a light stop by applying the service brakes.
	<ul style="list-style-type: none"> • Is the vibration/shudder present? <p>→ Yes INSPECT the brake system; for additional information, REFER to Section 206-00.</p> <p>→ No GO to D2.</p>
D2 PERFORM A NEUTRAL COAST TEST	
<div>1</div>  <p>Start the Engine</p>	
<div>2</div> 	2. Accelerate to the maximum legal speed.
<div>3</div> 	3. Allow the engine to return to idle. If the vibration exists with the transmission in NEUTRAL, the source is probably in the wheels, the tires, or the driveline.
	<ul style="list-style-type: none"> • Does the vibration disappear during the neutral coast test? <p>→ Yes PERFORM the neutral engine run-up (NERU) and the drive engine run-up (DERU) tests; for additional information, REFER to Road Test in this section.</p> <p>→ No For additional information, REFER to Section 204-04 for diagnosis and testing of the wheels and tires.</p>

PINPOINT TEST E: NON-AXLE NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 INSPECT THE VEHICLE TRIM	

	1. Inspect the grille and trim mouldings to see if they are the source of the noise; for additional information, refer to Section 501-08 .
	<ul style="list-style-type: none"> • Are the vehicle trim components causing the noise? <p>→ Yes REPLACE or REPAIR as necessary; for additional information, REFER to Section 501-08.</p> <p>→ No GO to E2.</p>
E2 CHECK FOR NON-FACTORY ACCESSORIES	
	1 Check for non-factory accessories as the source of the noise. Example: running boards grounding the body to the frame, antennas, visors, bug deflectors, etc.
	<ul style="list-style-type: none"> • Are any accessories the cause of the noise? <p>→ Yes ADJUST, REPAIR, or REPLACE the accessories/fasteners as required.</p> <p>→ No GO to E3.</p>
E3 CHECK FOR ENGINE/TRANSMISSION NOISE	
	1. Perform the Road Test in this section.
	<ul style="list-style-type: none"> • Is the noise engine speed related? <p>→ Yes For additional information, REFER to Section 303-00 for general engine, or to the appropriate transmission section.</p> <p>→ No GO to the Symptom Chart.</p>

Powertrain/Drivetrain Mount Neutralizing



CAUTION: You must neutralize the exhaust system after neutralizing the engine and transmission mounts to prevent the exhaust components from binding and introducing additional NVH into the vehicle.

1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
 2. Loosen, but do not remove, the engine and transmission mount fasteners.
 3. Lower the vehicle.
 4. Operate the vehicle in forward and reverse.
 5. Raise and support the vehicle.
 6. Tighten the engine and transmission mount fasteners.
 7. Neutralize the exhaust system; for additional information, refer to [Exhaust System Neutralizing](#) in this section.
-

Exhaust System Neutralizing




WARNING: Exhaust gases contain carbon monoxide, which is harmful to health and potentially lethal. Exhaust system leaks must be repaired immediately. Never operate the engine in an enclosed area.



WARNING: Exhaust system components are hot.

NOTE: Neutralize the exhaust system to relieve strain on mounts which may be sufficiently bound up to transmit vibration as if grounded.

1.  **CAUTION:** Make sure the system is warmed up to normal operating temperature, as thermal expansion can be the cause of a strain problem.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
 2. Loosen all hanger attachments and reposition the hangers until they hang free and straight.
 3. Loosen all flange joints.
 4. Tighten all the hanger clamps and flanges (tighten the manifold flange joint last); for additional information, refer to [Section 309-00](#).
 - Verify adequate clearance to prevent grounding at any point in the system.
 - After neutralization, the rubber in the exhaust hangers should show some flexibility when movement is applied to the exhaust system.
 5. Lower the vehicle.
 6. Perform a road test.
-

GROUP 04: Suspension

[SECTION 204-00: Suspension System — General Information](#)

[SECTION 204-01A: Front Suspension — 4x2](#)

[SECTION 204-01B: Front Suspension — 4x4](#)

[SECTION 204-02: Rear Suspension](#)

[SECTION 204-04: Wheels and Tires](#)

SECTION 204-00: Suspension System — General Information

[SPECIFICATIONS](#)

DESCRIPTION AND OPERATION

[Wheel Alignment Angles](#)

[Camber](#)

[Caster](#)

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[Ride Height](#)

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[Wander](#)

[Shimmy](#)

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[Poor Returnability/Sticky Steering](#)

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DIAGNOSIS AND TESTING

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[Symptom Chart](#)

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GENERAL PROCEDURES

[Wheel Bearing Inspection](#)

[Camber Adjustment—F-250, F-350, 4x4 and F-450, F-550](#)

[Caster Adjustment—Motorhome](#)

[Caster Adjustment—F-250, F-350, 4x4 and F-450, F-550](#)

[Camber and Caster Adjustment—F-250 and F-350, 4x2](#)

[Toe Adjustment—Motorhome](#)

[Toe Adjustment—F-250 and F-350, 4x2](#)

[Toe Adjustment—F-250, F-350, 4x4 and F-450, F-550](#)

[Lean Correction—Front, F-250 and F-350, 4x2](#)

[Lean Correction—Front, F-250, F-350, 4x4 and F-450, F-550](#)

[Lean Correction—Rear](#)

[Lean Correction—Motorhome](#)

SECTION 204-00: Suspension System — General
Information
SPECIFICATIONS

1999 F-Super Duty 250-550
Workshop Manual
[Procedure revision date: 01/26/2000](#)

General Specifications			
Item	LH	RH	Total/Split
Alignment Specifications — F-250 and F-350, 4x2			
Caster @ Curb Ride Height	$4.0^{\circ} \pm 2^{\circ}$	$4.0^{\circ} \pm 2^{\circ}$	$0^{\circ} \pm 1^{\circ}$
Camber @ Curb Ride Height	$0.62^{\circ} \pm 1^{\circ}$	$0.62^{\circ} \pm 1^{\circ}$	$0^{\circ} \pm 1^{\circ}$
Toe @ Curb Ride Height (Positive Value Is Toe-In, Negative Value Is Toe-Out)	—	—	$0.03^{\circ} \pm 0.25^{\circ}$
Steering Axis Inclination (SAI) @ Full Load	—	—	12.3°
Included Angle @ Full Load	—	—	12.3°
Alignment Specifications — F-250 and F-350, 4x4			
Caster @ Curb Ride Height	$3.5^{\circ} \pm 2^{\circ}$	$3.5^{\circ} \pm 2^{\circ}$	$0^{\circ} \pm 1^{\circ}$
Camber @ Curb Ride Height	$0.25^{\circ} \pm 1^{\circ}$	$0.25^{\circ} \pm 1^{\circ}$	$0^{\circ} \pm 1^{\circ}$
Toe @ Curb Ride Height (Positive Value Is Toe-In, Negative Value Is Toe-Out)	—	—	$0.03^{\circ} \pm 0.25^{\circ}$
Steering Axis Inclination (SAI) @ Full Load	—	—	8.5°
Included Angle @ Full Load	—	—	8.5°
Alignment Specifications — F-450 and F-550, 4x2 and 4x4			
Caster @ Curb Ride Height	$3.5^{\circ} \pm 2^{\circ}$	$3.5^{\circ} \pm 2^{\circ}$	$0^{\circ} \pm 1^{\circ}$
Camber @ Curb Ride Height	$0.25^{\circ} \pm 1^{\circ}$	$0.25^{\circ} \pm 1^{\circ}$	$0^{\circ} \pm 1^{\circ}$
Toe @ Curb Ride Height (Positive Value Is Toe-In, Negative Value Is Toe-Out)	—	—	$0.03^{\circ} \pm 0.25^{\circ}$
Steering Axis Inclination (SAI) @ Full Load	—	—	8.5°
Included Angle @ Full Load	—	—	8.5°
Alignment Specifications — Motorhome			
Caster @ Curb Ride Height	$4.63^{\circ} \pm 0.5^{\circ}$	$4.63^{\circ} \pm 0.5^{\circ}$	$0^{\circ} \pm 0.25^{\circ}$
Camber @ Curb Ride Height	$1.0^{\circ} \pm 0.375^{\circ}$	$1.0^{\circ} \pm 0.375^{\circ}$	$0^{\circ} \pm 0.375^{\circ}$
Toe @ Curb Ride Height (Positive Value Is Toe-In, Negative Value Is Toe-Out)	—	—	$1/16 \text{ In} \pm 1/32 \text{ In}$

Steering Axis Inclination (SAI)	—	—	5.52°
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General Specifications	
Item	Specification
Dogtracking — Motorhome	
Dogtracking — Maximum (Centerline of front tires compared to centerline of rear tires)	9 mm (0.375 in.)
Dogtracking — F-250, F-350, F-450, and F-550	
Dogtracking — Maximum (Centerline of front tires compared to centerline of rear tires)	30 mm (1.2 in.)
Clear Vision — F-250, F-350, F-450, and F-550	
Clear Vision (Negative value is counterclockwise)	-0.4° ± 3°
Clear Vision — Motorhome	
Clear Vision (Negative value is counterclockwise)	0° ± 5°
Curb Ride Height — F-250, 4x2	
Front	110-124 mm (4.3-4.9 in.)
Rear — Standard Suspension	157-219 mm (6.2-8.6 in.)
Rear — Heavy Duty Suspension	144-206 mm (5.7-8.1 in.)
Curb Ride Height — F-250, 4x4	
Front	108-132 mm (4.25-5.20 in.)
Rear — Standard Suspension	145-207 mm (5.7-8.1 in.)
Rear — Heavy Duty Suspension	132-194 mm (5.2-7.6 in.)
Curb Ride Height — F-350 Pick-Up, 4x2, Single Rear Wheel	
Front	110-124 mm (4.3-4.9 in.)
Rear — Standard Suspension	157-219 mm (6.2-8.6 in.)
Rear — Heavy Duty Suspension	144-206 mm (5.7-8.1 in.)
Curb Ride Height — F-350 Pick-Up, 4x4, Single Rear Wheel	
Front	108-132 mm

	(4.25-5.20 in.)
Rear — Standard Suspension	145-207 mm (5.7-8.1 in.)
Rear — Heavy Duty Suspension	132-194 mm (5.2-7.6 in.)
Curb Ride Height — F-350 Pick-Up, 4x2, Dual Rear Wheel	
Front	110-124 mm (4.3-4.9 in.)
Rear — Ford Axle with Standard Suspension	164-226 mm (6.5-8.9 in.)
Rear — Ford Axle with Heavy Duty Suspension	151-213 mm (5.9-8.4 in.)
Rear — Dana Axle with Standard Suspension	164-226 mm (6.5-8.9 in.)
Rear — Dana Axle with Heavy Duty Suspension	151-213 mm (5.9-8.4 in.)
Curb Ride Height — F-350 Pick-Up, 4x4, Dual Rear Wheel	
Front	108-132 mm (4.25-5.20 in.)
Rear — Ford Axle with Standard Suspension	153-215 mm (6.0-8.5 in.)
Rear — Ford Axle with Heavy Duty Suspension	140-202 mm (5.5-8.0 in.)
Rear — Dana Axle with Standard Suspension	153-215 mm (6.0-8.5 in.)
Rear — Dana Axle with Heavy Duty Suspension	140-202 mm (5.5-8.0 in.)
Curb Ride Height — F-350 Chassis Cab, 4x2, Single Rear Wheel	
Front	110-124 mm (4.3-4.9 in.)
Rear — Standard Suspension	142-204 mm (5.6-8.0 in.)
Curb Ride Height — F-350 Chassis Cab, 4x4, Single Rear Wheel	
Front	108-132 mm (4.25-5.20 in.)
Rear — Standard Suspension	142-204 mm (5.6-8.0 in.)
Curb Ride Height — F-350 Chassis Cab, 4x2, Dual Rear Wheel	
Front	110-124 mm

	(4.3-4.9 in.)
Rear — Ford Axle with Standard Suspension	148-210 mm (5.8-8.3 in.)
Rear — Dana Axle with Standard Suspension	148-210 mm (5.8-8.3 in.)
Curb Ride Height — F-350 Chassis Cab, 4x4, Dual Rear Wheel	
Front	108-132 mm (4.25-5.20 in.)
Rear — Ford Axle with Standard Suspension	148-210 mm (5.8-8.3 in.)
Curb Ride Height — F-450, 4x2 and 4x4	
Front	148-172 mm (5.8-6.8 in.)
Rear	159-221 mm (6.3-8.7 in.)
Curb Ride Height — F-550, 4x2 and 4x4	
Front	148-172 mm (5.8-6.8 in.)
Rear	175-237 mm (6.9-9.3 in.)
Ball Joint Radial Play	
Lower Ball Joint — Maximum	0.8 mm (1/32 in.)
Upper Ball Joint — Maximum	0.8 mm (1/32 in.)
Vehicle Lean (Side-to-Side Height Differences) — F-250, F-350, F-450, F-550	
Rear — Maximum	19 mm (0.75 in.)
Vehicle Lean (Side-to-Side Height Differences) — Motorhome	
Front — Maximum	15 mm (0.59 in.)
Rear — Maximum	20 mm (0.78 in.)
Sealant	
Threadlock and Sealer EOAZ-19554-AA	WSK-M2G315-A5 (Type II)

Camber/Caster Service Adjuster — F-250 and F-350, 4x2					
Service Adjuster Type (Degrees)	Position Slot in Axle (Degrees)	LH Axle		RH Axle	
		Camber Change (Degrees)	Caster Change (Degrees)	Camber Change (Degrees)	Caster Change (Degrees)
1/2	0	-0.5	0	+0.5	0
1	0	-1.0	0	+1.0	0
1-1/2	0	-1.5	0	+1.5	0
1/2	45	-0.25	+0.25	+0.25	+0.25
1	45	-0.75	+0.75	+0.75	+0.75
1-1/2	45	-1.0	+1.0	+1.0	+1.0
1/2	90	0	+0.5	0	+0.5
1	90	0	+1.0	0	+1.0
1-1/2	90	0	+1.5	0	+1.5
1/2	135	+0.25	+0.25	-0.25	+0.25
1	135	+0.75	+0.75	-0.75	+0.75
1-1/2	135	+1.0	+1.0	-1.0	+1.0
1/2	180	+0.5	0	-0.5	0
1	180	+1.0	0	-1.0	0
1-1/2	180	+1.5	0	-1.5	0
1/2	225	+0.25	-0.25	-0.25	-0.25
1	225	+0.75	-0.75	-0.75	-0.75
1-1/2	225	+1.0	-1.0	-1.0	-1.0
1/2	270	0	-0.5	0	-0.5
1	270	0	-1.0	0	-1.0
1-1/2	270	0	-1.5	0	-1.5
1/2	315	-0.25	-0.25	+0.25	-0.25
1	315	-0.75	-0.75	+0.75	-0.75
1-1/2	315	-1.0	-1.0	+1.0	-1.0

Torque Specifications		
Description	Nm	Lb/Ft
Adjusting Sleeve Clamp Nuts — F-250, F-350, F-450, F-550	55	41
Adjusting Sleeve Clamp Nuts — Motorhome	80	60

Front Spring U-Bolt Nut — F-250, F-350, 4x4 and F-450, F-550	133	99
Front Spring U-Bolt Nut — Motorhome	350	259
Lower Ball Joint Nut — F-250, F-350, 4x4 and F-450, F-550	^a	—
Rear Spring U-Bolt Nut — F-250, F-350	250	185
Rear Spring U-Bolt Nut — F-350 Chassis Cab	240	178
Rear Spring U-Bolt Nut — F-450	300	222
Rear Spring U-Bolt Nut — F-550	350	259
Rear Spring U-Bolt Nut — Motorhome	350	259
Upper Ball Joint Pinch Bolt — F-250 and F-350, 4x2	80	60
Upper Ball Joint Nut — F-250, F-350, 4x4 and F-450, F-550	125	93
1/4-Inch Diameter Bolts and Nuts — Grade 5	12	9
5/16-Inch Diameter Bolts and Nuts — Grade 5	20	15
3/8-Inch Diameter Bolts, U-Bolts and Nuts — Grade 8	50	37
7/16-Inch Diameter Bolts, U-Bolts and Nuts — Grade 8	82	61
1/2-Inch Diameter Bolts, U-Bolts and Nuts — Grade 8	122	90
9/16-Inch Diameter Bolts, U-Bolts and Nuts — Grade 8	176	130
5/8-Inch Diameter Bolts, U-Bolts and Nuts — Grade 8	240	178
3/4-Inch Diameter Bolts, U-Bolts and Nuts — Grade 8	350	259
7/8-Inch Diameter Bolts, U-Bolts and Nuts — Grade 8	570	420
1-Inch Diameter Bolts, U-Bolts and Nuts — Grade 5	860	634

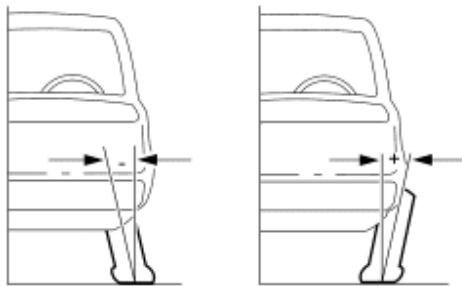
^a Refer to the procedure in this section.

Wheel Alignment Angles

Super Duty Series vehicle caster and camber correction requirements are factory-determined. Adjusters are available to correct a caster/camber measurement that does not meet specification. Before changing the production caster/camber adjuster, thoroughly inspect the suspension system to locate worn or damaged components that may have caused the setting to change.

Camber

Negative and Positive Camber

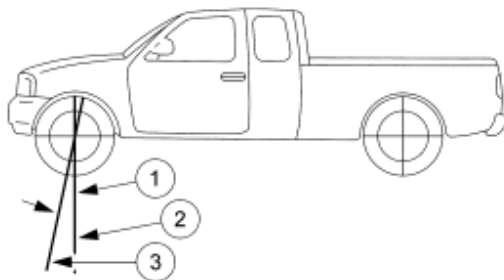


DF0078-A

Camber is the vertical tilt of the wheel (1007) when viewed from the front. Camber can be positive or negative and has a direct effect on tire wear.

Caster

Caster and Frame Angle



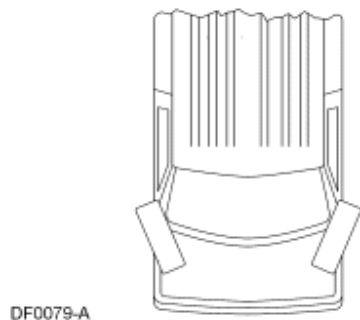
F8947-A

Item	Part Number	Description
1	—	Positive Caster
2	—	True Vertical
3	—	Steering Axis

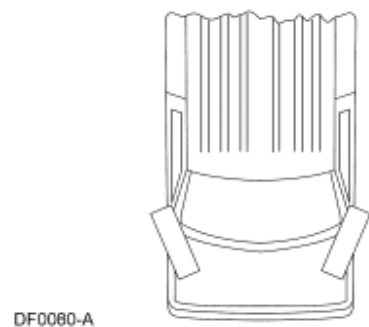
Caster is the deviation from vertical of an imaginary line drawn through the ball joints when viewed from the side. The caster specifications in this section will give the vehicle the best directional stability characteristics when loaded and driven. The caster setting is not related to tire wear.

Toe

Positive Toe (Toe In)



Negative Toe (Toe Out)

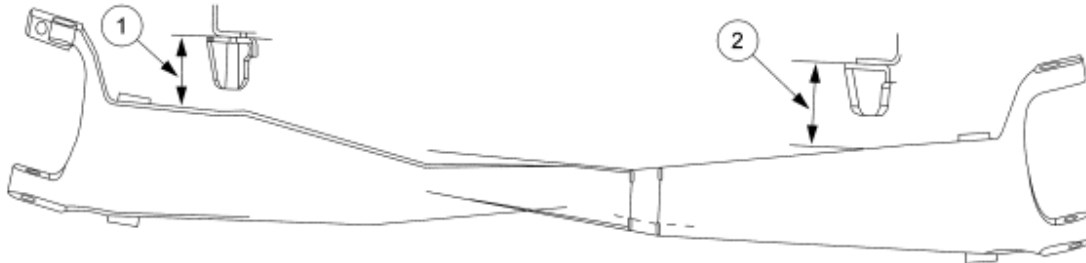


The vehicle toe setting:

- affects tire wear and directional stability.
- must be checked after adding aftermarket equipment, such as a snowplow or body.

Ride Height

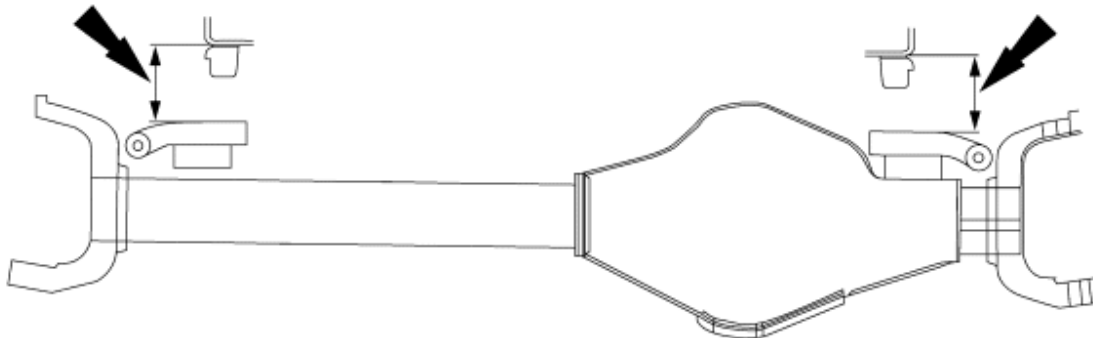
Front Ride Height Measurement — F-250 and F-350, 4x2



DF1262-A

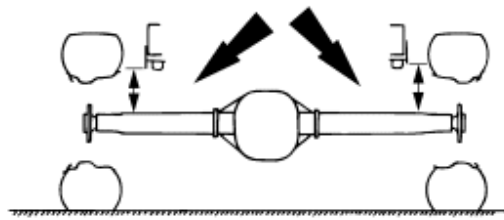
Item	Description
1	Ride Height Measurement — (RH)
2	Ride Height Measurement — (LH)

Front Ride Height Measurement — F-250 and F-350, 4x4, and F-450, F-550



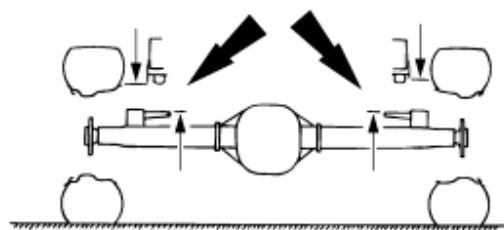
DF1263-A

Rear Ride Height Measurement — 4x2



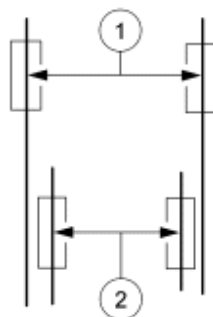
DF1260-A

Rear Ride Height Measurement — 4x4



DF1261-A

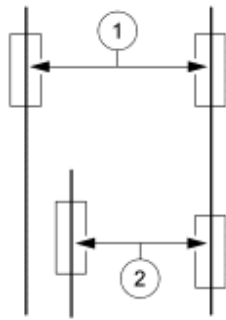
Wheel Track



GH0158-A

Item	Part Number	Description
1	—	Front Track
2	—	Rear Track

Dogtracking



F8950-A

Item	Part Number	Description
1	—	Front Track
2	—	Rear Track Dogtracking

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 (3600) corrections to maintain a straight path down a level road.

Shimmy

Shimmy, as observed 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 observed by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

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

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 hands off the steering wheel.

- A vehicle-related drift/pull, on a flat road, will cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull may be induced by conditions external to the vehicle (i.e., wind, road camber).

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). Efforts 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 gear teeth in the steering gear (3504). 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 roadability problem, it is important to understand the difference between wander and poor groove feel.
-

Suspension System

Inspection and Verification

1. Road test.
 - Verify the customer's concern by performing a road test on a smooth road. If any vibrations are apparent, for additional information, 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; for additional information, refer to [Section 204-04](#).
 - Inspect the tires for improper wear and damage; for additional information, refer to [Section 204-04](#).
3. Inspect 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, 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">• Front wheel bearing(s)• Loose or damaged front or rear suspension components• Loose, damaged or missing suspension fastener(s)• Loose or damaged shackle(s)• Improper spring usage• Damaged or sagging spring(s)• Damaged or leaking shock absorber(s)• Worn or damaged suspension bushing(s)• Loose, worn or damaged steering system components

- Damaged axle components

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, determine the symptom and proceed to the following symptom chart.

Symptom Chart

SYMPTOM CHART		
Condition	Possible Sources	Action
<ul style="list-style-type: none"> • Dogtracking 	<ul style="list-style-type: none"> • Excessive rear thrust angle. 	<ul style="list-style-type: none"> • ADJUST as necessary.
	<ul style="list-style-type: none"> • Front or rear suspension components. 	<ul style="list-style-type: none"> • INSPECT the front and rear suspension systems. REPAIR or REPLACE as necessary. For additional information, REFER to Section 204-01A, Section 204-01B or Section 204-02.
	<ul style="list-style-type: none"> • Drive axle damaged. 	<ul style="list-style-type: none"> • REPAIR as necessary. REFER to the appropriate section in Group 2.
<ul style="list-style-type: none"> • Drift/Pull 	<ul style="list-style-type: none"> • Unequal tire pressure. 	<ul style="list-style-type: none"> • ADJUST tire pressure.
	<ul style="list-style-type: none"> • Excessive side-to-side difference in caster or camber. 	<ul style="list-style-type: none"> • ADJUST as necessary.
	<ul style="list-style-type: none"> • Tire forces. 	<ul style="list-style-type: none"> • ROTATE tires front to rear.
	<ul style="list-style-type: none"> • Unevenly loaded or 	<ul style="list-style-type: none"> • NOTIFY the customer of

	overloaded vehicle.	improper vehicle loading.
	<ul style="list-style-type: none"> Steering components. 	<ul style="list-style-type: none"> For additional information, REFER to Section 211-00.
	<ul style="list-style-type: none"> Brake drag. 	<ul style="list-style-type: none"> For additional information, REFER to Section 206-00.
<ul style="list-style-type: none"> Front Bottoming or Riding Low 	<ul style="list-style-type: none"> Front spring(s). 	<ul style="list-style-type: none"> REPLACE any unserviceable front spring(s) as necessary. For additional information, REFER to Section 204-01A or Section 204-01B.
	<ul style="list-style-type: none"> Front suspension bumper(s). 	<ul style="list-style-type: none"> REPLACE as necessary. For additional information, REFER to Section 204-01A or Section 204-01B.
<ul style="list-style-type: none"> Improper Tire Wear 	<ul style="list-style-type: none"> Incorrect tire pressure (rapid center rib or inner and outer edge wear). 	<ul style="list-style-type: none"> ADJUST tire pressure.
	<ul style="list-style-type: none"> Excessive front or rear toe (rapid inner or outer edge wear). 	<ul style="list-style-type: none"> ADJUST as necessary.
	<ul style="list-style-type: none"> Excessive negative or positive camber (rapid inner or outer edge wear). 	<ul style="list-style-type: none"> ADJUST as necessary.
	<ul style="list-style-type: none"> Tires out of balance (tires cupped or dished). 	<ul style="list-style-type: none"> BALANCE tires.

<ul style="list-style-type: none"> • Rear Spring Squeak 	<ul style="list-style-type: none"> • Rear spring(s). 	<ul style="list-style-type: none"> • INSTALL new rear spring anti-squeak inserts.
	<ul style="list-style-type: none"> • Shackle bushing(s). 	<ul style="list-style-type: none"> • REPLACE as necessary.
<ul style="list-style-type: none"> • Rough Ride 	<ul style="list-style-type: none"> • Shock absorber(s). 	<ul style="list-style-type: none"> • REPLACE as necessary.
	<ul style="list-style-type: none"> • Spring(s). 	<ul style="list-style-type: none"> • REPLACE as necessary. For additional information, REFER to Section 204-01A, Section 204-01B or Section 204-02.
<ul style="list-style-type: none"> • Shimmy or Wheel Tramp 	<ul style="list-style-type: none"> • Loose lug nut(s). 	<ul style="list-style-type: none"> • TIGHTEN to specification. For additional information, REFER to Section 204-04.
	<ul style="list-style-type: none"> • Loose front suspension fasteners. 	<ul style="list-style-type: none"> • TIGHTEN to specification. For additional information, REFER to Section 204-01A or Section 204-01B.
	<ul style="list-style-type: none"> • Front wheel bearing adjustment. 	<ul style="list-style-type: none"> • GO to Wheel Bearing Inspection in this section.
	<ul style="list-style-type: none"> • Wheel or tire concerns. 	<ul style="list-style-type: none"> • For additional information, REFER to Section 204-04.
	<ul style="list-style-type: none"> • Springs. 	<ul style="list-style-type: none"> • REPLACE as necessary. For additional information, REFER to Section 204-01A, Section 204-01B or Section 204-02.
	<ul style="list-style-type: none"> • Loose, worn or damaged ball joints. 	<ul style="list-style-type: none"> • GO to the Ball Joint Inspection component test in this section.
	<ul style="list-style-type: none"> • Loose, worn or damage steering 	<ul style="list-style-type: none"> • For additional information,

	components.	REFER to Section 211-00 .
	<ul style="list-style-type: none"> Front wheel alignment. 	<ul style="list-style-type: none"> ADJUST as necessary.
<ul style="list-style-type: none"> Sticky Steering, Poor Returnability 	<ul style="list-style-type: none"> Ball joints. 	<ul style="list-style-type: none"> GO to the Ball Joint Inspection component test in this section.
	<ul style="list-style-type: none"> Steering components. 	<ul style="list-style-type: none"> For additional information, REFER to Section 211-00.
	<ul style="list-style-type: none"> Front wheel alignment. 	<ul style="list-style-type: none"> ADJUST as necessary.
<ul style="list-style-type: none"> Steering Wheel Off-Center 	<ul style="list-style-type: none"> Unequal front or rear toe settings (side-to-side). 	<ul style="list-style-type: none"> ADJUST as necessary.
	<ul style="list-style-type: none"> Steering components. 	<ul style="list-style-type: none"> For additional information, REFER to Section 211-00.
<ul style="list-style-type: none"> Sway or Roll 	<ul style="list-style-type: none"> Overloaded, unevenly or improperly loaded vehicle. 	<ul style="list-style-type: none"> NOTIFY the customer of improper vehicle loading.
	<ul style="list-style-type: none"> Loose lug nut(s). 	<ul style="list-style-type: none"> TIGHTEN to specification. For additional information, REFER to Section 204-04.
	<ul style="list-style-type: none"> Shock absorber(s). 	<ul style="list-style-type: none"> REPLACE as necessary.
	<ul style="list-style-type: none"> Loose stabilizer assembly. 	<ul style="list-style-type: none"> TIGHTEN to specification. For additional information, REFER to Section 204-01A, Section 204-01B or Section 204-02.
	<ul style="list-style-type: none"> Worn stabilizer assembly 	<ul style="list-style-type: none"> REPLACE as necessary. For additional information, REFER to Section 204-

	bushing(s).	01A, Section 204-01B or Section 204-02 .
	<ul style="list-style-type: none"> Worn spring(s). 	<ul style="list-style-type: none"> REPLACE as necessary. For additional information, REFER to Section 204-01A, Section 204-01B or Section 204-02.
<ul style="list-style-type: none"> Vehicle Leans to One Side 	<ul style="list-style-type: none"> Unevenly loaded or overloaded vehicle. 	<ul style="list-style-type: none"> NOTIFY the customer of improper vehicle loading.
	<ul style="list-style-type: none"> Front or rear suspension components. 	<ul style="list-style-type: none"> INSPECT the front and rear suspension systems. REPAIR or REPLACE as necessary. For additional information, REFER to Section 204-01A, Section 204-01B or Section 204-02.
	<ul style="list-style-type: none"> Spring(s). 	<ul style="list-style-type: none"> REPLACE any unserviceable spring(s) or components as necessary. For additional information, REFER to Section 204-01A, Section 204-01B or Section 204-02.
	<ul style="list-style-type: none"> Incorrect ride height. Lateral tilt out of specification. 	<ul style="list-style-type: none"> INSPECT the rear suspension system. REPAIR or REPLACE any unserviceable rear suspension components as necessary. For additional information, REFER to Section 204-01A, Section 204-01B or Section 204-02.
<ul style="list-style-type: none"> Vibration/Noise 	<ul style="list-style-type: none"> Tires and wheel concerns. Wheel bearings. Wheel hubs. Brake 	<ul style="list-style-type: none"> For additional information, REFER to Section 100-04.

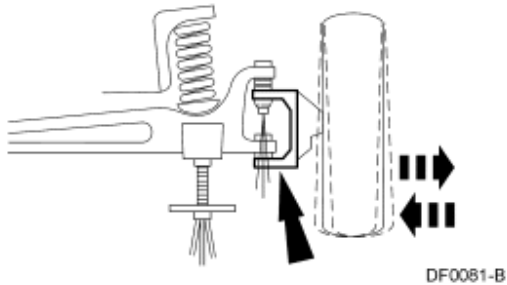
	<ul style="list-style-type: none"> components. Suspension components. Steering components. 	
<ul style="list-style-type: none"> Wander 	<ul style="list-style-type: none"> Unevenly loaded or overloaded vehicle. 	<ul style="list-style-type: none"> NOTIFY the customer of improper vehicle loading.
	<ul style="list-style-type: none"> Ball joint(s). 	<ul style="list-style-type: none"> GO to the Ball Joint Inspection component test in this section.
	<ul style="list-style-type: none"> Loose, worn or damaged front wheel bearing(s). 	<ul style="list-style-type: none"> GO to Wheel Bearing Inspection in this section.
	<ul style="list-style-type: none"> Loose, worn or damaged suspension components(s). 	<ul style="list-style-type: none"> REPLACE as necessary. For additional information, REFER to Section 204-01A or Section 204-01B.
	<ul style="list-style-type: none"> Loose suspension fasteners. 	<ul style="list-style-type: none"> TIGHTEN to specification. For additional information, REFER to Section 204-01A or Section 204-01B.
	<ul style="list-style-type: none"> Steering components. 	<ul style="list-style-type: none"> For additional information, REFER to Section 211-00.
	<ul style="list-style-type: none"> Wheel alignment (excessive total front toe out). 	<ul style="list-style-type: none"> ADJUST as necessary.

Component Tests

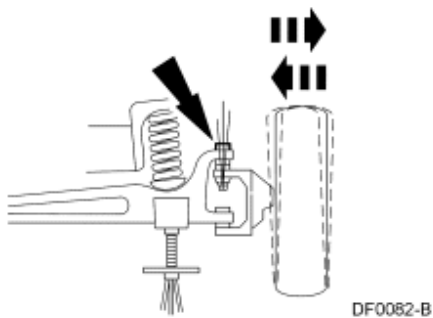
Ball Joint Inspection

1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

2. Prior to performing any inspection of the ball joints, inspect the front wheel bearings (1216); for additional information, refer to [Wheel Bearing Inspection](#) in this section.
3. Position a safety stand beneath the front axle to be tested.



4. While an assistant pulls and pushes the bottom of the tire, observe the relative movement between the lower spindle arm and the front axle. Any movement at or exceeding the specification indicates a worn or damaged lower ball joint. Replace as necessary; for additional information, refer to [Section 204-01A](#) or [Section 204-01B](#).



5. While an assistant pulls and pushes the top of the tire, observe the relative movement between the upper spindle arm and the front axle. Movement at or exceeding the specification indicates a worn or damaged upper ball joint. Replace the upper ball joint as necessary; for additional information, refer to [Section 204-01A](#) or [Section 204-01B](#).
-

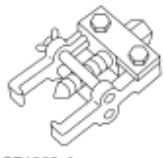
Wheel Bearing Inspection

1. Raise the vehicle until the tire is off the floor; for additional information, refer to [Section 100-02](#).
2. **NOTE:** Make sure the wheel rotates freely and the brake pads are retracted sufficiently to allow movement of the tire and wheel assembly.

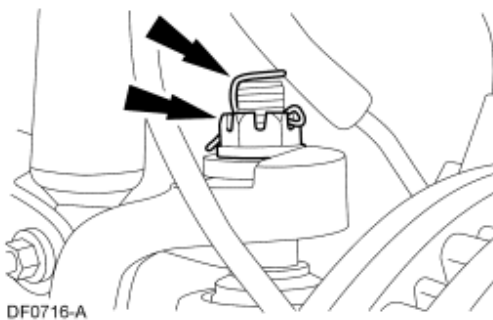
Grasp each front tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the front wheel bearing.

3. If the tire and wheel (hub) is loose on the wheel spindle or does not rotate freely, perform one of the following actions.
 - On 4x2 vehicles, adjust the front wheel bearings; for additional information, refer to [Section 204-01A](#).
 - On 4x4 vehicles, replace the wheel hub (1104); for additional information, refer to [Section 204-01B](#).
-

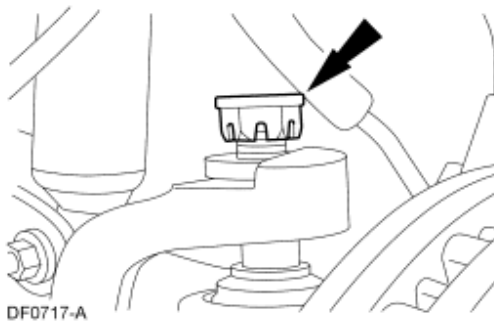
Camber Adjustment—F-250, F-350, 4x4 and F-450, F-550

Special Tool(s)	
 ST1263-A	Steering Arm Remover 211-003 (T64P-3590-F)

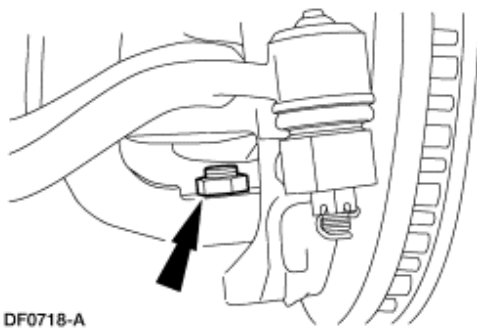
1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Remove the front wheel; for additional information, refer to [Section 204-04](#).
3. Check and note the amount of camber in the current camber adjuster sleeve.
4. Select a new camber adjuster sleeve.
 - The camber change required to obtain the optimum settings must be added or subtracted from the amount of camber in the old or production camber adjuster sleeve.
 - Use this example as a guide. If the LH wheel camber must be reduced 1 degree and the existing camber adjuster sleeve has a +5 degree of camber, select the -0.5 degree camber adjuster sleeve.
5. Remove the cotter pin and castellated nut. Discard the cotter pin.



6. Install the nut.



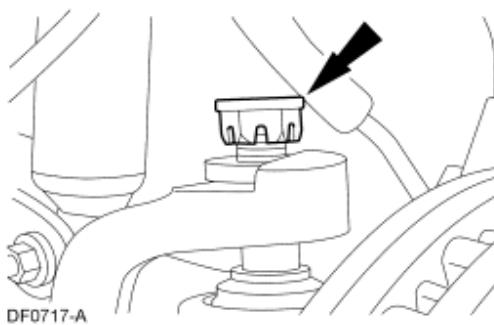
7. Loosen the nut to the end of the lower ball joint stud.



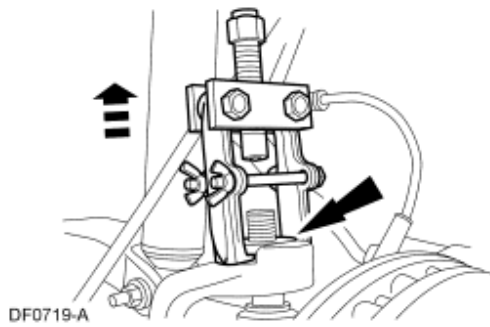
8.  **CAUTION:** Use care not to damage the brake and vacuum lines when striking the spindle.

Separate the spindle from the axle.

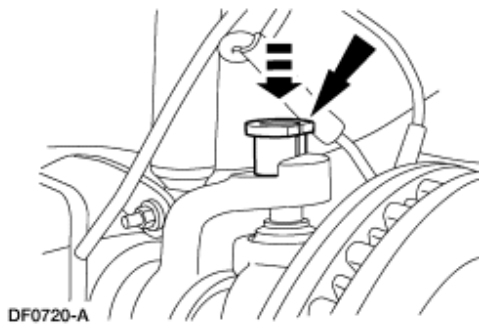
9. Remove the nut.



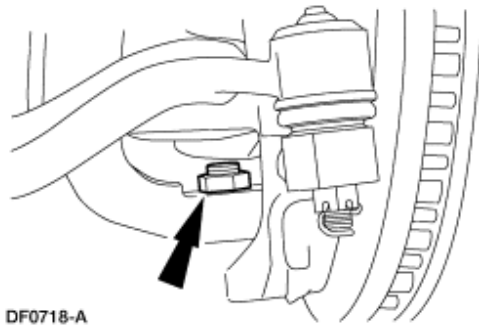
10. Remove the camber adjuster sleeve.
 - Use the Steering Arm Remover.



11. Install the new camber adjuster sleeve.

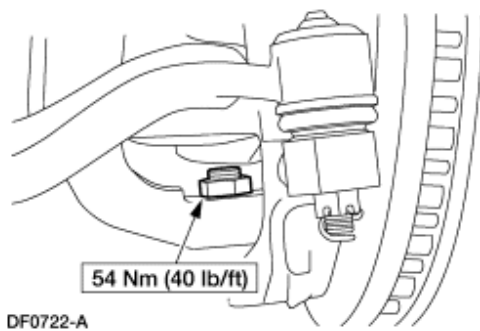


12. Remove the nut.

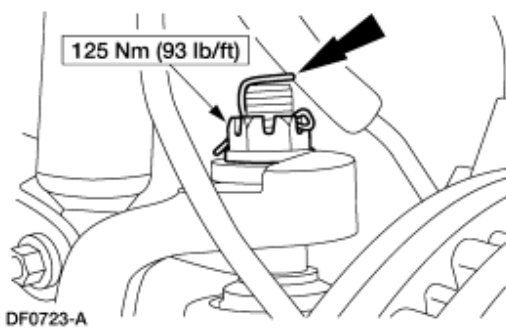


13. Install the nut and tighten to initial torque.

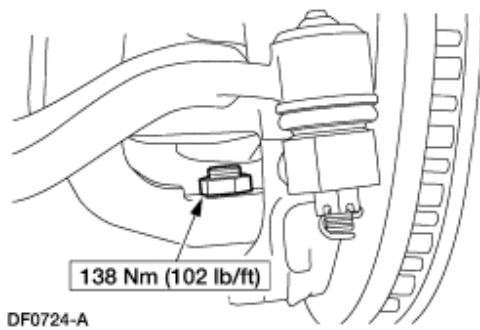
- Apply Threadlock and Sealer EOAZ-19554-AA or equivalent meeting Ford specification WSK-M2G315-A5 (Type II).



14. Install the castellated nut and a new cotter pin.



15. Tighten the nut to final torque.



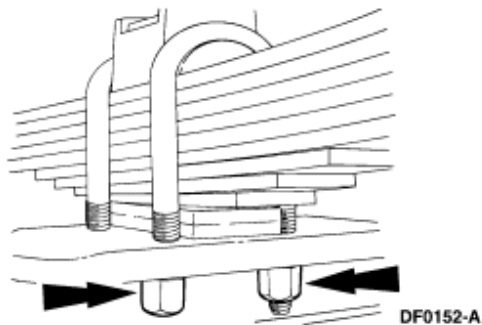
16. Install the front wheel; for additional information, refer to [Section 204-04](#).

17. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

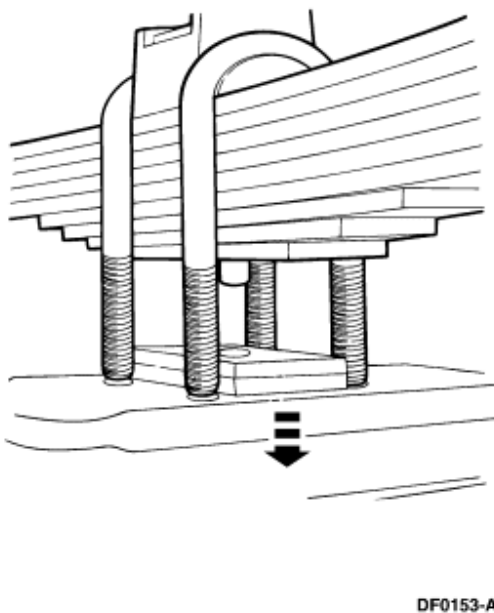
18. Recheck the camber measurement. Readjust as necessary.

Caster Adjustment—Motorhome

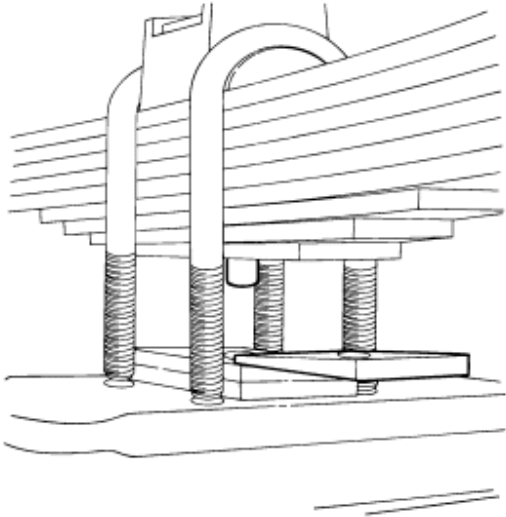
1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Support the axle and the chassis independently.
3. Remove the nuts. Discard the U-bolts and nuts.



4. Lower the axle enough to insert the adjustment wedge.

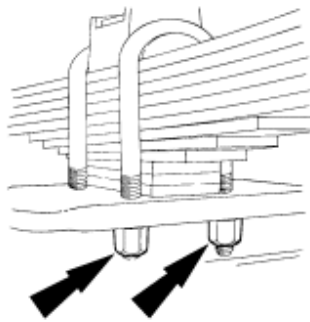


5. Insert the caster adjustment wedge.



DF0154-A

6. Install new U-bolts and nuts. Tighten the nuts.
 - Note the U-bolt size and tighten to specification.

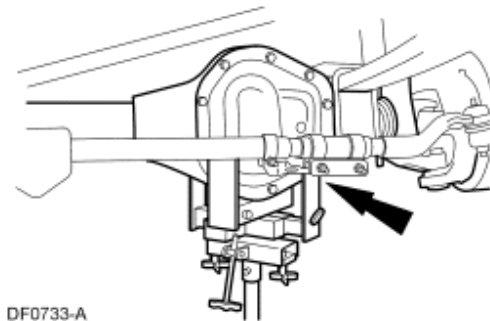


DF0155-B

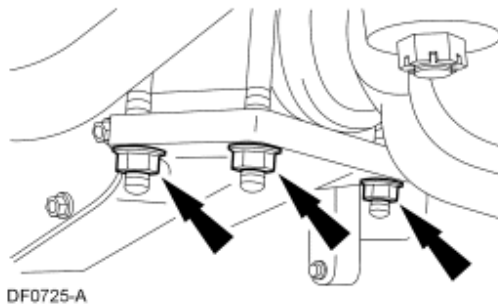
7. Lower the vehicle; for additional information, refer to [Section 100-02](#).
 8. Recheck the caster.
-

Caster Adjustment—F-250, F-350, 4x4 and F-450, F-550

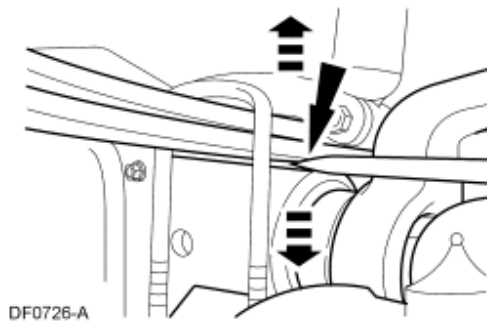
1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Remove the front wheel; for additional information, refer to [Section 204-04](#).
3. Support the axle.



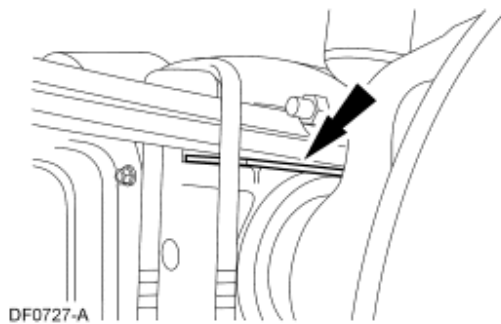
4. Remove and discard the four nuts and two U-bolts.



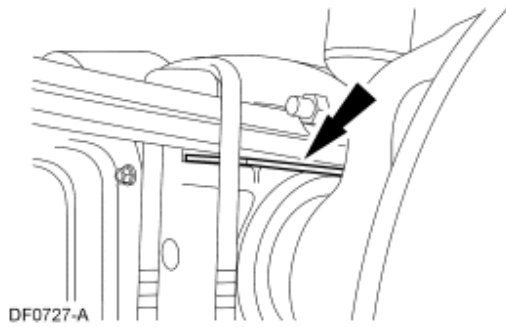
5. Separate the front axle from the springs.



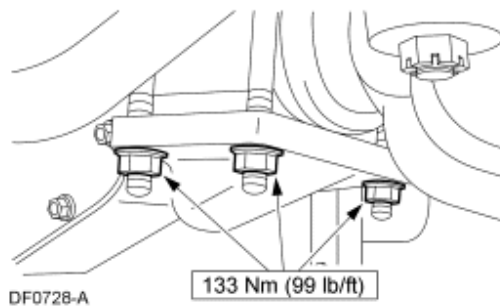
6. Remove the existing castor adjustment shim, if necessary.
 - Note the amount of castor and the orientation of the existing castor adjustment shim.



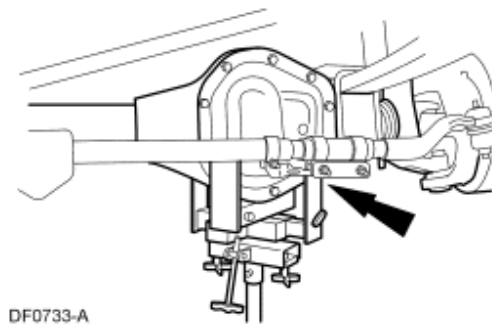
7. Select a new castor adjustment shim.
 - The castor change required to obtain the optimum settings must be added or subtracted from the amount of castor in the old or productions castor adjustment shim.
 - Use this example as a guide. If the LH wheel castor must be reduced 1 degree and the existing castor adjustment shim has +2 degree of castor, select the 1 degree castor adjustment shim.
8. Install the new castor adjustment shim.
 - To increase castor, position the thin edge of the shim toward the front of the vehicle.
 - To decrease castor, position the thin edge of the shim toward the rear of the vehicle.
 - Position the castor adjustment shim so the spring seat tie bolt sets through the shim into the axle housing.



9. Install four new nuts and two new U-bolts.

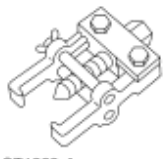


10. Remove the support from the axle.



11. Install the front wheel; for additional information, refer to [Section 204-04](#).
 12. Lower the vehicle; for additional information, refer to [Section 100-02](#).
 13. Recheck the caster measurement. Readjust as necessary.
-

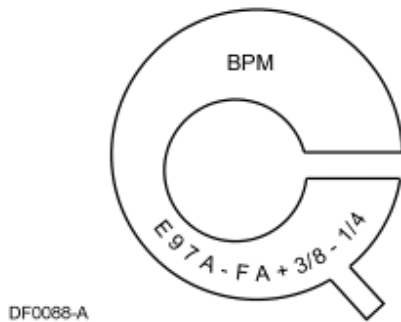
Camber and Caster Adjustment—F-250 and F-350, 4x2

Special Tool(s)	
	Steering Arm Remover 211-003 (T64P-3590-F)

1.  **CAUTION: Do not bend axles or radius arms to change alignment.**

Using an alignment rack and manufacturer's instructions, measure the caster and camber.

- Refer to Alignment Specifications in the Specifications portion of this section for optimal alignment settings.
 - Note any difference between the actual measurements and the specification. This information will be used to select the correct service adjuster.
2. Raise and support the front end; for additional information, refer to [Section 100-02](#).
 3. Remove the front wheel(s); for additional information, refer to [Section 204-04](#).
 4. Check the type and orientation of the installed adjuster.
 - Production adjusters have a round flange, a side tab and the amounts of caster and camber stamped in the top of the adjuster.
 - The first number is the amount of caster; the second number is the amount of camber in degrees if the adjuster is installed in the right-hand axle position.
 - If the adjuster is in the left-hand axle, the caster number is the opposite sign of the number shown. For example, a positive amount in the right-hand axle is a negative amount in the left axle, and a negative amount in the right-hand is a positive in the left-hand position.
 - Service adjusters have a hex flange, no side tab and the adjustment amount of the caster and camber stamped into the top.



5. **NOTE:** The assembly plant sometimes builds vehicles with adjusters that are not 0-degree type to control alignment. The Camber/Caster Service Adjuster chart shows the alignment changes that will occur if the vehicle was originally built with 0-degree adjusters.

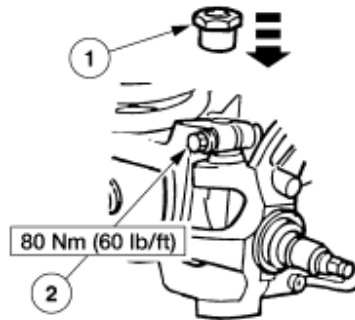
Select a new service adjuster and its orientation in the axle to obtain the optimum caster/camber. Refer to the Camber/Caster Service Adjuster chart in the Specifications portion of this section.

- Note that the caster change or camber change required to obtain the optimum settings must be added to amounts of caster/camber in the old or production adjuster.
 - Use this example as a guide. If caster must be reduced 1 degree and camber increased +0.75 degree at the LH wheel, and the existing adjuster has +0.25-degree caster as installed, select the 1-degree service adjuster and orient the slot 225 degrees from the straight-ahead position. In all cases, select the adjuster and orientation that will bring the alignment closest to the optimal settings.
6. Loosen the pinch bolt. Using the Steering Arm Remover, remove the adjuster from the axle.



DF0090-A

7. Install the new service adjuster. Orient the slot as noted in Step 5.
 1. Position the new adjuster as specified in the chart.
 2. Tighten the pinch bolt.

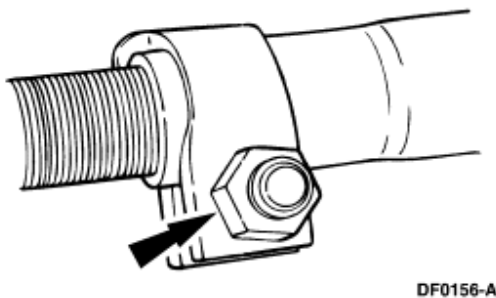


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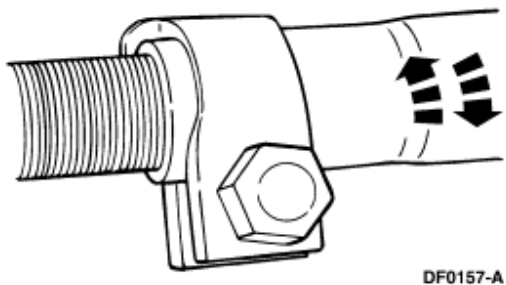
8. Install the front wheel; for additional information, refer to [Section 204-04](#).
 9. Lower the front end; for additional information, refer to [Section 100-02](#).
 10. Check the alignment. If not at optimal caster/camber specification, additional adjustment of the rotational orientation of the adjuster is required.
 11. Once optimal caster/camber has been achieved, reset the toe and clear vision to optimal settings.
-

Toe Adjustment—Motorhome

1. Loosen the clamp at both ends of the tie rod.



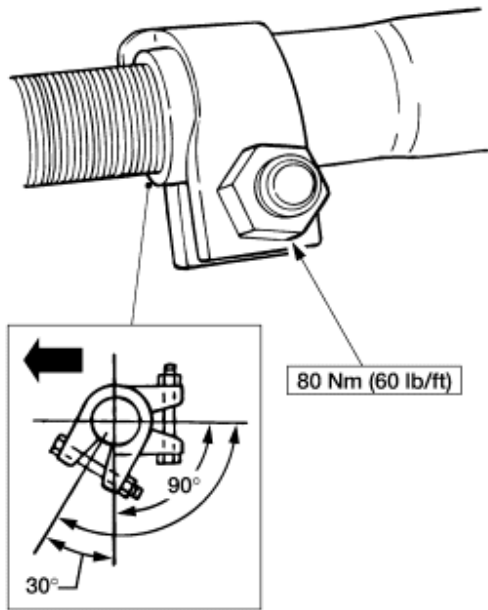
2. Rotate the tie rod to bring the toe into specification.



3. **NOTE:** For movable tie rod clamps, make sure the tab is against the end of the tie rod.

NOTE: Note the specification for the tie rod clamp orientation.

Tighten the clamp to specification.

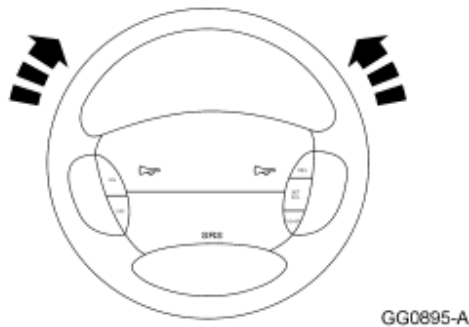


DF1230-A

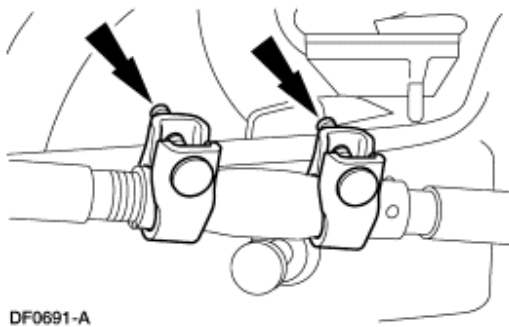
4. Recheck the toe.
-

Toe Adjustment—F-250 and F-350, 4x2

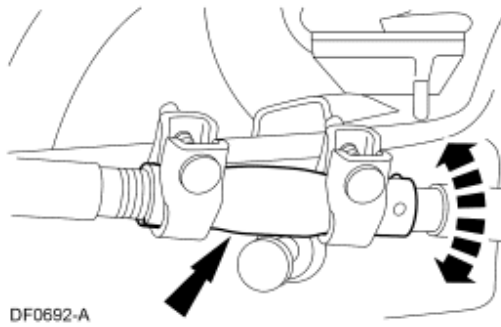
1. Start the engine (6007) and center the steering wheel (3600).



2. Turn the engine off, and hold the steering wheel in the straight-forward position by attaching a rigid link from the steering wheel to the brake pedal.
3. Check the toe settings; follow the manufacturer's instructions.
4. Loosen the nuts.
 - Clean and lubricate the steering linkage and tie rod end threads.



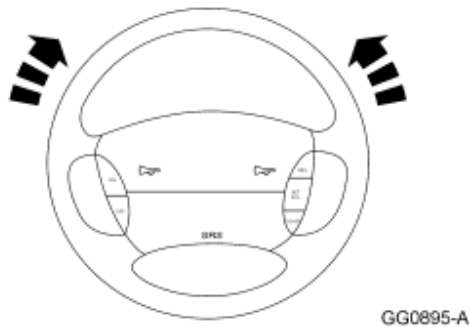
5. Rotate the tie rod adjusting sleeves (3281) to obtain the correct toe setting.



6. Position the RH adjusting sleeve clamp opening downward within 45 degrees of vertical. Tighten the nuts.
 7. Position the LH adjusting sleeve clamp opening upward within 45 degrees of vertical. Tighten the nuts.
 8. Recheck the toe settings; follow the manufacturer's instructions.
-

Toe Adjustment—F-250, F-350, 4x4 and F-450, F-550

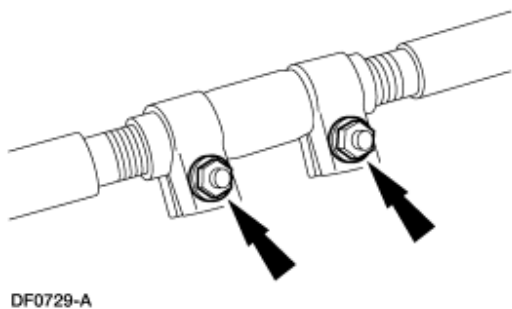
1. Start the engine. Center the steering wheel.



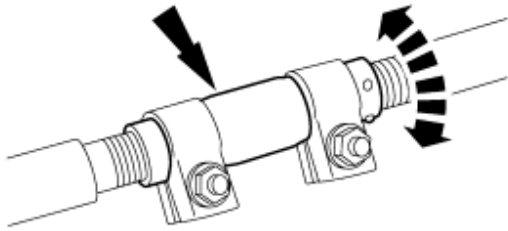
2. Turn the engine off. Use a rigid link from the steering wheel to the brake pedal to lock the steering wheel in the straight-forward position.
3. **NOTE:** If the RH toe measurement is within specifications and only the LH toe measurement needs adjustment, go to Step 6.

Loosen the nuts.

- Clean and lubricate the steering linkage and tie rod end threads.

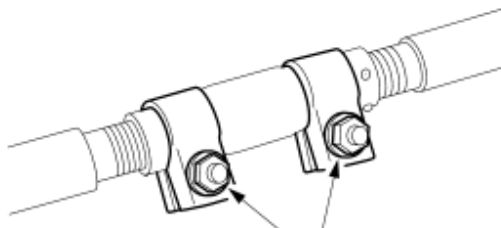


4. Rotate the tie rod adjusting sleeve to the correct toe setting.



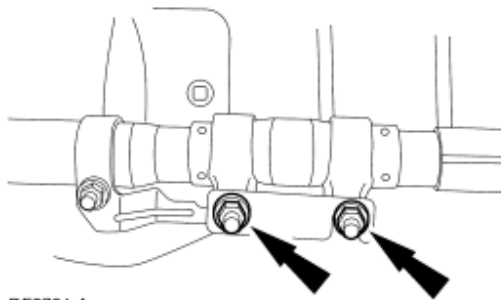
DF0730-A

5. Tighten the nuts.



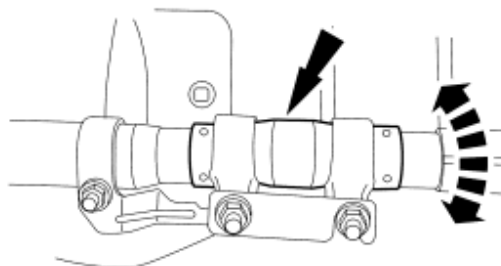
DF1228-B

6. Loosen the nuts.
 - Clean and lubricate the steering linkage and tie rod end threads.



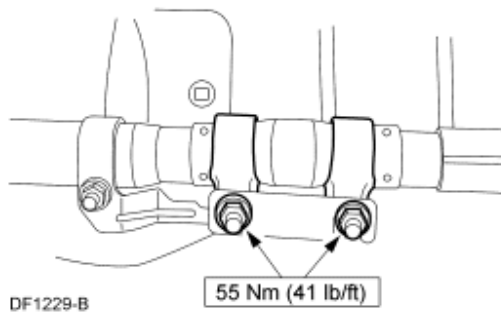
DF0731-A

7. Rotate the tie rod adjusting sleeve to the correct toe setting.



DF0732-A

8. Tighten the nuts.



9. Recheck the toe settings. Follow the manufacturer's instructions.
-

Lean Correction—Front, F-250 and F-350, 4x2

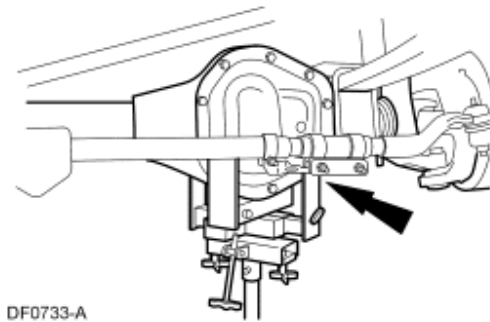
1. If lean correction is required, remove the high side front coil spring (5310); for additional information, refer to [Section 204-01A](#).
 2. Compare the height of the original front coil spring with a new one with the same part number. Note the difference.
 3. If the original front coil spring exceeds the height of the new one by 13 mm (1/2 in.), install the new front coil spring in the vehicle; for additional information, refer to [Section 204-01A](#).
 4. If the original front coil spring is shorter than the new one by at least 13 mm (1/2 in.), remove the low side front coil spring from the vehicle; for additional information, refer to [Section 204-01A](#).
 5. Compare all three front coil springs and select the two most evenly matched for installation.
 6. Install the tallest replacement front coil spring on the low side of the vehicle; for additional information, refer to [Section 204-01A](#).
-

Lean Correction—Front, F-250, F-350, 4x4 and F-450, F-550

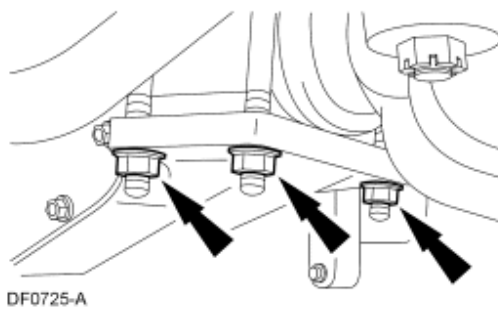
1. **NOTE:** Front side lean can be adjusted approximately 10 mm (3/8 in.) by installing shim D7TZ-5742-A on the low side. A vehicle that is low at the front can be raised by installing shims at both sides.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

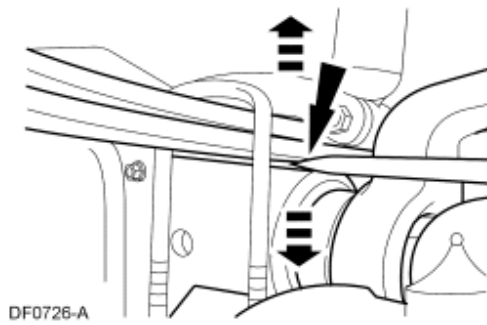
2. Support the axle.



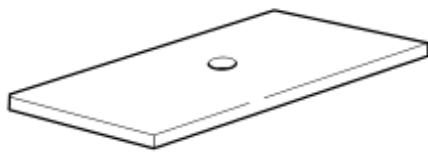
3. Remove and discard the four nuts and two U-bolts.



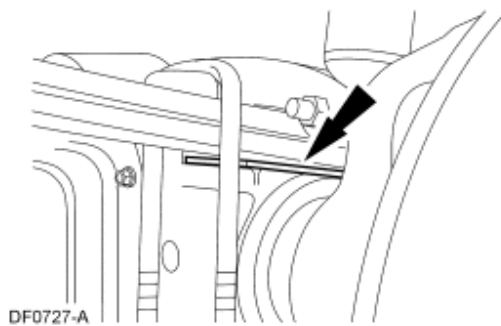
4. Separate the front axle from the springs.



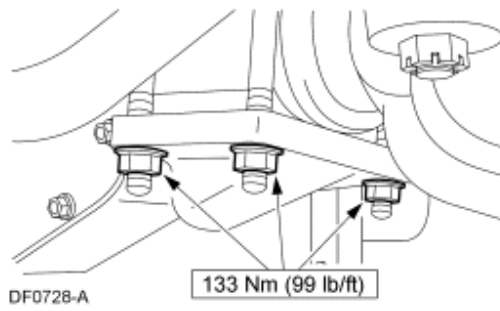
5. Turn the shim so the recess is facing upward.



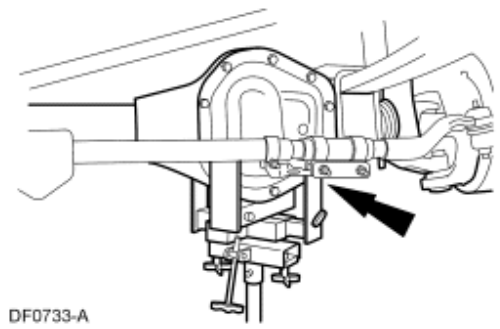
6. Insert the shim between the spring and the spring seat.
 - Position the shim so the spring tie bolt is in the shim recess, the stud on the bottom of the shim is in the spring seat recess, and the shim is aligned with the spring.



7. Install two new U-bolts and four new nuts.



8. Remove the support from the axle.



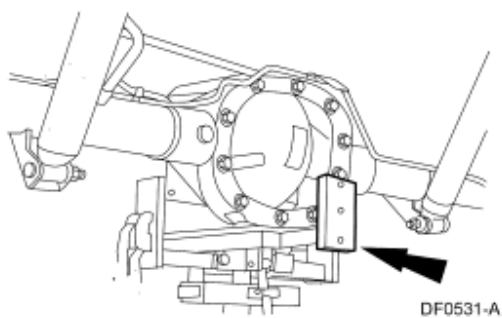
9. Lower the vehicle; for additional information, refer to [Section 100-02](#).
-

Lean Correction—Rear

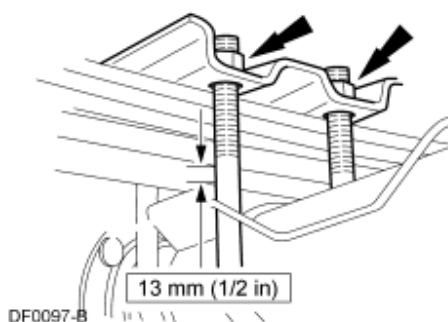
1. **NOTE:** Rear side lean can be adjusted approximately 10 mm (3/8 in.) by installing shim D7TZ-5742-A on the low side. A vehicle that is low at the rear can be raised by installing shims at both sides.

Raise and support the vehicle frame until the weight is off the rear springs but with the tires still touching the floor; for additional information, refer to [Section 100-02](#).

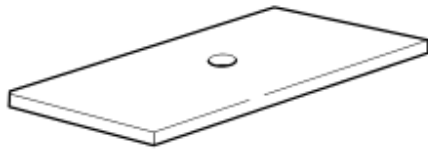
2. Support the axle.



3. Remove and discard the four nuts and two U-bolts to allow the rear axle to separate from the rear spring (5560).

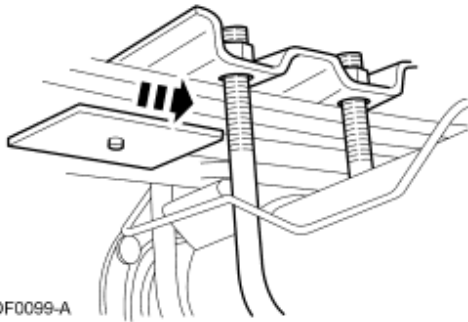


4. Turn the shim so the recess is facing upward.



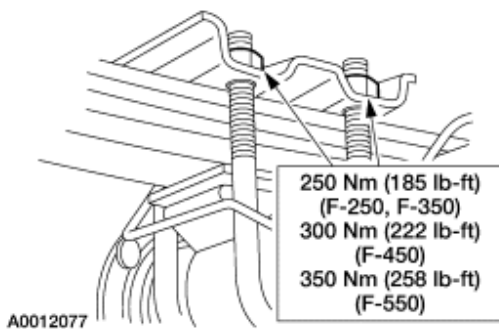
DF0098-A

5. Insert the shim between the rear spring and the spring seat.
 - Position the shim so the tie bolt through the spring leaves is in the shim recess, the stud on the bottom of the shim is in the spring seat recess, and the shim is aligned with the rear spring.



DF0099-A


6. Install two new U-bolts and four new nuts.



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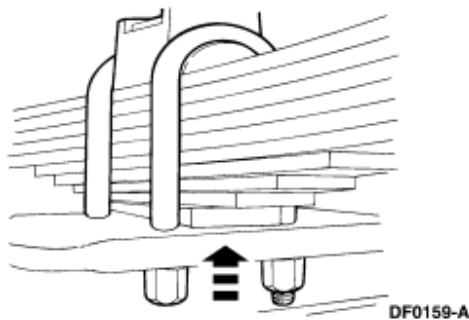
7. Remove the support from the axle.
 8. Lower the vehicle; for additional information, refer to [Section 100-02](#).
-

Lean Correction—Motorhome

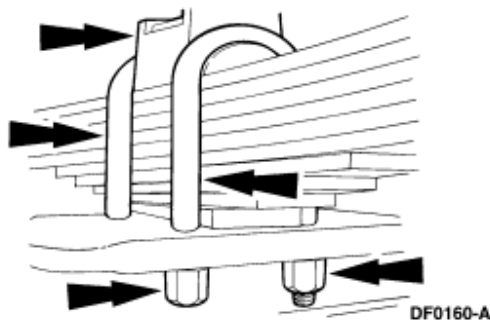
1.  **CAUTION:** Corrections should not be attempted on vehicles with a bumper-to-ground height right-to-left variation of 25.4 mm (1 inch) or less. Corrections should not be made if the ride height variation is 12.7 mm (1/2 inch or less).

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

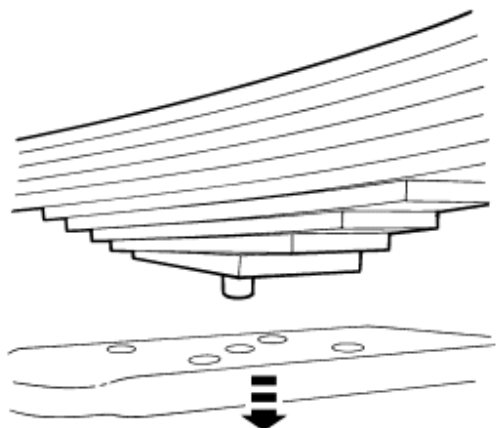
2. Position a separate support for the front axle.
3. Raise the front axle to relieve front spring tension.



4. Remove the nuts, U-bolts and upper spacer. Discard the nuts and U-bolts.



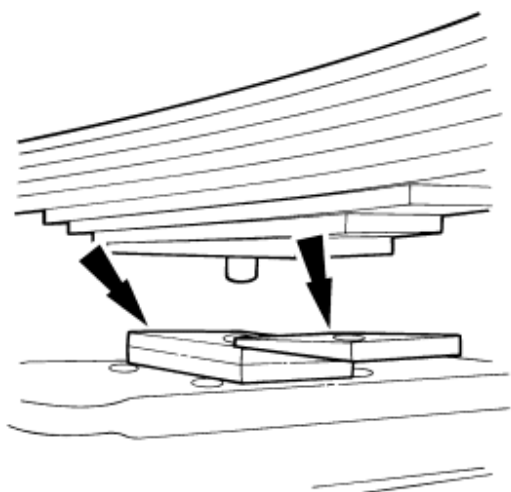
5. Lower the front axle enough to insert the spacer.



DF0161-A

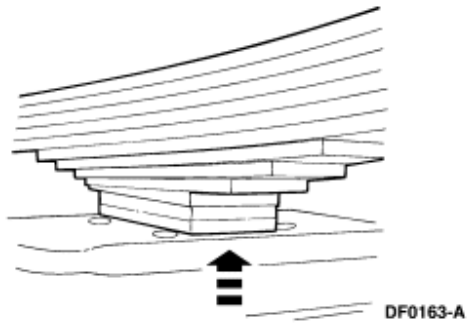
6. **NOTE:** Make sure the locator pin on the bottom of the spacer is in the locator hole in the spring pad.

Position the spacer and caster adjustment wedge, if required, on the spring pad.



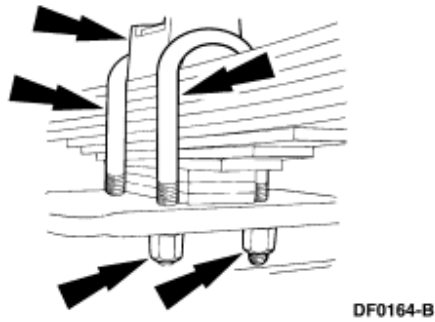
DF0162-A

7. Raise the axle.



8. Install the upper spacer, new U-bolts and new nuts.

- Tighten to specification.



9. Remove the support from the axle.

10. Lower the vehicle; for additional information, refer to [Section 100-02](#).

SECTION 204-01A: Front Suspension —
4x2
SPECIFICATIONS

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)

General Specifications	
Item	Specification
Motorcraft Premium Long-Life Grease XG-1-C or -K	ESA-M1C75-B
Threadlock® and Sealer EOAZ-19554-AA	WSK-M2G315-A5 (Type II)

Torque Specifications — F-250, F-350			
Description	Nm	Lb/Ft	Lb/In
Upper Spring Retainer Bolt-to-Spring/Shock Tower	35	26	—
Lower Spring Retainer Nut-to-Lower Spring Seat	133	99	—
Radius Arm Retainer Bolt-to-Axle/Radius Arm Retainer Nut	400	295	—
Radius Arm Pivot Bolt Retainer Nut-to-Radius Arm Bracket	250	185	—
Radius Arm Bracket-to-Frame	80	60	—
Axle Pivot Bolt Retainer Nut-to-Axle Pivot Bracket	175	130	—
Axle Pivot Bracket Nut-to-Frame	80	60	—
Shock Absorber-to-Spring/Shock Tower Nut	40	30	—
Upper Spindle Pinch Bolt Nut-to-Axle	80	60	—
Lower Spindle Nut-to-Axle	^a	—	—
Lower Shock Absorber Retainer Nut	80	60	—
Stabilizer Bar Link Nut-to-Lower Spring Seat	80	60	—
Stabilizer Bar Link Nut-to-Stabilizer Bar	80	60	—
Stabilizer Bar Retainer Bracket-to-Frame	48	36	—
Tie Rod End Retainer Nut-to-Spindle	90	67	—
Steering Damper Retainer Nut-to-Steering Damper Bracket	90	67	—
Steering Damper Retainer Nut-to-Steering Linkage Bracket	90	67	—
Steering Damper Bracket Retainer Nut-to-Frame	90	67	—
Steering Damper Bracket-to-Steering Linkage	28	21	—
ABS Sensor Retaining Bolt-to-Spindle	8	—	71

ABS Sensor Harness Retaining Bolt	8	—	71
Disc Brake Rotor Shield	8	—	71

^a Follow the procedure in this section.

Torque Specifications — F-450, F-550				
Description	Nm	Lb/Ft	Lb/In	
Front Spring Hanger Nut-to-Front Spring	350	259	—	
Front Spring Hanger Bracket Bolts-to-Frame	103	76	—	
Front Spring Shackle Bracket Nut-to-Front Spring	250	185	—	
Front Spring Shackle Bracket Nut-to-Shackle Bracket Assembly	250	185	—	
Shackle Bracket Assembly Bolt-to-Frame	90	67	—	
Front Spring U-Bolt Nut-to-Axle	133	99	—	
Trackbar-to-Trackbar Bracket	175	130	—	
Trackbar-to-Trackbar Axle Bracket	175	130	—	
Lower Shock Absorber Retaining Nut-to-Front Spring Spacer Plate	103	76	—	
Upper Shock Absorber Retainer Bolt-to-Upper Shock Absorber Bracket	103	76	—	
Upper Shock Absorber Bracket-to-Frame	103	76	—	
Stabilizer Bar Link Nut-to-Stabilizer Bar Link Bracket	80	60	—	
Stabilizer Bar Link Bracket-to-Frame	103	76	—	
Stabilizer Bar Link Nut-to-Stabilizer Bar	80	60	—	
Stabilizer Bar Retainer Bracket-to-Axle	47	35	—	
Axle Bumper Assembly-to-Frame	40	30	—	
Upper Spindle Nut-to-Axle	125	93	—	
Lower Spindle Nut-to-Axle	^a	—	—	
Tie Rod End Retainer Nut-to-Spindle	90	67	—	
Steering Damper Retainer Nut-to-Steering Damper Bracket	90	67	—	
Steering Damper Retainer Nut-to-Steering Linkage Bracket	90	67	—	
Steering Damper Bracket Retainer Nut-to-Frame	90	67	—	
Steering Damper Bracket-to-Steering Linkage	28	21	—	
ABS Sensor Retainer Bolt-to-Spindle	8	—	71	
ABS Sensor Harness Retaining Bolt	8	—	71	

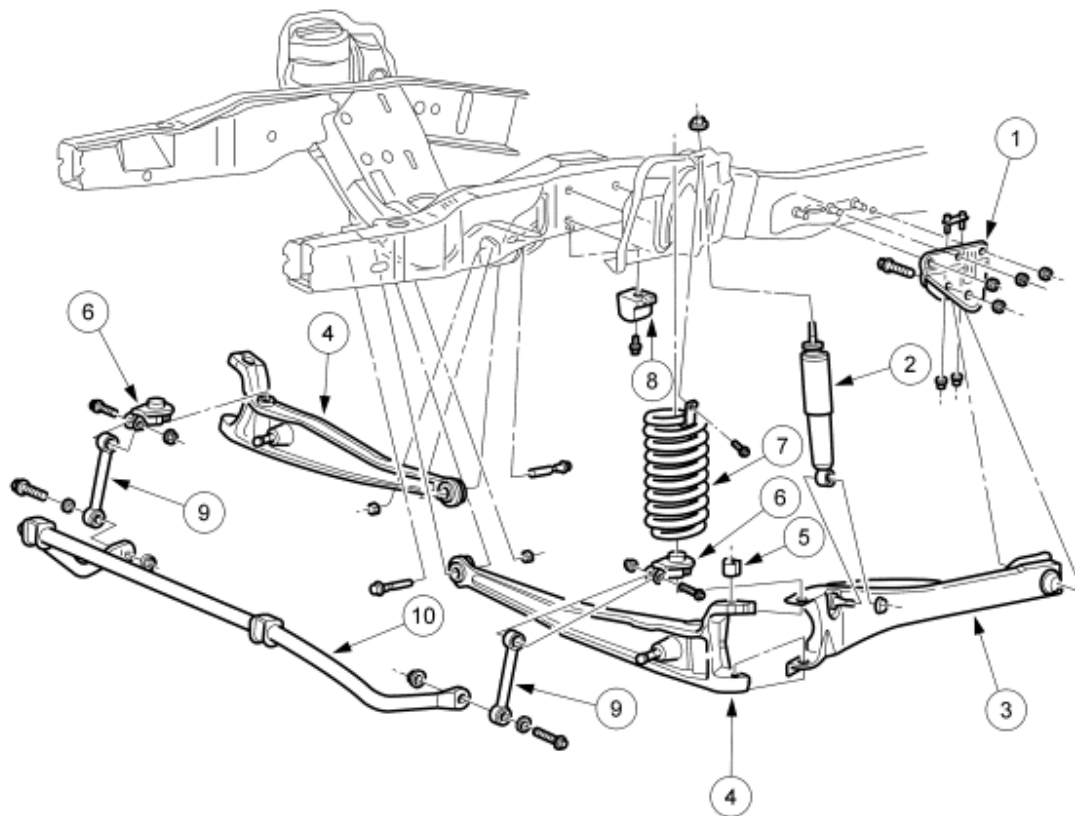
^a Follow the procedure in this section.

Torque Specifications — Motorhome Chassis

Description	Nm	Lb/Ft	Lb/In
Front Spring Hanger Nut-to-Front Spring	246	182	—
Front Spring Hanger Bracket Nut-to-Frame	90	67	—
Front Spring Shackle Bracket Nut-to-Front Spring	125	93	—
Front Spring Shackle Bracket Nut-to-Shackle Bracket Assembly	133	99	—
Shackle Bracket Assembly Nut-to-Frame	90	67	—
Front Spring U-Bolt Nut-to-Axle	353	260	—
Lower Shock Absorber Retaining Nut-to-Front Spring	353	260	—
Upper Shock Absorber Retainer Bolt-to-Upper Shock Absorber Bracket	353	260	—
Upper Shock Absorber Bracket-to-Frame	352	260	—
Upper Stabilizer Bar Link Nut-to-Frame	90	67	—
Stabilizer Bar Clamp-to-Axle Bracket	90	67	—
Stabilizer Bar Axle Bracket-to-Axle	80	60	—
Axle Bumper Assembly-to-Frame	48	36	—
Spindle Steering Drag Link Arm Nut-to-Spindle	575	424	—
Spindle Steering Arm Nut-to-Spindle	575	424	—
Spindle Lock Pin Retaining Nut	81	60	—
Spindle Pin Cap	56	42	—
Tie Rod End Retainer Nut-to-Spindle Steering Arm	89	66	—
Spindle Adapter Plate Retaining Nut-to-Spindle	90	67	—
ABS Sensor Retaining Bolt-to-Spindle	11	—	98
ABS Sensor Harness Retaining Bolt	11	—	98

Front Suspension

Front Suspension Components — F-250, F-350

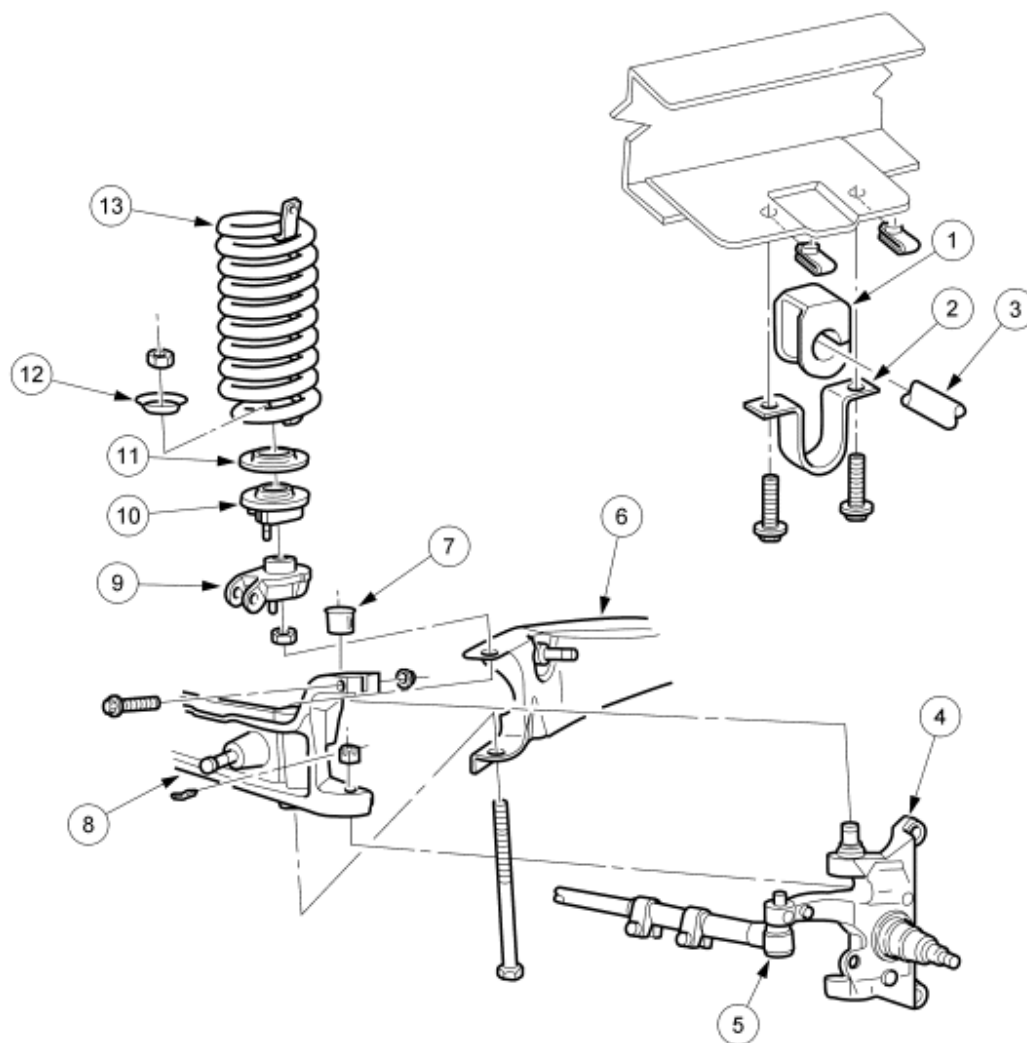


DF1071-A

Item	Part Number	Description
1	3B183	Radius Arm Bracket — (LH)
1	3B095	Radius Arm Bracket — (RH)
2	18045	Shock Absorber
3	3B346	Radius Arm — (LH)

3	3405	Radius Arm — (RH)
4	3007	Front Axle I-Beam — (LH)
4	3006	Front Axle I-Beam — (RH)
5	3B404	Upper Ball Joint Adjuster
6	5B316	Lower Spring Seat — (LH)
6	5B307	Lower Spring Seat — (RH)
7	5310	Coil Spring
8	3020	Front Axle Jounce Bumper
9	3C140	Front Stabilizer Bar Link
10	5494	Front Stabilizer Bar

Front Suspension Components — F-250, F-350

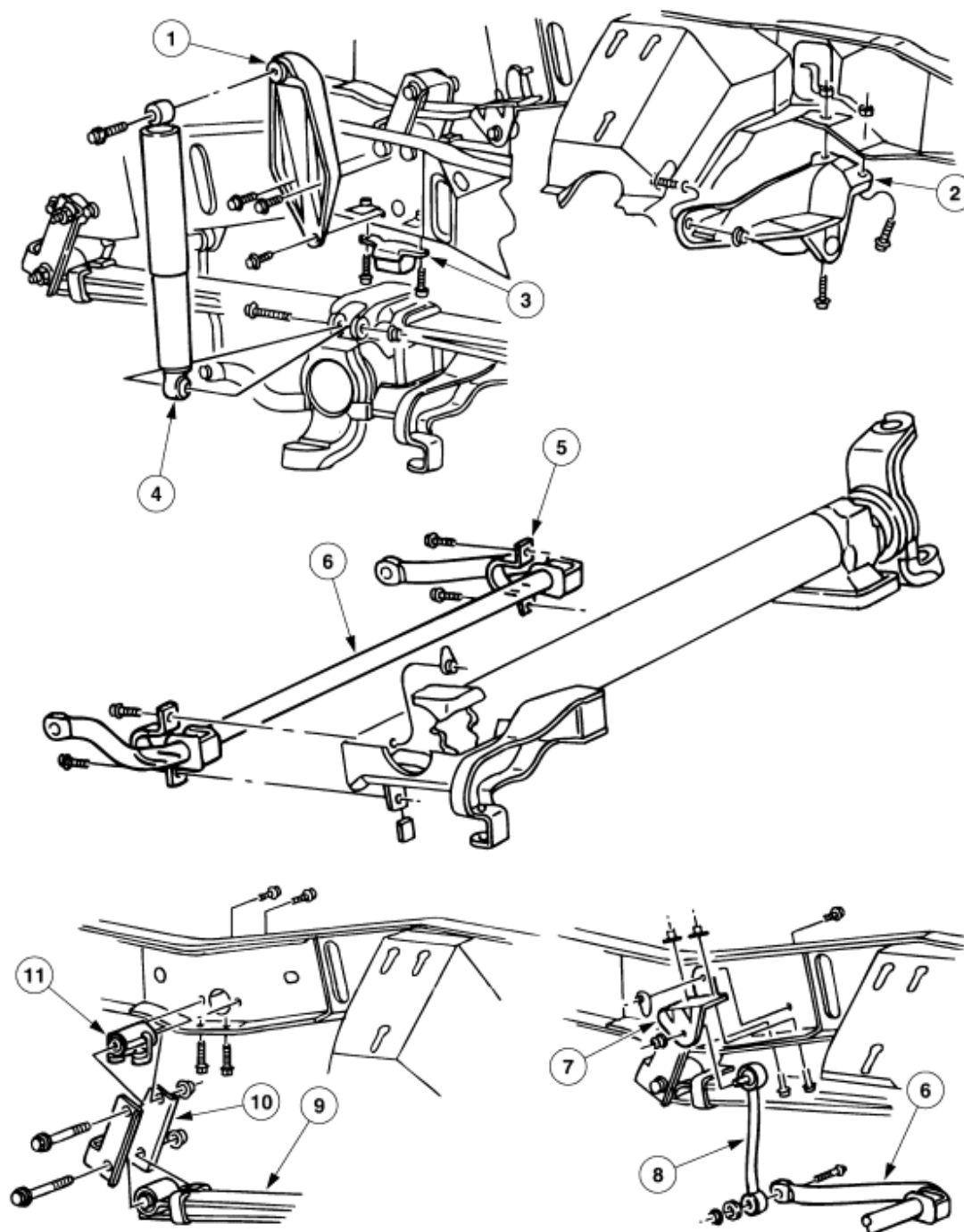


DF1072-A

Item	Part Number	Description
1	5484	Front Stabilizer Bar Insulator
2	3B353	Front Stabilizer Bar Retainer
3	5494	Front Stabilizer Bar
4	3106	Front Spindle Assy
5	3B008	Tie Rod End
6	3B346	Radius Arm — (LH)
6	3405	Radius Arm — (RH)
7	3B404	Upper Ball Joint Adjuster
8	3007	Front Axle I-Beam — (LH)
8	3006	Front Axle I-Beam — (RH)
9	5B316	Lower Spring Seat —

		(with Stabilizer Bar)
10	5A316	Lower Spring Seat — (Without Stabilizer Bar)
11	5414	Lower Spring Insulator
12	5A349	Lower Spring Retainer
13	5310	Coil Spring

Front Suspension Components — F-450, F-550

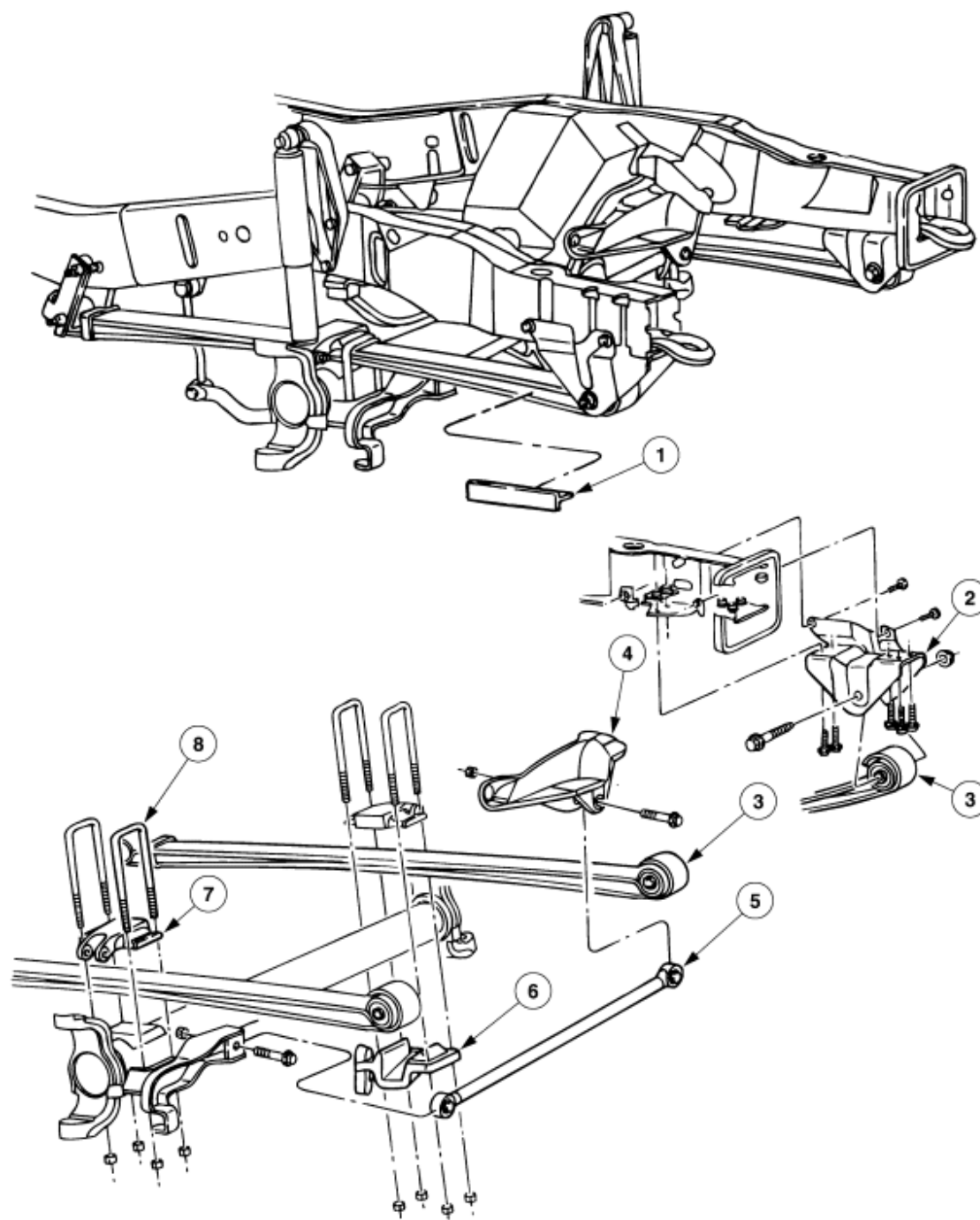


DF1073-B

Item	Part Number	Description
1	18035	Upper Shock Bracket
2	3A094	Front Trackbar Bracket
3	3020	Front Axle Jounce Bumper
4	18045	Shock Absorber
5	3B353	Stabilizer Bar Retainer

6	5494	Stabilizer Bar
7	5C495	Stabilizer Link Bracket
8	5K483	Stabilizer Bar Link
9	5310	Front Spring Assy
10	5B311	Front Spring Shackle
11	5335	Front Spring Shackle Assy

Front Suspension Components — F-450, F-550

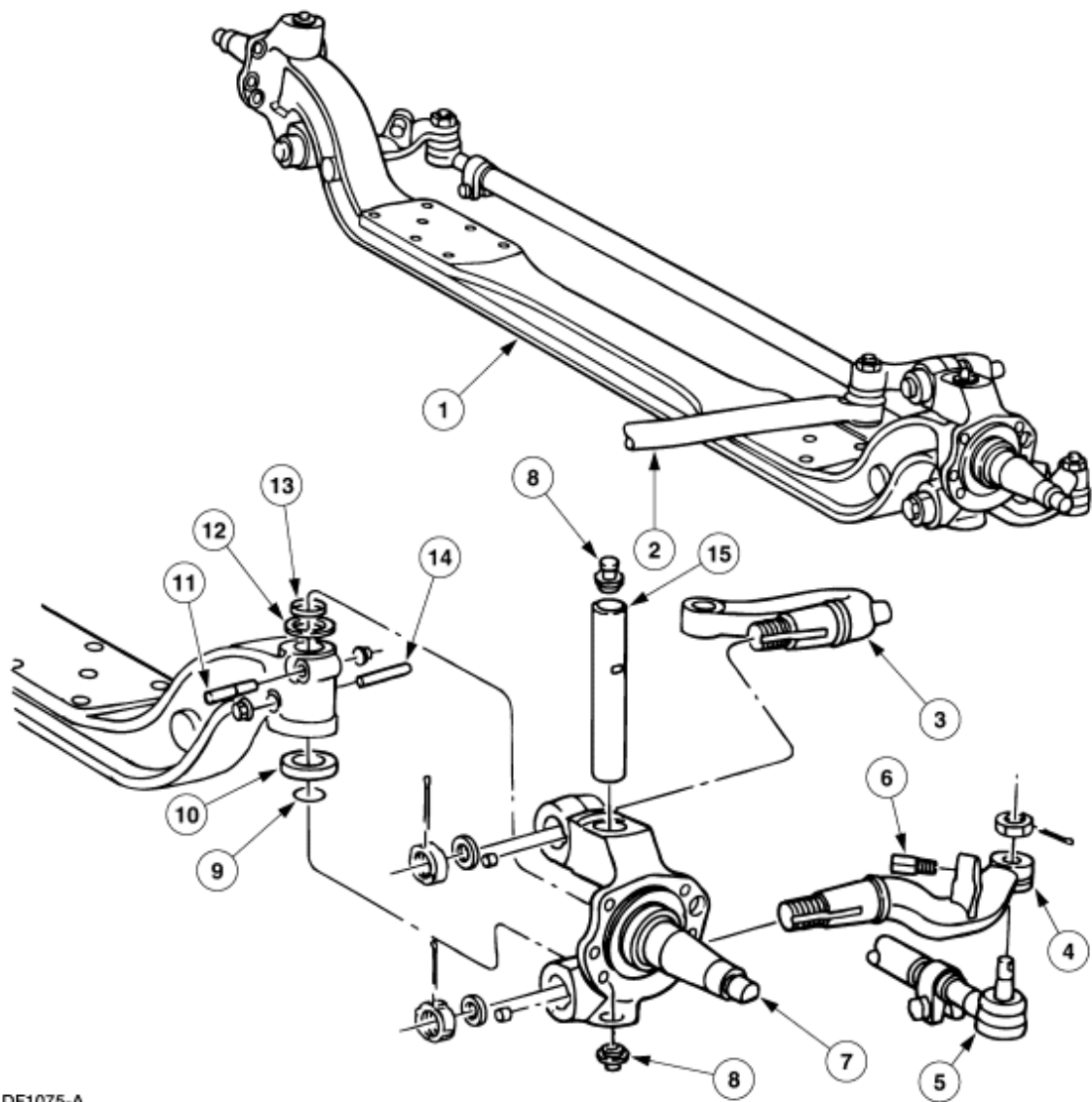


DF1074-B

Item	Part Number	Description
1	5L302	Front Spring Insulator Sleeve
2	5341	Front Spring Hanger Bracket — (LH)
2	5340	Front Spring Hanger Bracket — (RH)
3	5310	Front Spring Assy
4	3A094	Front Trackbar Bracket

5	3B239	Front Trackbar Assy
6	5A316	Front Spring Cap
7	5458	Front Spring Spacer Plate
8	N801485-S428	Front Spring U-Bolt

Front Suspension Components — Motorhome Chassis

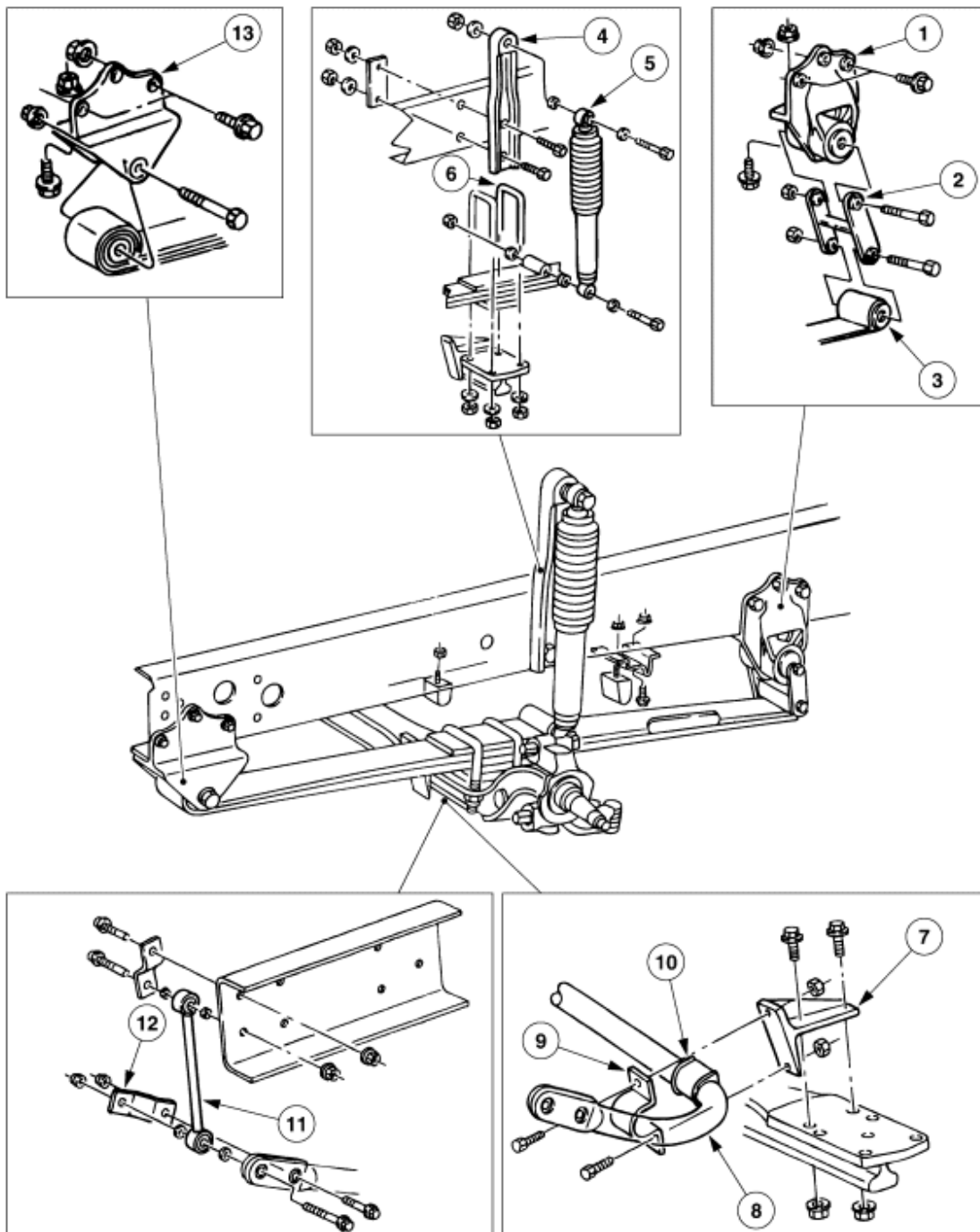


DF1075-A

Item	Part Number	Description
1	3010	Front Axle Assy
2	3B406	Drag Ling
3	3146	Steering Spindle Drag Link Arm
4	3131	Steering Spindle Arm — (LH)

4	3130	Steering Spindle Arm — (RH)
5	3280	Tie Rod End
6	3145	Front Wheel Spindle Stop
7	3106	Front Wheel Spindle — (LH)
7	3105	Front Wheel Spindle — (RH)
8	3113	Spindle Pin Cap
9	3125	Spindle Pin Seal
10	3123	Spindle Bearing Assy
11	3122	Spindle Pin Locking Bolt
12	3117	Spindle Shim
13	3125	Spindle Pin Seal
14	3122	Spindle Pin Locking Bolt
15	3115	Spindle Pin

Front Suspension Components — Motorhome Chassis



DF1076-B

Item	Part Number	Description
1	5335	Front Spring Shackle Bracket
2	5B311	Front Spring Shackle
3	5310	Front Spring Assy
4	18035	Front Shock Absorber Bracket
5	18045	Shock Absorber

6	5455	Front Spring U-Bolt
7	5486	Stabilizer Bar Mounting Bracket
8	5494	Front Stabilizer Bar
9	5488	Front Stabilizer Bar-to-Axle Clamp
10	5484	Stabilizer Bar Insulator
11	5K484	Stabilizer Bar Link
12	5L496	Stabilizer Bar Link Bracket
13	5340	Front Spring Hanger Bracket

SECTION 204-01A: Front Suspension —
4x2
DIAGNOSIS AND TESTING

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)

Front Suspension

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

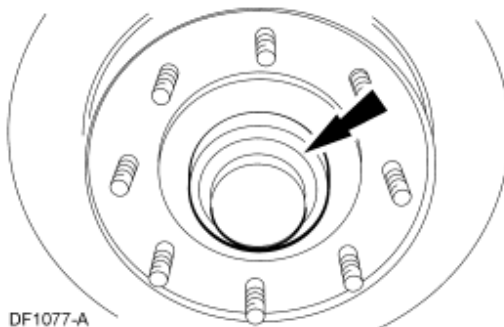
Wheel Bearing Adjustment—F-250, F-350, F-450, F-550

⚠ CAUTION: Wheel seals on the front axles must be replaced any time the axle lubricants are changed from factory-installed mineral lube to synthetic lube or vice versa.

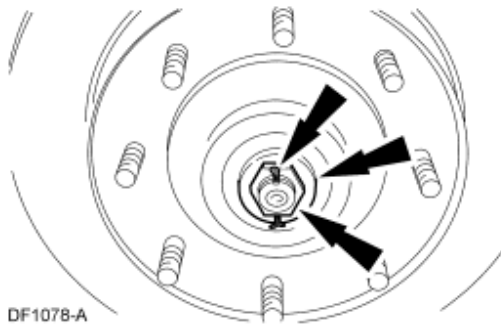
⚠ CAUTION: If bearings are adjusted too tightly, they will overheat and wear rapidly. An adjustment that is excessively loose can cause pounding and contribute to uneven tire wear, steering difficulties and inefficient brakes. Check bearing adjustment at regular inspection intervals. New wheel seals must be installed when the hub is removed. A damaged or worn seal can permit bearing lubricant to reach the brake linings, resulting in ineffective brake operation and necessitating premature replacement of linings. To check the wheel bearing adjustment, raise the front of the vehicle. Grasp the tire at the sides, and alternately push inward and pull outward on the tire. If any looseness is felt, adjust the front wheel bearings as follows.

NOTE: Super Duty F-250, F-350 shown, Super Duty F-450, F-550 similar.

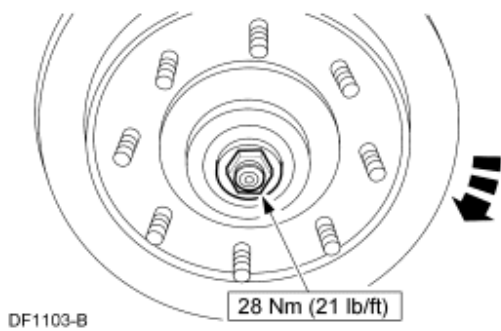
1. Remove the hub cap from the hub.



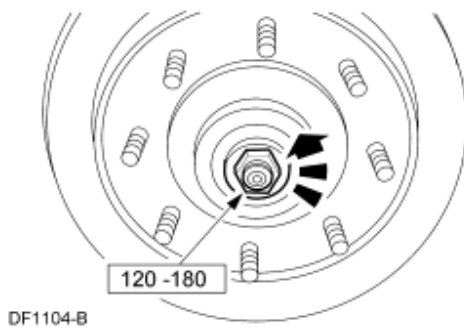
2. Remove the cotter pin and the castellated nut.



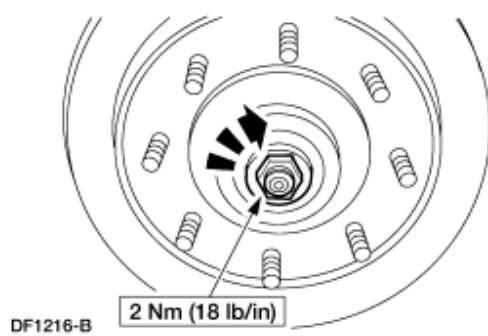
3. While rotating the wheel, tighten the adjusting nut to specification as illustrated to seat the bearings.



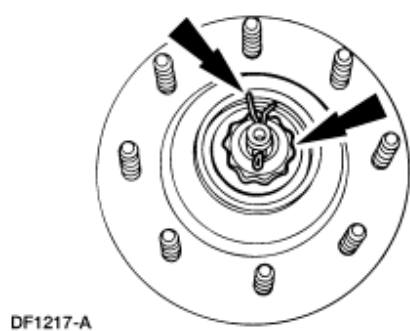
4. Back off the adjusting nut until loose.



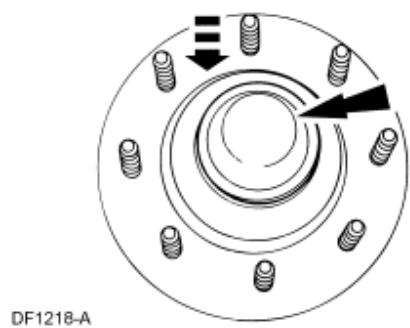
5. While rotating the wheel, tighten the adjusting nut to specification as illustrated. Torque required to rotate the hub should be 2 Nm (18 lb-in).



6. Install the castellated nut and insert a new cotter pin.



7. Install the hub cap.

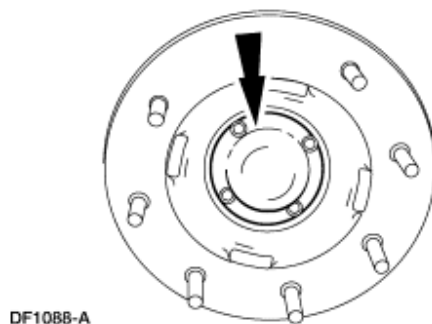


Wheel Bearing Adjustment—Motorhome

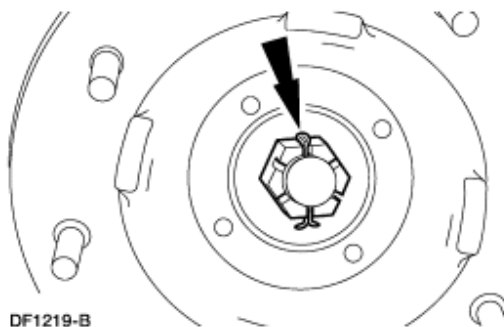
⚠ CAUTION: Wheel seals on the front axles must be replaced any time the axle lubricants are changed from factory-installed mineral lube to synthetic lube or vice versa.

⚠ CAUTION: If bearings are adjusted too tightly, they will overheat and wear rapidly. An adjustment that is excessively loose can cause pounding and contribute to uneven tire wear, steering difficulties and inefficient brakes. Check bearing adjustment at regular inspection intervals. New wheel seals must be installed when the hub is removed. A damaged or worn seal can permit bearing lubricant to reach the brake linings, resulting in ineffective brake operation and necessitating premature replacement of linings. To check the wheel bearing adjustment, raise the front of the vehicle. Grasp the tire at the sides, and alternately push inward and pull outward on the tire. If any looseness is felt, adjust the front wheel bearings as follows.

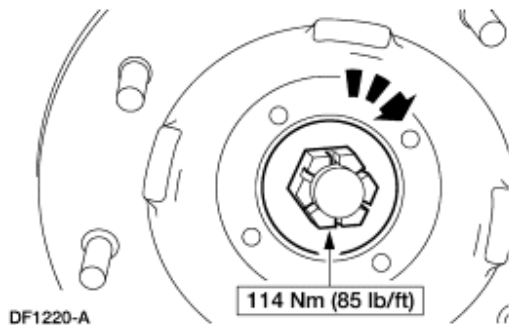
1. Remove the hub cap and gasket from the hub.



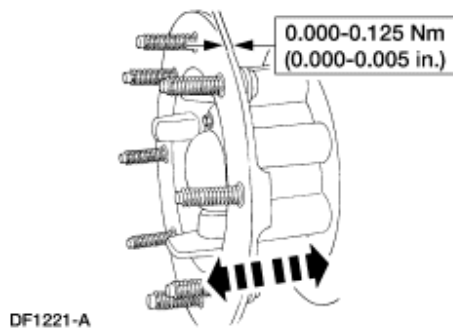
2. Remove the cotter pin.



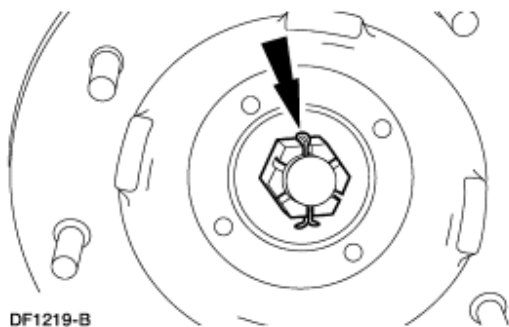
3. While rotating the wheel, tighten the adjusting nut to specification as illustrated to seat the bearings.



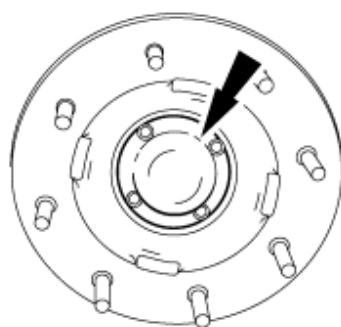
4. Back off the adjusting nut until loose.
5. Finger-tighten the adjusting nut. Final bearing adjustment end play must be within the specification as illustrated. The final adjustment must not result in a preloaded bearing.



6. If the cotter pin hole lines up with a slot in the nut, insert and secure the new cotter pin. If it does not, advance the adjusting nut to align a slot with the first available cotter pin hole. Insert and secure a new cotter pin.



7. Install the gasket and hub cap.

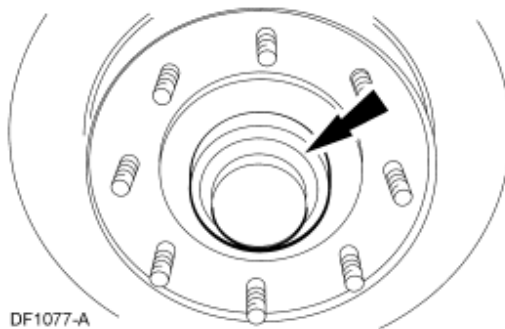


DF1097-A

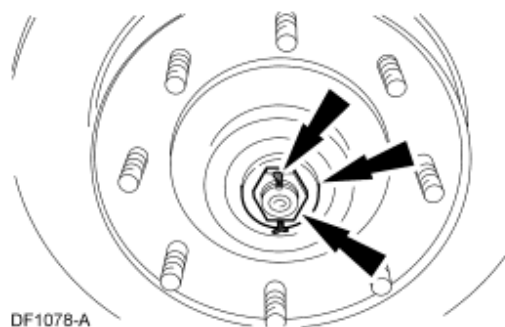
Wheel Hub and Bearing—F-250, F-350

Removal

1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Remove the front wheel and tire assemblies; for additional information, refer to [Section 204-04](#).
3. Remove the front disc brake caliper and rotor, and position the caliper out of the way; for additional information, refer to [Section 206-03](#).
4. Remove the hub cap from the hub assembly.

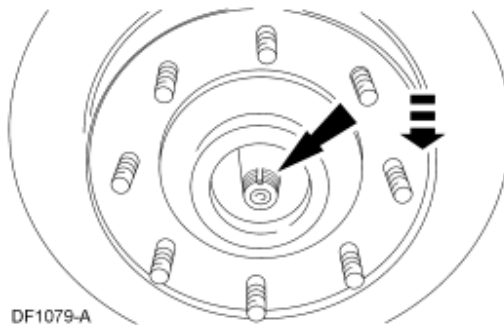


5. Remove the cotter pin, adjusting nut and flatwasher.

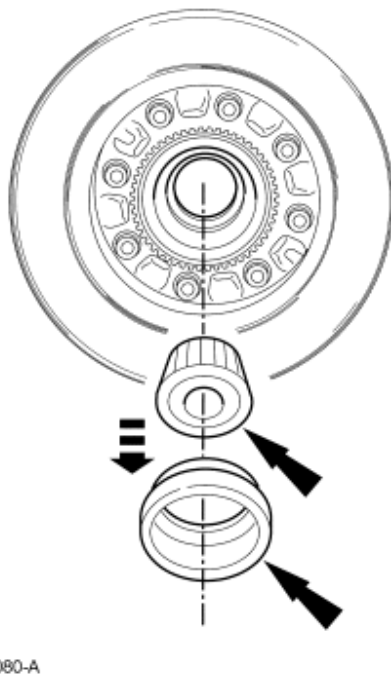


6. **NOTE:** Inspect the condition of the spindle and nut threads to ensure a free turning nut when reassembling.

Remove the outer bearing cone and roller assembly, and pull the hub assembly from the spindle.



7. Using care not to damage the bearing cage, use a suitable slide hammer and bearing seal remover to remove the inner bearing cone and bearing seal.



Installation

1.  **CAUTION: Do not spin the bearing dry with compressed air.**

NOTE: Remove all traces of lubricant from the bearings, hub and axle spindle. Inspect bearings and bearing cups for pitting, spalling or unusual wear. If either bearings or bearing cups are worn or damaged, replace both bearings and bearing cups.

NOTE: It is recommended that bearings and bearing cups be replaced in sets. If cups are worn or damaged, install the inner and outer bearing cups in the hub with an appropriate


bearing cup driver tool. Check for proper seating of new bearing cups by trying to insert a 0.38-mm (0.0015-inch) feeler gauge between the bottom face of the cup and wheel hub seat. You should not be able to insert the feeler gauge.

Remove all burrs, nicks or scratches from the shoulder of the spindle and seal bore in the hub with emery cloth.

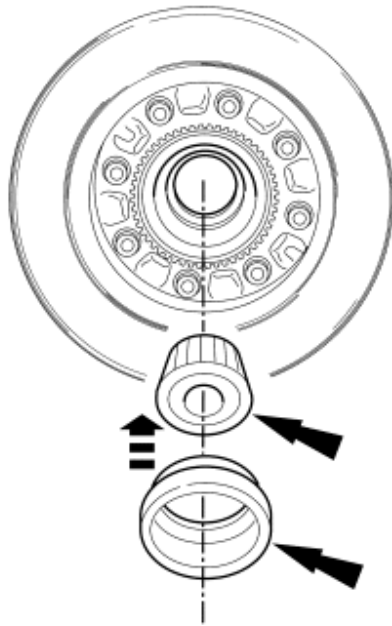
2. Pack the inside of the hub with lithium-base wheel bearing grease such as Motorcraft Premium Long-Life Grease XG-1-C or -K or equivalent meeting Ford specification ESA-M1C75-B. Fill the hub until the grease is flush with the inside diameters of both bearing cups.



DF1081-A

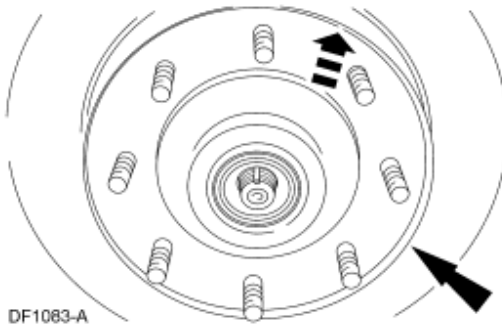
3. Pack the bearing cone and roller assemblies with wheel bearing grease. Use a bearing packer for this operation. If a packer is not available, work as much lubricant as possible between the rollers and cages.
4.  **CAUTION: Keep the hub centered on the spindle to prevent damage to the grease seal or spindle threads.**

Place the inner bearing cone and roller assembly in the inner cup and install the wheel bearing hub seal, using a suitable seal replacer. Make sure seal is fully seated and lubricated.



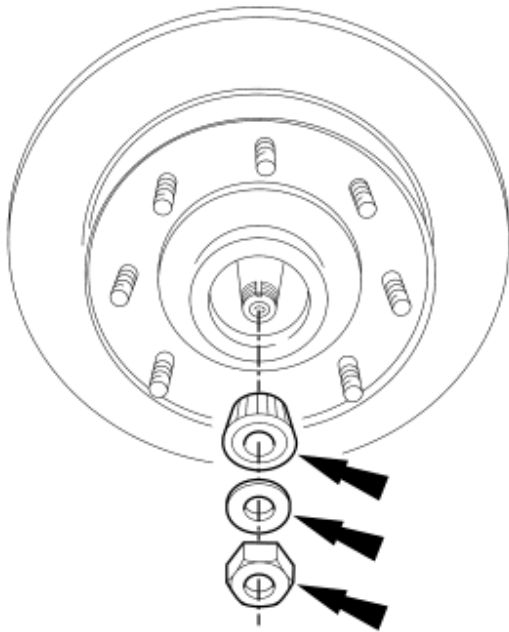
DF1082-A

5. Install the hub assembly.



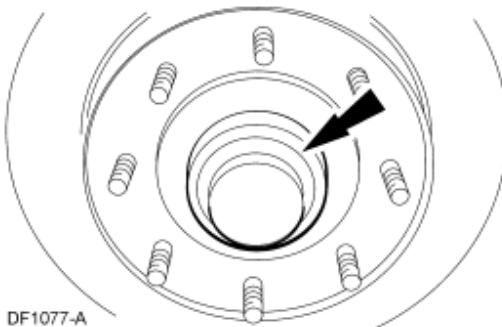
DF1083-A

6. Install the outer bearing cone and roller assembly and the flatwasher on the spindle and install the adjusting nut; refer to [Wheel Bearing Adjustment—F-250, F-350, F-450, F-550](#) in this section for final bearing adjustment. Install a new cotter pin.



DF1084-A

7. Install the hub cap.



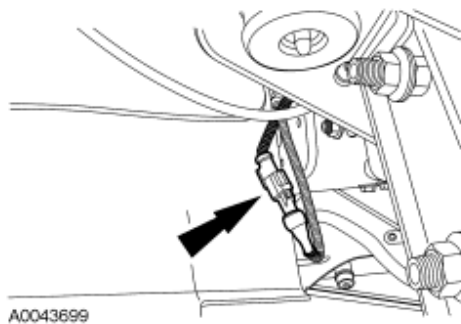
DF1077-A

8. Install the front disc brake caliper and rotor; for additional information, refer to [Section 206-03](#).
 9. Install the front wheel and tire assemblies; for additional information, refer to [Section 204-04](#).
 10. Lower the vehicle; for additional information, refer to [Section 100-02](#).
-

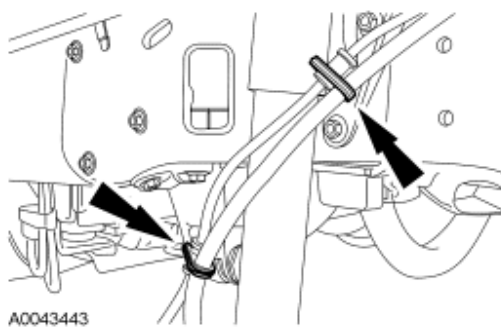
Wheel Hub and Bearing—F-450, F-550

Removal and Installation

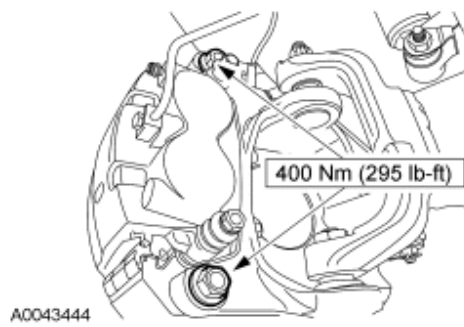
1. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
2. Disconnect the wheel speed sensor electrical connector.



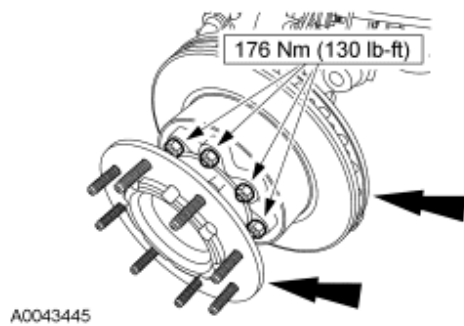
3. Detach the sensor harness from the brake hose.



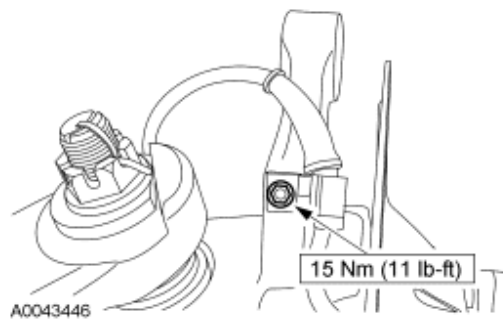
4. Remove the bolts and position the caliper, pads and anchor plate aside.



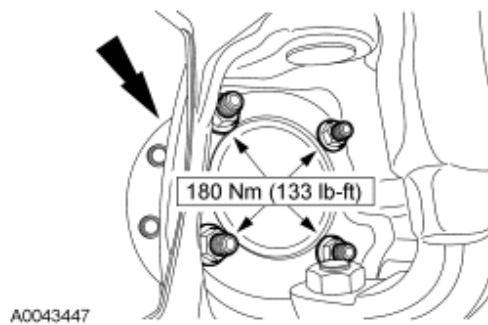
5. Remove the eight nuts, the hub extender and the brake disc.



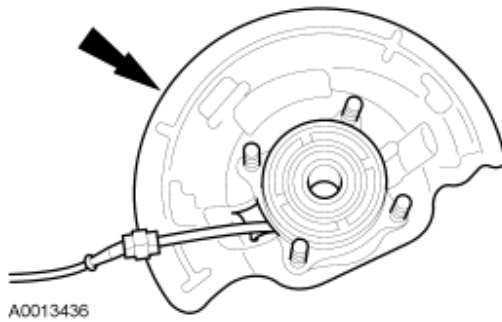
6. Remove the bolt.



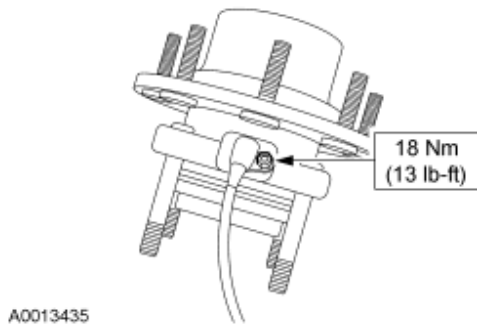
7. Remove the nuts and the hub and bearing.



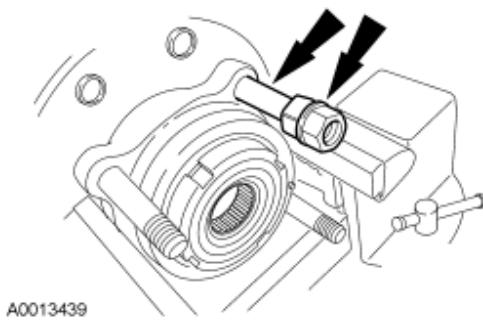
8. Remove the shield.



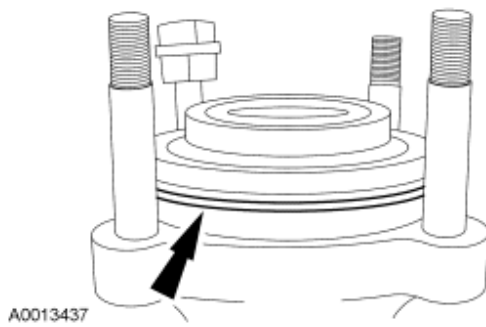
9. Remove the bolt and the sensor.




10. Position the hub and bearing in a vise with protective caps, and remove the studs using two mounting nuts.



11. Remove and discard the O-ring.



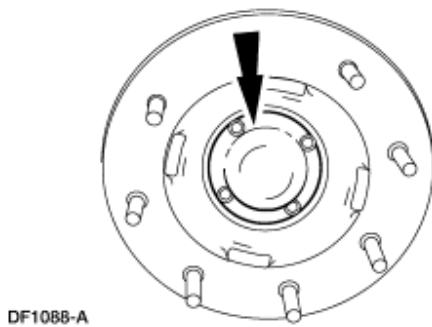
12.  **CAUTION:** Make sure that the wheel hub and brake disc mounting surfaces are clean.

To install, reverse the removal procedure.

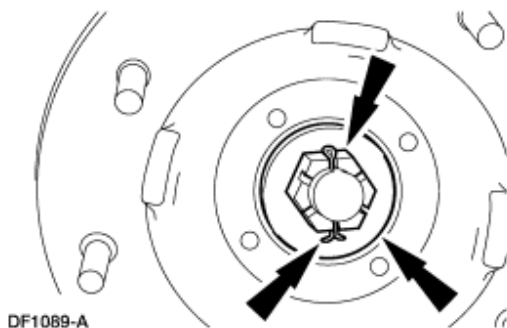
Wheel Hub and Bearing—Motorhome

Removal

1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Remove the front wheel and tire assemblies; for additional information, refer to [Section 204-04](#).
3. Remove the front disc brake caliper and position out of the way; for additional information, refer to [Section 206-03](#).
4. Remove the hub cap and gasket from the hub and rotor assembly.

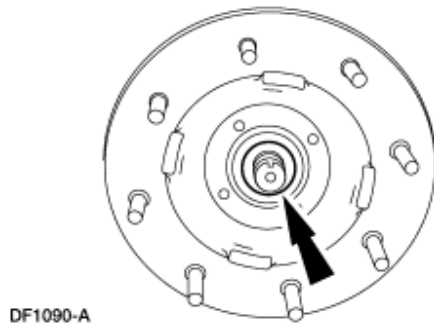


5. Remove the cotter pin, adjusting nut and flatwasher.

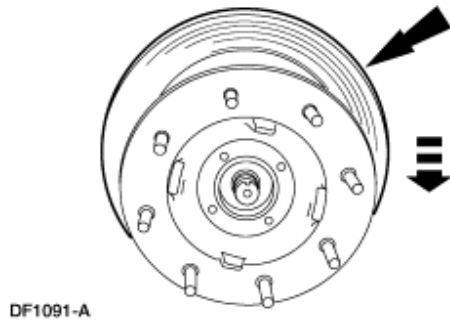


6. **NOTE:** Inspect the condition of the spindle and nut threads to ensure a free turning nut when reassembling.

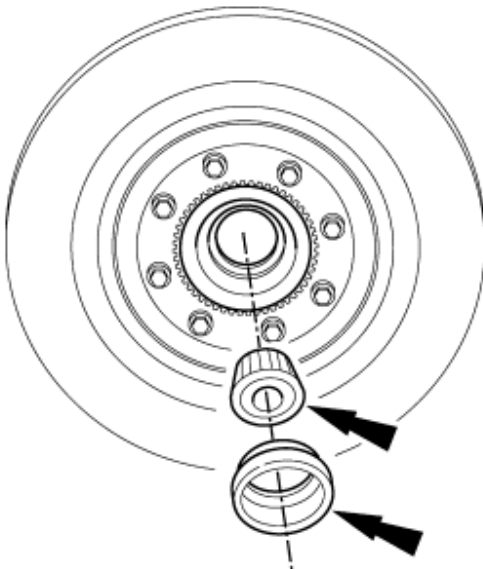
Remove the outer bearing cone and roller assembly.



7. Pull the hub and rotor assembly from the spindle.



8. Using care not to damage the bearing cage, use a suitable slide hammer and bearing seal remover to remove the inner bearing cone and bearing seal.



Installation

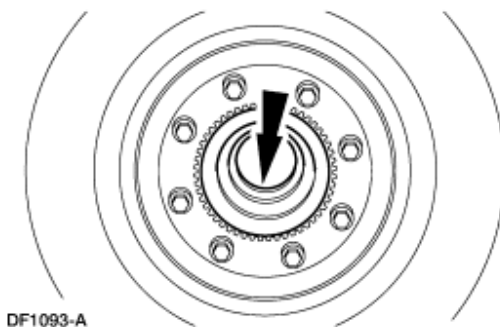
1.  **CAUTION: Do not spin the bearing dry with compressed air.**


NOTE: Remove all traces of old lubricant from the bearings, hub and axle spindle. Inspect bearings and bearing cups for pitting, spalling or unusual wear. If either bearings or bearing cups are worn or damaged, replace both bearings and bearing cups.

NOTE: It is recommended that bearings and bearing cups be replaced in sets. If cups are worn or damaged, install the inner and outer bearing cups in the hub with an appropriate bearing cup driver tool. Check for proper seating of new bearing cups by trying to insert a 0.38-mm (0.0015-inch) feeler gauge between the bottom face of the cup and wheel hub seat. You should not be able to insert the feeler gauge.

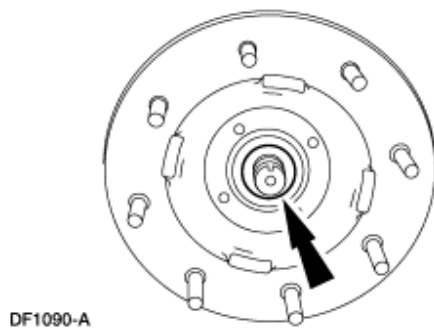
Remove all burrs, nicks or scratches from the shoulder of the spindle and seal bore in the hub with emery cloth.

2. Pack the inside of the hub with lithium-base wheel bearing grease such as Motorcraft Premium Long-Life Grease XG-1-C or -K or equivalent meeting Ford specification ESA-M1C75-B. Fill the hub until the grease is flush with the inside diameters of both bearing cups.

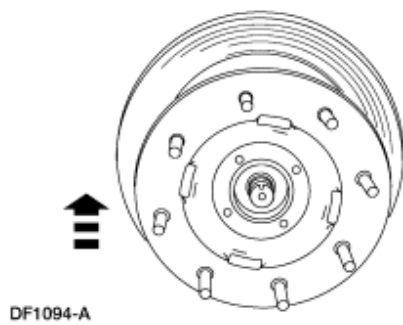


3. Pack the bearing cone and roller assemblies with wheel bearing grease. Use a bearing packer for this operation. If a packer is not available, work as much lubricant as possible between the rollers and cages.
4.  **CAUTION: Keep the hub centered on the spindle to prevent damage to the grease seal or spindle threads.**

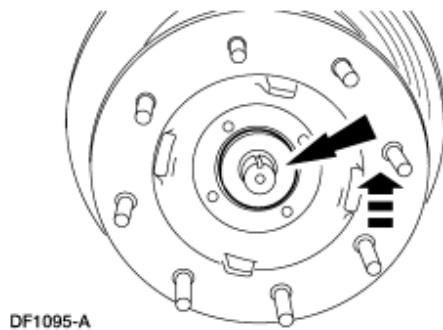
Place the inner bearing cone and roller assembly in the inner cup and install the wheel bearing hub seal, using a suitable seal replacer. Make sure seal is fully seated and lubricated.



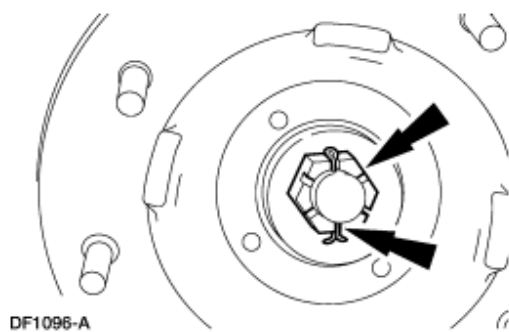
5. Install the rotor and hub assembly.



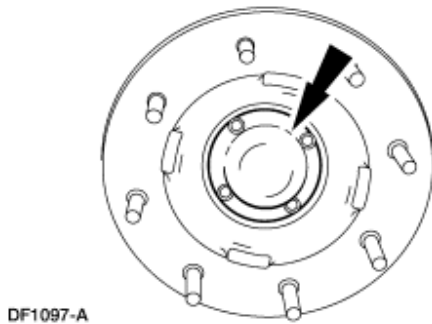
6. Install the outer bearing cone and roller assembly and the flatwasher on the spindle.



7. Install the adjusting nut, refer to [Wheel Bearing Adjustment—Motorhome](#) in this section for final bearing adjustment. Install a new cotter pin.



8. Install a new gasket and the hub cap.



9. Install the front disc brake caliper and rotor; for additional information, refer to [Section 206-03](#).
10. Install the front wheel and tire assemblies; for additional information, refer to [Section 204-04](#).
11. Lower the vehicle; for additional information, refer to [Section 100-02](#).

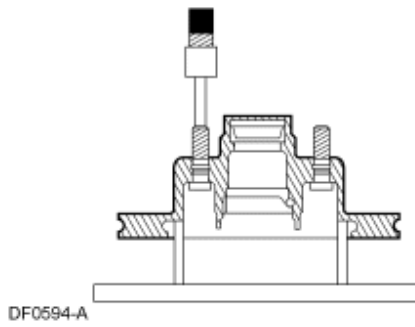
SECTION 204-01A: Front Suspension —
4x2
REMOVAL AND INSTALLATION

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)

Wheel Studs—F-250, F-350

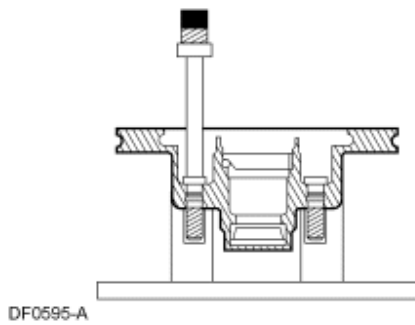
Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the disc brake caliper and the disc brake rotor. For additional information, refer to [Section 206-04](#).
4. Using a suitable press, remove the lug bolt from the disc brake rotor and discard.




Installation

1. Using a suitable press, install the new lug bolt aligning the serrations in the disc brake rotor flange made by the original lug bolt.



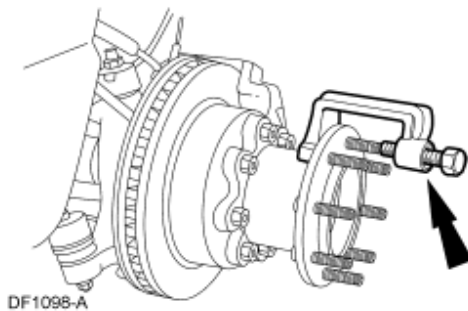
2. Install the disc brake rotor and disc brake caliper. For additional information, refer to [Section 206-04](#).
 3. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 4. Lower the vehicle. For additional information, refer to [Section 100-02](#).
-

Wheel Studs—F-450, F-550 and Motorhome

Special Tool(s)	
 ST1494-A	C-Frame and Clamp Assembly Tool 211-023 (T74P-3044-A1)

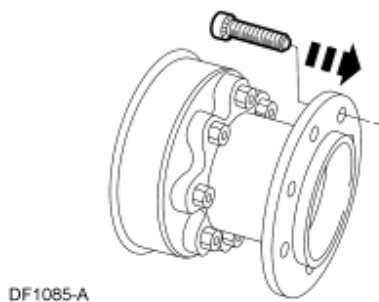
Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Using the C-Frame and Clamp Assembly Tool, remove the lug bolt from the wheel adapter and discard.

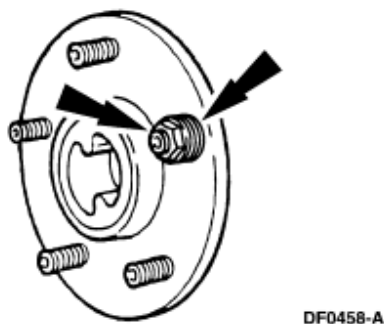


Installation

1. Install the new lug bolt aligning the serrations in the wheel adapter flange made by the original lug bolt.
 - Place four flatwashers over the outside end of the lug bolt and thread a standard lug nut with the flat side against the washers.
 - Tighten the lug nut until the lug bolt head seats against the back side of the wheel adapter flange.



2. Remove the lug nut and flatwashers.



3. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
4. Lower the vehicle. For additional information, refer to [Section 100-02](#).

SECTION 204-01A: Front Suspension —
4x2
REMOVAL AND INSTALLATION

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)


Arm—Radius, F-250, F-350, Excursion

Removal and Installation

For additional information, refer to [Axle—F-250, F-350](#) in this section.

Bar—Trackbar, F-450, F-550

Removal

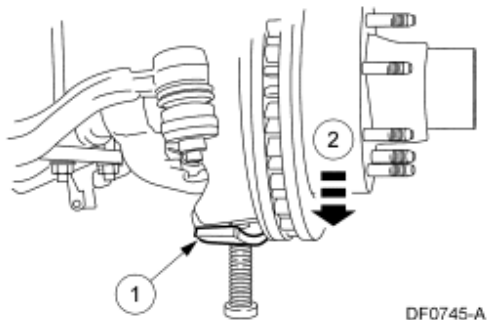
1.  **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

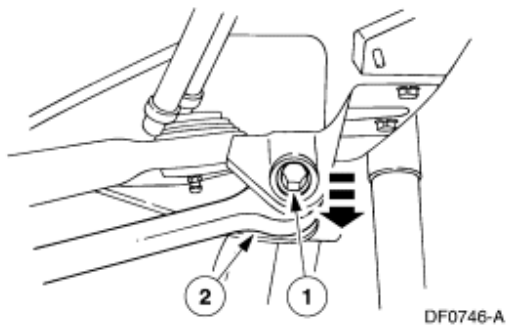
2. **NOTE:** To prevent the front suspension from shifting when the trackbar is removed, the front suspension must be supporting the vehicle weight.

Load the front suspension with the vehicle weight.

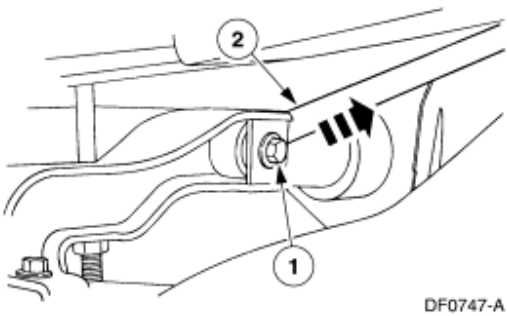
1. Position the jack stand under the front axle assembly.
2. Lower the vehicle until the front suspension is supporting the vehicle weight.



3. Disconnect the trackbar from the upper mounting bracket.
 1. Remove the nut and bolt.
 2. Remove the trackbar from the bracket.

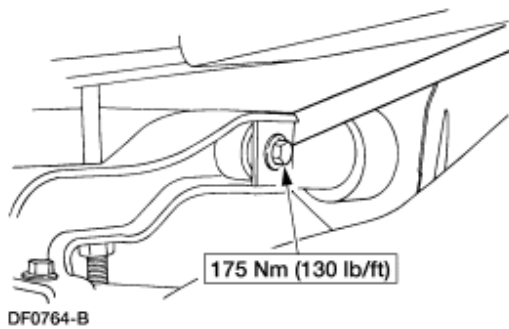


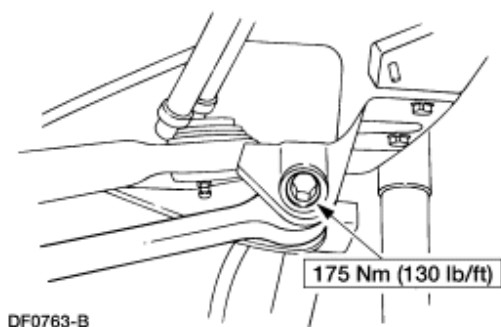
4. Remove the trackbar from the lower mounting bracket.
 1. Remove the nut and bolt.
 2. Remove the trackbar.



Installation

1. Using new fasteners, follow the removal procedure in reverse order.






SECTION 204-01A: Front Suspension —
4x2
REMOVAL AND INSTALLATION

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)

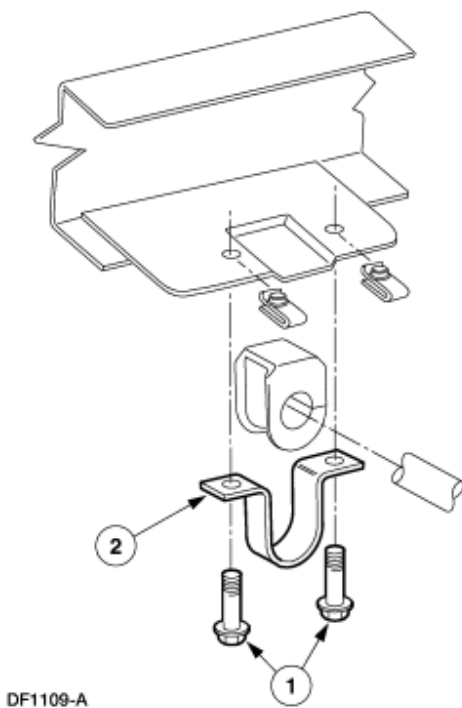
Bar and Link—F-250, F-350

Removal

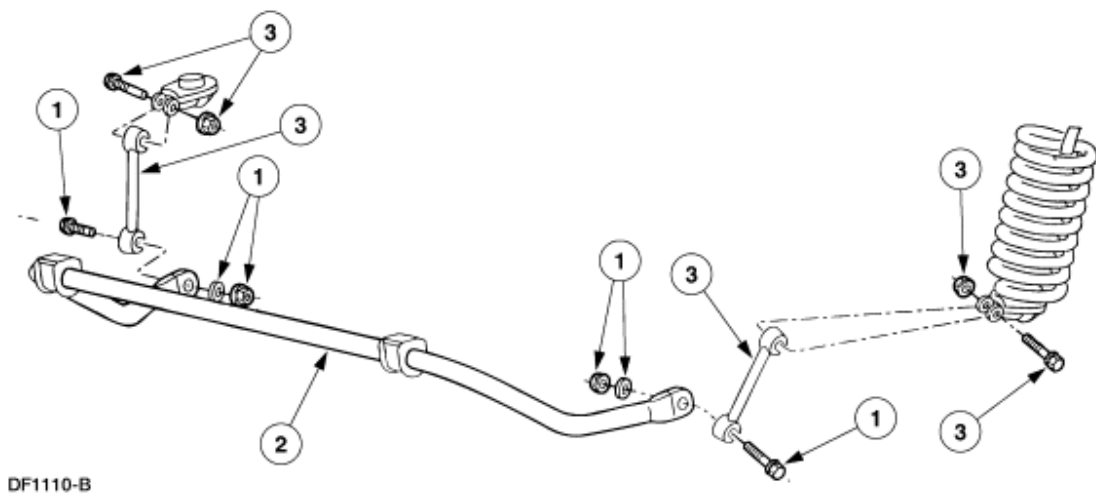
1.  **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

2. Remove the stabilizer bar retainer brackets.
 1. Remove the bolts.
 2. Remove the retainer brackets.

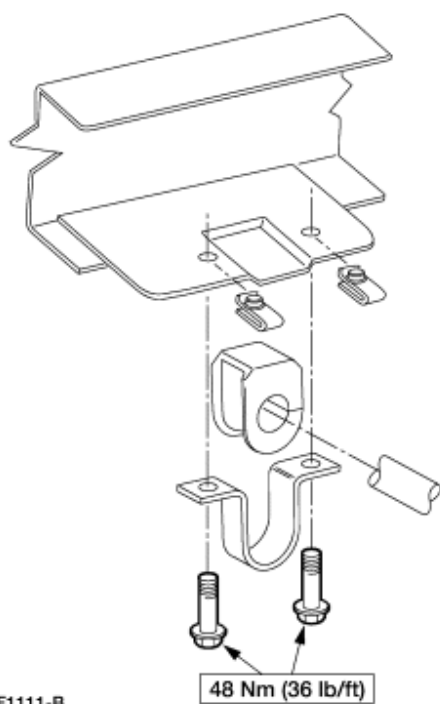


3. Remove the stabilizer bar.
 1. Remove the lower stabilizer bar link nuts, washers and bolts.
 2. Remove the stabilizer bar.
 3. Remove the upper stabilizer bar link nuts and bolts, and remove the links.

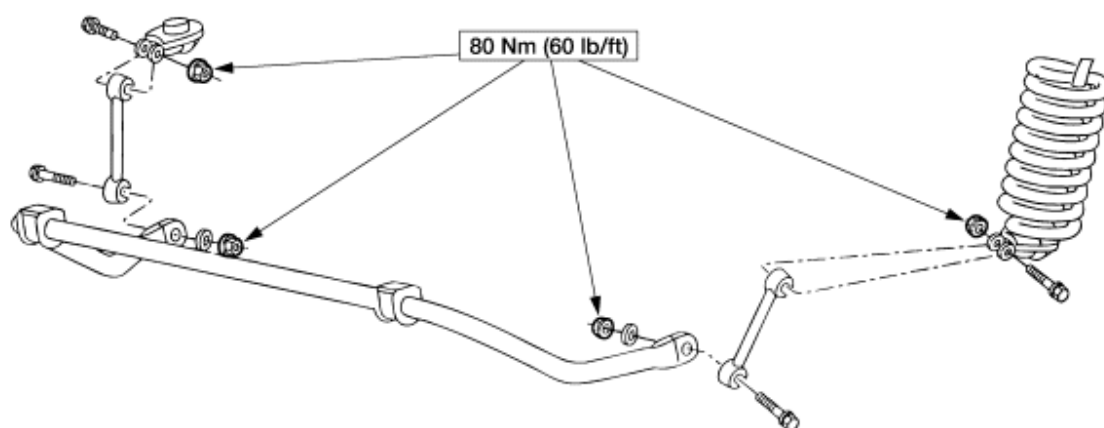


Installation

1. Using new fasteners, follow the removal procedure in reverse order.




DF1111-B



DF1112-B

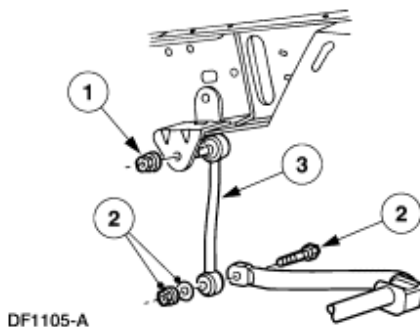
Bar and Link—F-450, F-550

Removal

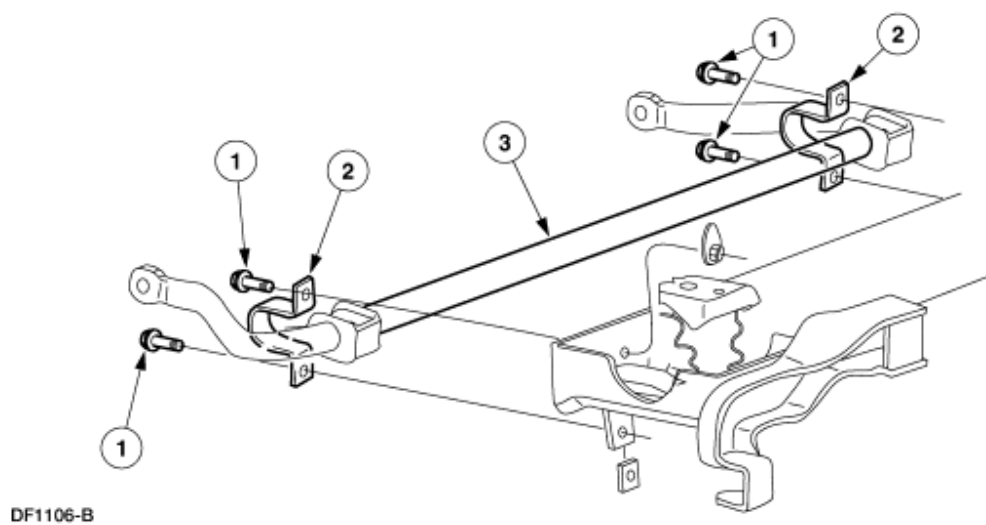
1.  **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

2. Remove the stabilizer bar link.
 1. Remove the nut.
 2. Remove the nut, washer and bolt.
 3. Remove the stabilizer bar link.
 - Repeat on the other side.

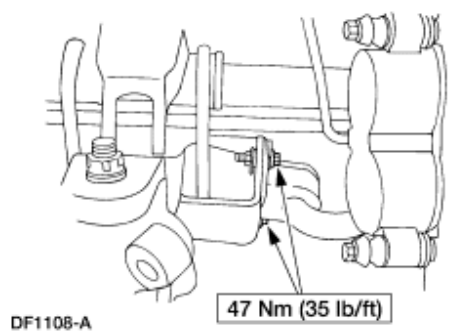
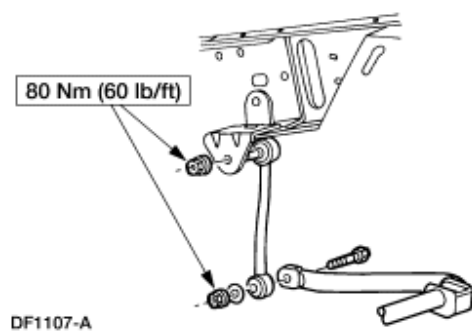


3. Remove the stabilizer bar.
 1. Remove the retainer bracket bolts.
 2. Remove the retainer brackets.
 3. Remove the stabilizer bar.




Installation

1. Using new fasteners, follow the removal procedure in reverse order.



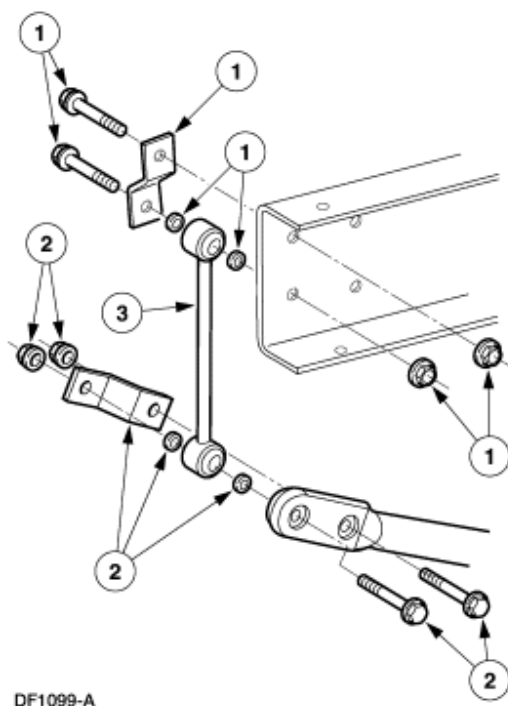
Bar and Link—Motorhome

Removal

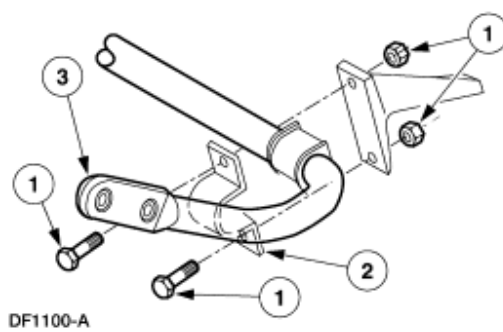
1.  **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

2. Remove the stabilizer bar links.
 1. Remove the upper stabilizer bar link nuts, washers, bolts and bracket.
 2. Remove the lower stabilizer bar link nuts, washers, bolts and bracket.
 3. Remove the stabilizer bar link.
 4. Repeat on the other side.

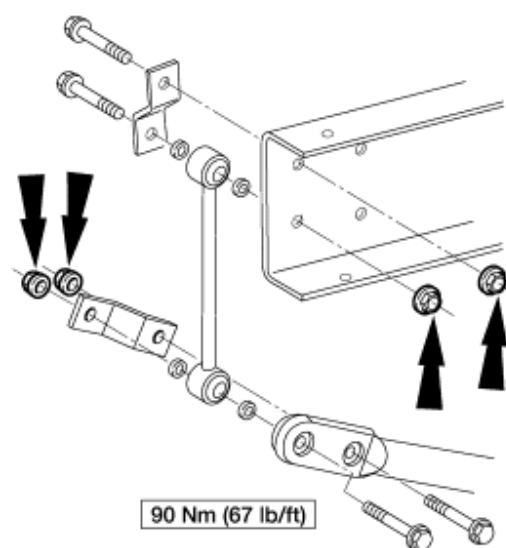
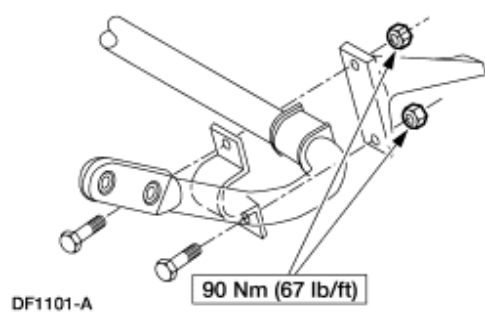


3. Remove the front stabilizer bar.
 1. Remove the retaining nuts and bolts. Repeat on the other side.
 2. Remove the retaining clamp. Repeat on the other side.
 3. Remove the stabilizer bar.



Installation

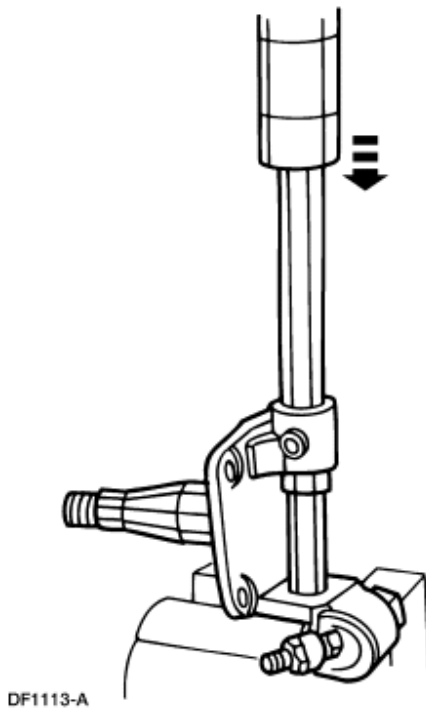
1. Using new fasteners, follow the removal procedure in reverse order.



Bushing—Spindle, Motorhome

Removal

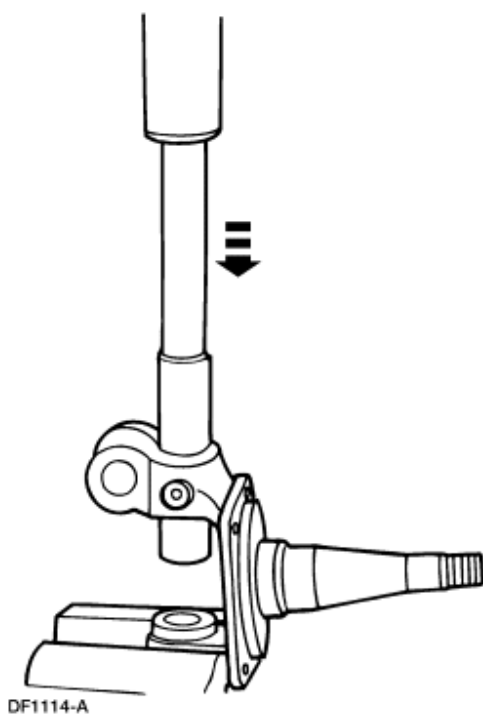
1. Remove spindle; for additional information, refer to [Spindle—Motorhome](#).
2. On a spindle with bronze or low friction (garlock) bushings, press the bushing out of the spindle with a tool that is slightly smaller than the spindle bore.



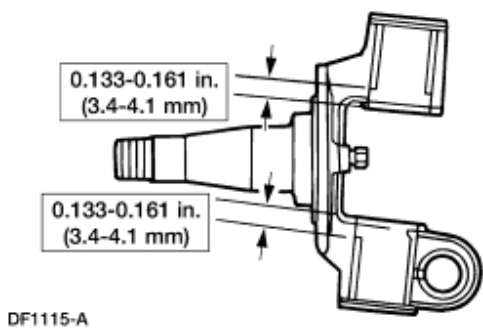
3. Clean the spindle bores thoroughly. Make sure lubricating holes are not plugged.

Installation

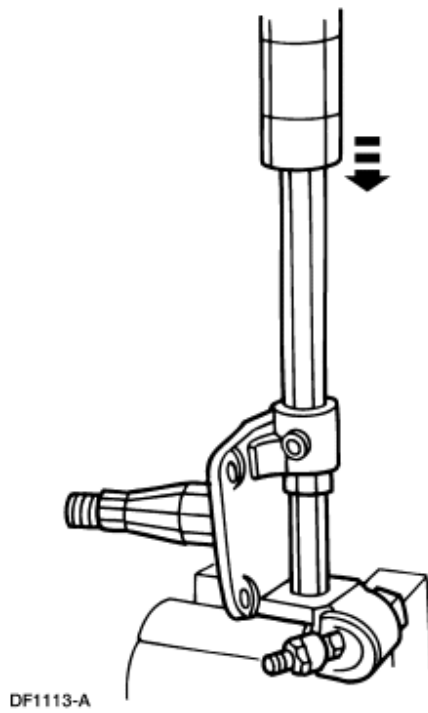
1. Position the new bushing in the spindle bore. For spindles with bronze bushings, position the lubricating hole in line with the lubricating fitting, and the open end of the oil groove toward the axle. Press the bushing into the spindle with a driver that pilots in the bushing.



2. Press the bushing until there is 3.4-4.1 mm (0.133-0.161 inch) between the bottom of the bushing and the bottom of the top bore.

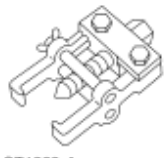


3. Turn the spindle over and install the remaining bushing in the same manner.




4. Clean the bushing and coat the bushing and pin with lubricant prior to assembly.
 5. Install spindle; for additional information, refer to [Spindle—Motorhome](#) in this section.
-

Spindle—F-250, F-350

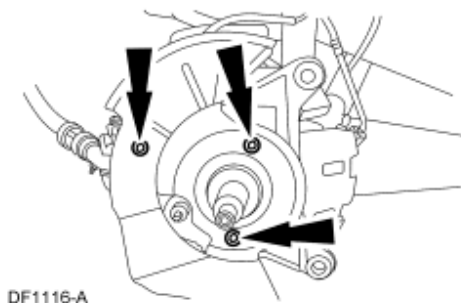
Special Tool(s)	
 ST1263-A	Pitman Arm Puller 211-003 (T64P-3590-F)

Removal

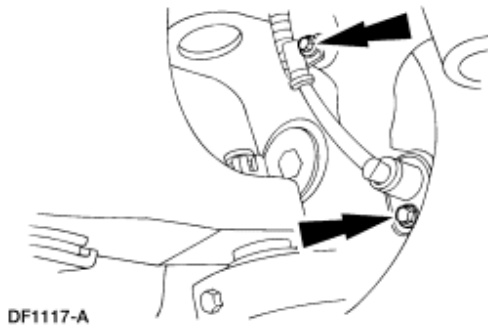
1.  **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

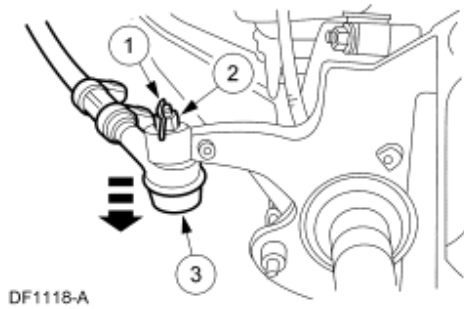
2. Remove the wheel and tire assembly; for additional information, refer to [Section 204-04](#).
3. Remove the disc brake caliper and the front disc brake hub and rotor; for additional information, refer to [Section 206-03](#).
4. Remove the front disc brake rotor shield.



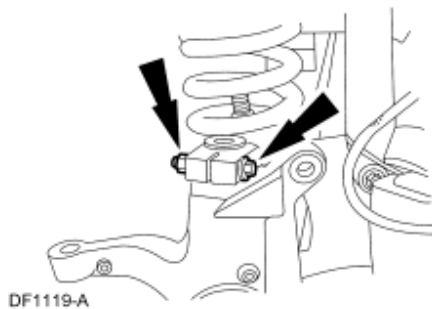
5. If equipped, remove the ABS sensor retaining bolt, ABS sensor harness retaining bolt and the ABS sensor. Position out of the way.



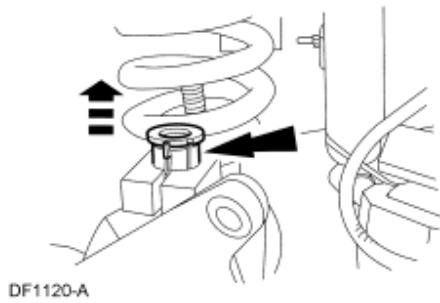
6. Disconnect the tie rod end.
 1. Remove and discard the cotter pin.
 2. Remove the castellated nut.
 3. Using the Pitman Arm Puller, remove the tie rod end.



7. Remove the pinch bolt.



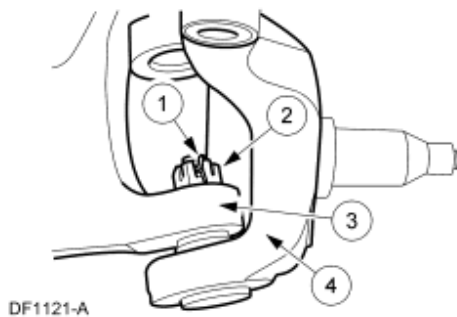
8. Remove the camber adjuster.



9. **⚠ CAUTION:** To prevent damage to the ball joint seal and the ball joint socket, do not use a pickle fork-type remover to loosen the ball joints.

Remove the front wheel spindle.

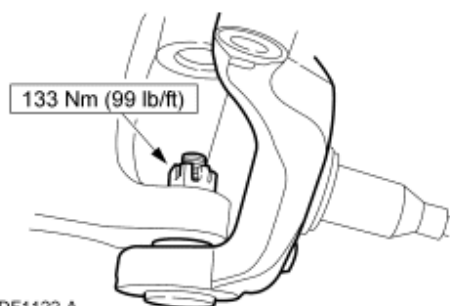
1. Remove and discard the cotter pin.
2. Loosen, but do not remove, the castellated nut.
3. Strike the lower end of the front axle to loosen the ball joint.
4. Remove the castellated nut and the front wheel spindle.



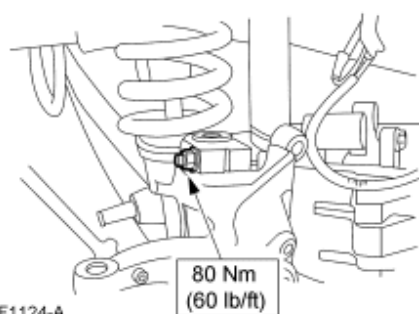
Installation

1. **NOTE:** Tighten the ball joint nut further, if necessary, in order to insert a new cotter pin.

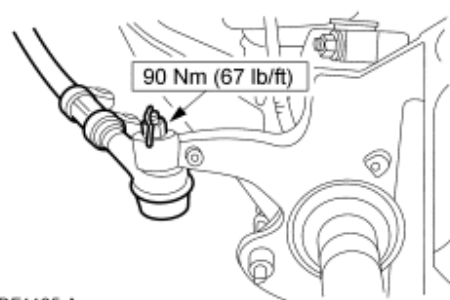
Using new fasteners, follow the removal procedure in reverse order.



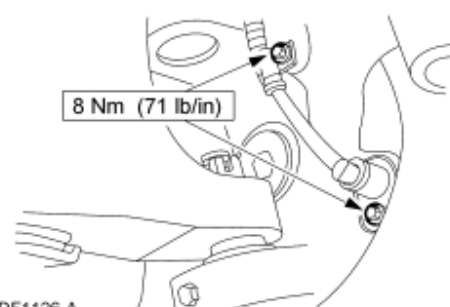
DF1122-A



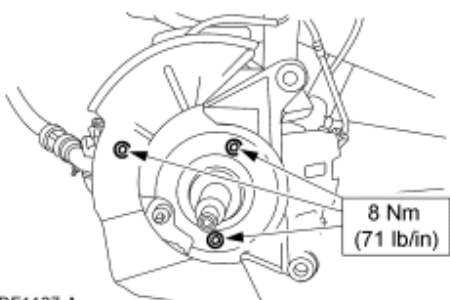
DF1124-A



DF1125-A



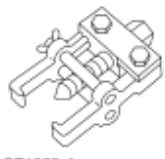
DF1126-A




DF1127-A

2. Check the front end alignment; for additional information, refer to [Section 204-00](#).
-

Spindle—F-450, F-550

Special Tool(s)	
	Pitman Arm Puller 211-003 (T64P-3590-F) or Equivalent

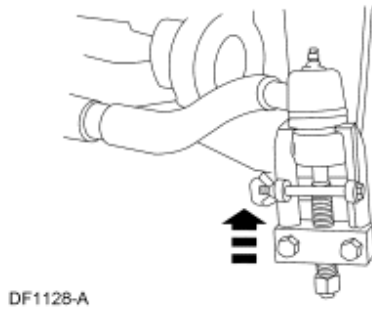
Removal

1.  **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an 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 re-assembly to ensure proper retention of these parts.

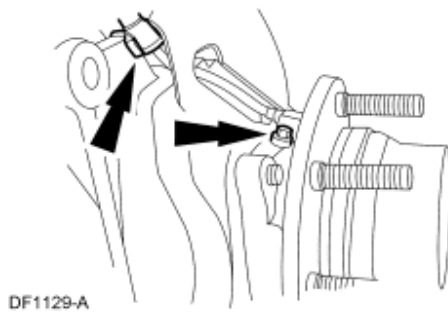
NOTE: Right side shown, left side similar.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

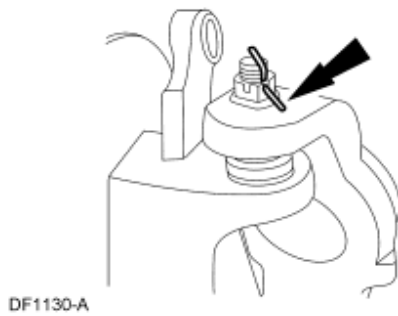
2. Remove the wheel and tire assembly; for additional information, refer to [Section 204-04](#).
3. Remove the front disc brake caliper and the front disc brake rotor; for additional information, refer to [Section 206-03](#).
4. Remove and discard the cotter pin, and remove the castellated nut.
5. Using the Pitman Arm Puller, remove the tie rod end.



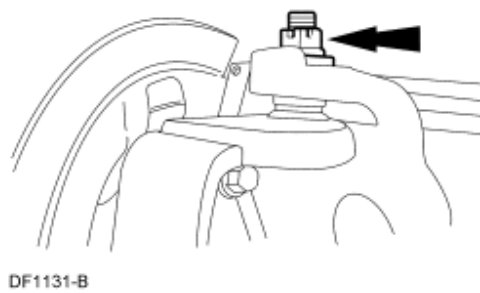
6. If equipped, remove the ABS sensor retaining bolt, ABS sensor harness retaining bolt and the ABS sensor. Position out of the way.



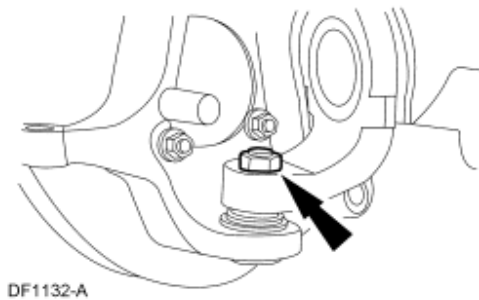
7. Remove and discard the cotter pin.




8. Remove the upper ball joint castellated nut.

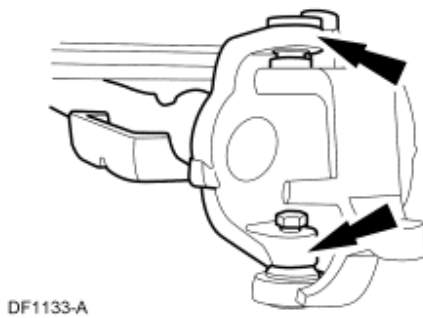


9. Loosen, but do not remove, the lower ball joint retaining nut.

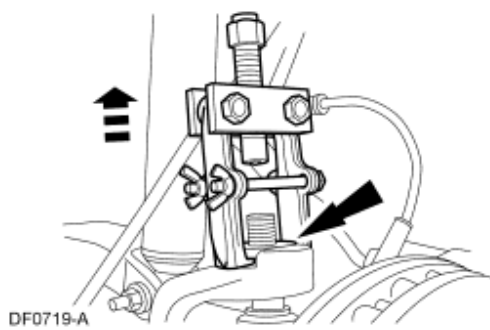


10.  **CAUTION:** To prevent damage to the ball joint seal and the ball joint socket, do not use a pickle fork-type remover to loosen the ball joints.

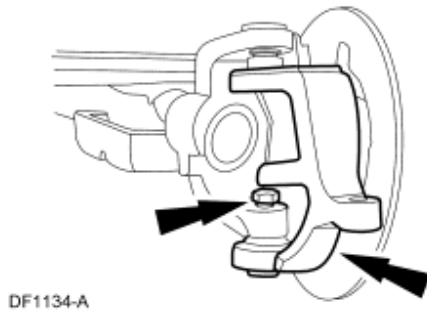
Strike the lower and upper end of the axle to loosen ball joints and the camber adjuster.



11. Using the Pitman Arm Puller, remove the camber adjuster sleeve.

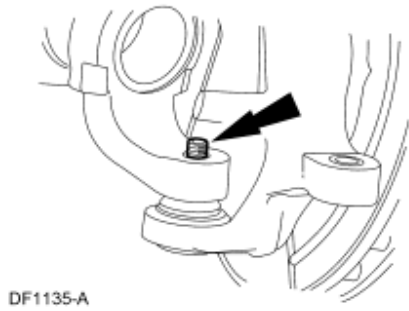


12. Remove the lower ball joint retaining nut and front wheel spindle.



Installation

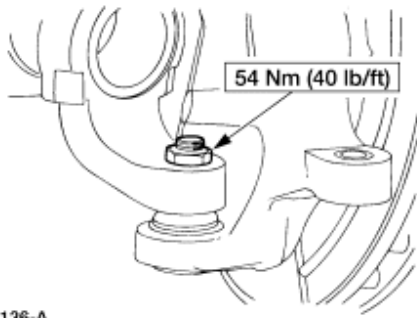
1. Position the spindle into the axle.
 - Apply Threadlock® and Sealer EOAZ-19554-AA or equivalent meeting Ford Specification WSK-M2G315-A5 (Type II).



2. Install the camber adjuster sleeve.



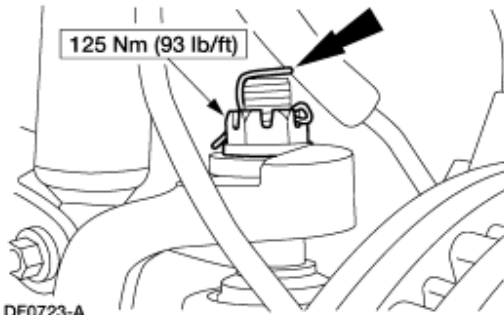
3. Install the new nut and tighten to initial torque.



DF1136-A

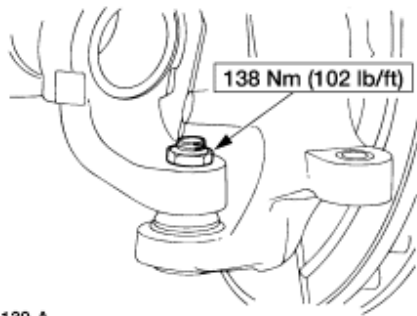
4. **NOTE:** Tighten the upper ball joint nut further, if necessary, in order to insert the new cotter pin.

Install a new castellated nut and a new cotter pin.



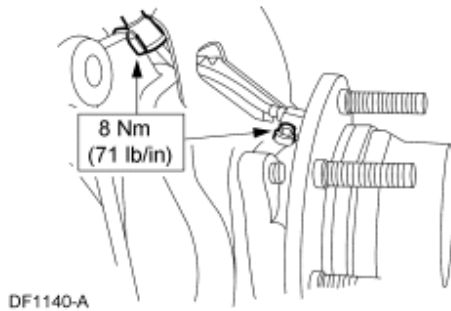
DF0723-A

5. Tighten the nut to final torque.

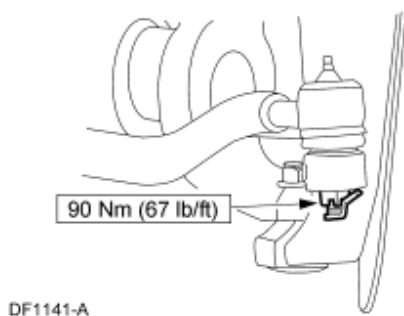


DF1139-A

6. If equipped, install the ABS sensor, ABS sensor retaining bolt and the ABS sensor harness retaining bolt.



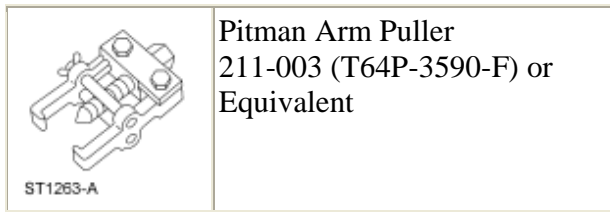
7. Using a new castellated nut and a new cotter pin, install the tie rod end.




8. Install the front disc brake rotor and the front disc brake caliper; for additional information, refer to [Section 206-03](#).
9. Install the wheel and tire assembly, for additional information, refer to [Section 204-04](#).
10. Lower the vehicle; for additional information, refer to [Section 100-02](#).
11. Check the front end alignment; for additional information, refer to [Section 204-00](#).

Spindle—Motorhome

Special Tool(s)



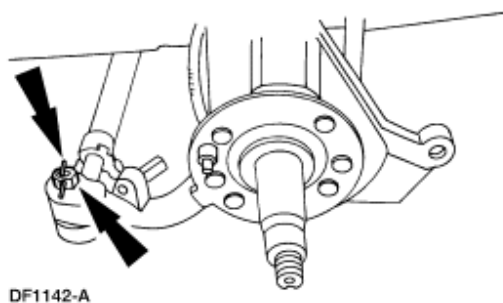
Removal

1.  **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an 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 re-assembly to ensure proper retention of these parts.

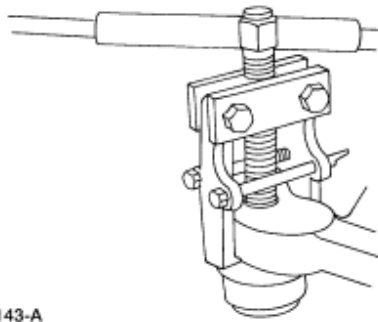
NOTE: Right side shown, left side similar.

Raise and support the vehicle; for additional information, refer to [Section 100-02](#).

2. Remove the wheel and tire assembly; for additional information, refer to [Section 204-04](#).
3. Remove the front disc brake caliper and the front disc brake hub and rotor; for additional information, refer to [Section 206-03](#).
4. Remove and discard the cotter pin and remove the castellated nut.

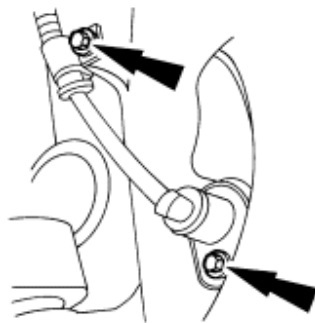


5. Using the Pitman Arm Puller, remove the tie rod end.



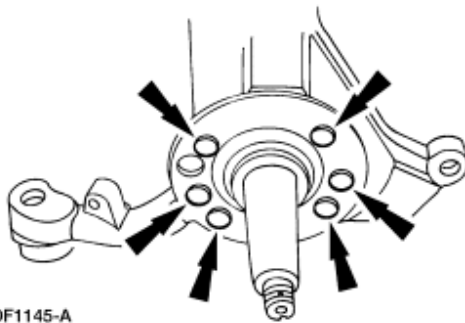
DF1143-A

6. If equipped, remove the ABS sensor retaining bolt, ABS sensor harness retaining bolt and the ABS sensor. Position out of the way.



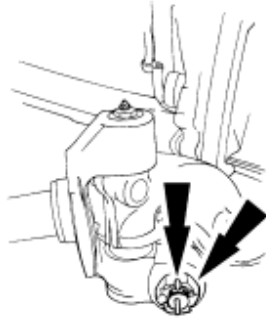
DF1144-A

7. Remove the six torque plate retaining nuts and bolts, and remove the torque plate.



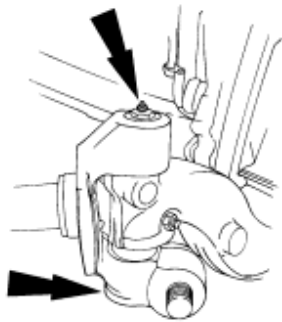
DF1145-A

8. Remove and discard the cotter pin and remove the castellated nut. Disconnect the spindle arm from the spindle.



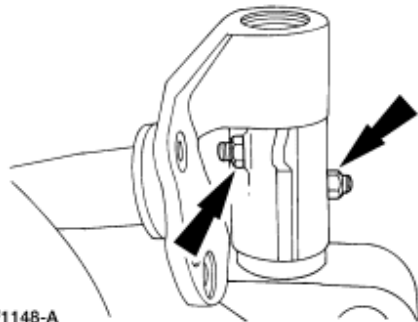
DF1146-A

9. Remove the upper and lower spindle caps and spindle seals.



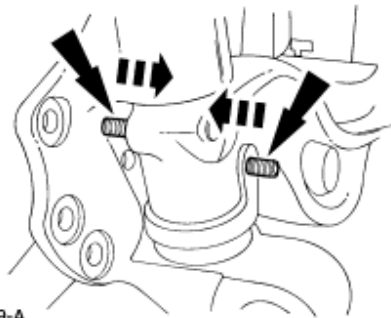
DF1147-A

10. Remove the upper and lower lock pin retaining nuts.



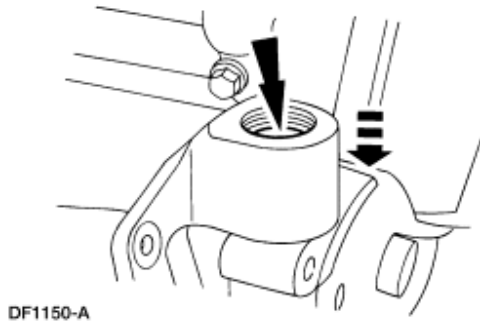
DF1148-A

11. Using a bronze drift, drive out the lock pins.

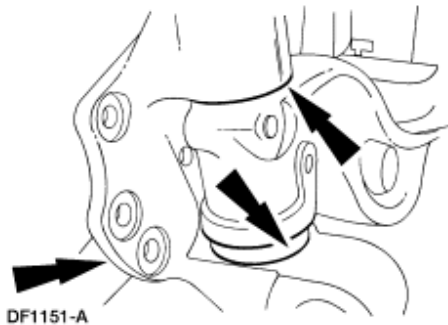


DF1149-A

12. Using a bronze drift, drive out the spindle pin.



13. Remove the spindle, spindle bearing and the spindle shim(s) from the axle assembly.



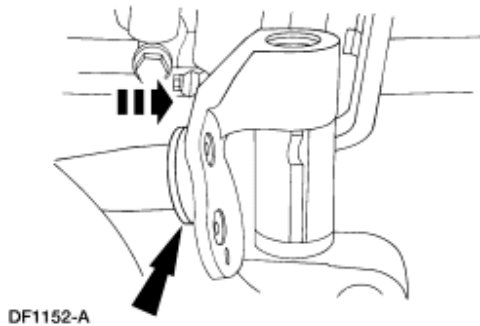
Installation

1. **NOTE:** Pack the spindle bearing and coat all mating surfaces of spindle and axle parts with Motorcraft Premium Long Life Grease XG-1-C or -K or equivalent meeting Ford specification ESA-M1C75-B prior to assembly.

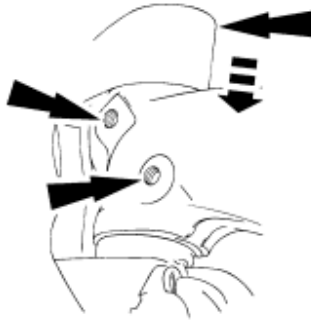
NOTE: The spindle bearing must be installed with the retainer lip facing down.

NOTE: Use shims as required to maintain a 0.076-0.254-mm (0.003-0.010-inch) axle-to-spindle clearance.

Position the spindle, spindle bearing and the spindle shim(s) on the front axle assembly.



2. Insert the spindle pin into the axle until the notches in the spindle pin and the holes in the axle are in line.



DF1153-A

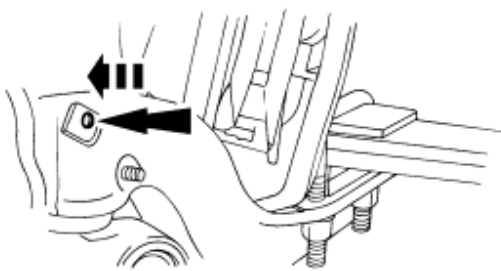
3. **NOTE:** Do not install both lock pins from the same side of axle.

Install the lower (longer) lock pin first, and seat using a bronze drift.



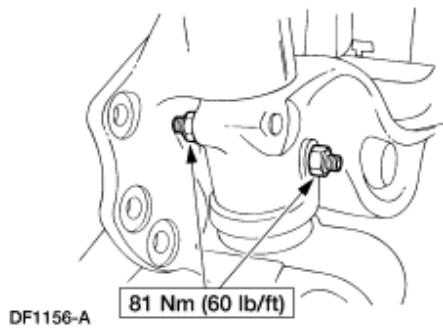
DF1154-A

4. Install the upper (shorter) lock pin, and seat using a bronze drift.

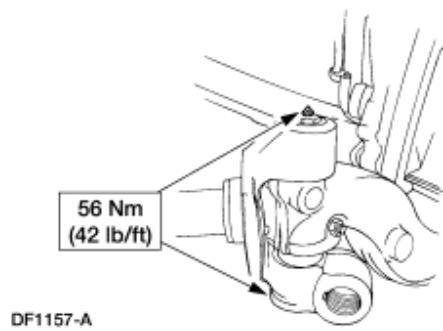


DF1155-A

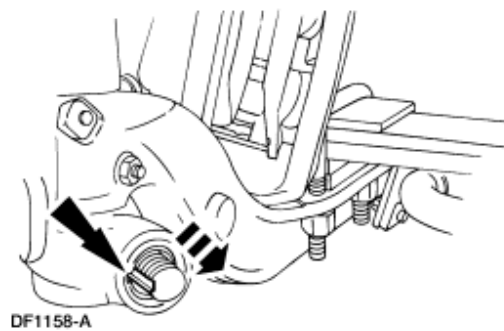
5. Install new lock pin retaining nuts.



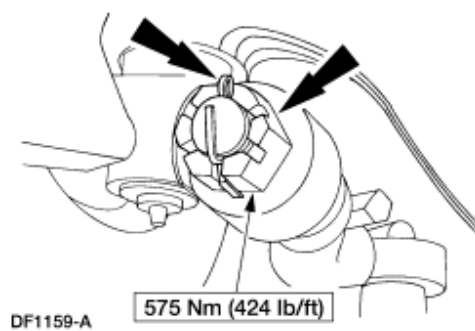
6. Install the upper and lower spindle seals and caps.



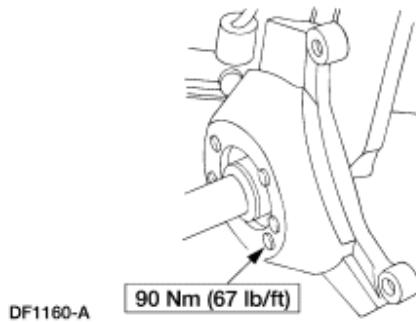
7. Align the key in the spindle arm with the key way slot in the spindle, and insert the spindle arm.



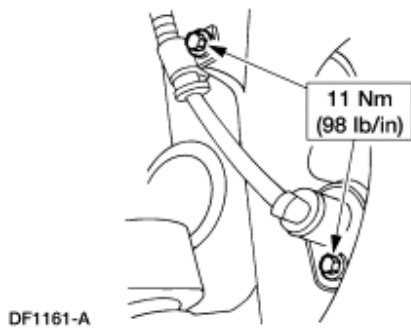
8. Install a new castellated nut and a new cotter pin.



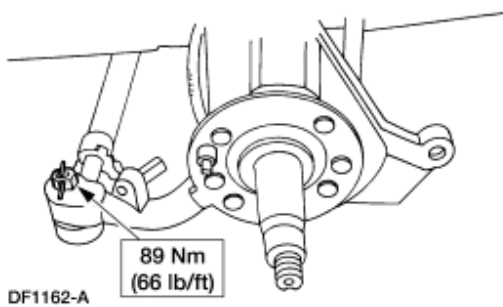
9. Using new fasteners, install the torque plate.



10. If equipped, install the ABS sensor, ABS sensor retaining bolt and the ABS sensor harness retaining bolt.



11. Install the tie rod end using a new castellated nut and a new cotter pin.



12. Install the front disc brake hub and rotor and the front disc brake caliper; for additional information, refer to [Section 206-03](#).
13. Install the wheel and tire assembly; for additional information, refer to [Section 204-04](#).
14. Lower the vehicle; for additional information, refer to [Section 100-02](#).
15. Check the front end alignment; for additional information, refer to [Section 204-00](#).

Shock Absorber—F-250, F-350

Removal

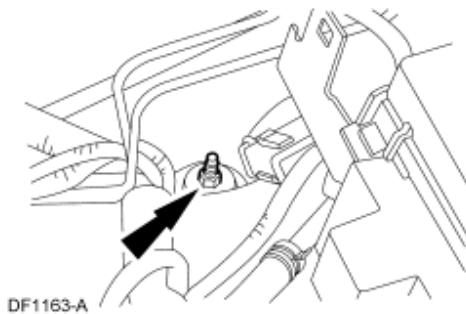


WARNING: All vehicles are equipped with gas-pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing.

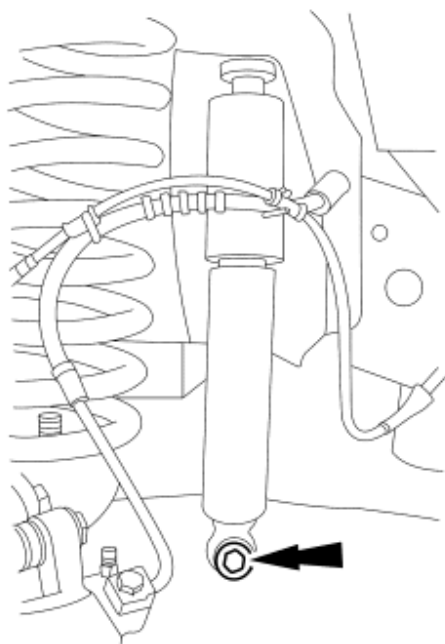


CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

1. Raise the hood and remove the upper shock absorber retaining nut and upper shock absorber insulator.



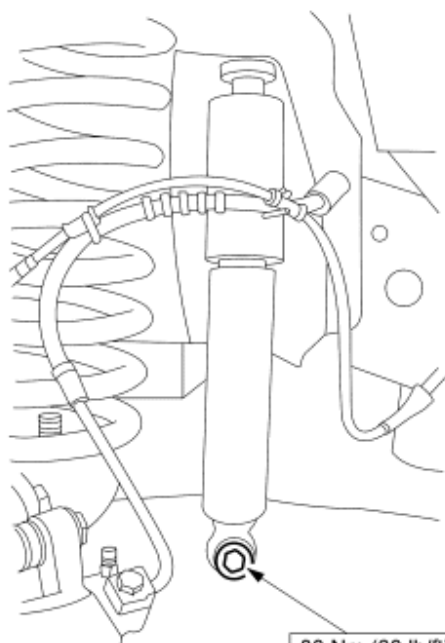
2. Raise and support the vehicle: for additional information, refer to [Section 100-02](#).
3. Remove the lower shock absorber retaining nut and remove the shock absorber.



DF1164-A

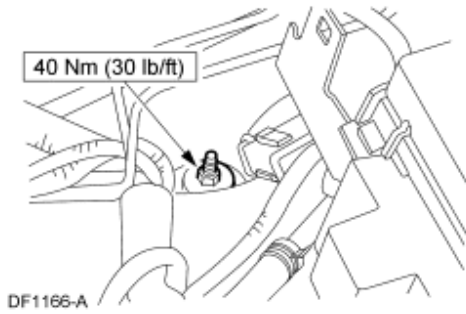
Installation

1. Using new fasteners, follow the removal procedure in reverse order.



DF1165-A

80 Nm (60 lb/ft)



SECTION 204-01A: Front Suspension —
4x2
REMOVAL AND INSTALLATION

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)

Shock Absorber—F-450, F-550

Removal

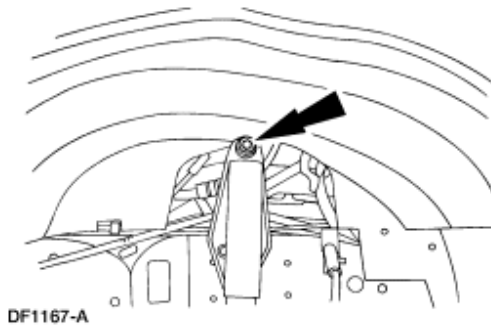


WARNING: All vehicles are equipped with gas-pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing.

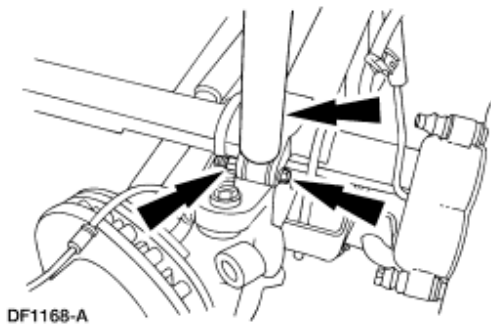


CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

1. Raise and support the vehicle: for additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Using a suitable jack, support the front axle assembly.
4. Remove the upper shock absorber retaining bolt.

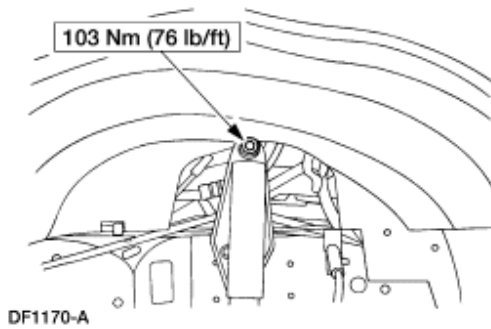
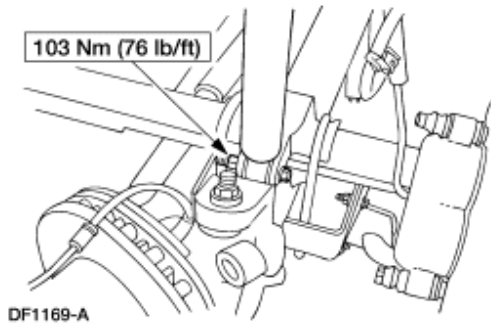


5. Remove the lower shock absorber retaining nut and bolt. Remove the shock absorber.



Installation

1. Using new fasteners, follow the removal procedure in reverse order.



Shock Absorber—Motorhome

Removal

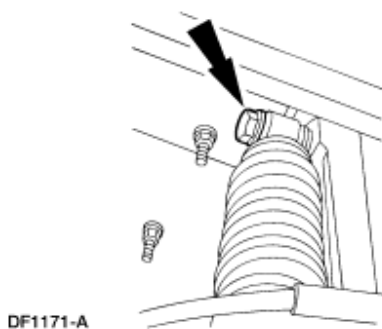


WARNING: All vehicles are equipped with gas-pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing.

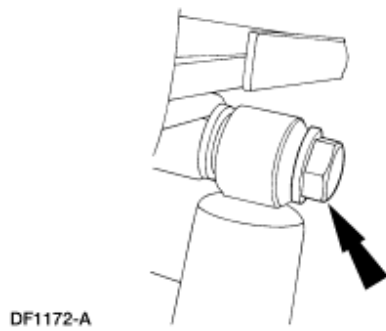


CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

1. Raise and support the vehicle: for additional information, refer to [Section 100-02](#).
2. Using a suitable jack, support the front axle assembly.
3. Remove the upper shock absorber retaining nut, washers and bolt.

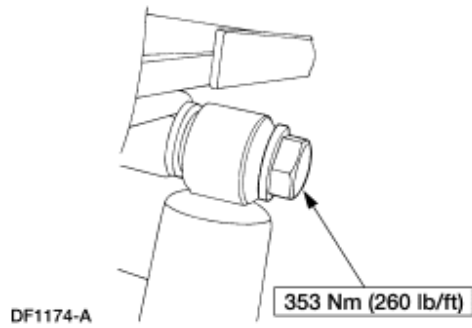
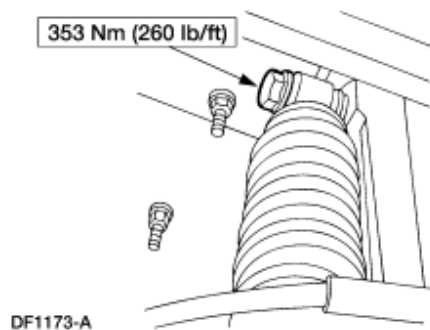


4. Remove the lower shock absorber retaining nut, washers and bolt. Remove the shock absorber.



Installation

1. Using new fasteners, follow the removal procedure in reverse order.

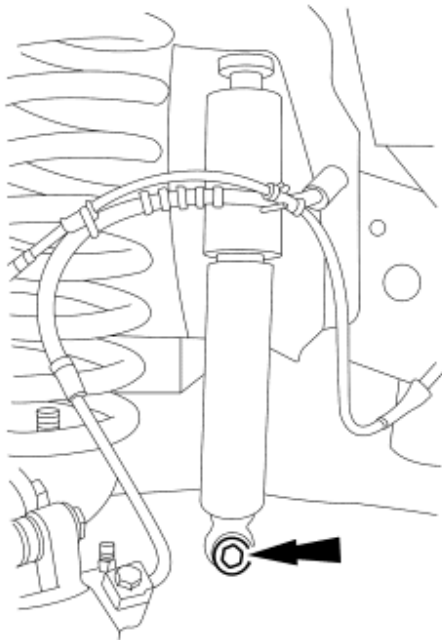


Spring—F-250, F-350

Removal

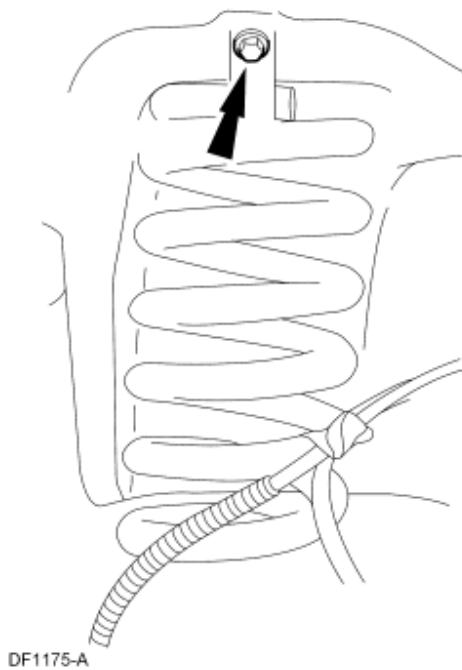
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. Install new parts with the same part number or an equivalent part if installation is necessary. Do not install a part of lesser quality or substitute design. Torque values must be used as specified during reassembly to ensure correct retention of these parts.

1. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
2. Using a suitable jack, support the front axle assembly.
3. Remove the nut and detach the shock from the mounting stud.

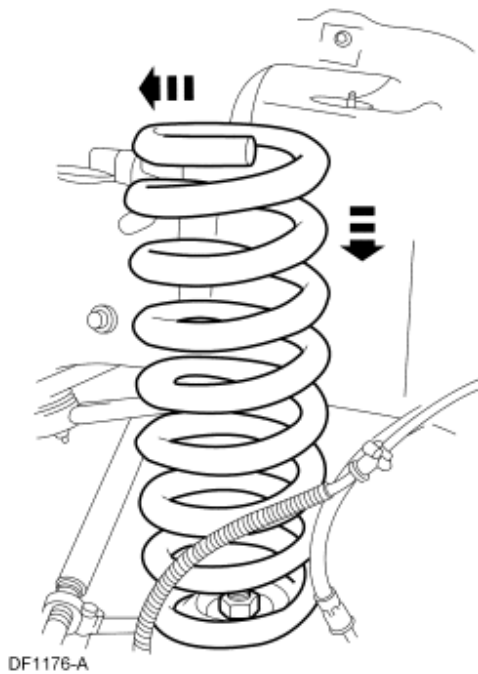


DF1164-A

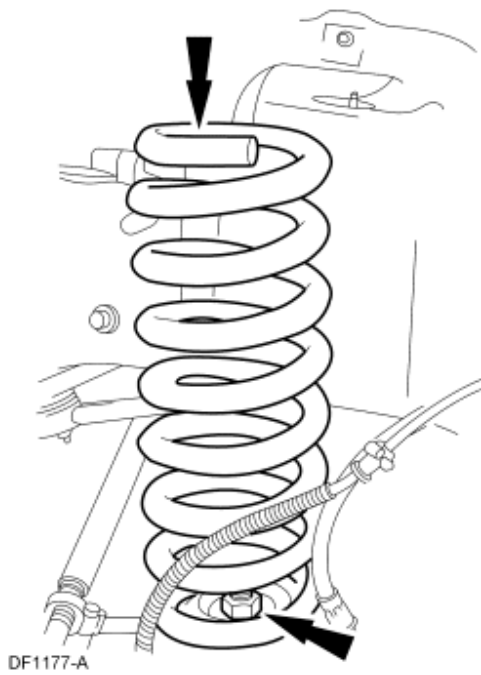
4. Remove the upper spring retainer.



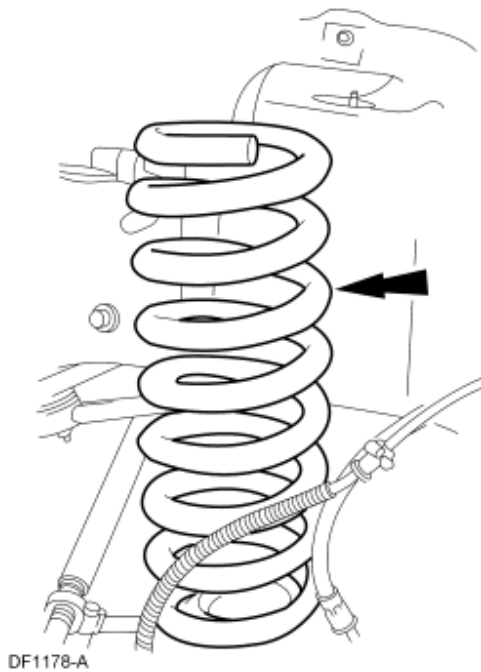
5. Lower the front axle until the spring is free of the upper spring seat.



6. Using an extension through the top of the spring, remove the lower spring retainer.

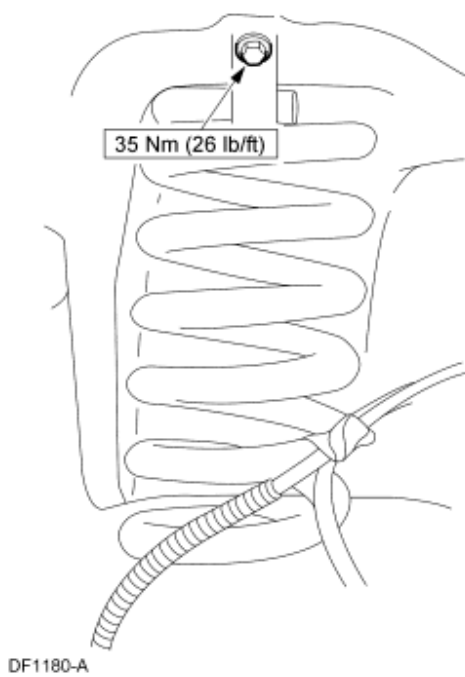
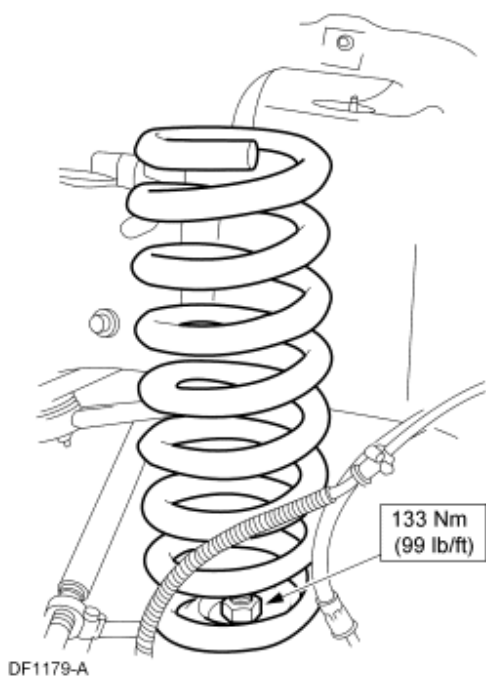


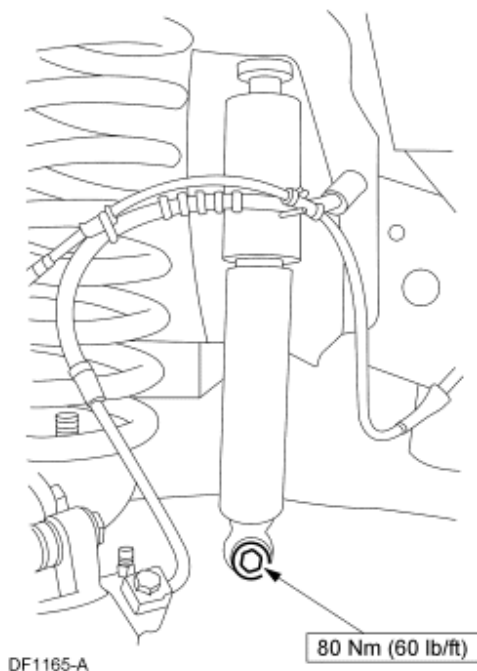
7. Remove the front spring.



Installation

1. Using new fasteners, reverse the removal procedure.





SECTION 204-01A: Front Suspension —
4x2
REMOVAL AND INSTALLATION

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)

Spring—F-450, F-550

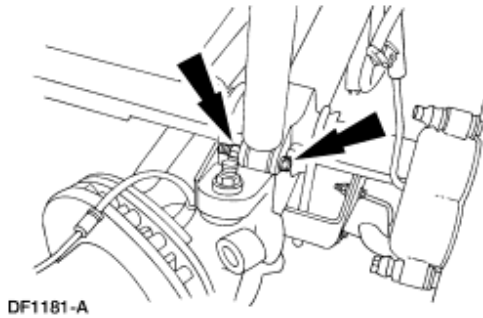
Removal

⚠ WARNING: All vehicles are equipped with gas-pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing.

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an 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 re-assembly to ensure proper retention of these parts.

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).

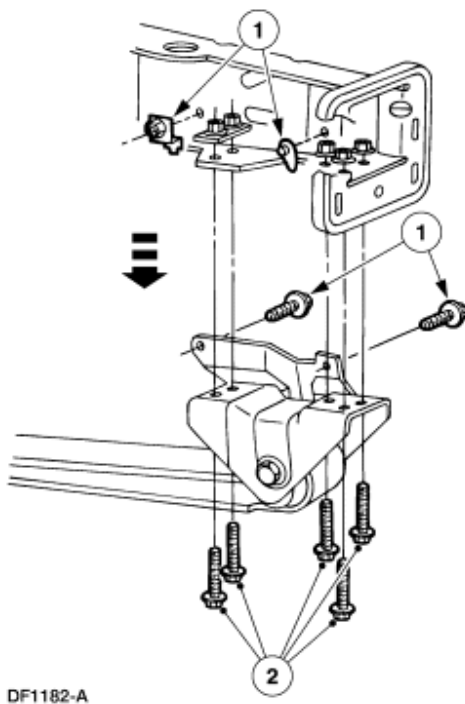
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Using a suitable jack, support the front axle assembly.
4. Remove the front shock absorber lower mounting nut and bolt.



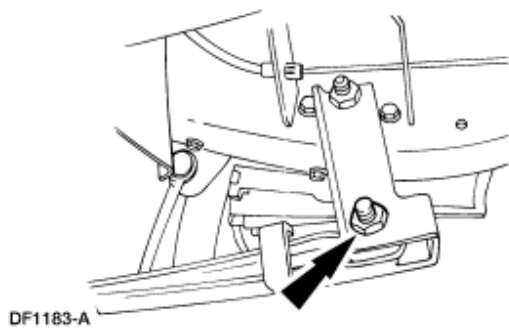
5. **NOTE:** The front spring hanger has seven flange nuts located inside the frame rail and must be positioned in the same location for installation.

Remove the front spring hanger and hanger bracket.

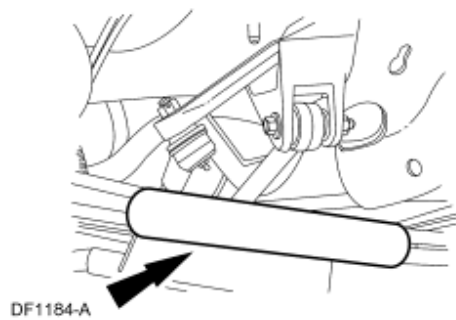
1. Remove the two spring hanger bracket bolts and flange nuts.
2. Remove the five spring hanger bolts.



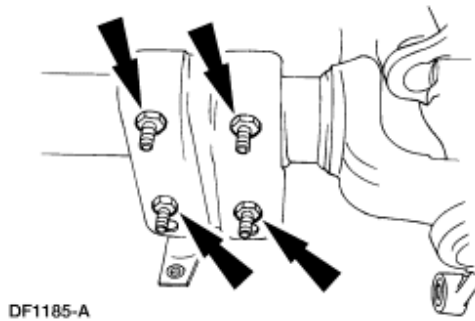
6. Remove and discard the nut and bolt that retain the front spring to the spring shackle.



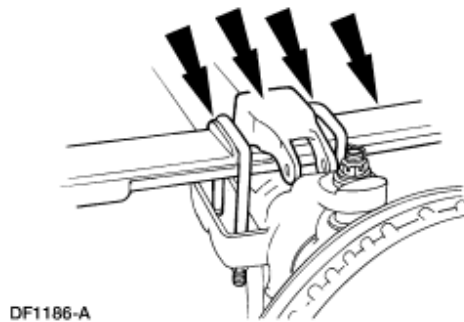
7. If equipped, remove the spring insulator and hold for reinstallation.



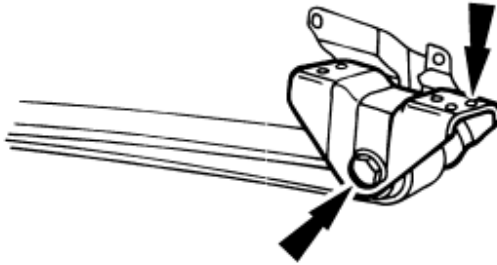
8. Remove and discard the four U-bolt nuts.



9. Remove and discard the two U-bolts, and remove the spring spacer and the spring.



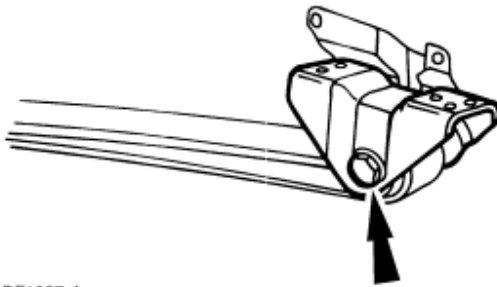
10. Remove the nut and bolt from the front spring hanger, and remove the hanger and hanger bracket.



DF1187-A

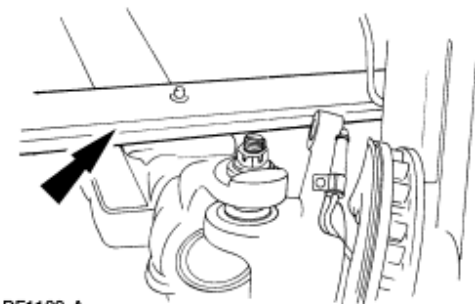
Installation

1. Position the spring in the front spring hanger and install a new bolt from inside to outside. Position the spring hanger bracket to the spring hanger, and install a new nut hand-tight.



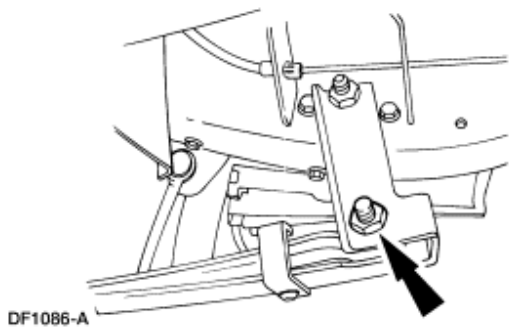
DF1087-A

2. Position the spring on the axle.

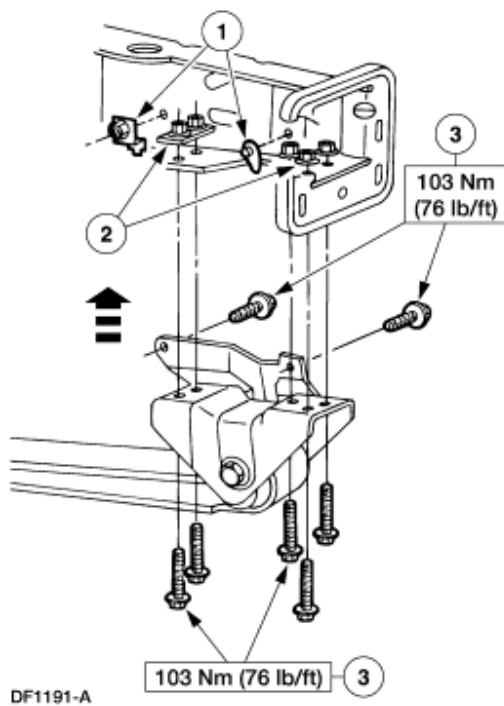


DF1189-A

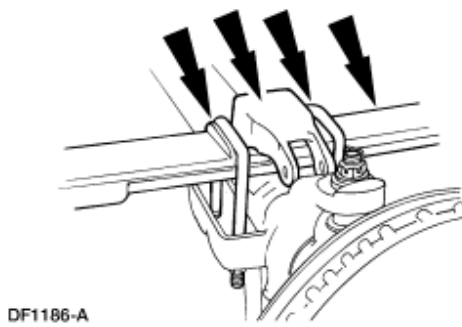
3. Install a new bolt and nut to retain the front spring to the spring shackle hand-tight.



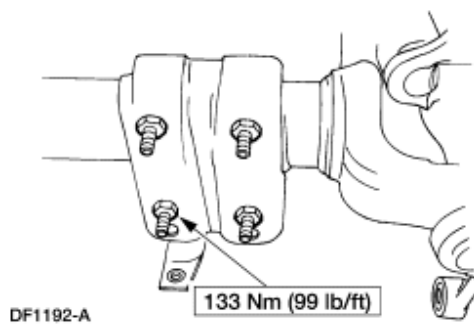
4. Using new fasteners, install the front spring hanger and hanger bracket.
 1. Position the spring, spring hanger and spring hanger bracket. Line up the flange nuts inside the frame rail, and start the spring hanger bracket retaining bolts by hand, using caution not to cross thread the bolts.
 2. Position the flange nuts inside the frame rail and start the spring hanger retainer bolts by hand, using caution not to cross-thread the bolts.
 3. Tighten the bolts.



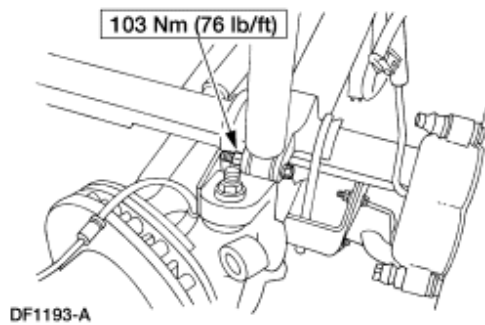
5. Position the spring spacer and two new U-bolts.



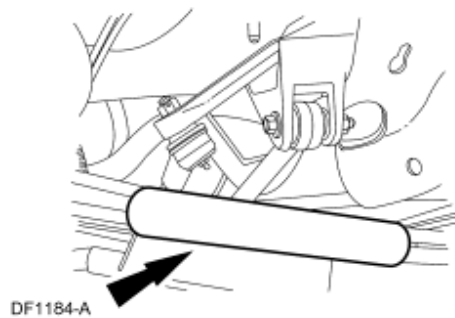
6. Install four new U-bolt retaining nuts.



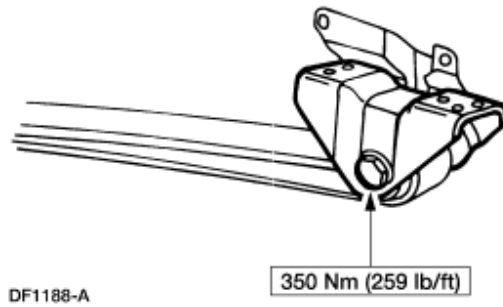
7. Install a new front shock absorber lower bolt and nut.



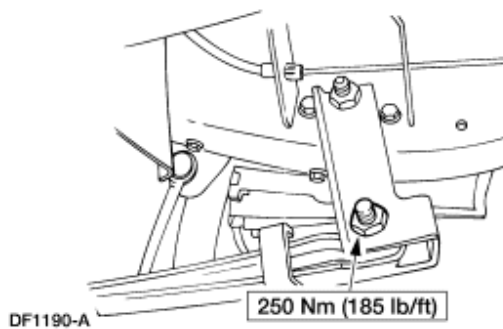
8. If equipped, install the spring insulator.



9. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
10. Remove the jack stands.
11. Lower the vehicle. For additional information, refer to [Section 100-02](#).
12. With the weight of the vehicle on the wheels, tighten the front hanger bolt and nut.




13. With the weight of the vehicle on the wheels, tighten the shackle bolt and nut.



Spring—Motorhome

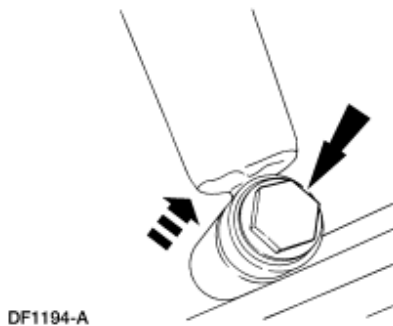
Removal

 **WARNING:** All vehicles are equipped with gas-pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing.

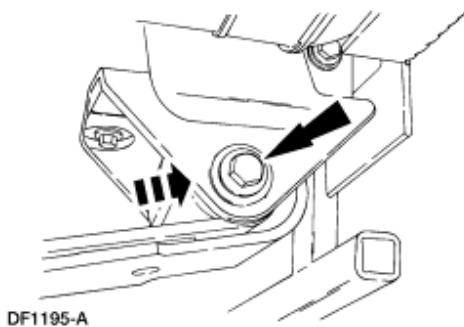


CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an equivalent part if replacement is necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during re-assembly to ensure proper retention of these parts.

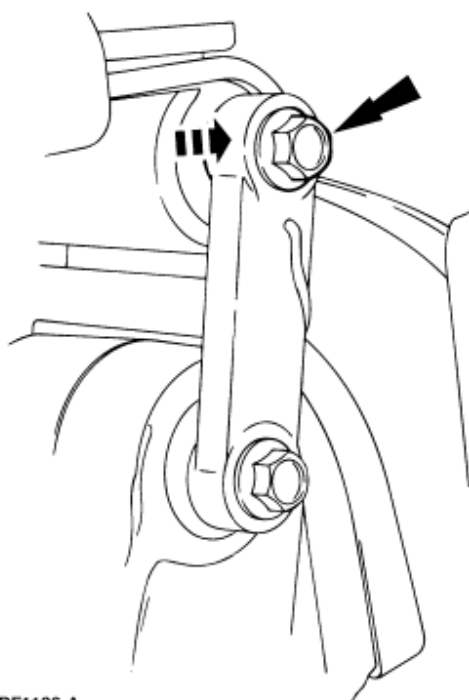
1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly; for additional information, refer to [Section 204-04](#).
3. Using suitable jack stands, support the front axle assembly.
4. Remove the front shock absorber lower mounting nut, washers and bolt.



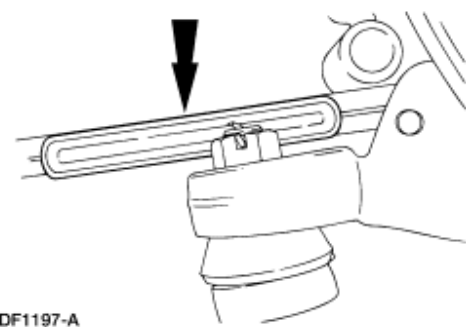
5. Remove the nut and bolt that retain the spring to the front spring hanger.



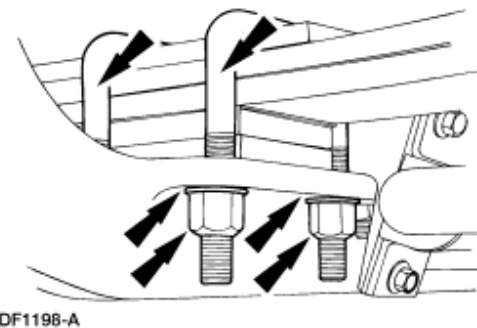
6. Remove the nut and bolt that retain the spring to the spring shackle.



7. If equipped, remove the spring insulator and hold for reinstallation.

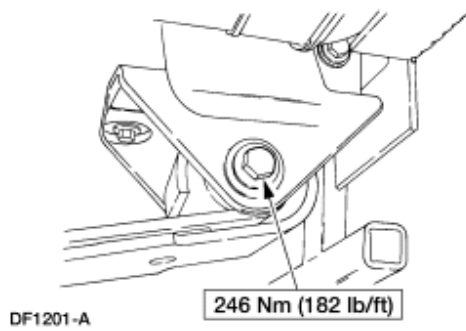
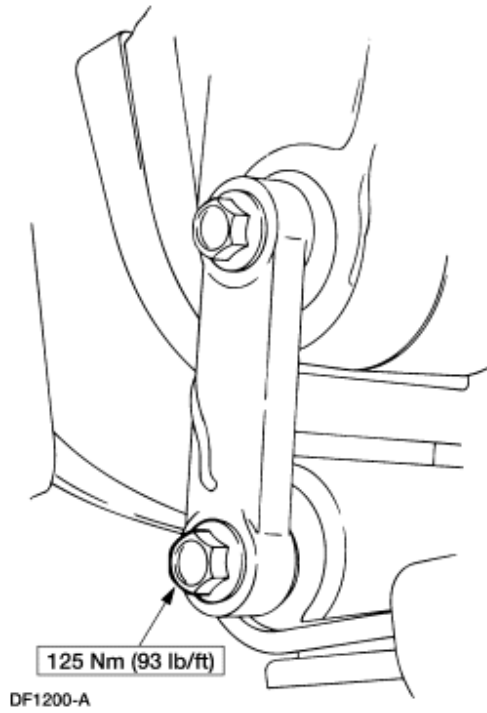
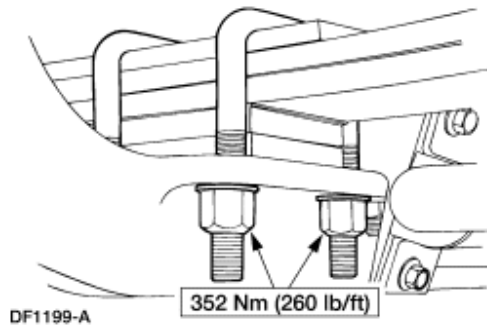


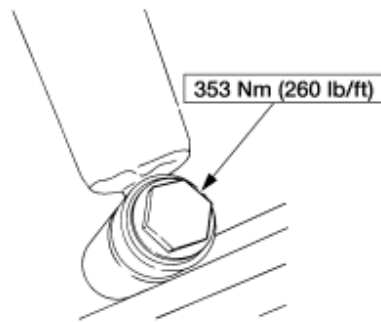
8. Remove the four U-bolt nuts, washers and the two U-bolts. Remove the spring.



Installation

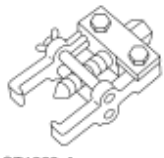
1. Using new fasteners, follow the removal procedure in reverse order.





DF1202-A

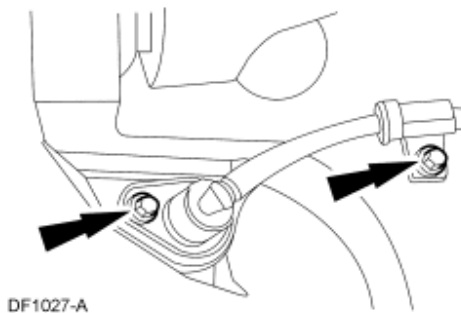
Axle—F-250, F-350

Special Tool(s)	
 ST1263-A	Pitman Arm Puller 211-003 (T64P-3590-F) or Equivalent

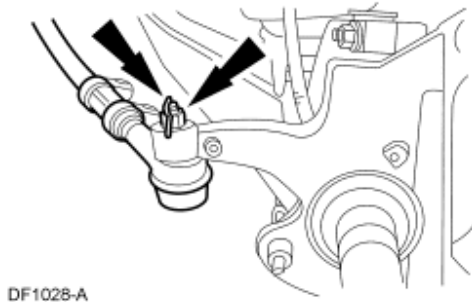
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an 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 re-assembly to ensure proper retention of these parts.

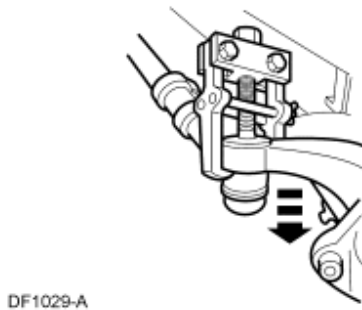
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the front disc brake caliper, front disc brake hub and rotor and front disc brake rotor shield. For additional information, refer to [Section 206-03](#).
4. If equipped, remove the front disc brake ABS sensor retainer bolt and the ABS sensor harness bracket bolt from the front wheel spindle. Position the ABS sensor out of the way.



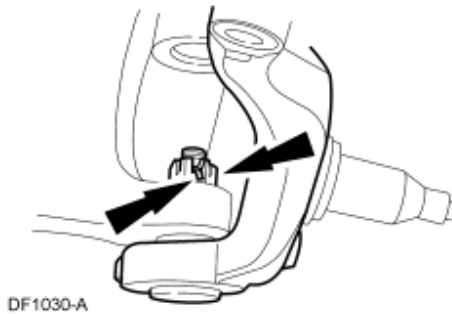
5. Remove the cotter pin and the castellated nut from the tie rod end. Discard the cotter pin.



6. Using the Pitman Arm Puller, remove the tie rod end.



7. Remove the cotter pin and the lower ball joint castellated nut. Discard the cotter pin.



8. Remove the pinch bolt and the camber adjuster from the upper ball joint.



DF0090-A

9. **⚠ CAUTION:** To prevent damage to the ball joint seal and the ball joint socket, do not use a pickle fork-type remover to loosen the ball joints.

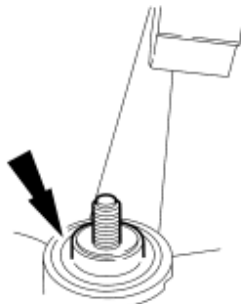
Remove the front wheel spindle.

1. Strike the lower end of the axle to loosen the ball joint.
2. Remove the front wheel spindle.



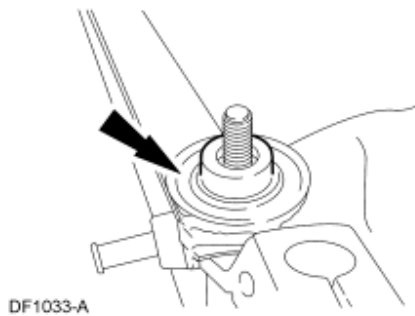
DF1031-A

10. Using a suitable jack, support the front axle.
11. Remove the front coil spring. For additional information, refer to [Spring—F-250, F-350](#) in this section.
12. Remove the lower spring insulator.

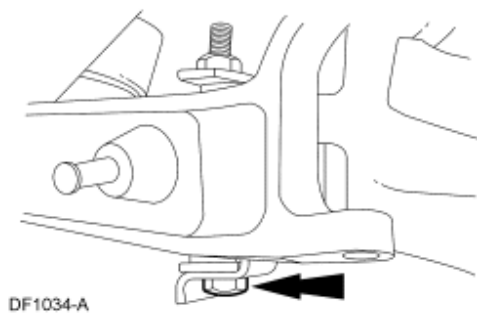


DF1032-A

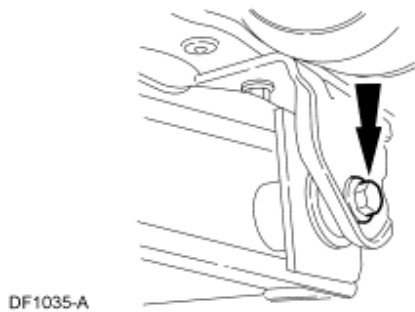
13. Remove the lower spring seat.



14. Remove the radius arm-to-axle bolt and nut.

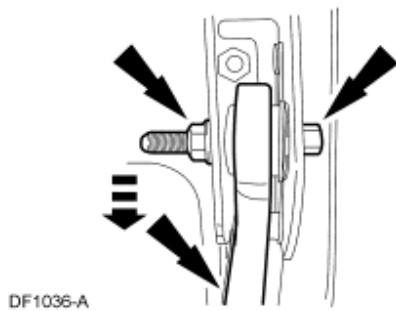


15. Remove the radius arm-to-frame bracket pivot bolt and nut. Remove the radius arm.



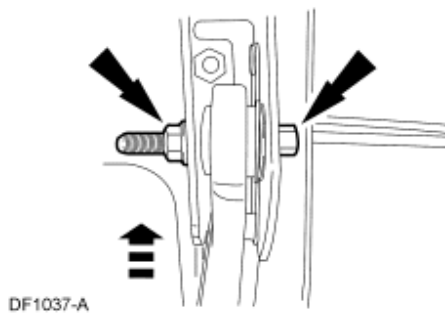
16. **NOTE:** In order to obtain clearance for the pivot bolt removal when servicing the RH front axle, it may be necessary to raise the side of the vehicle to relieve the weight on the suspension.

Remove the pivot nut and bolt, and remove the axle.

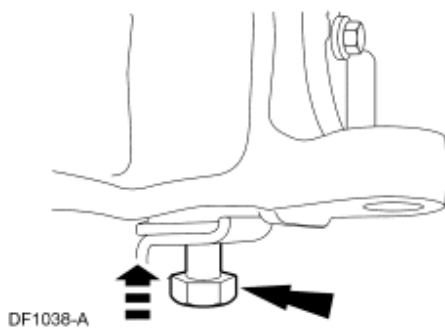


Installation

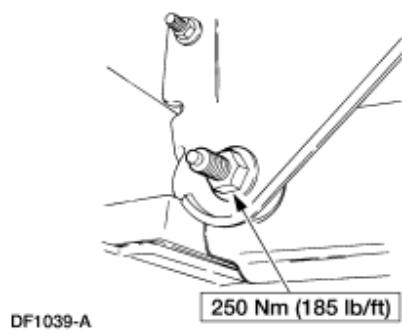
1. Inspect the pivot bushing for wear or damage. Replace as necessary.
2. Position the front axle into the pivot bracket and install a new pivot bolt and nut hand-tight.



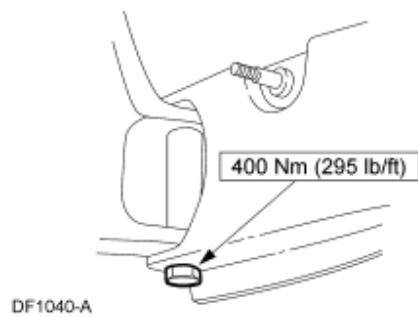
3. Inspect the radius arm pivot bushing for wear or damage. Replace as necessary.
4. Install a new radius arm-to-axle bolt and nut hand-tight.



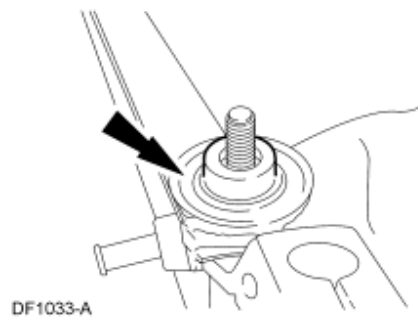
5. Install a new radius arm-to-frame bracket pivot bolt and nut. Tight to specification.



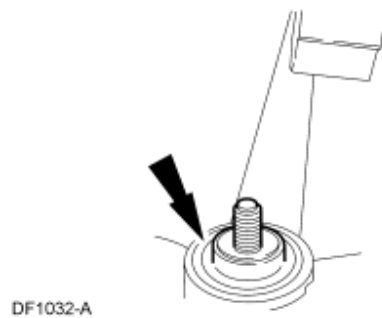
6. Tighten the radius arm-to-axle bolt and nut to specification.



7. Install the lower spring seat.



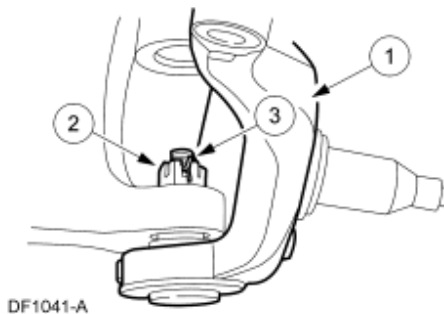
8. Install the lower spring insulator.



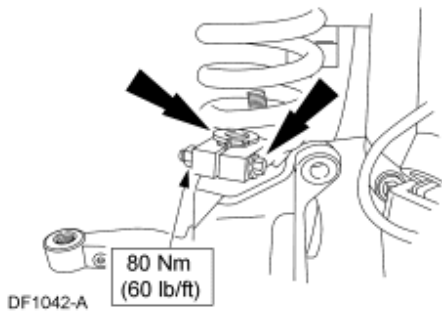
9. Install the front coil spring. For additional information, refer to [Spring—F-250, F-350](#) in this section.
10. **NOTE:** Tighten the ball joint nut further, if necessary, in order to insert the new cotter pin.

Using new fasteners, install the front wheel spindle in the front axle.

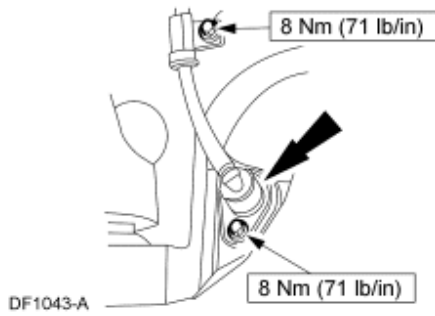
1. Position the front wheel spindle in the front axle.
2. Install the ball joint nut and tighten to specification.
3. Install the new cotter pin.



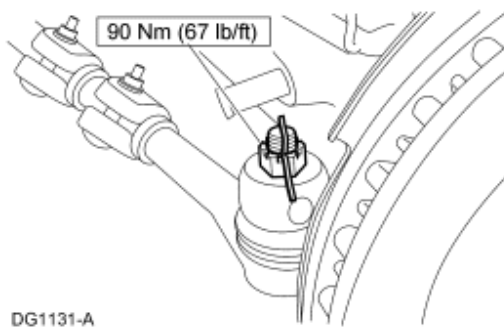
11. Install the camber adjuster and a new pinch bolt.



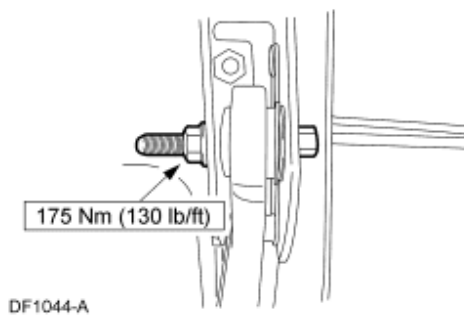
12. Install the front disc brake rotor shield, front disc brake hub and rotor and the front disc brake caliper. For additional information, refer to [Section 206-03](#).
13. If equipped, install the front disc brake ABS sensor, retainer bolt and the ABS sensor harness bracket bolt.



14. Install the tie rod end in the front wheel spindle using a new nut and a new cotter pin.

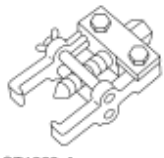


15. Install the tire and wheel assembly. For additional information, refer to [Section 204-04](#).
16. Lower the vehicle and with the vehicle weight on the suspension, tighten the axle pivot bolt and nut to specification.



17. Perform front end alignment. For additional information, refer to [Section 204-00](#).
-

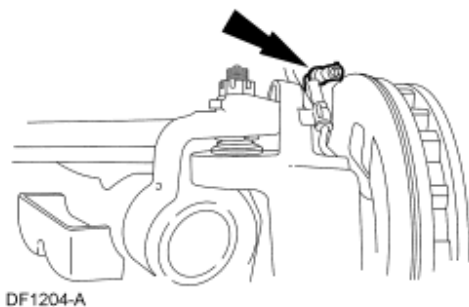
Axle—F-450, F-550

Special Tool(s)	
 ST1263-A	Pitman Arm Puller 211-003 (T64P-3590-F) or Equivalent

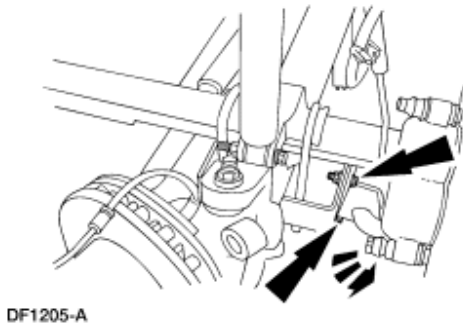
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an 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 re-assembly to ensure proper retention of these parts.

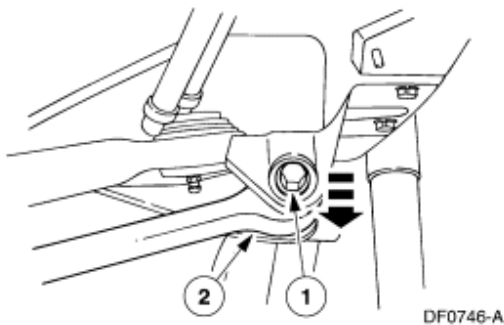
1. Raise and support the vehicle: for additional information, refer to [Section 100-02](#).
2. Remove the front wheels and tire assemblies. For additional information, refer to [Section 204-04](#).
3. Remove the front disc brake calipers and position out of the way. For additional information, refer to [Section 206-03](#).
4. If equipped, disconnect the front disc brake ABS sensor harness connectors and position harness out of the way. For additional information, refer to [Section 206-09A](#) or [Section 206-09B](#).



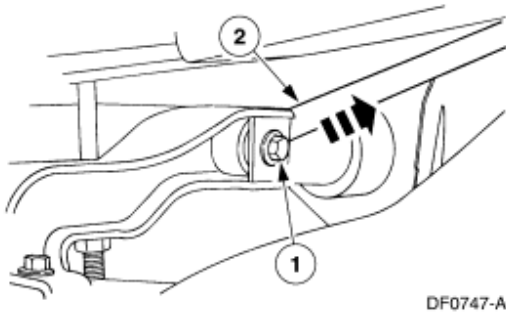
5. Using a suitable jack, equipped with safety chains, support the front axle.
6. Remove the front shock absorbers. For additional information, refer to [Shock Absorber—F-450, F-550](#) in this section.
7. Remove and discard the bolts from the stabilizer bar mounting brackets to axle, and position out of the way.



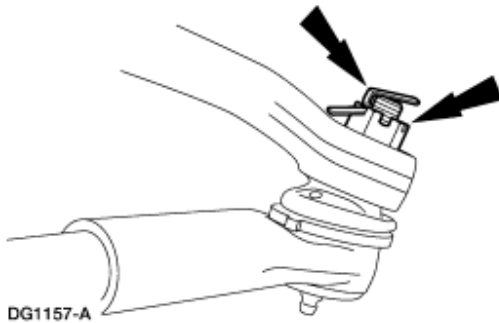
8. Disconnect the trackbar from the upper mounting bracket.
 1. Remove and discard the nut and bolt.
 2. Remove the trackbar from the bracket.



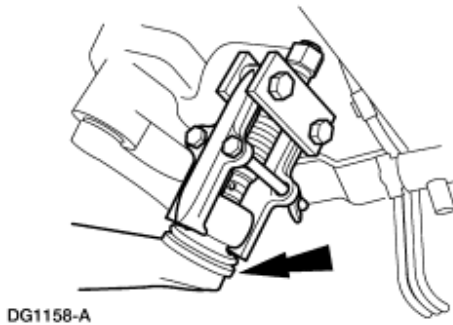
9. Remove the trackbar from the lower mounting bracket.
 1. Remove and discard the nut and bolt.
 2. Remove the trackbar.



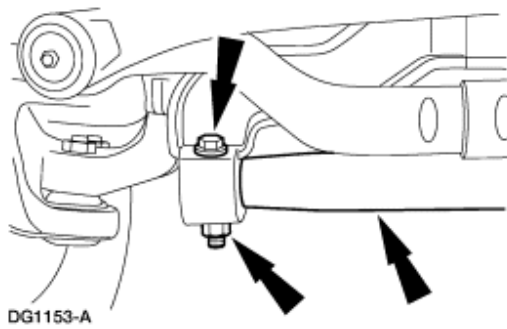
10. Remove the cotter pin and the castellated nut from the drag link to pitman arm. Discard the cotter pin.



11. Using the Pitman Arm Puller, remove the drag link to pitman arm, and secure the drag link to the tie rod.

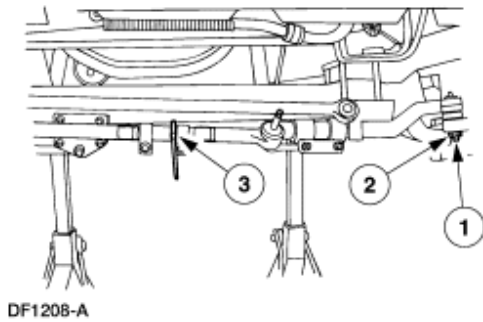


12. Remove and discard the nut and bolt from the steering damper-to-axle mounting bracket, and secure the steering damper to the tie rod.



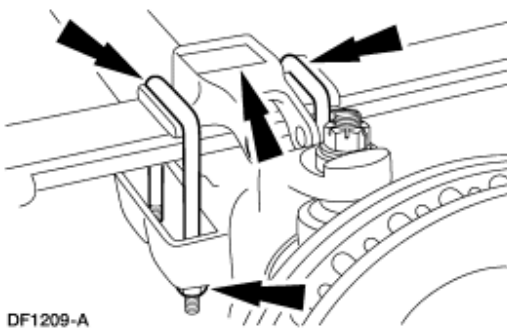
13. Remove the steering linkage assembly.

1. Remove both cotter pins from the outer tie rod ends and discard.
2. Remove both castellated nuts from the outer tie rod ends.
3. Remove the steering linkage assembly.



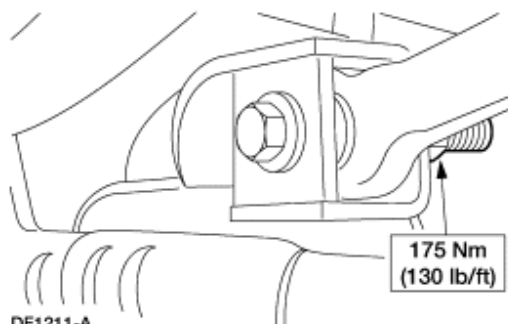
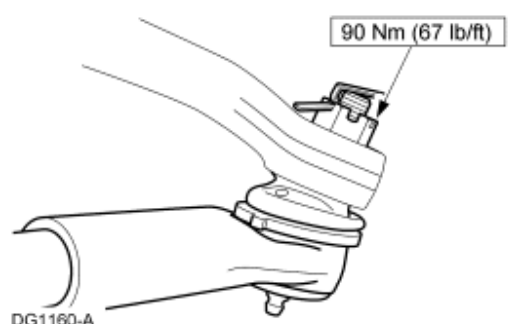
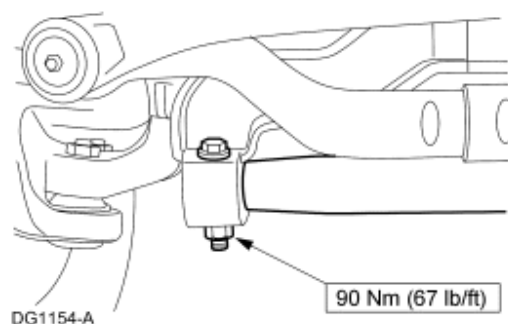
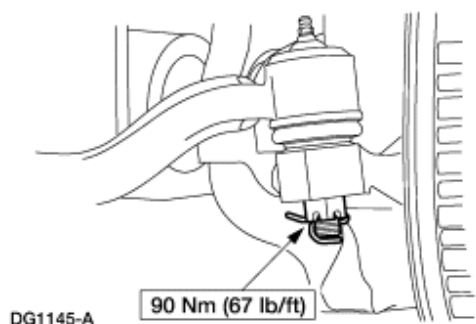
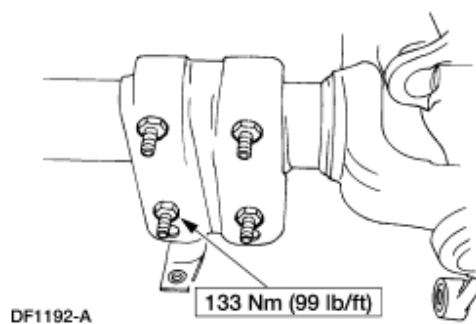
14. Remove and discard the U-bolt retaining nuts and the U-bolts.

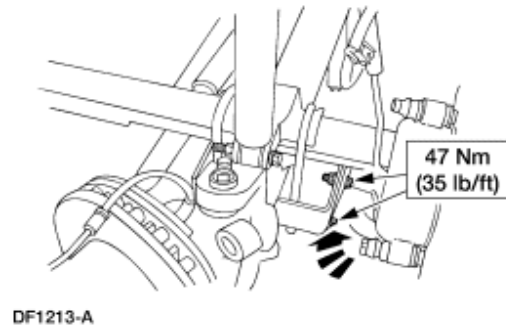
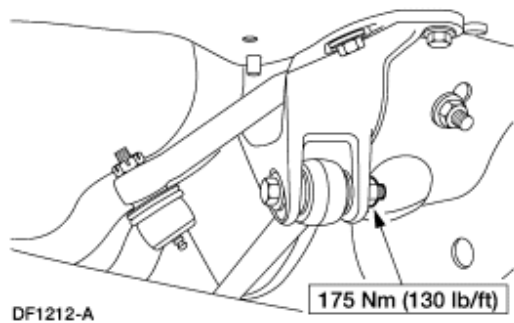
- Remove the spring spacer plates.
- Lower the jack, and remove the axle assembly.



Installation

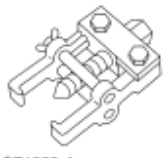
1. Using new fasteners, follow the removal procedure in reverse order.





2. Perform front end alignment. For additional information, refer to [Section 204-00](#).
-

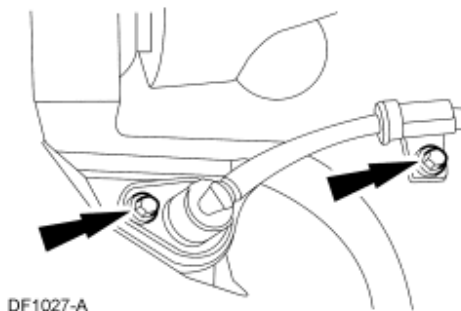
Axle—Motorhome

Special Tool(s)	
 ST1263-A	Pitman Arm Puller 211-003 (T64P-3590-F) or Equivalent

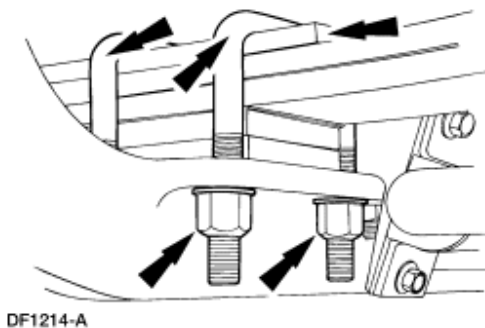
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an 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 re-assembly to ensure proper retention of these parts.

1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Remove the front wheel and tire assemblies; for additional information, refer to [Section 204-04](#).
3. Remove the front disc brake calipers and position out of the way; for additional information, refer to [Section 206-03](#).
4. If equipped, remove the ABS sensor retaining bolt and ABS sensor harness retaining bolt and position out of the way.



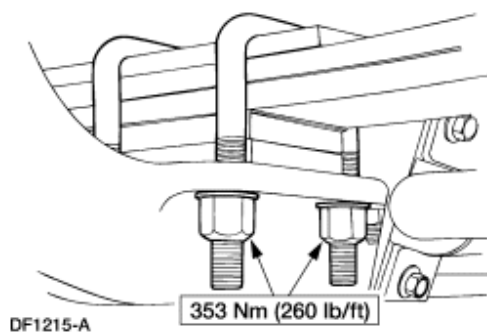
5. Using a suitable jack equipped with safety chains, support the front axle.
6. Remove the front shock absorbers; for additional information, refer to [Shock Absorber—Motorhome](#) in this section.
7. Remove the spindles; for additional information, refer to [Spindle—Motorhome](#) in this section.
8. Remove the sway bar; for additional information, refer to [Bar and Link—Motorhome](#) in this section.
9. Remove the front spring U-bolt retaining nuts and remove the U-bolts and upper spring spacer plates.

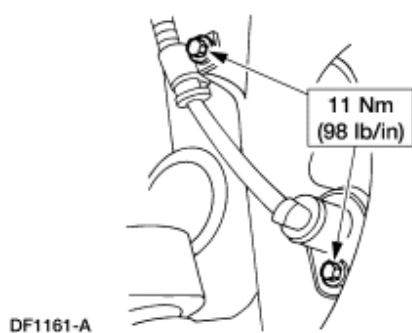


10. Lower the jack and remove the axle assembly.

Installation

1. Using new fasteners, follow the removal procedure in reverse order.





2. Perform front end alignment; for additional information, refer to [Section 204-00](#).
-

SECTION 204-01B:
Front Suspension — 4x4

[SPECIFICATIONS](#)

DESCRIPTION AND OPERATION

[Front Suspension](#)

DIAGNOSIS AND TESTING

[Front Suspension](#)

GENERAL PROCEDURES

[Ride Height](#)

[Vacuum Leak Test—Wheel End](#)

REMOVAL AND INSTALLATION

[Wheel Hub](#)

[Wheel Studs](#)

[Bar—Stabilizer](#)

[Bar—Track](#)

[Bar—Link Stabilizer](#)

[Bushing—Stabilizer Bar](#)

[Wheel Knuckle](#)

[Ball Joint—Upper](#)

[Ball Joint—Lower](#)

[Shock Absorber](#)

[Spring—Leaf](#)

[Spring—Shackle](#)

[Spring—Hanger](#)

[Vacuum Valve](#)

SPECIFICATIONS

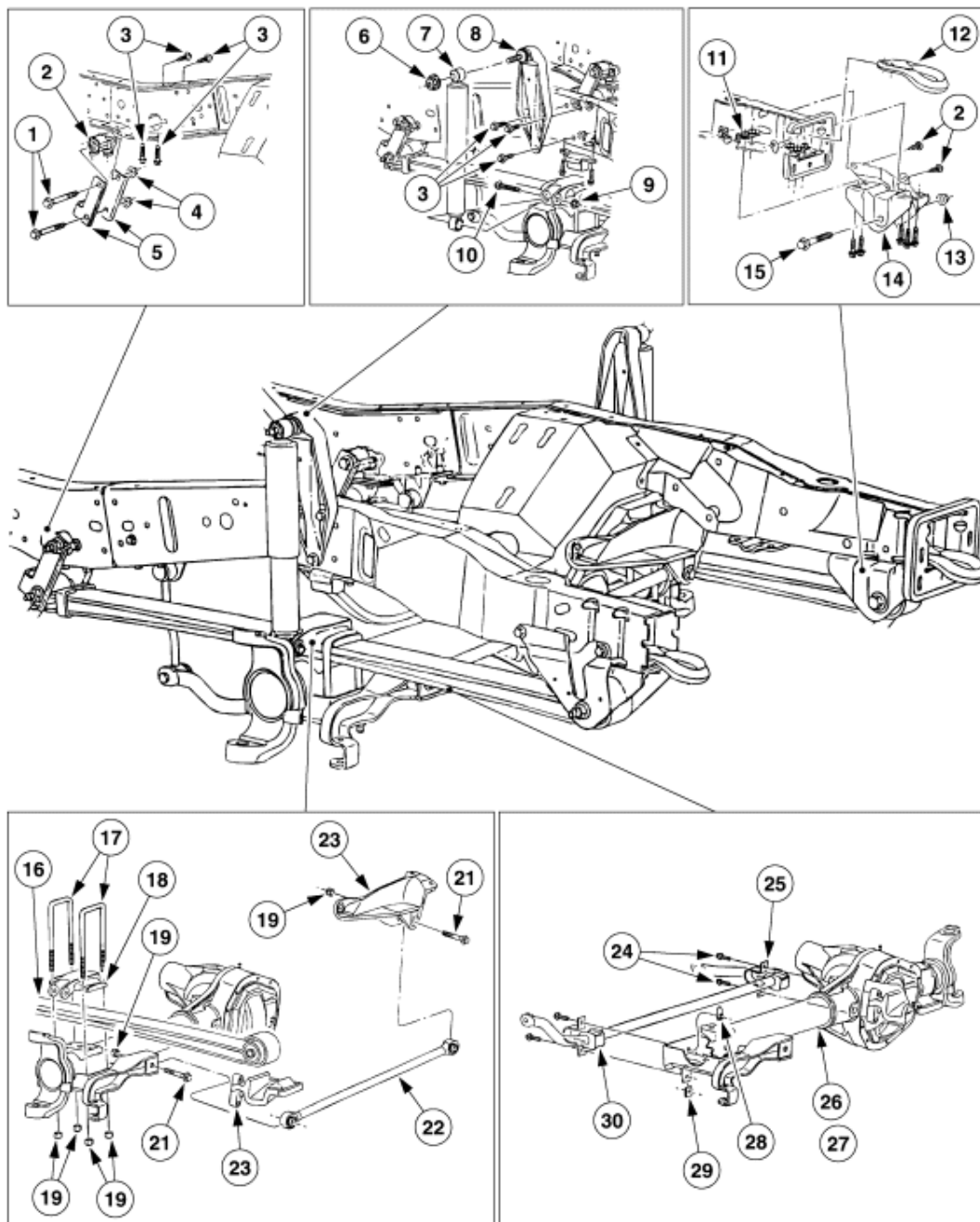
[Procedure revision date: 01/26/2000](#)

General Specifications	
Item	Specification
High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A	ESA-M1C198-A

Torque Specifications			
Description	Nm	Lb/Ft	Lb/In
Front Spring-to-Axle U-Bolts	133	99	—
Front Spring-to-Spring Hanger Nut	350	259	—
Front Spring-to-Shackle Nut	250	185	—
Spring Hanger-to-Frame Bolts	103	76	—
Spring Shackle-to-Frame Nut	250	185	—
Stabilizer Bar-to-Front Spring Spacer Bolts (LH Side Only)	47	35	—
Stabilizer Bar-to-Axle Assembly Bracket Bolts (RH Side Only)	47	35	—
Stabilizer Bar-to-Link Nut	80	60	—
Stabilizer Bar Link-to-Bracket Nut	80	60	—
Front Shock-to-Upper Shock Bracket Nut	103	76	—
Front Shock-to-Front Spring Spacer Nut	103	76	—
Jounce Bumper-to-Frame Bolts	40	30	—
Shock Absorber Upper Mounting Bracket-to-Frame Bolts	103	76	—
Trackbar-to-Upper Mounting Bracket Nut	174	129	—
Trackbar-to-Lower Mounting Bracket Nut	174	129	—
Shackle Bracket Assembly-to-Frame Bolts	87	65	—
Stabilizer Bar Bracket-to-Frame Bolts	47	35	—
Front Driveshaft-to-Pinion Flange Bolts	102	76	—
Front Hub and Bearing-to-Knuckle Nuts	74	55	—
Tie Rod End-to-Front Knuckle Nut	70	52	—
Vacuum Valve Mounting Bolts	11	—	98
Lower Ball Joint Nut	136	101	—
Upper Ball Joint Nut	136	101	—

Front Suspension

Front Suspension with Dana Model 50 and Dana Model 60 Front Drive Axles



Item	Part Number	Description
1	N807147-S426	Bolt, M16 x 2 x 143 x 10.9
2	5335	Bracket Assy
3	N811403-S426	Bolt, M12 x 1.75 x 40 x 10.9
4	N800237-S426	Flag Nut, M1.6 x 2 x 20 x 10
5	5B311	Spring Shackle
6	N806085-S426	Nut and Washer, M12 x 1.75
7	18045	Shock Assy
8	18035	Upper Shock Bracket
9	N800937-S426	Flag Nut
10	N805845-S426	Bolt, M12 x 1.75 x 80 x 10.9
11	N811631-S426	Nut, M12 x 1.75 x 13 x 10
12	—	Tow Hook
13	N807659-S426	Flag Nut
14	5341	Spring Hanger
15	W704660-S426	Bolt, M18 x 2.5 x 136 x 10.9
16	5310	Spring Assy
17	N801485-S428	U-Bolt, M14 x 2 x 92 x 201
18	5458	Spacer
19	N805480-S426	Flag Nut
20	3A094	Trackbar Bracket
21	N803960-S426	Bolt, M14 x 2 x 90 x 10.9
22	3B239	Trackbar
23	5A316	Spring Cap
24	N605803-S426	Bolt, M10 x 1.5 x 40 x 9.8
25	3B353	Stabilizer Bar Retainer Bracket
26	—	Drive Axle, Dana Model 50
27	—	Drive Axle, Dana Model 60
28	N807164-S426	Flag Nut
29	N801673-S426	U-Nut
30	5484	Stabilizer Bar Insulator


Front Suspension

Refer to [Section 204-00](#) or [Section 100-04](#).

Ride Height

For additional information, refer to [Section 204-00](#).

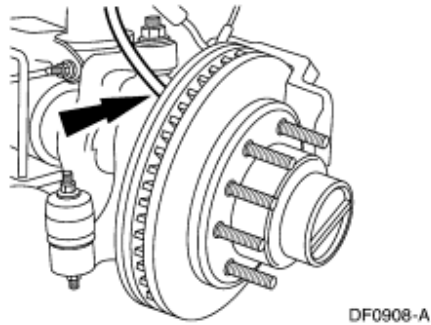
Vacuum Leak Test—Wheel End

	Special Tool(s)
	Vacuum Tester 416-D002 (D95L-7559-A) or Equivalent

1. **NOTE:** Whenever the front wheel hub, axle shaft or the hub lock is removed and installed, the front wheel-end assemblies must be leak-checked to ensure that the sealing

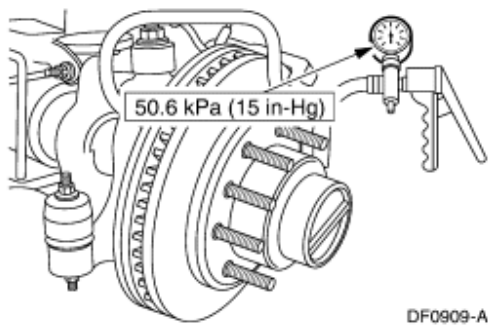
surfaces are intact. Failure to do so can cause the loss of four-wheel drive operation and contamination of the vacuum system.

Disconnect the wheel-end vacuum hose.



2. Connect the hand vacuum pump (part of Vacuum Tester) to the vacuum fitting on the wheel knuckle.
3. **NOTE:** The wheel-end assembly must not leak more than 0.50 in-Hg in 30 seconds. If the wheel-end leak rate exceeds the specification, refer to [Section 308-07A](#) under Diagnosis and Testing.

Apply 15 in-Hg of vacuum to the wheel-end assembly and observe the reading for 30 seconds.



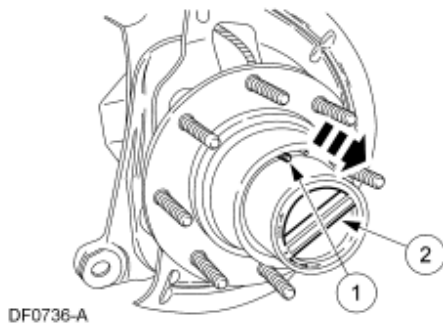
4. Repeat the leak testing procedure for the opposite wheel-end.
-

Wheel Hub

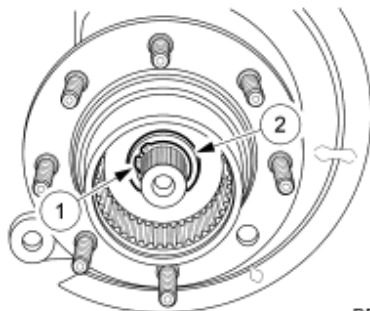
Removal

All vehicles


1. Remove the front brake disc. For additional information, refer to [Section 206-03](#).
2. Remove the hub lock.
 1. Remove the retainer ring.
 2. Pull outward and remove the hub lock.



3. Remove the axle shaft thrust washers.
 1. Remove the snap ring.
 2. Remove the three thrust washers.

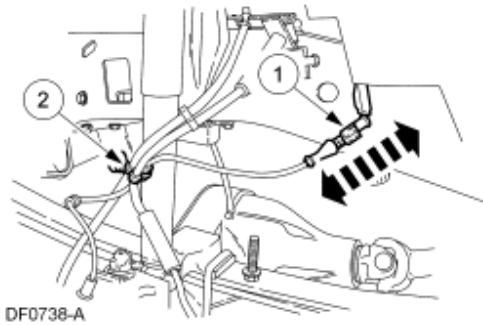


Vehicles equipped with ABS

4.  **CAUTION: Do not remove the ABS sensor from the bearing.**

Disconnect the ABS wheel sensor harness.

1. Disconnect the connector.
2. Disconnect the harness routing clips.

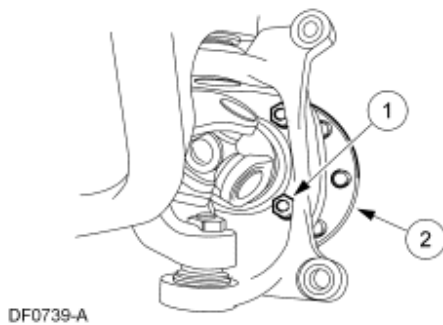


All vehicles

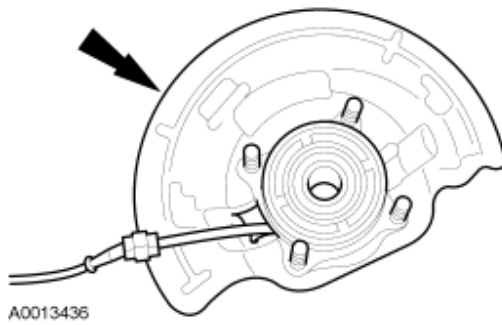
5. **NOTE:** The wheel hub and bearing is a slip fit design and should not require a puller to remove it.

Remove the wheel hub and bearing.

1. Remove the four lock nuts.
2. Remove the wheel hub and bearing.

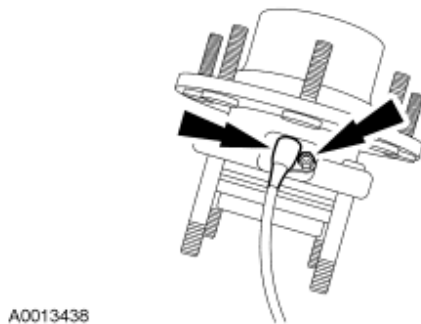


6. Remove the brake disc shield.



Vehicles with ABS

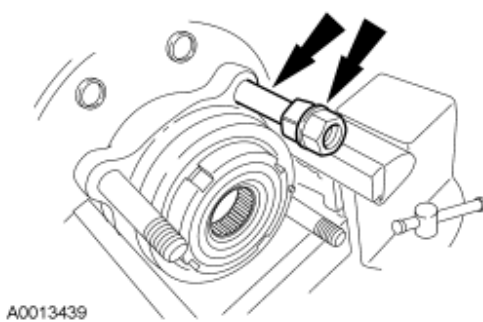
7. Remove the bolt and the ABS sensor.



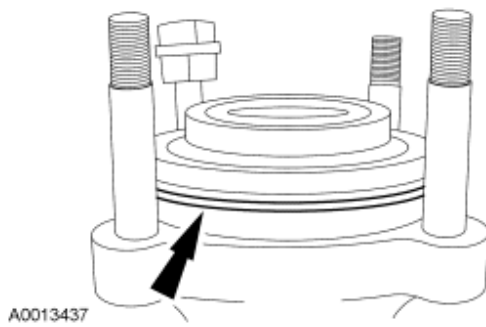
All vehicles

8. **NOTE:** Position the hub in a soft-jawed vise.

Install two nuts on the studs and use the inner nut to remove the studs.



9. Remove and discard the O-ring.

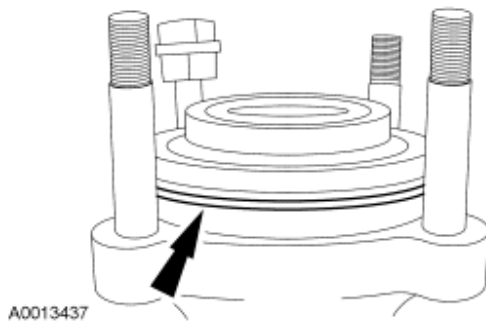


Installation

All vehicles

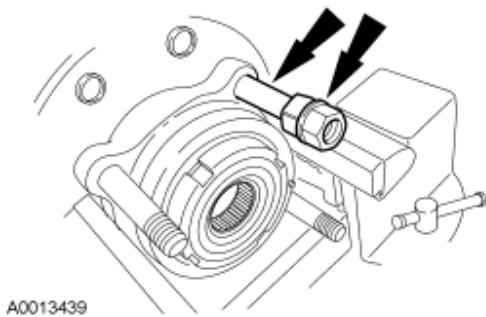
1. **NOTE:** Any time the wheel hub is removed for any reason, a new O-ring seal must be installed. Failure to do so can cause a vacuum leak and loss of four wheel drive operations.

Install a new O-ring.



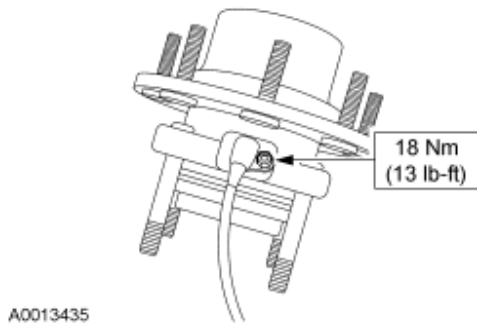
2. **NOTE:** Position the hub in a soft-jawed vise.

Install two nuts on the studs and use the outer nut to install the studs.



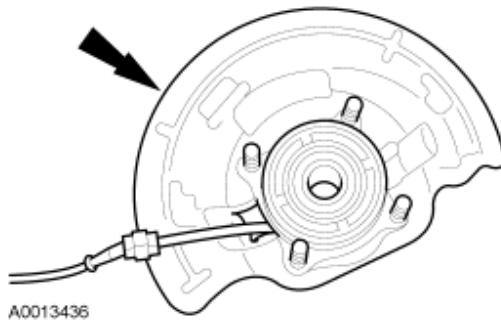
Vehicles equipped with ABS

3. Position the ABS sensor and install the bolt.



All vehicles

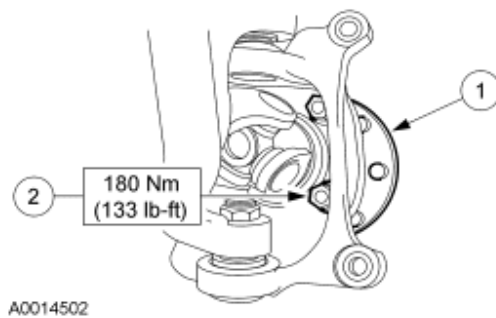
4. Position the brake disc shield.



5. **NOTE:** Apply a coat of Ford High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A meeting Ford specification ESA-M1C198-A to the O-ring area of the wheel hub and bearing before installing the hub and bearing.

Install the wheel hub and bearing.

1. Position the wheel hub and bearing.
2. Install the four lock nuts.

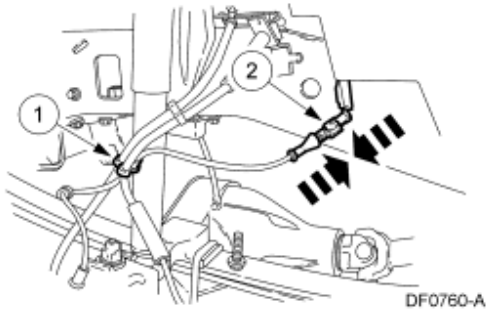


Vehicle equipped with ABS

6. **NOTE:** The following step applies only to vehicles equipped with ABS.

Connect the ABS sensor harness.

1. Position the ABS sensor harness and install the routing clips.
2. Connect the harness connector.

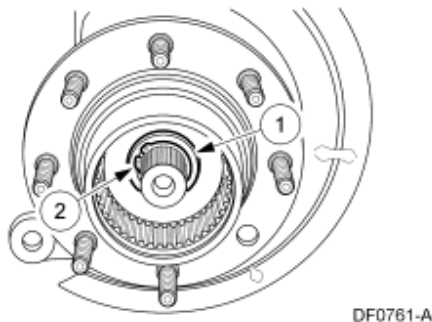


All vehicles

7. **⚠ CAUTION:** The non-metallic thrust washer must be installed between the two metal thrust washers. Failure to do so will cause severe wear to the non-metallic thrust washer, allowing the axle shaft to travel further in and out during torque thrust causing damage to the wheel hub and bearing, the axle shaft end seal and the axle shaft.

Install the snap ring.

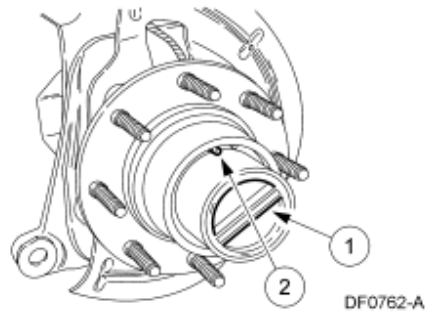
1. Position the three thrust washers onto the axle shaft.
2. Install the snap ring.



8. **NOTE:** Any time the hub lock is removed, a new O-ring seal must be installed. Failure to do so can cause a vacuum leak and loss of four wheel drive functions.

Install a new O-ring.

9. Install the hub lock.
 1. Position the hub lock.
 2. Install the retainer ring.



10. Install the brake disc. For additional information, refer to [Section 206-03](#).
 11. Perform the wheel-end vacuum leak test. For additional information, refer to [Section 308-07A](#).
-

Wheel Studs

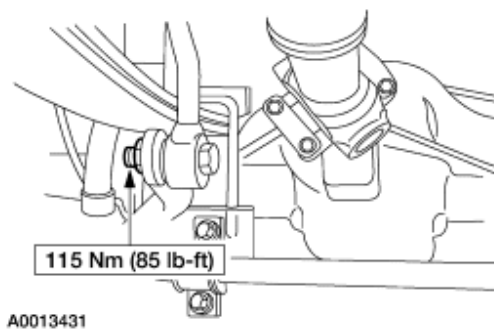
For additional information, refer to [Section 204-01A](#).

Bar—Stabilizer

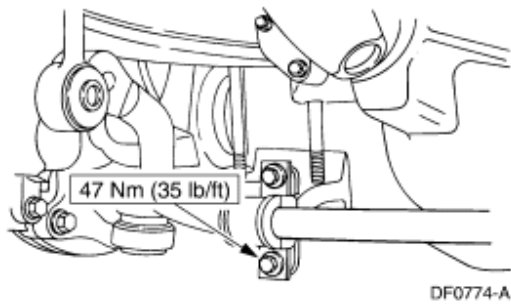
Removal and Installation

1. **NOTE:** Both the left and right sides of the stabilizer bar are removed and installed the same way. Only the left side is shown.

Remove the nut, washer, and bolt, and disconnect the stabilizer bar link.



2. Remove the bolts and the stabilizer bar.



3. To install, reverse the removal procedure.

SECTION 204-01B: Front Suspension —
4x4
REMOVAL AND INSTALLATION

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)

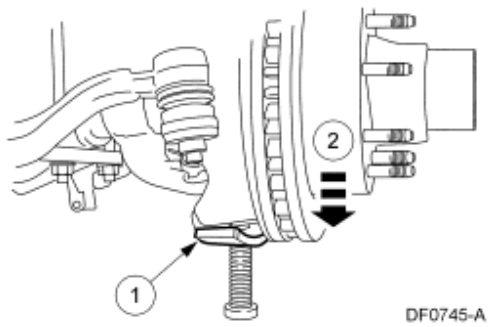
Bar—Track

Removal

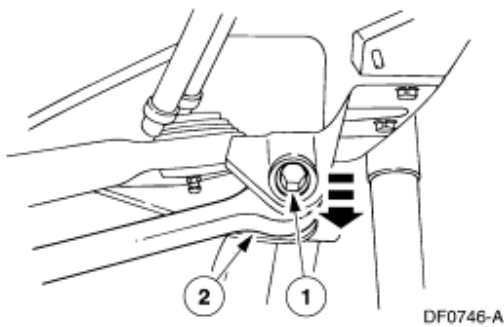
1. Raise and support the vehicle; refer to [Section 100-02](#).
2. **NOTE:** To prevent the front suspension from shifting when the trackbar is removed, the front suspension must be supporting the vehicle's weight.

Load the front suspension with the vehicle's weight.

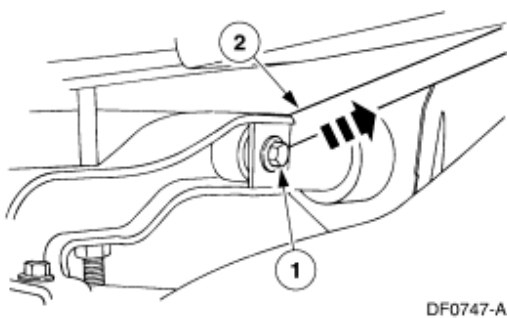
1. Position jack stands under the front axle housing.
2. Lower the vehicle until the front suspension is supporting the vehicle's weight.



3. Disconnect the trackbar from the upper mounting bracket.
 1. Remove the nut and bolt.
 2. Remove the trackbar from the bracket.

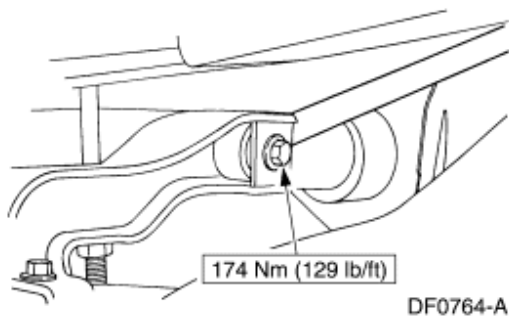
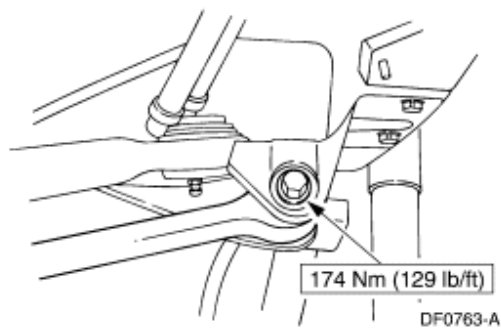


4. Remove the trackbar from the lower mounting bracket.
 1. Remove the nut and bolt.
 2. Remove the trackbar.



Installation

1. Follow the removal procedure in reverse order.



SECTION 204-01B: Front Suspension —
4x4
REMOVAL AND INSTALLATION

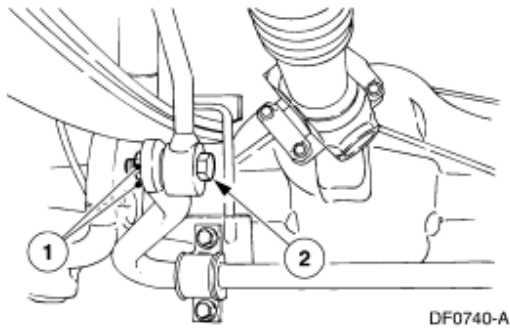
1999 F-Super Duty 250-550 Workshop
Manual

[Procedure revision date: 01/26/2000](#)

Bar—Link Stabilizer

Removal

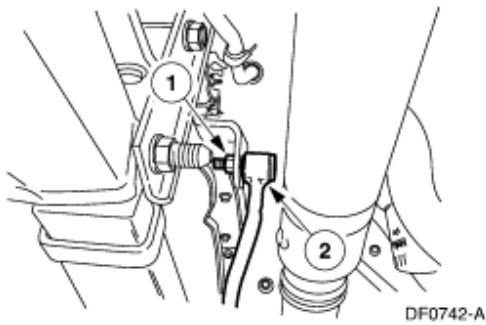
1. Disconnect the stabilizer bar link from the stabilizer bar.
 1. Remove the nut and washer.
 2. Remove the bolt.



2. **NOTE:** The following step is for the left hand stabilizer bar link only.

Remove the stabilizer bar link.

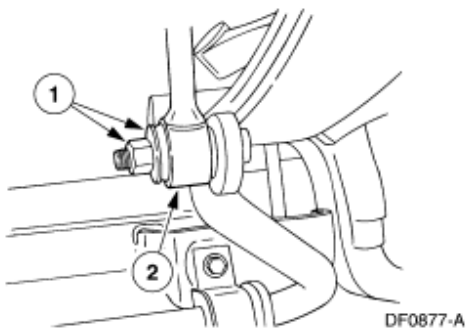
1. Remove the nut.
2. Remove the stabilizer bar link.



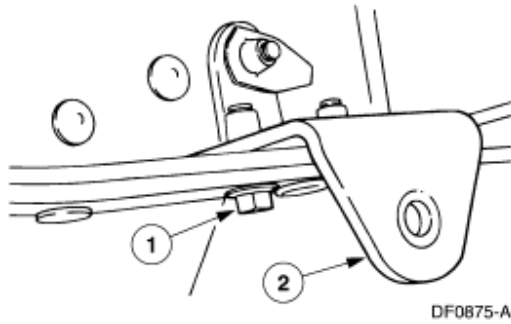
3. **NOTE:** The following step is for the right hand stabilizer bar link only.

Remove the stabilizer bar link.

1. Remove the nut and washer.
2. Remove the bolt and the stabilizer bar link.

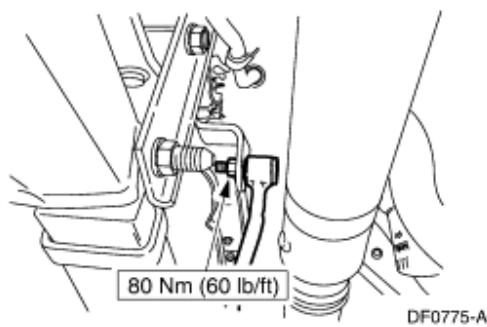
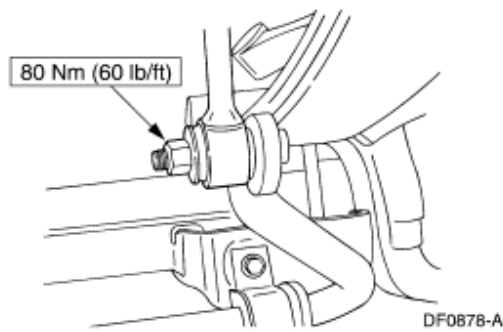
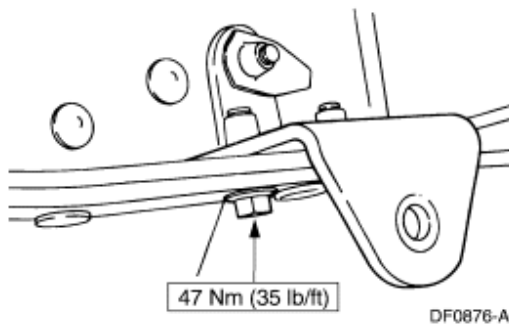


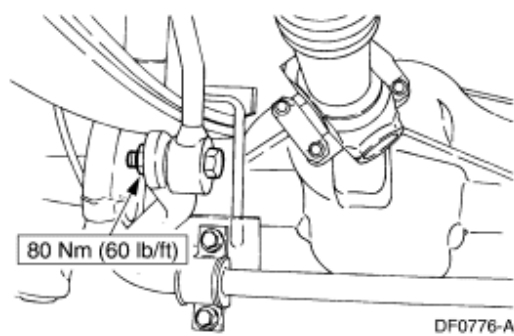
4. Remove the stabilizer bar link bracket.
 1. Remove the three bolts and flag nuts.
 2. Remove the stabilizer bar link bracket.



Installation

1. Follow the removal procedure in reverse order.



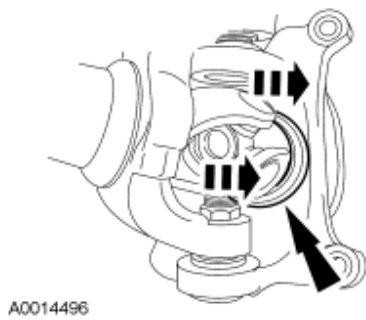


Wheel Knuckle

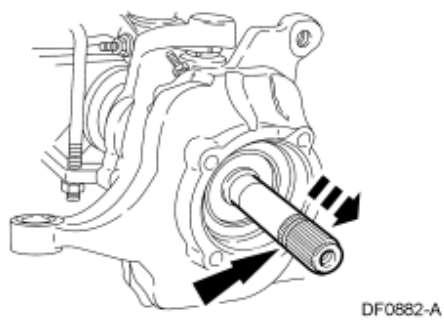
Special Tool(s)	
 ST1263-A	Steering Arm Remover 211-003 (T64P-3590-F)
 ST2216-A	Driver 205-199 (T83T-3132-A1)
 ST2217-A	Knuckle Seal Installer 205-429

Removal

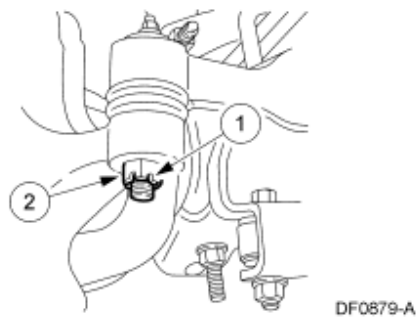
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Remove the front brake disc. For additional information, refer to [Section 206-03](#).
4. Remove the wheel hub and bearing. For additional information, refer to [Wheel Hub](#) in this section.
5. Using a drift, drive the axle shaft main seal out of the wheel knuckle.



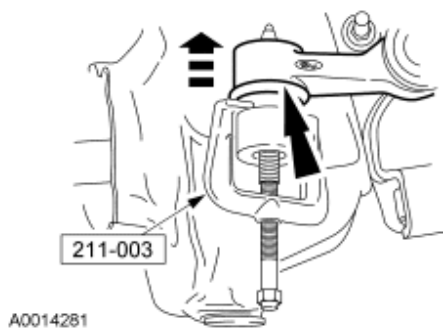
6. Remove the axle shaft and main seal.



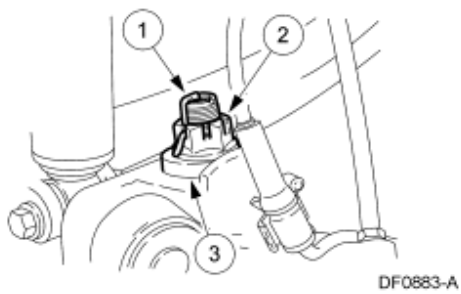
7. Remove the tie-rod end castellated nut.
 1. Remove the cotter pin.
 2. Remove the castellated nut.



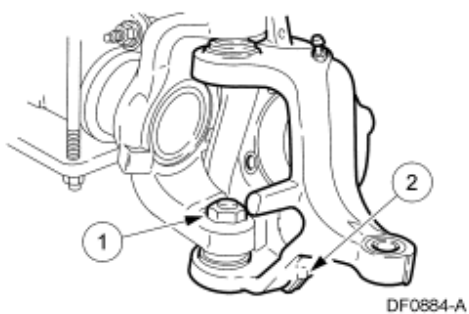
8. Using the special tool, disconnect the tie-rod end from the wheel knuckle.



9. Remove the upper ball joint castellated nut and the insert.
 1. Remove the cotter pin.
 2. Remove the nut.
 3. Remove the insert.



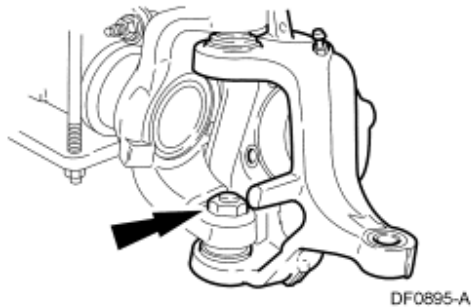
10. Remove the wheel knuckle.
 1. Remove the lower ball joint nut.
 2. Remove the knuckle.



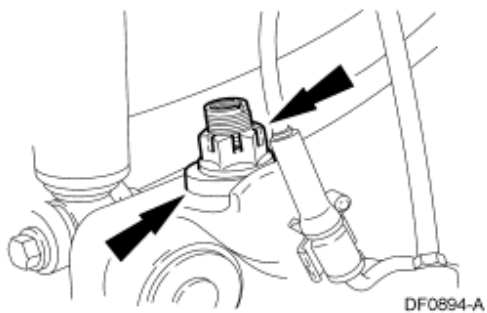
11. Clean and inspect the wheel knuckle ball joint bores.

Installation

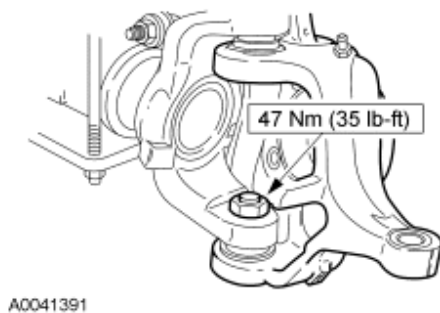
1. Position the wheel knuckle onto the axle housing.
2. Install the nut onto the lower ball joint. Do not tighten the nut at this time.



3. Install the insert and the castellated nut onto the upper ball joint. Do not tighten the nut at this time.



4. Tighten the lower ball joint retaining nut. Pre-tighten the nut to 47 Nm (35 lb-ft).

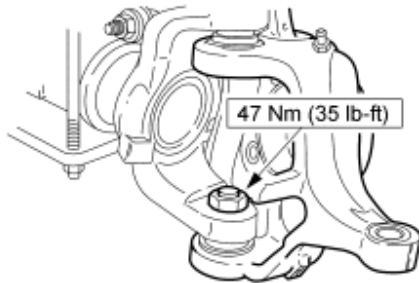


5. **NOTE:** Do not loosen the castellated nut to install the cotter pin.

Install the cotter pin into the upper ball joint.

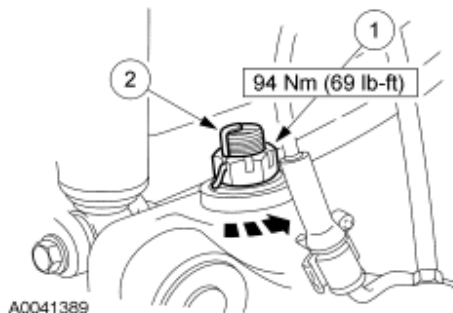
1. Tighten the upper ball joint castellated nut.

2. Install the cotter pin. If necessary, tighten the castellated nut until the cotter pin can be installed.



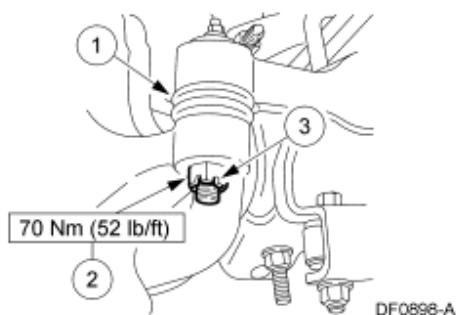
A0041391

6. Tighten the lower ball joint nut to 204 Nm (150 lb-ft).



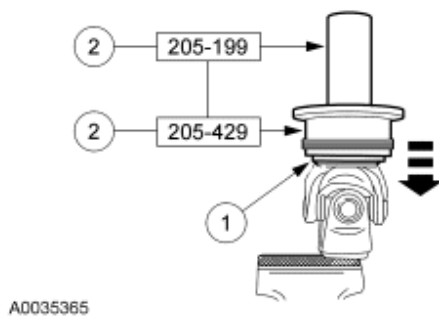
A0041389

7. Install the tie-rod end onto the wheel knuckle.
 1. Position the tie-rod end into the wheel knuckle.
 2. Install and tighten the castellated nut.
 3. Install the cotter pin.

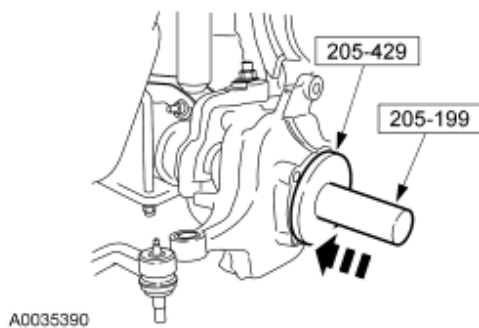


DF0898-A

8. Install the new main seal onto the axle shaft.
 1. Position the main seal onto the axle shaft.
 2. Using the special tools and a hammer, seat the main seal onto the axle shaft.



9. Position the axle shaft into the axle housing.
10. Using the special tools and a hammer, install the main seal into the wheel knuckle.



11. Install the wheel hub and bearing. For additional information, refer to [Wheel Hub](#) in this section.
 12. Install the front brake disc. For additional information, refer to [Section 206-03](#).
 13. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
-

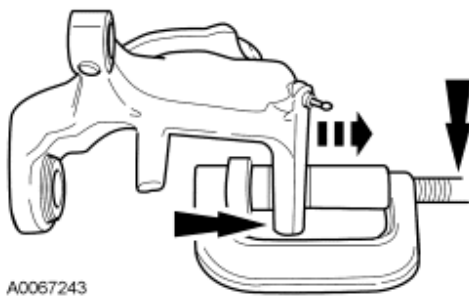
Ball Joint—Upper

Removal

1. Remove the wheel knuckle. For additional information, refer to [Wheel Knuckle](#) in this section.
2. Place the wheel knuckle into a suitable vise.
3. **NOTE:** Always remove the lower ball joint first.

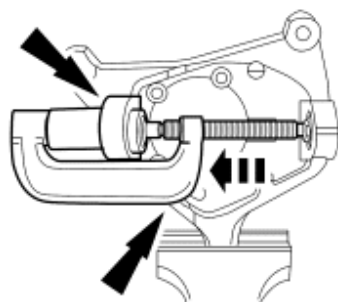
Remove the lower ball joint. For additional information, refer to [Ball Joint—Lower](#) in this section.

4. Using a suitable ball joint press, remove the ball joint.



Installation

1. Clean the wheel knuckle ball joint bores.
2. Using a suitable ball joint press, install the ball joint.



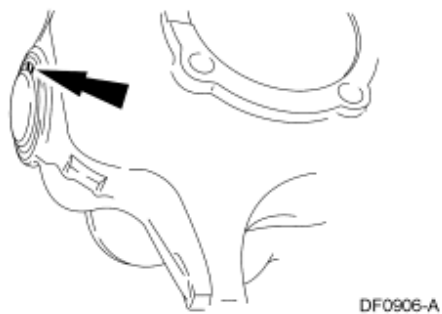
A0067242

3. Install the lower ball joint. For additional information, refer to [Ball Joint—Lower](#) in this section.
 4. Install the wheel knuckle. For additional information, refer to [Wheel Knuckle](#) in this section.
-

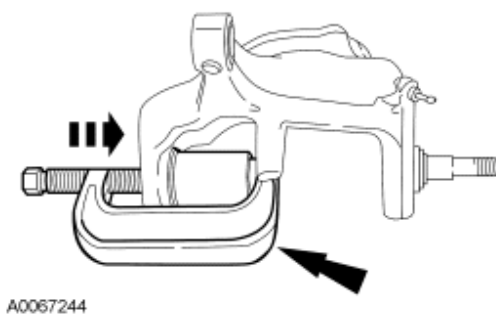
Ball Joint—Lower

Removal

1. Remove the wheel knuckle. For additional information, refer to [Wheel Knuckle](#) in this section.
2. Place the wheel knuckle into a suitable vise.
3. Remove the snap ring.

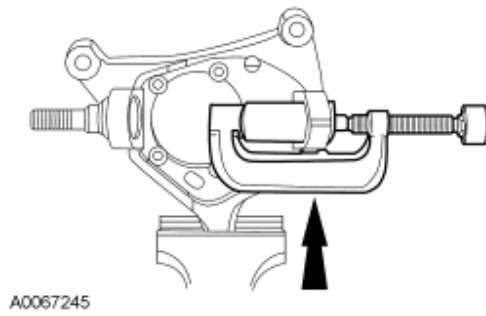


4. Using a suitable ball joint press, remove the ball joint.

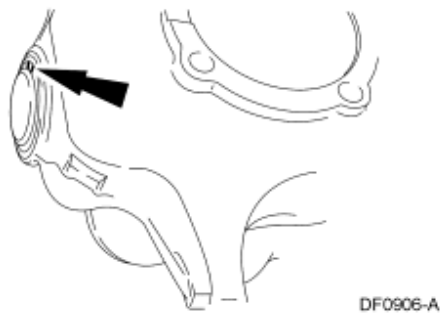


Installation

1. Clean the wheel knuckle ball joint bore.
2. Using a suitable ball joint press, install the ball joint.



3. Install the snap ring.



4. Install the wheel knuckle. For additional information, refer to [Wheel Knuckle](#) in this section.
-

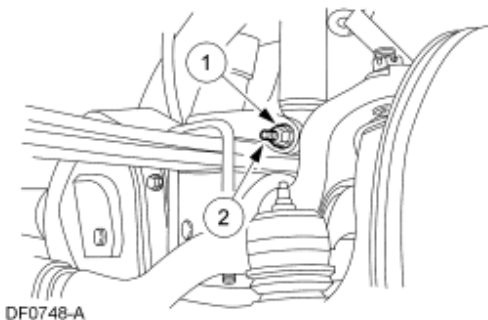
Shock Absorber

Removal and Installation

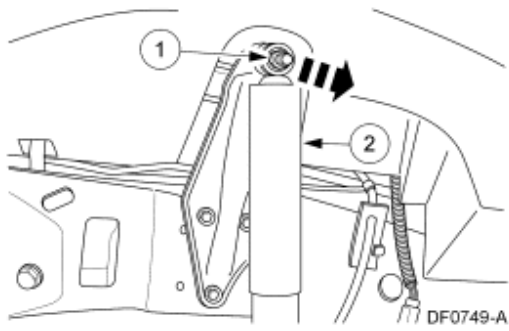
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. **NOTE:** Both the left and right side shock absorbers are removed and installed the same way. Only the left side is shown.

Disconnect the shock absorber lower mount.

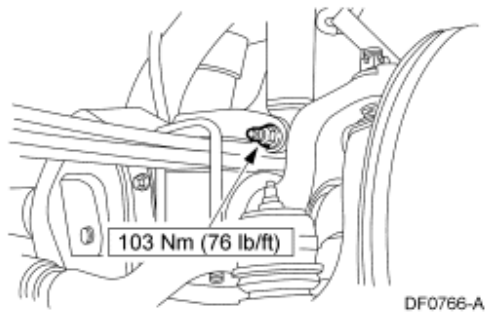
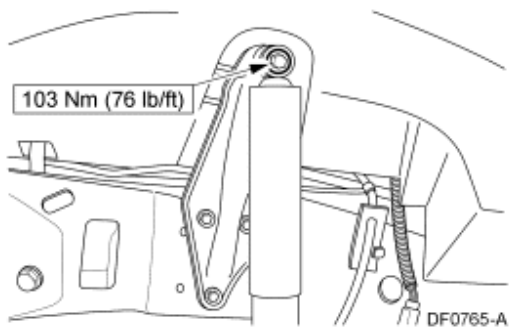
1. Remove the nut.
2. Remove the bolt.



4. Disconnect the shock absorber upper mount.
 1. Remove the nut.
 2. Pull the shock absorber away from the mounting stud.



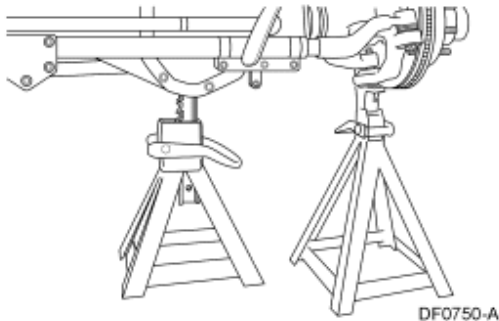
5. To install, reverse the removal procedure.



Spring—Leaf

Removal

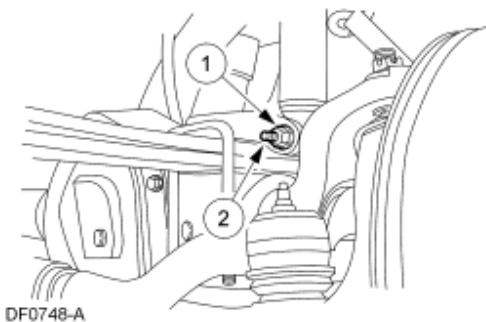
1. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
2. Position jack stands under the axle housing.




3. **NOTE:** The following step is for the left-hand shock only.

Remove the shock.

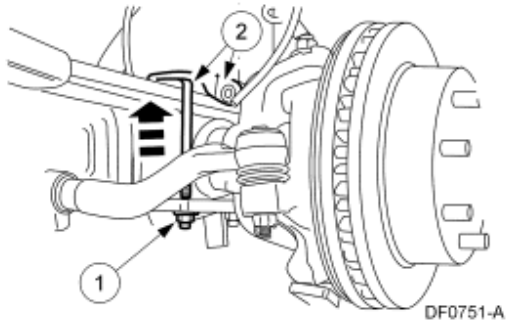
1. Remove the nut and bolt.
2. Remove the shock from the front spring cap.



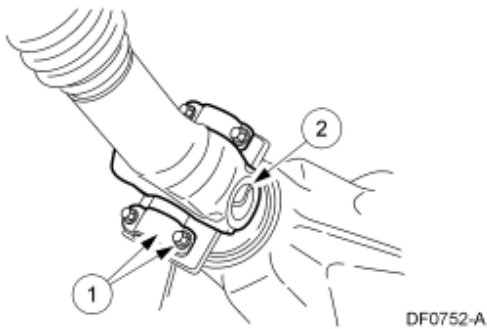
4.  **CAUTION:** Never reuse U-bolts. The U-bolts are a torque-to-yield design and cannot be retightened. Failure to use a new U-bolt can result in loose or broken springs and suspension components.

Remove the U-bolts.

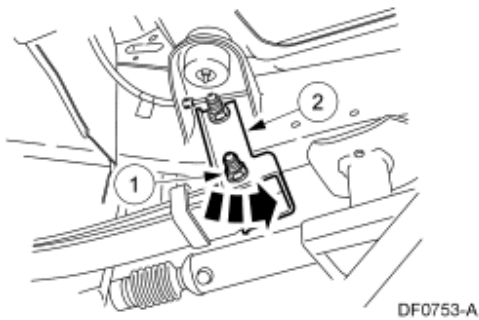
1. Remove the four nuts.
2. Remove the two U-bolts and the front spring spacer. Discard the U-bolts.



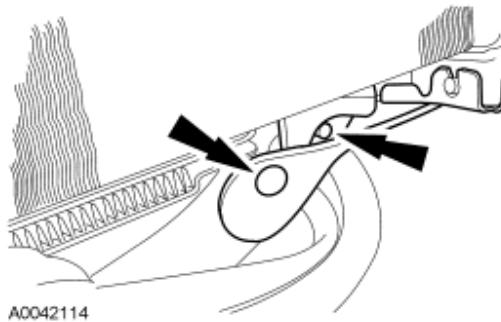
5. Disconnect the front driveshaft.
 1. Remove the four bolts and the two straps.
 2. Remove the driveshaft from the pinion flange.



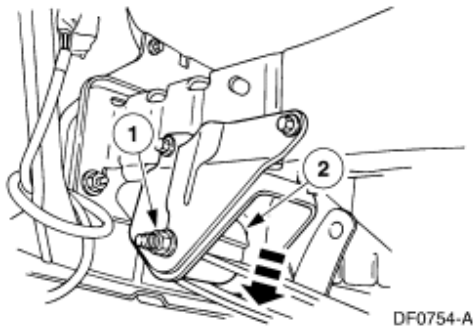
6. Disconnect the spring shackle.
 1. Remove the nut and bolt.
 2. Position the spring shackle away from the spring.



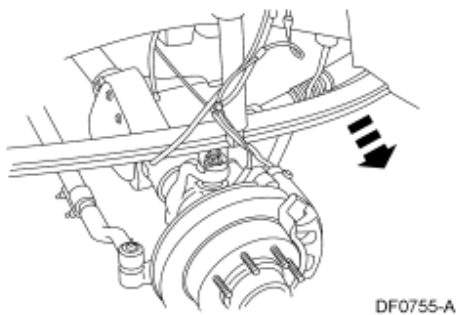
7. Detach the pushpin and remove the bolt and condenser bracket.



8. Disconnect the spring hanger.
 1. Remove the nut and bolt.
 2. Using a hammer, tap the spring until the spring is free from the hanger bracket.



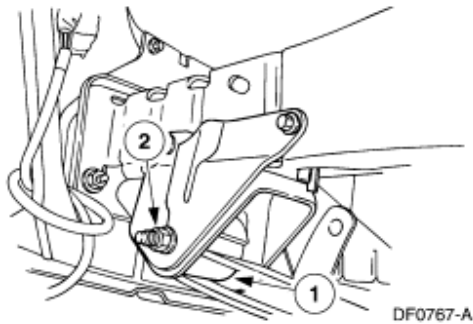
9. Remove the spring from the vehicle.



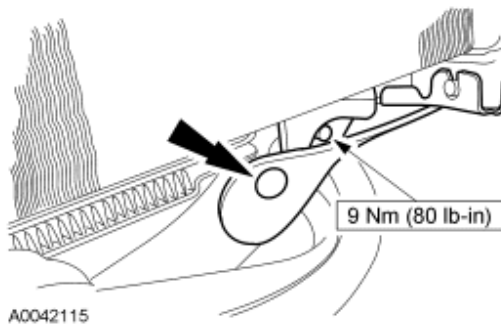
Installation

1. Position the spring in the vehicle.
2. Install the spring into the spring hanger.
 1. Position the spring into the hanger.

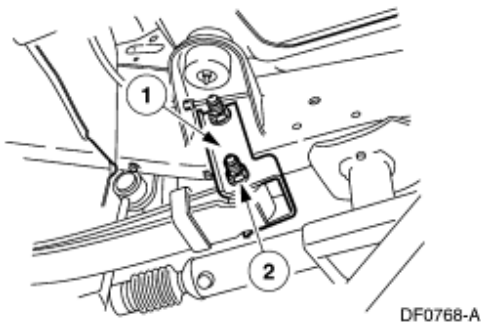
2. Install the bolt and nut. Do not tighten the nut and bolt at this time.



3. Install the bracket and bolt and the pushpin.



4. Install the spring into the spring shackle.
 1. Position the shackle.
 2. Install the bolt and nut. Do not tighten the nut and bolt at this time.

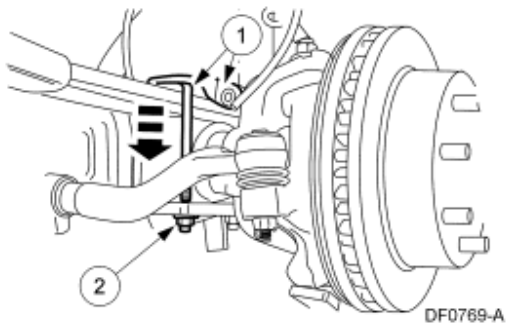


5. **NOTE:** The U-bolts insert through the front spring cap on the left-hand side and through the axle assembly bracket on the right-hand side.

Install the upper front spring spacer and U-bolts.

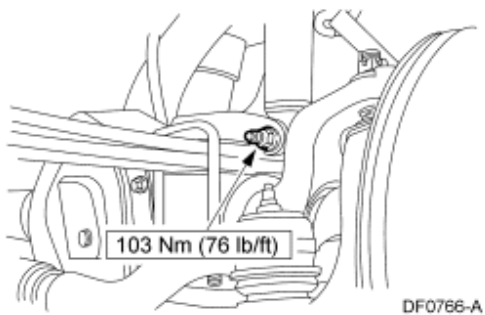
1. Position the front spring spacer and the new U-bolts.

2. Install the four nuts. Do not tighten the nuts at this time.



6. **NOTE:** The following step is for the left-hand shock only. The right-hand shock is similar.

Install the shock, bolt and nut onto the spring cap.

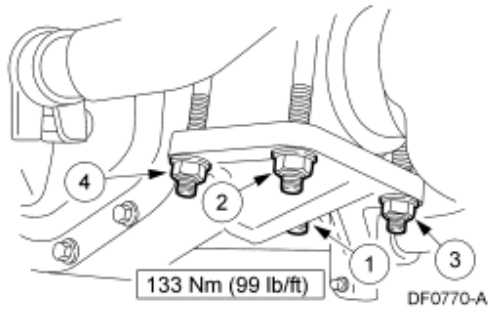


7. **NOTE:** The suspension must be loaded with the weight of the vehicle before the U-bolts and the leaf spring mounting bolts can be tightened. Make sure that the locating pin is correctly aligned with the axle.

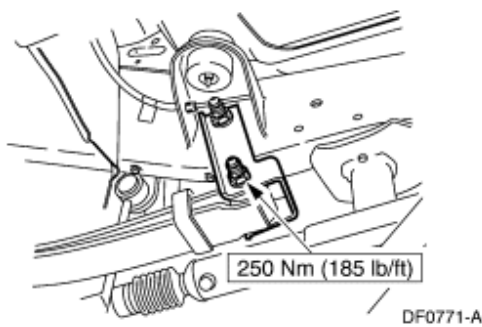
Lower the vehicle onto the jack stands until the front suspension is supporting the weight of the vehicle.

8. **NOTE:** The U-bolts must be tightened in a criss-cross sequence. This will tighten the U-bolts evenly.

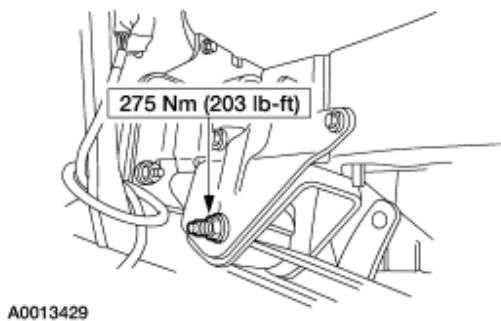
Tighten the U-bolts following the sequence.



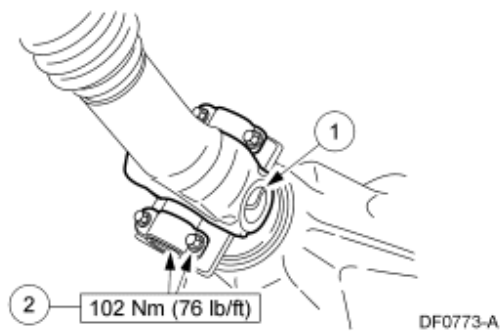
9. Tighten the leaf spring rear retaining bolt and nut.



10. Tighten the leaf spring front retaining bolt and nut.



11. Raise the vehicle and remove the jack stands.
12. Install the front driveshaft.
 1. Position the driveshaft onto the pinion flange.
 2. Install the two straps and the four bolts.



13. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).

SECTION 204-01B: Front Suspension —
4x4
REMOVAL AND INSTALLATION

1999 F-Super Duty 250-550 Workshop
Manual
[Procedure revision date: 01/26/2000](#)

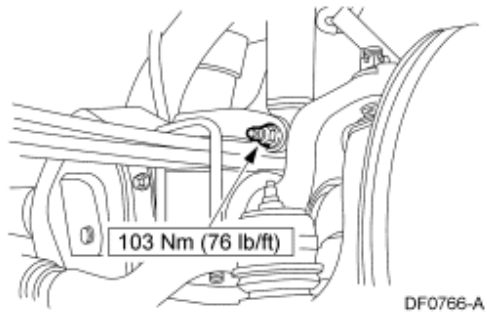
Spring—Shackle

Removal and Installation

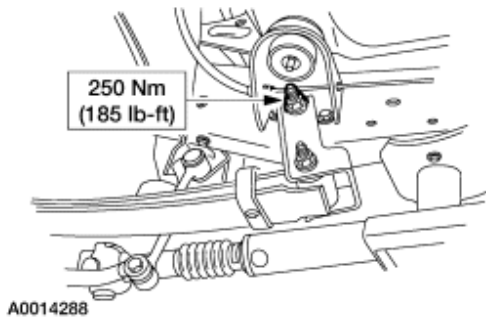
1. **NOTE:** Both the left side and right side spring shackles are removed and installed the same way. Only the left side is shown.

Raise and support the vehicle; refer to [Section 100-02](#).

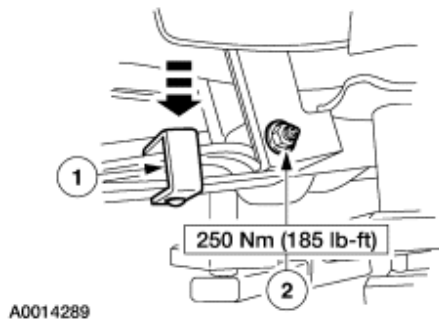
2. Remove the wheel and tire assembly; refer to [Section 204-04](#).
3. Place a suitable jack under the front drive axle housing.
4. Remove the nut and bolt, and disconnect the shock absorber from the spring cap.



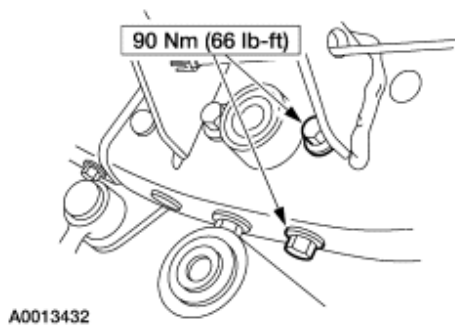
5. Remove the nut and bolt.



6. Remove the spring shackle from the leaf spring.
 1. Lower the jack until the nut and bolt can be removed.
 2. Remove the nut, bolt and the spring shackle.



7. Remove the bolts and the shackle bracket.



8. **NOTE:** The spring shackle retaining nuts and bolts must be tightened with the suspension supporting the weight of the vehicle.

To install, reverse the removal procedure.

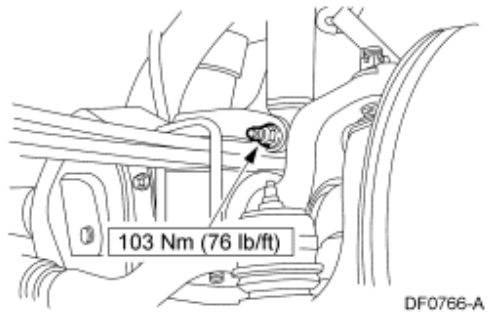
Spring—Hanger

Removal and Installation

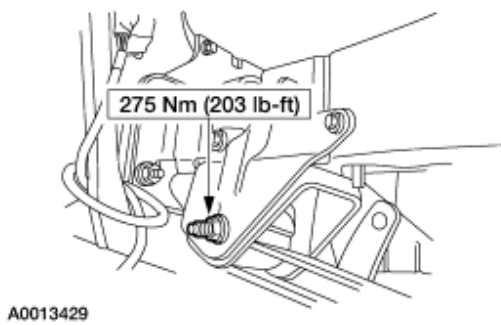
1. **NOTE:** Both the left side and the right side spring hangers are removed and installed the same way. Only the left side is shown.

Raise and support the vehicle; refer to [Section 100-02](#).

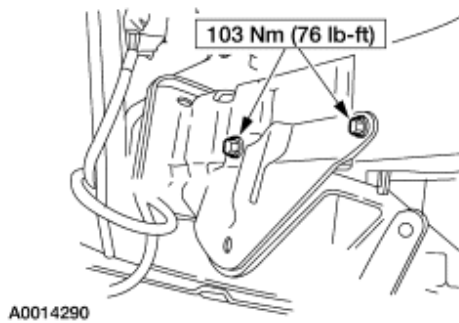
2. Remove the wheel and tire assembly; refer to [Section 204-04](#).
3. Place a suitable jack under the front drive axle housing.
4. Remove the nut and bolt, and disconnect the shock absorber from the spring cap.



5. Remove the nut and bolt, and lower the jack until the spring is out of the spring hanger.



6. Remove seven bolts and the spring hanger.

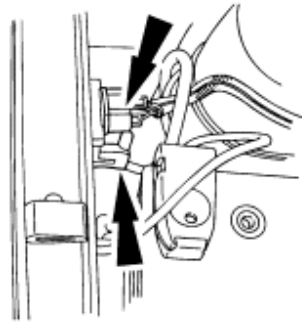


7. To install, reverse the removal procedure.
-

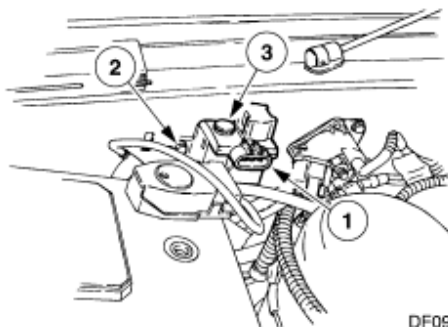
Vacuum Valve

Removal

1. Open the hood.
2. Disconnect the electrical connector and the vacuum harness.

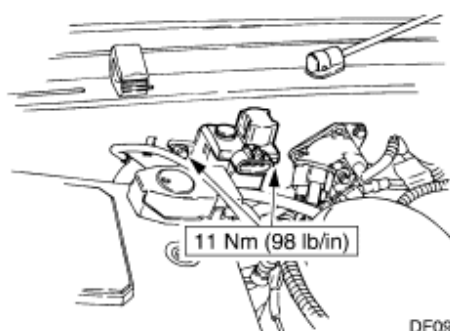


3. Remove the valve.
 1. Remove the bolt.
 2. Loosen the bolt.
 3. Remove the valve.



Installation

1. **NOTE:** The vacuum valve must be installed with the white cap facing upward.
Follow the removal procedure in reverse order.



DF0903-A

SECTION 204-02: Rear Suspension

SPECIFICATIONS

DESCRIPTION AND OPERATION

[Rear Suspension](#)

DIAGNOSIS AND TESTING

[Rear Suspension](#)

GENERAL PROCEDURES

[Wheel Bearing End Play](#)

REMOVAL AND INSTALLATION

[Hub](#)

[Wheel Studs](#)

[Bar and Link—Super Duty F-250, F-350, Ford Axle](#)

[Bar and Link—Super Duty F-350, Dana Axle](#)

[Bar and Link—Super Duty F-450, F-550, Dana Axle](#)

[Bar and Link—Super Duty Motorhome Chassis](#)

[Shock Absorber—Super Duty F-250, F-350, Ford Axle](#)

[Shock Absorber—Super Duty F-450, F-550, Dana Axle](#)

[Shock Absorber—Super Duty Motorhome Chassis](#)

[Spring—Super Duty F-250, F-350](#)

[Spring—Super Duty F-450, F-550](#)

SECTION 204-02: Rear Suspension
SPECIFICATIONS

1999 F-Super Duty 250-550 Workshop Manual

[Procedure revision date: 01/26/2000](#)

Torque Specifications — Super Duty F-250, F-350 Wide Frame		
Description	Nm	Lb/Ft
Leaf Spring-to-Axle U-Bolt Nut	250	185
Leaf Spring-to-Front Spring Hanger Bracket Nut and Bolt	250	185
Leaf Spring-to-Rear Shackle Nut and Bolt	250	185
Rear Shackle-to-Frame Mounted Bracket Nut and Bolt	250	185
Shock Absorber-to-Frame Mounted Bracket Nut	62	46
Shock Absorber-to-Axle Bracket Nut and Bolt	62	46
Shock Absorber Bracket-to-Axle U-Bolt and Nut (Ford Axle)	47	35
Stabilizer Bar Retainer Bracket-to-Axle Bolt (Dana Axle)	40	30
Stabilizer Bar Retainer Bracket-to-Axle U-Bolt and Nut (Ford Axle)	47	35
Stabilizer Bar Link-to-Frame Nut	70	52
Stabilizer Bar Link-to-Stabilizer Bar Nut	70	52

Torque Specifications — Super Duty F-350 Narrow Frame		
Description	Nm	Lb/Ft
Leaf Spring-to-Axle U-Bolt Nut	250	185
Leaf Spring-to-Front Spring Hanger Bracket Nut and Bolt	250	185
Leaf Spring-to-Rear Shackle Nut and Bolt	225	166
Rear Shackle-to-Frame Mounted Bracket Nut and Bolt	225	166
Shock Absorber-to-Frame Mounted Bracket Nut	62	46
Shock Absorber-to-Axle Bracket Nut and Bolt	62	46
Shock Absorber Bracket-to-Axle U-Bolt and Nut (Ford Axle)	47	35
Stabilizer Bar Retainer Bracket-to-Axle Bolt (Dana Axle)	40	30
Stabilizer Bar Retainer Bracket-to-Axle U-Bolt and Nut (Ford Axle)	47	35
Stabilizer Bar Link-to-Frame Nut	70	52
Stabilizer Bar Link-to-Stabilizer Bar Nut	70	52

Torque Specifications — Super Duty F-450		
Description	Nm	Lb/Ft
Leaf Spring-to-Axle U-Bolt Nut	300	222
Leaf Spring-to-Front Spring Hanger Bracket Nut and Bolt	400	295
Leaf Spring-to-Rear Shackle Nut and Bolt	250	185
Rear Shackle-to-Frame Mounted Bracket Nut and Bolt	250	185
Shock Absorber-to-Frame Mounted Bracket Nut	62	46
Shock Absorber-to-Axle Bracket Nut and Bolt	62	46
Stabilizer Bar Retainer Bracket-to-Axle Bolt	80	60
Stabilizer Bar Link-to-Frame Nut	70	52
Stabilizer Bar Link-to-Stabilizer Bar Nut	70	52

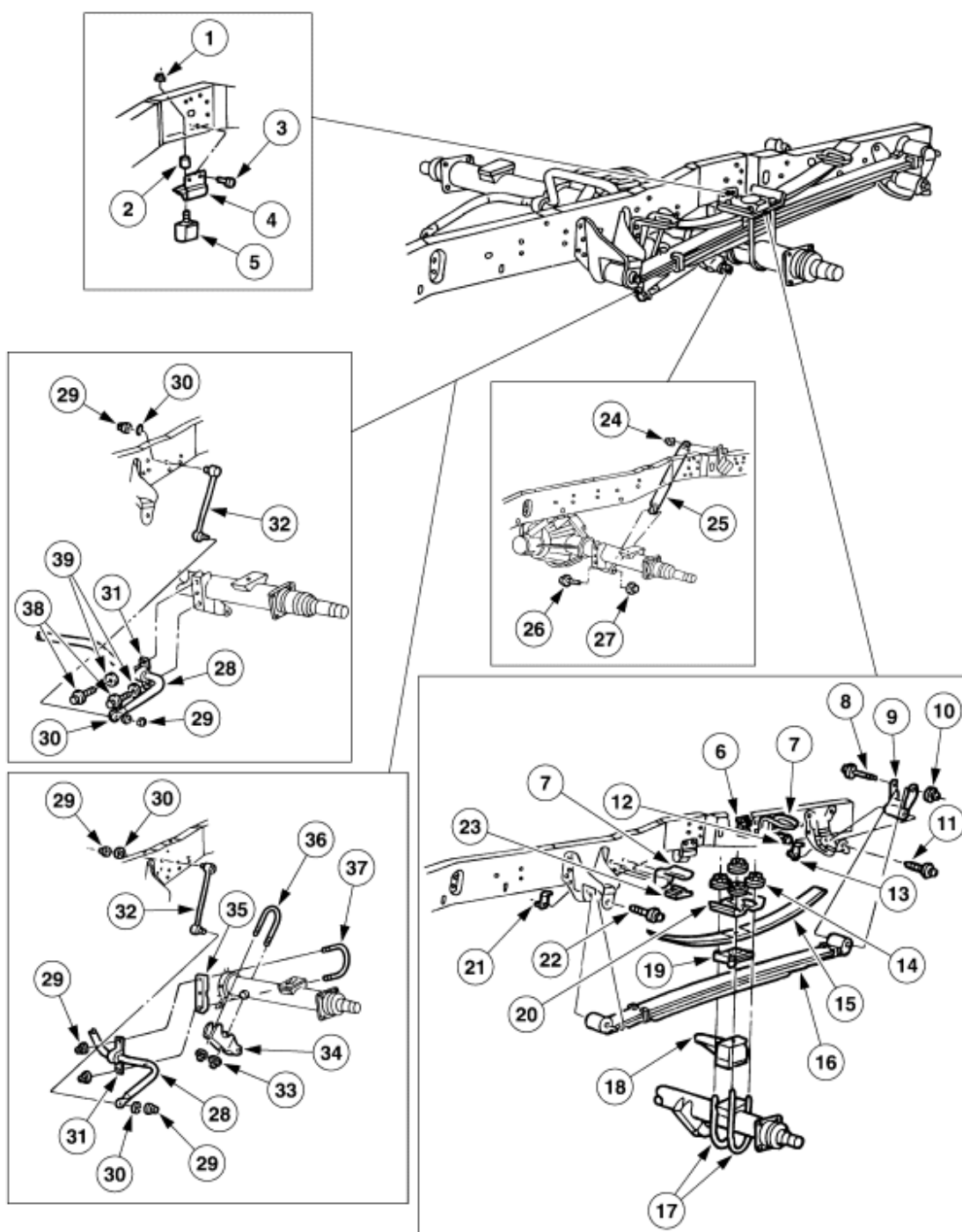
Torque Specifications — Super Duty F-550		
Description	Nm	Lb/Ft
Leaf Spring-to-Axle U-Bolt Nut	350	259
Leaf Spring-to-Front Spring Hanger Bracket Nut and Bolt	400	295
Leaf Spring-to-Rear Shackle Nut and Bolt	250	185
Rear Shackle-to-Frame Mounted Bracket Nut and Bolt	250	185
Shock Absorber-to-Frame Mounted Bracket Nut	62	46
Shock Absorber-to-Axle Bracket Nut and Bolt	62	46
Stabilizer Bar Retainer Bracket-to-Axle Bolt	80	60
Stabilizer Bar Link-to-Frame Nut	70	52
Stabilizer Bar Link-to-Stabilizer Bar Nut	70	52

Torque Specifications — Super Duty Motorhome		
Description	Nm	Lb/Ft
Leaf Spring-to-Axle U-Bolt Nut	350	259
Leaf Spring-to-Front Spring Hanger Bracket Nut and Bolt	400	295
Leaf Spring-to-Rear Shackle Nut and Bolt	250	185
Rear Shackle-to-Frame Mounted Bracket Nut and Bolt	250	185
Rear Spring Bracket-to-Frame Nut and Bolt	90	67
Shock Absorber-to-Frame Mounted Bracket Nut and Bolt	350	259
Shock Absorber-to-Axle Bracket Nut and Bolt	350	259

Stabilizer Bar Bracket Bolt-to-Axle	90	67
Stabilizer Bar Link-to-Frame Nut	90	67
Stabilizer Bar Link-to-Stabilizer Bar Nut	90	67

Rear Suspension

Super Duty F-250, F-350 Wide Frame



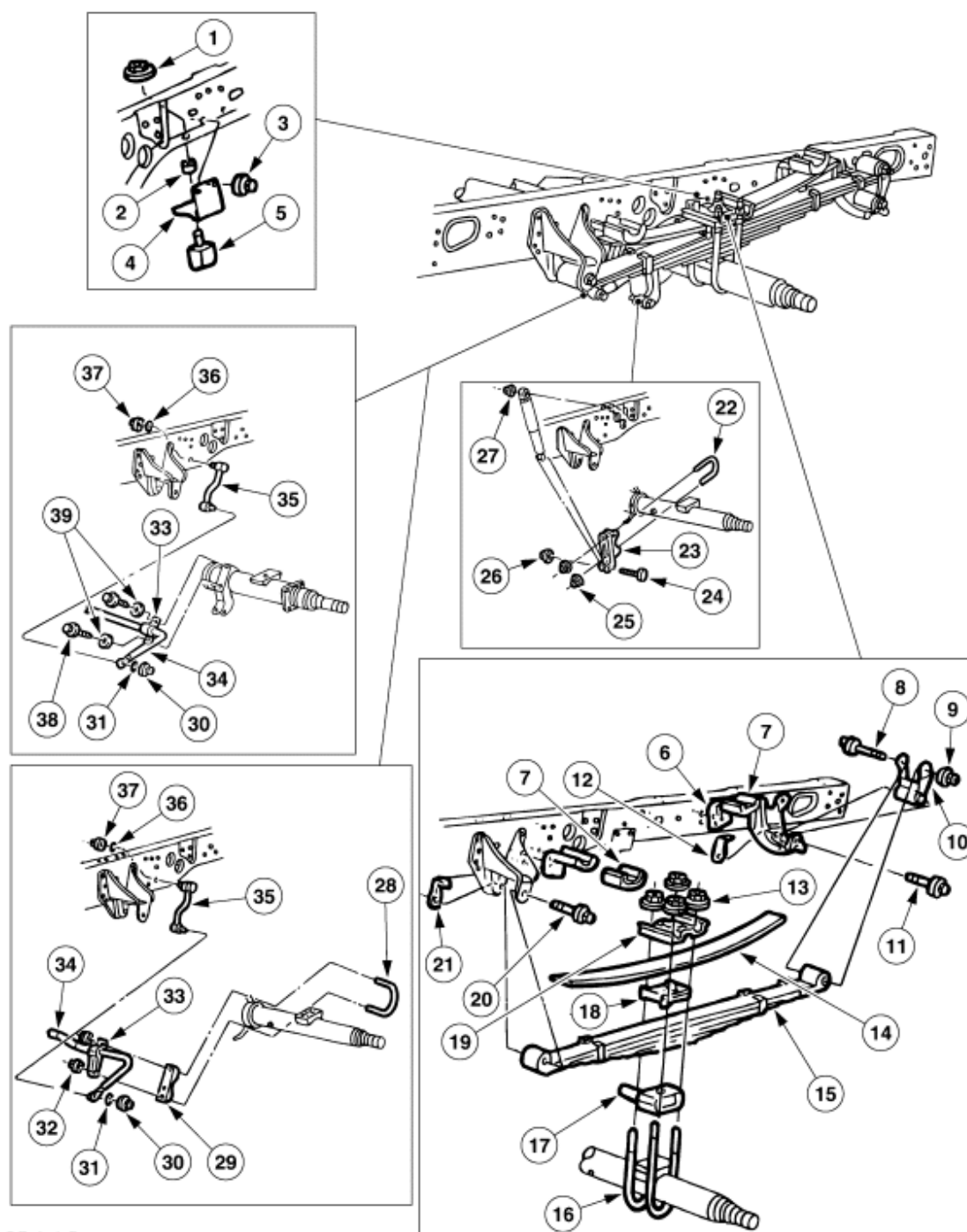
DF1015-B

Item	Part Number	Description
1	N620482-S56	Nut, M10-1.5 Hex
2	N800878-S	Spacer
3	N647097-S	Rivet, M10 x 25
4	4A171	Rear Axle Bumper Stop
5	4002	Rear Axle Bumper Assy

6	W704838-S428	Nut and Retainer Assy, M10 x 1.5 x 35
7	5700	Front Auxiliary Spring Bracket
8	W500593-S426	Bolt, M16-2.0 x 135 Hex
9	5776	Shackle Assy
10	N620485-S56	Nut, M16-2.0 Hex
11	N500593-S426	Bolt, M16-2.0 x 175 x 10.9
12	N605920-S2	Bolt, M10 x 1.5 x 33.5
13	N806367-S428	Nut and Retainer, M16-2.0 x 20 x 10
14	N620485-S56	Nut, M16-2.0 Hex
15	5588	Auxiliary Spring
16	5560	Rear Spring Assy
17	N811673-S428	U-Bolt, M16-2.0 x 108/225
18	5598	Rear Spring Spacer (4x4 Only)
19	5594	Auxiliary Spring Spacer
20	5798	Rear Spring Plate
21	N807044-S428	Nut and Retainer, M18-2.5 x 19 x 10
22	N806967-S426	Bolt, M18-2.5 x 139 x 10.9
23	5A636	Auxiliary Spring Bumper
24	N806085-S8	Nut and Washer Assy, M12-1.75 Hex
25	18080	Rear Shock
26	N806496-S301	Nut and Washer Assy, M12-1.75 Hex
27	N605705-S2	Bolt, M12-1.75 Hex
28	5A771	Stabilizer Bar Assy
29	N800937-S301	Nut, M12-1.75 Hex
30	N801527-S2	Washer, M12
31	5B491	Rear Stabilizer Bar Retainer
32	5K484	Link Assy
33	N620482-S56	Nut, M10-1.5 Hex (Ford Axle Only)
34	4A047	Lower Shock Bracket (Ford Axle Only)
35	4A047	Rear Stabilizer Bar Bracket (Ford Axle Only)

36	N811672-S428	U-Bolt, M10-1.5 x 101/152.5 (Ford Axle Only)
37	N803758-S56	U-Bolt, M10-1.5 x 137.5/161.5 (Ford Axle Only)
38	N605546-S2	Bolt, M10-1.5 x 33.5
39	N630088-S2	Washer, M10-15 x 33.5

Super Duty F-350 Narrow Frame



DF1016-B

Item	Part Number	Description
1	N620482-S56	Nut, M10-1.5 Hex
2	N800878-S	Spacer
3	N647097-S	Rivet, M10 x 25
4	4A171	Rear Axle Bumper Stop
5	4002	Rear Axle Bumper Assy

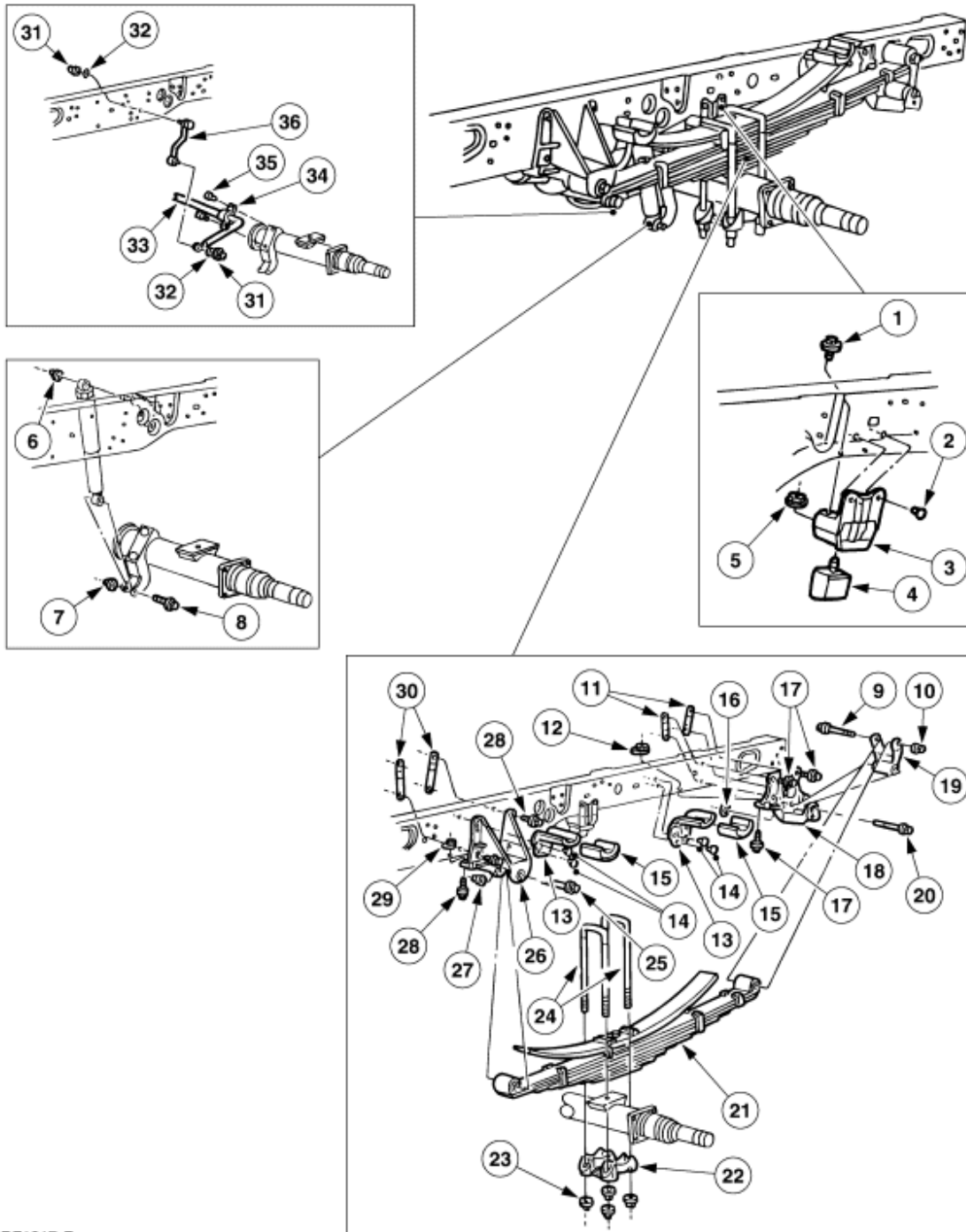
6	5700	Front Auxiliary Spring Bracket
7	5A978	Auxiliary Spring Bracket Liner — (RR)
8	W500593-S426	Bolt, M16-2.0 x 145 Hex
9	N620485-S56	Nut, M16-2.0 Hex
10	5776	Shackle Assy
11	W500593-S426	Bolt, M16-2.0 x 175 x 10.9
12	N806367-S428	Nut and Retainer, M16-2.0 x 20 x 10
13	N620485-S56	Nut, M16-2.0 Hex
14	5588	Auxiliary Spring
15	5560	Rear Spring Assy
16	N811673-S428	U-Bolt, M16-2.0 x 108/225
17	5598	Rear Spring Spacer (4x4 Only)
18	5594	Auxiliary Spring Spacer
19	5798	Rear Spring Plate
20	N804967-S426	Bolt, M18-2.5 x 139 x 10.9
21	N807044-S428	Nut and Retainer, M18-2.5 x 19 x 10
22	N811672-S428	U-Bolt, M10-1.75 x 101/152.5 (Ford Axle Only)
23	4A047	Lower Shock Bracket (Ford Axle Only)
24	N605705-S2	Bolt, M12-1.75 x 70 Hex
25	N620482-S56	Nut, M10-1.5 Hex (Ford Axle Only)
26	N806496-S301	Nut and Washer Assy, M12-1.75 Hex
27	N806085-S8	Nut and Washer Assy, M12-1.75 Hex
28	N803758-S56	U-Bolt, M10-1.75 x 137.5/161.5 (Ford Axle Only)
29	4A047	Rear Stabilizer Bar Bracket (Ford Axle Only)
30	N800937-	Nut, M12-1.75 Hex

	S301	
31	N801527-S2	Washer, M12
32	N620482-S56	Nut, M10-1.5 Hex (Ford Axle Only)
33	5B491	Rear Stabilizer Bar Retainer
34	5A771	Stabilizer Bar Assy
35	5K484	Link Assy
36	N801527-S2	Washer, M12
37	N800937-S301	Nut, M12-1.75 Hex
38	N605546-S2	Bolt, M10-1.5 x 33.5 Hex
39	N630088-S2	Washer, M10-1.5 x 33.5

Super Duty F-450 and F-550

6	N805007-S100	Nut and Retainer Assy, M12-1.75 Hex
7	N805136-S56	Nut and Retainer Assy, M12-1.75 x 80
8	W500593-S426	Bolt, M16-2.0 x 145 Hex
9	N620485-S56	Nut, M16-2.0 Hex
10	5776	Shackle Assy
11	N805041-S2	Bolt, M16-2.0 x 145 Hex
12	5775	Rear Shackle Bracket
13	N808591-S2	Bolt, M12-1.75 x 49.5 Hex
14	N806367-S428	Nut, M16-2.0 Hex
15	5A978	Auxiliary Spring Bracket Liner
16	5700	Rear Auxiliary Spring Bracket
17	N811826-S428	U-Bolt, M20-2.5 x 98.3 x 400
18	5A975	Rear Spring Assy
19	—	Rear Axle Assy (Dana S135)
20	N805028-S56	Nut, M20-2.5 Hex
21	5796	Rear Spring Seat Cap
22	N805444-S100	Bolt, M20-2.5 x 145 Hex
23	5700	Front Auxiliary Spring Bracket
24	5785	Front Hanger Bracket
25	N805161-S56	Nut and Retainer Assy, M20-2.5 Hex
26	W500760-S428	Bolt, M14-2.0 x 50 Hex
27	N811835-S428	Nut and Retainer Assy, M14-2.0 x 50
28	5K484	Stabilizer Bar Link Assy
29	N605814-S426	Bolt, M12-1.75 x 30 Hex
30	5B491	Stabilizer Bar Retainer Bracket
31	N800937-S301	Nut, M12-1.75 Hex
32	N801527	Washer, M12
33	5A771	Stabilizer Bar Assy
34	N605705-S2	Bolt, M12-1.75 x 70 Hex
35	N806496-S301	Nut and Washer Assy, M12-1.25 Hex
36	N806085-S8	Nut and Washer Assy, M12 Hex

Super Duty F-450

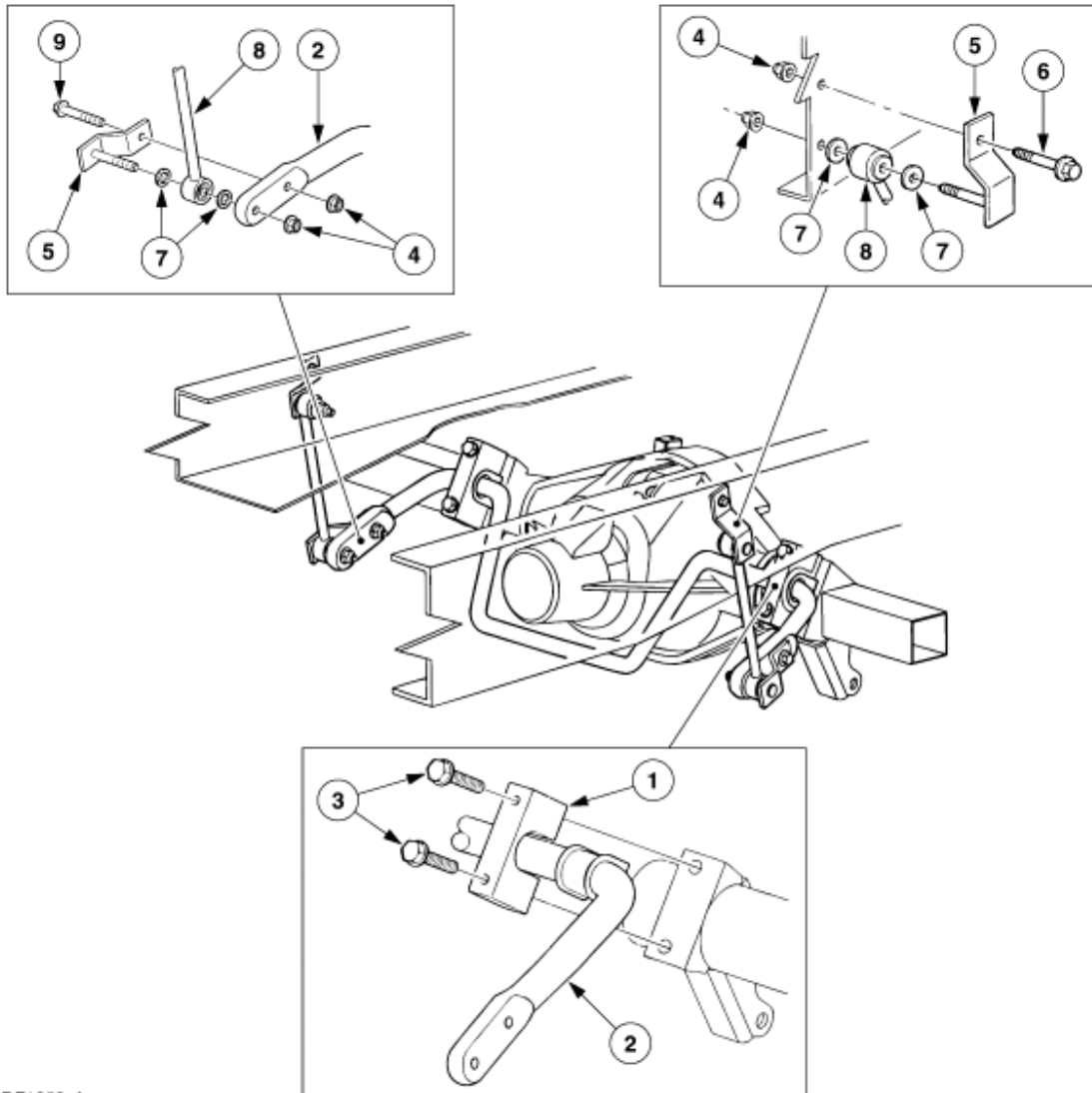


DF1017-B

Item	Part Number	Description
1	N605920-S2	Bolt, M10-1.5 x 20 Hex
2	N647098-S	Rivet, M10 x 35
3	4002	Rear Axle Bumper Assy
4	4A171	Rear Axle Bumper Stop
5	N620482-S56	Nut, M10-1.5 Hex

6	N806085-S8	Nut and Washer Assy, M12-1.75 Hex
7	N806496-S301	Nut and Washer Assy, M12-1.75 Hex
8	N605705-S2	Bolt, M12-1.75 x 70 Hex
9	W500593-S426	Bolt, M16-2.0 x 145 Hex
10	N620485-S56	Nut, M16-2.0 Hex
11	N805136-S56	Nut and Retainer Assy, M12-1.75 x 80
12	N805007-S100	Nut and Retainer Assy, M12-1.75 Hex
13	5700	Front Auxiliary Spring Bracket
14	N647100-S	Rivet 10 x 35
15	5A978	Auxiliary Spring Bracket Liner
16	N806367-S428	Nut, M16-2.0 Hex
17	N808591-S2	Bolt, M12-1.75 x 49.5 Hex
18	5775	Rear Shackle Bracket
19	5776	Shackle Assy
20	N805041-S2	Bolt, M16-2.0 x 145 Hex
21	5A975	Rear Spring Assy
22	5796	Rear Spring Seat Cap
23	N805028-S56	Nut, M20-2.5
24	N811362-S56	U-Bolt, M20-2.5 x 100 x 364
25	N805444-S100	Bolt, M20-2.5 x 145 Hex
26	5785	Front Hanger Bracket
27	N805161-S56	Nut and Retainer, M20-2.5 Hex
28	W500760-S428	Bolt, M14-20 x 50 Hex
29	N811833-S428	Nut and Retainer Assy, M14-2.0 Hex
30	N811835-S428	Nut and Retainer Assy, M14-2.0 x 127
31	N800937-S301	Nut, M12-1.75 Hex
32	N801527-S2	Washer, M12
33	5A771	Stabilizer Bar Assy
34	5B491	Stabilizer Bar Retainer Bracket
35	N605920-S2	Bolt, M10-1.5 x 33.5 Hex
36	5K484	Stabilizer Bar Link

Super Duty Motorhome



DF1253-A

Item	Part Number	Description
1	5B491	Rear Stabilizer Bar Retainer
2	5A771	Rear Stabilizer Bar Assy
3	N601423-S2	Bolt, M12-1.5 x 100
4	N800937-S427	Nut, M12-1.75
5	5L496	Rear Stabilizer Bar Link Mounting Bracket
6	W500443-S426	Bolt, M12-1.75 x 35
7	N803447-S36MC	Washer, M12
8	5K484	Rear Stabilizer Bar Link Assy
9	W500541-S426	Bolt, M12-1.75 x 50

SECTION 204-02: Rear Suspension
DIAGNOSIS AND TESTING

1999 F-Super Duty 250-550 Workshop Manual
[Procedure revision date: 01/26/2000](#)

Rear Suspension

For additional information, refer to [Section 204-00](#).

SECTION 204-02: Rear Suspension
GENERAL PROCEDURES

1999 F-Super Duty 250-550 Workshop Manual
[Procedure revision date: 01/26/2000](#)

Wheel Bearing End Play

For additional information, refer to [Section 204-00](#).

SECTION 204-02: Rear Suspension
REMOVAL AND INSTALLATION

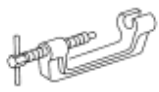
1999 F-Super Duty 250-550 Workshop Manual

[Procedure revision date: 01/26/2000](#)

Hub

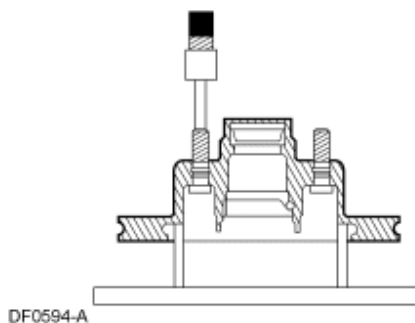
For additional information, refer to [Section 205-02C](#).

Wheel Studs

Special Tool(s)	
 ST1494-A	C-Frame and Screw 211-023 (T74P-3044-A1)

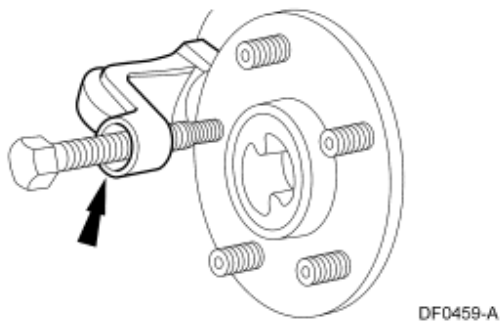
Removal

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. On vehicles equipped with dual rear wheels, go to Step 7.
4. Remove the disc brake caliper and rotor. For additional information, refer to [Section 206-04](#).
5. Remove the rear wheel hub assembly. For additional information, refer to [Section 205-02C](#).
6. Using a suitable press, remove the wheel bolt from the wheel hub and discard.



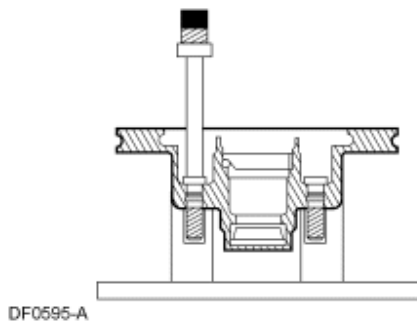
7. **NOTE:** For vehicles equipped with dual rear wheels, use the C-Frame and Clamp Assembly Tool to remove the wheel bolt on the vehicle.

Remove the wheel bolt from the wheel hub and discard.

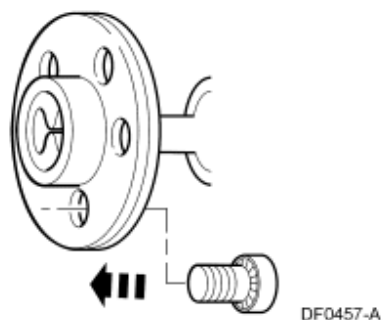


Installation

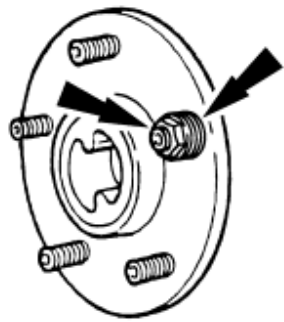
1. Using a suitable press, install the new wheel bolt aligning the serrations in the wheel hub flange made by the original wheel bolt.



2. On vehicles with dual rear wheels, install the new wheel bolt aligning the serrations in the wheel hub flange made by the original wheel bolt.
 - Place four flatwashers over the outside end of the wheel bolt and thread a standard wheel nut with the flat side against the washers.
 - Tighten the wheel nut until the wheel bolt head seats against the back side of the hub flange.



3. Remove the wheel nut and flatwashers.




DF0458-A

4. On vehicles with dual rear wheels, go to Step 7.
 5. Install the rear wheel hub assembly. For additional information, refer to [Section 205-02A](#).
 6. Install the disc brake caliper and rotor. For additional information, refer to [Section 206-04](#).
 7. Install the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
 8. Lower the vehicle. For additional information, refer to [Section 100-02](#).
-

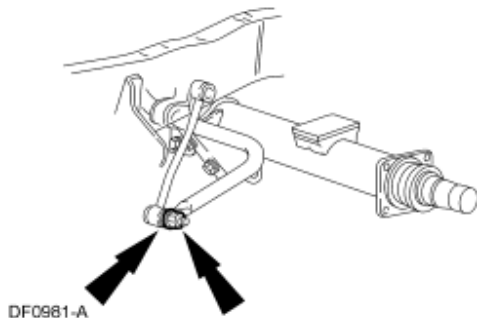
Bar and Link—Super Duty F-250, F-350, Ford Axle

Removal

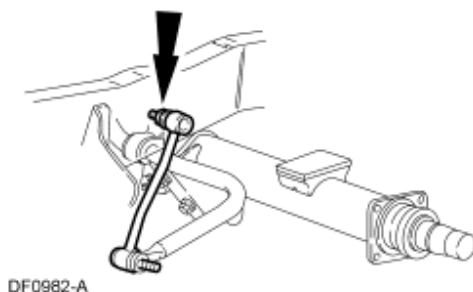
 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. Install new parts with the same part number or an equivalent part if installation is necessary. Do not use an installation part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

NOTE: Super Duty F-250, F-350 Wide Frame shown, Super Duty F-350 Narrow Frame similar.

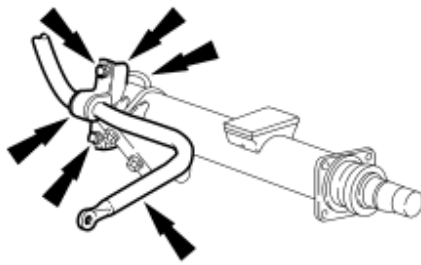
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the nuts from both lower ends of the stabilizer bar links and remove the washers.



3. Remove the nuts and washers from both upper ends of the stabilizer bar links-to-frame and remove the links.



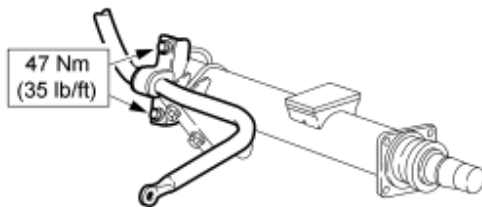
4. Remove the nuts from both stabilizer bar retainer-to-axle brackets and remove the stabilizer bar retainers, stabilizer bar mounting brackets, U-bolts and the stabilizer bar.



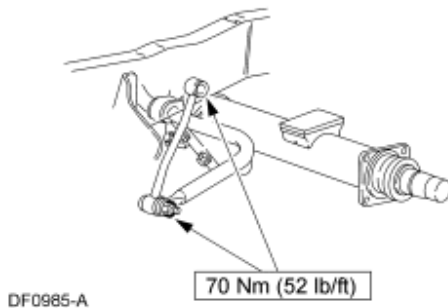
DF0983-A

Installation

1. Using new fasteners, follow the removal procedure in reverse order.



DF0984-A



DF0985-A

Bar and Link—Super Duty F-350, Dana Axle

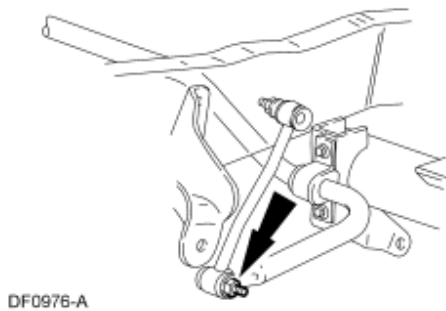
Removal



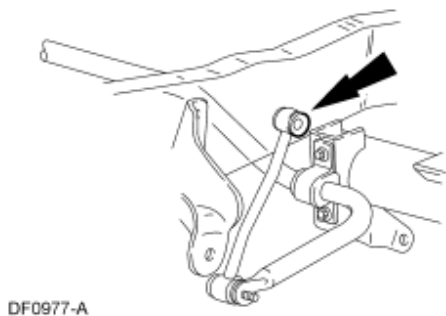
CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. Install new parts with the same part number or an equivalent part if installation is necessary. Do not use an installation part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

NOTE: Super Duty F-350 Wide Frame shown, Super Duty F-350 Narrow Frame similar.

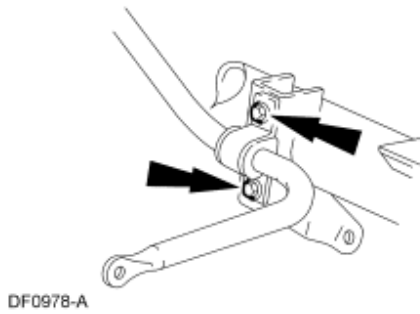
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the nuts from both lower ends of the stabilizer bar links and remove the washers.



3. Remove the nuts and washers from both upper ends of the stabilizer bar links-to-frame and remove the links.

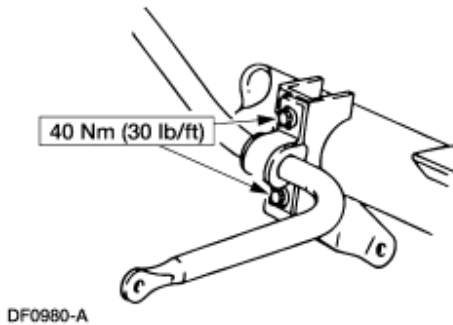
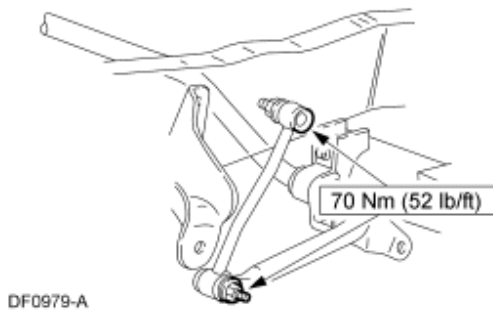


4. Remove the bolts from both stabilizer bar retainer-to-axle brackets and remove the stabilizer bar.



Installation

1. Using new fasteners, follow the removal procedure in reverse order.



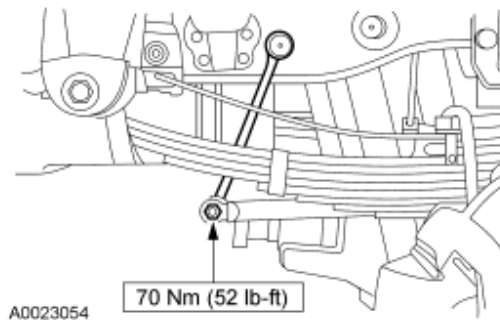
Bar and Link—Super Duty F-450, F-550, Dana Axle

Removal and Installation

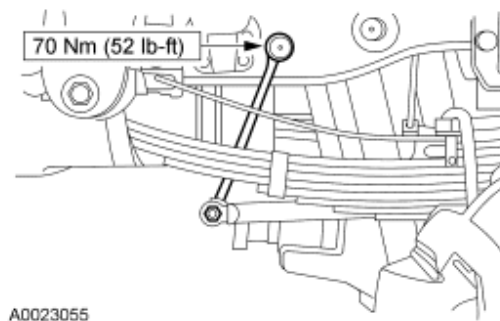


CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. Install new parts with the same part number or an equivalent part if installation is necessary. Do not use an installation part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

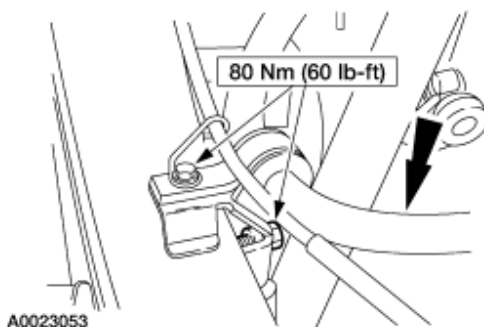
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the nuts from both lower ends of the stabilizer bar links and remove the washers.



3. Remove the nuts and washers from both upper ends of the stabilizer bar links and remove the links.



4. Remove the bolts from both stabilizer bar retainer-to-axle brackets and remove the stabilizer bar.
 - Remove the stabilizer bar bushings if necessary.



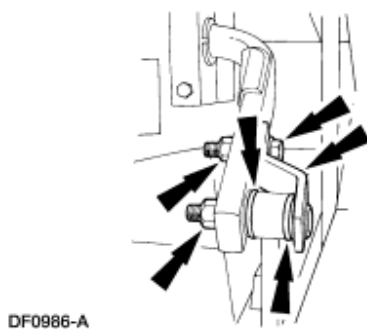
5. To install, reverse the removal procedure.
 - Install all new fasteners.
-

Bar and Link—Super Duty Motorhome Chassis

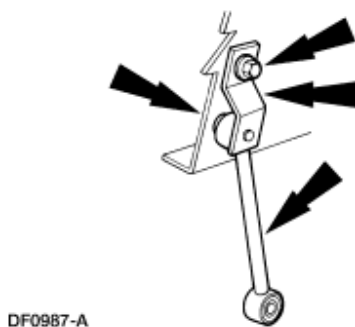
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. Install new parts with the same part number or an equivalent part if installation is necessary. Do not use an installation 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.

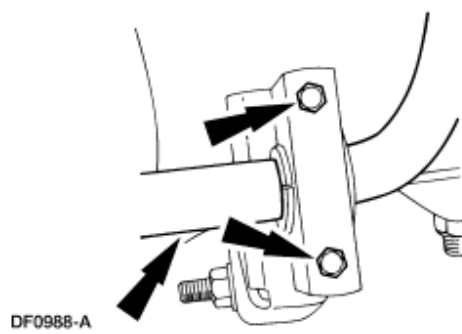
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the nuts and bolt from both lower ends of the stabilizer bar links.



3. Remove the nuts and washers from both upper ends of the stabilizer bar links-to-frame and remove the links.

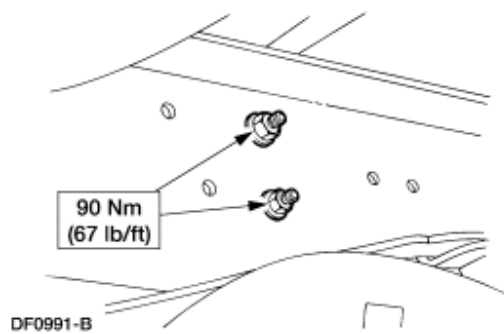
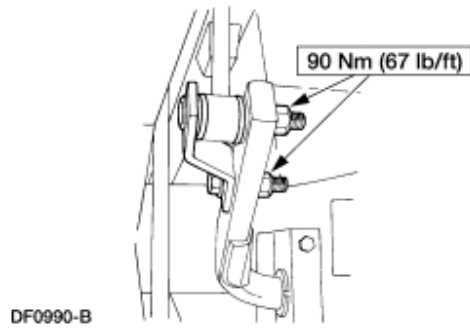
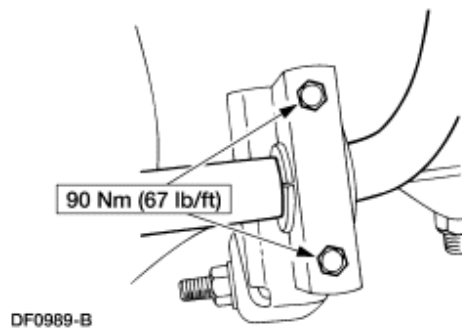


4. Remove the bolts from both stabilizer bar retainer-to-axle brackets and remove the stabilizer bar.



Installation

1. Using new fasteners, follow the removal procedure in reverse order.



Shock Absorber—Super Duty F-250, F-350, Ford Axle

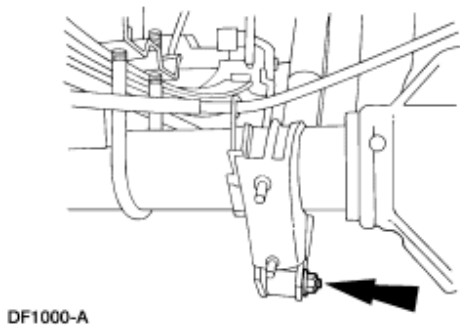
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an 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 re-assembly to ensure proper retention of these parts.

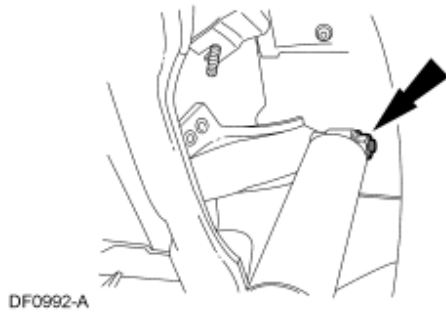
⚠ CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas. Do not attempt to open, puncture or apply heat to shock absorbers.

NOTE: Super Duty F-250, F-350 Ford axle shown, Super Duty F-350 Dana axle similar.

1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Using a suitable jack, support the rear axle.
3. Remove the shock absorber lower retaining nut and bolt.

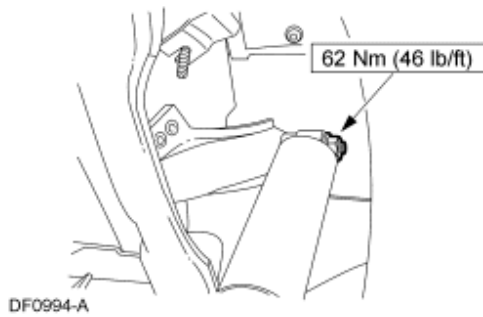
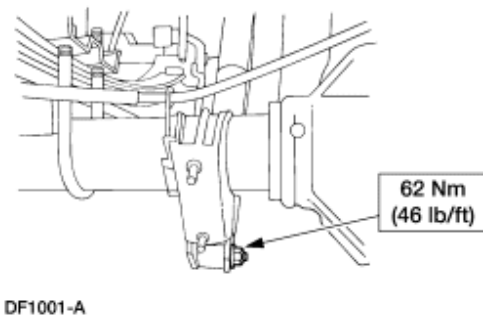


4. Remove the nut from the upper shock absorber mounting bracket and remove the shock.



Installation

1. Using new fasteners, follow the removal procedure in reverse order.



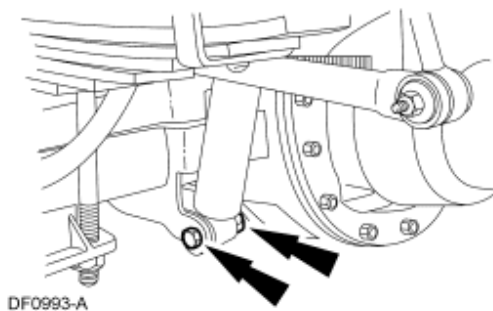
Shock Absorber—Super Duty F-450, F-550, Dana Axle

Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. Install new parts with the same part number or an equivalent part if installation is necessary. Do not use an installation 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.

⚠ CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas. Do not attempt to open, puncture or apply heat to shock absorbers.

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Using a suitable jack, support the rear axle.
3. Remove the shock absorber lower retaining nut and bolt.

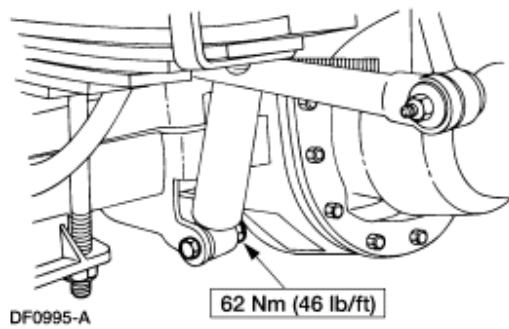
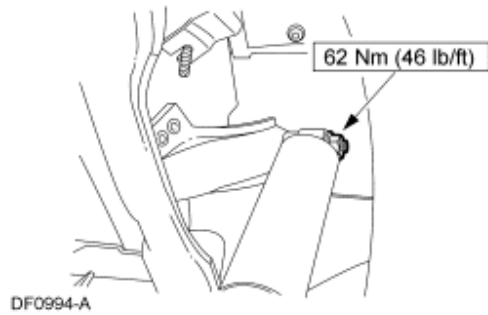


4. Remove the nut from the upper shock absorber mounting bracket and remove the shock.



Installation

1. Using new fasteners, follow the removal procedure in reverse order.



Shock Absorber—Super Duty Motorhome Chassis

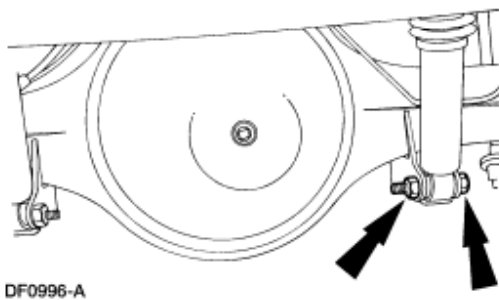
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. Install new parts with the same part number or an equivalent part if installation is necessary. Do not use an installation 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.

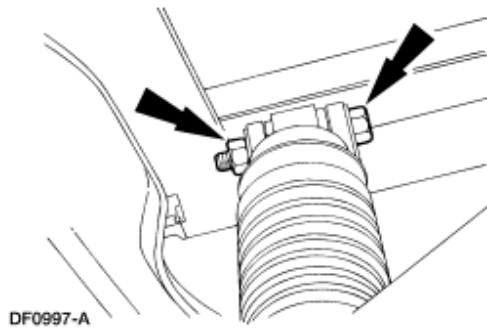
⚠ CAUTION: The low pressure gas shock absorbers are charged with nitrogen gas. Do not attempt to open, puncture or apply heat to shock absorbers.

NOTE: Super Duty Motorhome Chassis Dana axle shown, Super Duty Motorhome Chassis Ford axle similar.

1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Using a suitable jack, support the rear axle.
3. Remove the shock absorber lower retaining nut and bolt.

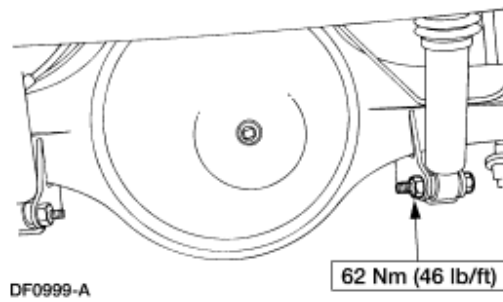
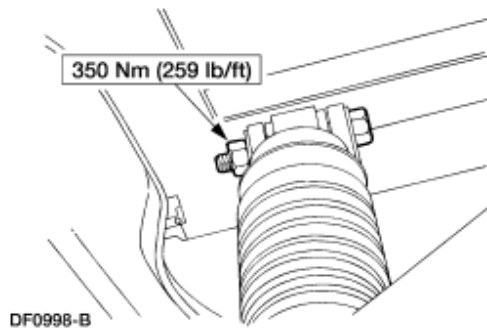


4. Remove the nut from the upper shock absorber mounting bracket and remove the shock.




Installation

1. Using new fasteners, follow the removal procedure in reverse order.

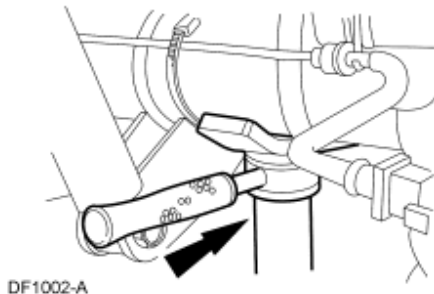


Spring—Super Duty F-250, F-350

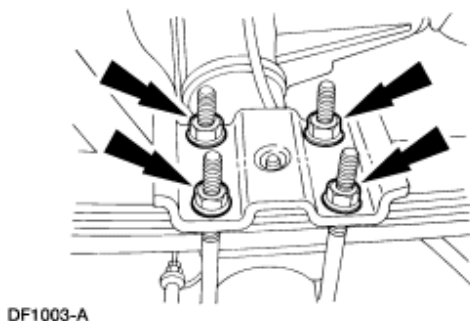
Removal

 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. They must be replaced with the same part number or an 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 re-assembly to ensure proper retention of these parts.

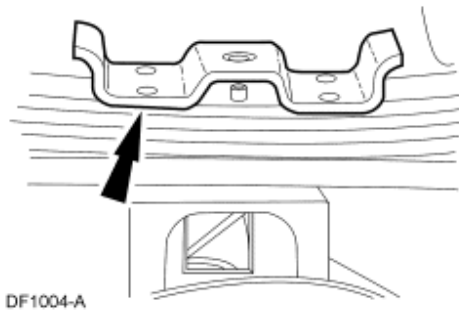
1. Raise and support the vehicle; for additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly; for additional information, refer to [Section 204-04](#).
3. Support the rear axle with a suitable jack.



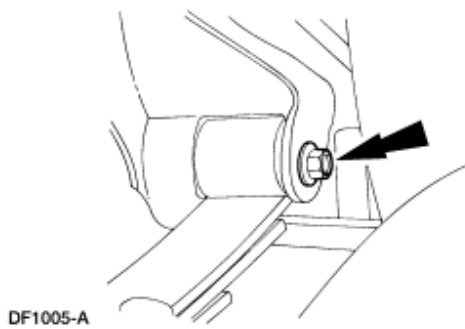
4. Remove the U-bolt retaining nuts and remove the U-bolts.



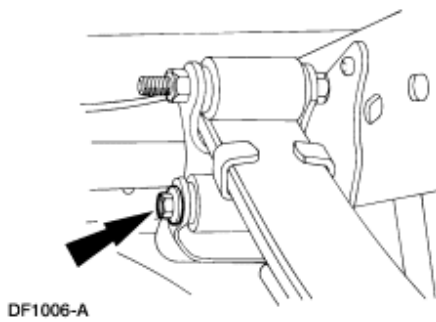
5. Remove the rear spring upper plate.



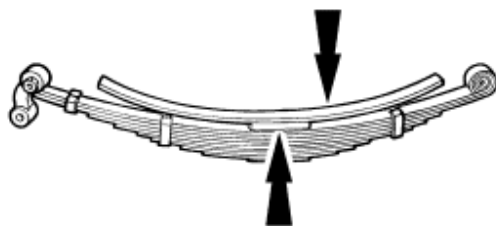
6. Remove the nut and bolt from the rear spring front hanger bracket.



7. Remove the lower nut and bolt from the rear spring shackle bracket. Remove the rear spring assembly.



8. If equipped, remove the auxiliary spring and auxiliary spring spacer.



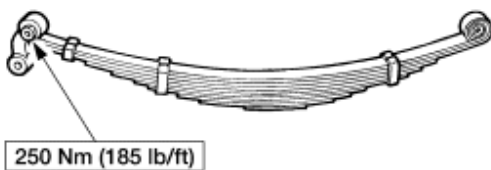
9. Remove the nut and bolt from the rear spring shackle assembly and remove the rear spring shackle.



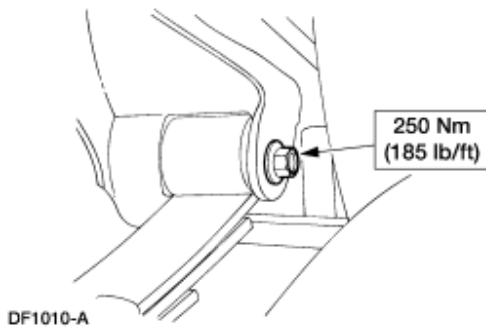
DF1008-A

Installation

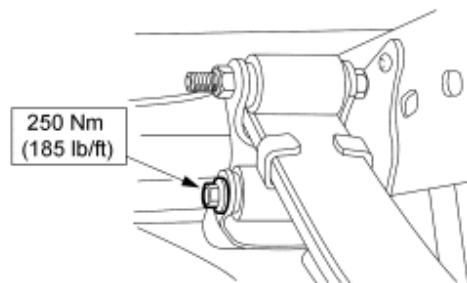
1. Using new fasteners, follow the removal procedure in reverse order.



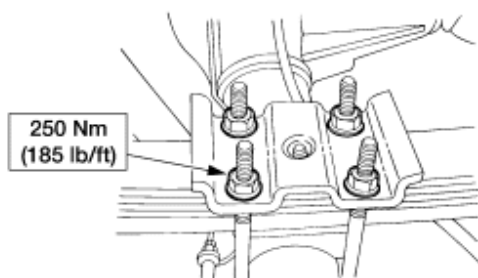
DF1009-B



DF1010-A




DF1011-B



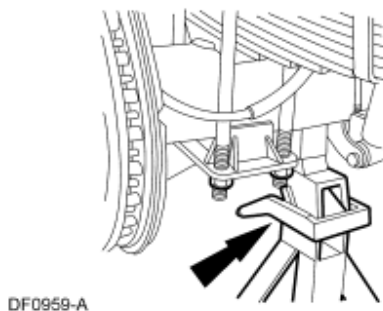
DF1012-A

Spring—Super Duty F-450, F-550

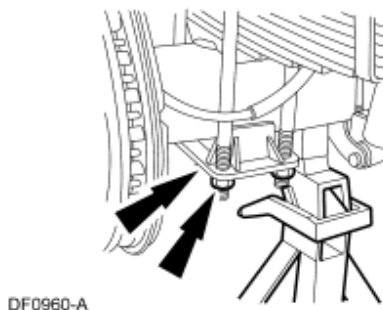
Removal

 **CAUTION:** Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. Install new parts with the same part number or an equivalent part if installation is necessary. Do not use an installation 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.

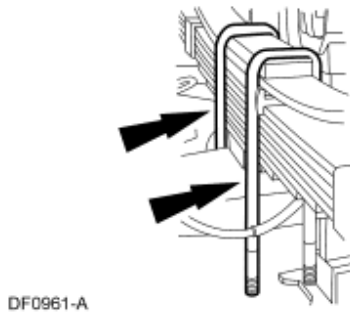
1. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
2. Remove the wheel and tire assembly. For additional information, refer to [Section 204-04](#).
3. Support the rear axle with a suitable jack.



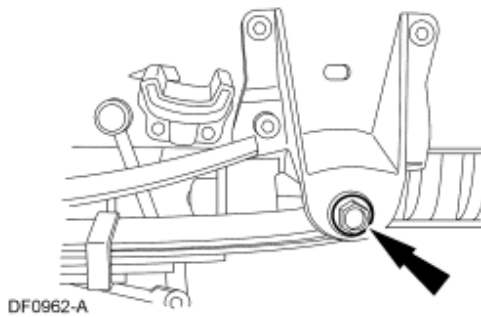
4. Remove the U-bolt retaining nuts and remove the spring plate.



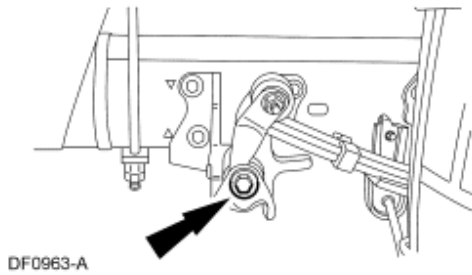
5. Remove the U-bolts.



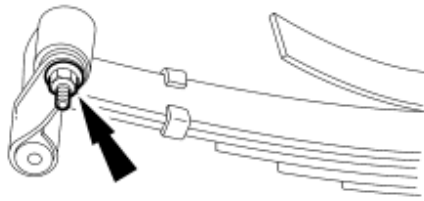
6. Remove the nut and bolt from the front spring hanger bracket.



7. Remove the lower nut and bolt from the rear spring shackle bracket. Remove the rear spring assembly.

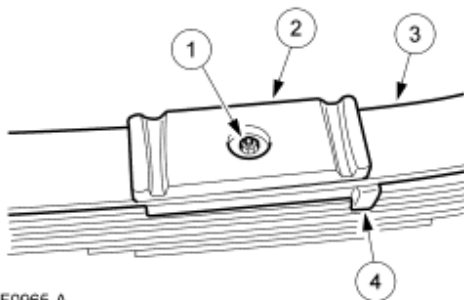


8. On 4x4 vehicles, remove the spacer plate.
9. Remove the nut and bolt from the rear spring shackle assembly and remove the rear spring shackle.



DF0966-A

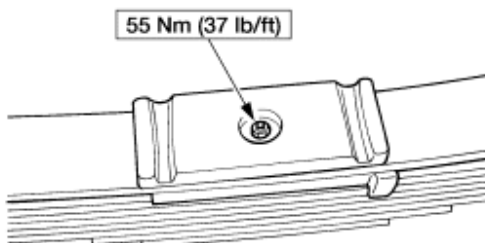
10. Remove the auxiliary spring.
 1. Remove the auxiliary spring retaining nut.
 2. Remove the upper spring plate.
 3. Remove the auxiliary spring.
 4. Remove the auxiliary spring spacer.



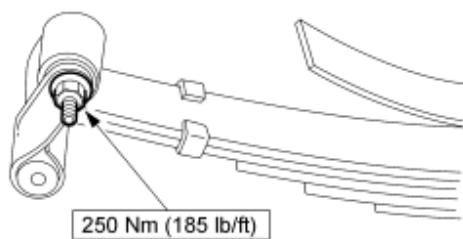
DF0965-A

Installation

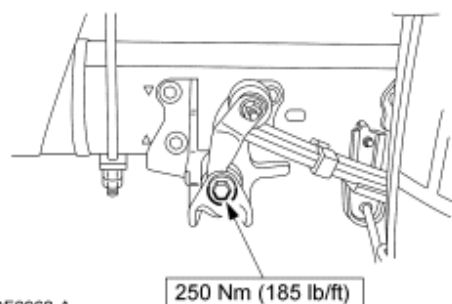
1. Using new fasteners, follow the removal procedure in reverse order.



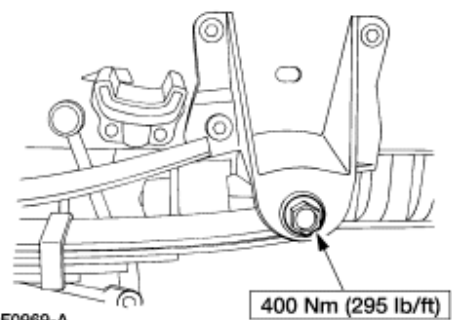
DF1013-A



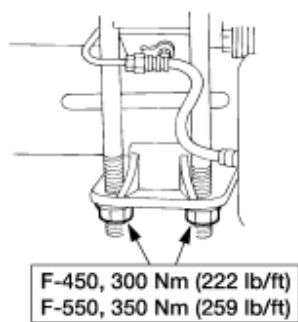
DF0967-A



DF0968-A



DF0969-A



DF0970-B

SECTION 204-04: Wheels and Tires

SPECIFICATIONS

DESCRIPTION AND OPERATION

[Safety Precautions](#)

[Wheels And Tires](#)

DIAGNOSIS AND TESTING

[Wheels And Tires](#)

[Inspection and Verification](#)

[Road Test](#)

[Symptom Chart](#)

[Component Tests](#)

[Tire and Wheel Runout](#)

[Tire Runout](#)

[Wheel Runout](#)

GENERAL PROCEDURES

[Wheel Leaks](#)

REMOVAL AND INSTALLATION

[Wheel and Tire — Single](#)

[Wheel and Tire — Dual Wheel and Tire](#)

SECTION 204-04: Wheels and Tires
SPECIFICATIONS

1999 F-Super Duty 250-550 Workshop Manual

[Procedure revision date: 08/16/2005](#)

General Specifications	
Item	Specification
Tires	See Safety Certification Sticker Located on Driver Door Jamb.
Cleaners — Wheel	
Custom Bright Metal Cleaner 8A-19522-A	ESR-M5B194-B

Wheel Rim Runout		
Type Wheel	Max. Radial Runout	Max. Lateral Runout
Aluminum	1.21 mm (0.04 in)	1.52 mm (0.06 in)
Steel	1.21 mm (0.04 in)	1.52 mm (0.06 in)

Tire Runout Specifications		
Type Wheel	Max. Radial Runout	Max. Lateral Runout
Aluminum	1.27 mm (0.05 in)	1.27 mm (0.05 in)
Steel	1.27 mm (0.05 in)	1.27 mm (0.05 in)

Torque Specifications		
Description	Nm	lb-ft
8-Lug M14 wheel bolts	224	165
Spare tire carrier bolts	20	15

Safety Precautions



WARNING: Never run the engine with one wheel off the ground, for example, when changing a tire. The wheel(s) resting on the ground could cause the vehicle to move.



WARNING: The tire and wheel must always be properly matched. It is very important to determine the size of each component before any assembly operations commence. Failure to adhere to these instructions can result in an explosive separation and cause serious bodily injury or death.



WARNING: Aftermarket aerosol tire sealants are extremely flammable. Always question the customer to make sure these products have not been used.



WARNING: Aftermarket wheel assemblies may not be compatible with the vehicle. Use of incompatible wheel assemblies can result in equipment failure and possible injury. Use only approved wheel assemblies.



WARNING: Use only wheels and lug nuts that have been designed for current model year Ford trucks. Aftermarket wheels or lug nuts may not fit or function properly, and can cause personal injury or damage the vehicle.



WARNING: Always wear safety goggles or a face shield when performing any work with tire and wheel assemblies.



CAUTION: Do not clean aluminum wheels with steel wool, abrasive-type cleaners or strong detergents. Use Custom Bright Metal Cleaner 8A-19522-A or equivalent meeting Ford specifications ESR-M5B194-B.



CAUTION: Reduce the air pressure as much as possible by pushing the valve core plunger in prior to removing the valve core. Avoid working in a position in which the face or body is directly over a tire in which there is pressure.

When performing any inspection or repair procedures on wheels (1007) and tires, follow the preceding safety precautions.

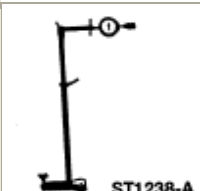
Wheels And Tires



WARNING: Do not mix different types of tires, such as radial, bias, or bias-belted, on the same vehicle except in emergencies. Vehicle handling can be seriously affected and can result in loss of control.

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.

Wheels And Tires

Special Tool(s)	
	Radial Runout Gauge 418-F123 (007-0056A) or Equivalent

Inspection and Verification



WARNING: A vehicle equipped with a Traction-Lok® differential will always have both wheels driving. If, while the vehicle is being serviced, only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack. Be sure both rear wheels are off the floor.



WARNING: Never run the engine with one wheel off the ground, for example, when changing a tire. The wheel(s) resting on the ground could cause the vehicle to move.



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

Be sure to follow the warnings when performing inspection and verification.

Road Test

Verify the customer concern by performing a road test on a smooth road. If any vibrations are apparent, go to [Section 100-04](#).

To maximize tire performance, inspect for signs of improper 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 increases tire wear.

Replacement tires must follow the recommended:

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

Use of any other tire size or type can seriously affect:

- ride.
- handling.
- speedometer/odometer calibration.
- vehicle ground clearance.
- tire clearance between the body and chassis.
- wheel bearing life.
- brake cooling.

Wheels need to be replaced when:

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

Wheel and tire assemblies are attached by eight integral two-piece swiveling lug nuts.

It is mandatory to use only the tire sizes recommended on the tire chart 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 for signs of uneven wear that may indicate a need for balancing, rotation, front suspension alignment, damaged tie rod, or steering components.
2. Check tires for:
 - cuts.
 - stone bruises.
 - abrasions.
 - blisters.
 - embedded objects.
3. Tread wear indicators are molded into the bottom of the tread grooves. Replace the tire when the indicator bands become visible.

Symptom Chart

SYMPTOM CHART		
Condition	Possible Sources	Action
<ul style="list-style-type: none"> Tires Show Excess Wear on Edge of Tread 	<ul style="list-style-type: none"> Underinflated tires. 	<ul style="list-style-type: none"> ADJUST air pressure in tires.
	<ul style="list-style-type: none"> Vehicle overloaded. 	<ul style="list-style-type: none"> RETURN vehicle — NOTIFY customer of overload condition.
	<ul style="list-style-type: none"> High-speed cornering. 	<ul style="list-style-type: none"> RETURN vehicle — NOTIFY customer of cause of condition.
	<ul style="list-style-type: none"> Incorrect wheel alignment. 	<ul style="list-style-type: none"> SET toe to specification; for additional information REFER to Section 204-00.
<ul style="list-style-type: none"> Tires Show Excess Wear in Center of Tread 	<ul style="list-style-type: none"> Tires overinflated. 	<ul style="list-style-type: none"> ADJUST air pressure.
<ul style="list-style-type: none"> Other Excessive Tire Wear Problems 	<ul style="list-style-type: none"> Improper tire pressure. 	<ul style="list-style-type: none"> ADJUST pressure.
	<ul style="list-style-type: none"> Loose or leaking shock absorbers. 	<ul style="list-style-type: none"> TIGHTEN or REPLACE as necessary.
	<ul style="list-style-type: none"> Front end out of alignment. 	<ul style="list-style-type: none"> ALIGN front end; for additional information REFER to Section 204-00.
	<ul style="list-style-type: none"> Front wheel bearings out 	<ul style="list-style-type: none"> REFER to Section 204-00 for inspection

	of adjustment.	procedure.
	<ul style="list-style-type: none"> Loose, worn or damaged suspension components. 	<ul style="list-style-type: none"> For additional information REFER to Section 204-00.
	<ul style="list-style-type: none"> Wheel and tire assembly out of balance. 	<ul style="list-style-type: none"> BALANCE wheel and tire assembly.
	<ul style="list-style-type: none"> Excessive lateral or radial runout of wheel or tire. 	<ul style="list-style-type: none"> REFER to Component Tests in this section.
	<ul style="list-style-type: none"> Improper tire rotation intervals. 	<ul style="list-style-type: none"> ADVISE customer of condition.
<ul style="list-style-type: none"> Wobble or Shimmy 	<ul style="list-style-type: none"> Damaged wheel bearings. 	<ul style="list-style-type: none"> For additional information REFER to Section 204-00.
	<ul style="list-style-type: none"> Loose or damaged suspension components. 	<ul style="list-style-type: none"> REPLACE as necessary.
	<ul style="list-style-type: none"> Bent wheel. 	<ul style="list-style-type: none"> REPLACE as necessary.
	<ul style="list-style-type: none"> Damaged tire. 	<ul style="list-style-type: none"> REPLACE as necessary.
	<ul style="list-style-type: none"> Loose lug nuts. 	<ul style="list-style-type: none"> TIGHTEN to specification.
<ul style="list-style-type: none"> High-Speed Shake 	<ul style="list-style-type: none"> Wheel hub face/pilot/bolt circle runout. Tires/wheels. Wheel bearings. Suspension/steering linkage. Engine. Transmission. Brake rotor. 	<ul style="list-style-type: none"> For additional information REFER to Section 100-04.

<ul style="list-style-type: none"> • Vehicle Vibration 	<ul style="list-style-type: none"> • Driveline — engine. • Tires. 	<ul style="list-style-type: none"> • For additional information REFER to Section 100-04.
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Component Tests

Tire and Wheel Runout

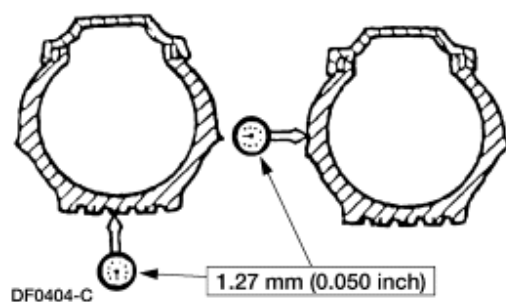
Excessive radial and lateral runout of a wheel and tire assembly can cause roughness, vibration, wheel tramp, tire wear, and steering wheel tremor.

Before checking runout, and to avoid false readings caused by temporary flat spots in the tires, check runout only after the vehicle has been driven far enough to warm the tires.

The extent of the runout is measured with the radial runout gauge. All measurements are made on the vehicle with the tires inflated to recommended inflation pressures and with the front wheel bearings adjusted to specifications.

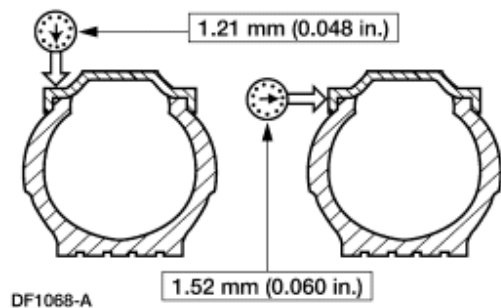
Tire Runout

Measure radial and lateral tire runout at the positions shown in the illustration. Runout should not exceed specifications.



Wheel Runout

Measure radial and lateral wheel runout at the positions shown in the illustration. Runout should not exceed specifications.



SECTION 204-04: Wheels and Tires
GENERAL PROCEDURES

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Wheel Leaks


1. There is no approved repair method for forged aluminum or steel wheels. If the wheel is damaged or has an air leak, a new wheel must be installed.
-

Wheel and Tire — Single

Removal



WARNING: Use only the integral two-piece swiveling wheel nuts. Do not attempt to use cone-shaped one-piece wheel nuts on these vehicles. If used, cone-shaped one-piece wheel nuts can come loose in vehicle operation. Do not attempt to use past model wheels, which have cone-shaped wheel hub bolt nut seats, on this vehicle. Do not attempt to use present design wheels and wheel nuts on past model wheel hubs. Attempted use of intermixed wheels can lead to damage to the wheel mounting system and could result in wheels coming loose.

1. Remove the wheel cover, if equipped.
2.  **CAUTION:** Do not use heat to loosen a seized wheel nut. Heat can damage the wheel and wheel bearings.

NOTE: Do not remove the wheel nuts at this time.

With the weight of the vehicle still on the tires, loosen the wheel nuts.

3. Raise the vehicle until the wheel and tire assembly clears the floor. For additional information, refer to [Section 100-02](#).
4. Remove the wheel nuts.
5. 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 surfaces of the wheel or the surface of the front disc brake hub and rotor that contacts the wheel. Installing wheels without correct metal-to-metal contact at the wheel mounting surfaces can cause the wheel nuts to loosen and the wheel to come off while the vehicle is in motion, resulting in loss of control.

Position the wheel and tire assembly on the vehicle.


2.  **CAUTION: Do not apply motor oil to the wheel nut threads or the wheel stud threads.**

On all two-piece flat wheel nuts, apply one drop of motor oil between the flat washer and the nut. If corrosion exists, or the integral two-piece swiveling wheel nut does not rotate freely, install new swiveling wheel nuts as necessary.

- Install the wheel nuts loosely.

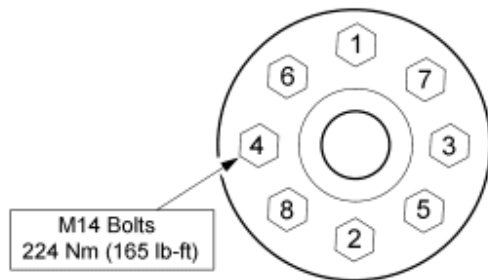


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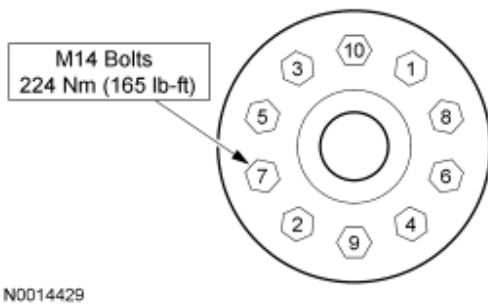
3. Turn the wheel until one wheel nut is at the top of the wheel hub bolt circle. Tighten the wheel nut until snug. In a crisscross-type pattern, tighten the remaining wheel nuts until snug to minimize runout.
4. Lower the vehicle.
5.  **CAUTION: Failure to tighten the wheel nuts in the sequence shown can result in high wheel and tire runout, which will speed up the development of brake roughness, shudder and vibration.**

 **CAUTION: Torque specifications are for nut and bolt threads that are free of dirt and rust. Use only Ford-recommended replacement fasteners.**

With the weight of the vehicle on the tires, tighten the wheel nuts to specification in the sequence shown.




A0087982



6. Install the wheel cover, if equipped.
7. Advise the customer that the wheel nuts need to be retightened at 800 km (500 miles) after wheel change or any other time the wheel nuts have been loosened. This is required to permit the wheel clamping system to seat correctly so that the wheel nuts will hold a uniform clamp load and remain fully tightened.

Wheel and Tire — Dual Wheel and Tire

Removal

1.  **WARNING:** Use only the integral two-piece swiveling wheel nuts. Do not attempt to use cone-shaped one-piece wheel nuts on these vehicles. If used, cone shaped one-piece wheel nuts can come loose in vehicle operation. Do not attempt to use past model wheels, which have cone-shaped wheel hub bolt nut seats, on this vehicle. Do not attempt to use present design wheels and wheel nuts on past model wheel hubs. Attempted use of intermixed wheels can lead to damage to the wheel mounting system and could result in wheels coming loose.

Remove the wheel cover, if equipped.


2.  **CAUTION:** Do not use heat to loosen a seized wheel nut. Heat can damage the wheel and wheel bearings.


NOTE: Do not remove the wheel nuts at this time.

With the weight of the vehicle still on the tires, loosen the wheel nuts.

3. Raise and support the vehicle. For additional information, refer to [Section 100-02](#).
4. Remove the wheel nuts.
5. Remove the outer wheel and tire assembly.
6. Remove the inner wheel and tire assembly.

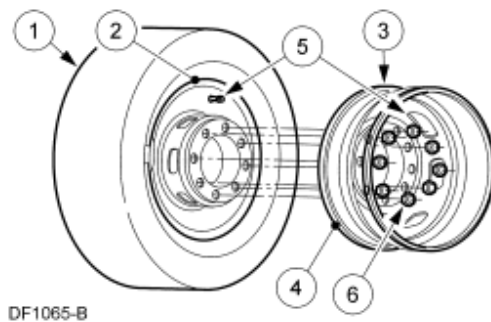
Installation

1.  **CAUTION:** It is imperative that the stamped indents located on the tire bead portion of the wheels are placed as close to 180 degrees from each other while still allowing access to the valve stem on the inside wheel. Failure to correctly install the wheel and tire assemblies can result in a vibration condition.

 **CAUTION:** Do not apply motor oil to the wheel nut threads or the wheel stud threads.

Install the inner and outer wheel and tire assemblies.

1. Position the inner wheel and tire assembly onto the axle.
2. Note the location of the alignment mark.
3. Position the outer wheel and tire assembly.
4. Position the alignment mark on the outer wheel and tire assembly as close to 180 degrees away from the alignment mark on the inner wheel and tire assembly.
5. The valve stem on the inner wheel and tire assembly must be aligned with one of the hand holes in the outer wheel and tire assembly.
6. Install the wheel nuts loosely.
 - On all two-piece flat wheel nuts, apply one drop of motor oil between the flat washer and the nut.



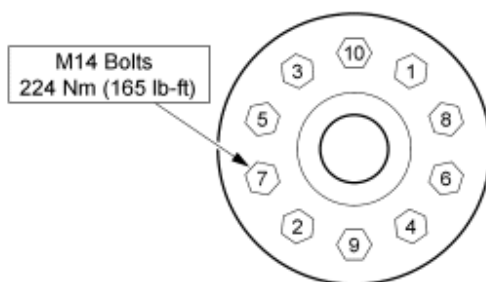
A0060800

2. Lower the vehicle.

3. **⚠ CAUTION: Failure to tighten the wheel nuts in the sequence shown can result in high wheel and tire runout, which will speed up the development of brake roughness, shudder and vibration.**

⚠ CAUTION: Torque specifications are for nut and bolt threads that are free of dirt and rust. Use only Ford recommended replacement fasteners.

With the weight of the vehicle on the tires, tighten the wheel nuts to specification in the sequence shown.



N0014429

4. Install the wheel cover, if equipped.
5. Advise the customer that the wheel nuts need to be retightened at 160 km (100 miles) and then again at 800 km (500 miles) after wheel change or any other time the wheel nuts

have been loosened. This is required to permit the wheel clamping system to seat correctly so that the wheel nuts will hold a uniform clamp load and remain fully tightened.

GROUP 05: Driveline

[SECTION 205-00: Driveline System — General Information](#)

[SECTION 205-01: Driveshaft](#)

[SECTION 205-02A: Rear Drive Axle/Differential — Dana 80](#)

[SECTION 205-02B: Rear Drive Axle/Differential — Dana S135](#)

[SECTION 205-02C: Wheel Hubs and Bearings — Full Floating Axle — Dana](#)

[SECTION 205-02D: Rear Drive Axle/Differential — Ford 10.50-Inch Ring Gear](#)

[SECTION 205-02E: Wheel Hubs and Bearings — Full Floating Axle — Ford](#)

[SECTION 205-03: Front Drive Axle/Differential](#)

SECTION 205-00:
Driveline System — General Information

[SPECIFICATIONS](#)

DESCRIPTION AND OPERATION

[Driveline System](#)

DIAGNOSIS AND TESTING

[Driveline System](#)

[Inspection and Verification](#)

[Universal Joint \(U-Joint\) Inspection](#)

[Inspection For Bent Rear Axle Housing](#)

[Noise Acceptability](#)

[Preliminary Diagnosis](#)

[Road Test](#)

[Analysis of Leakage](#)

[Analysis of Vibration](#)

[Non-Axle Noise](#)

[Axle Noise](#)

[Total Backlash Check](#)

[Symptom Chart](#)

[Component Tests](#)

[Driveline Vibration](#)

[Runout Check — Circular Pinion Flange](#)

[Runout Check — Half-Round Companion Flange](#)

[Differential Check — Ford Traction-Lok® Road Test \(Ford\)](#)

[Differential Check — Tractech® Truetrac®](#)

[Differential Check — Powr-Lok® Road Test \(Dana\)](#)

[Tooth Contact Pattern Check — Gearset, Dana S135](#)

[Tooth Contact Pattern Check — Gearset, Except Dana S135](#)

GENERAL PROCEDURES

[Axle Housing Casting Porosity \(Holes in Casting\) Repair](#)

SECTION 205-00: Driveline System — General
Information
SPECIFICATIONS

1999 F-Super Duty 250-550
Workshop Manual
[Procedure revision date: 01/26/2000](#)

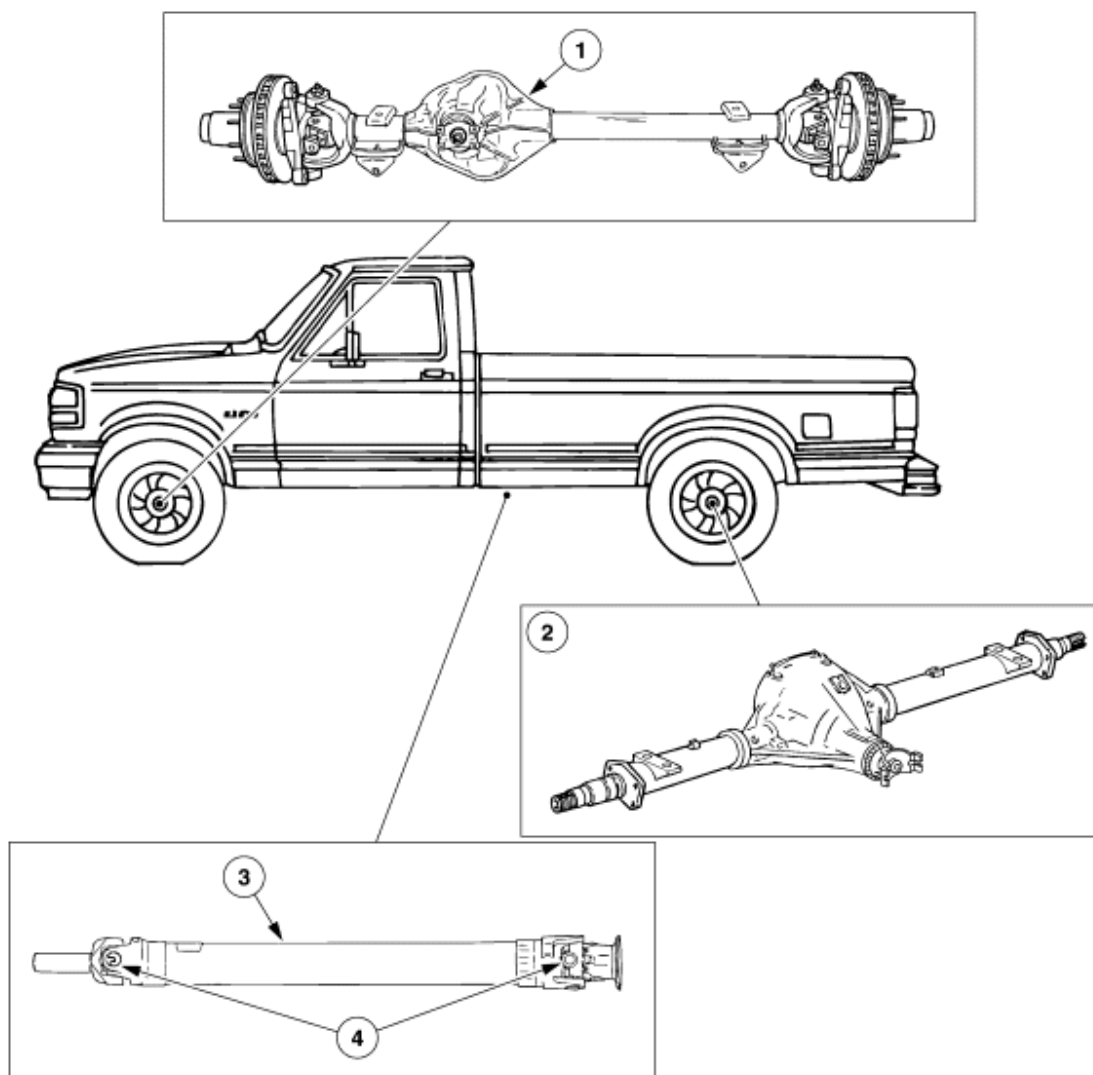
General Specifications	
Item	Specification
Lubricants	
Front Axle	
Premium Rear Axle Lubricant XY-80W90-QL	WSP-M2C197-A
Rear Axle	
Ford Rear Axle: SAE 75W-140 Synthetic Rear Axle Lubricant F1TZ-19580-B	WSL-M2C192-A
Dana 80 Rear Axle: SAE 75W-90 Synthetic Rear Axle Lubricant XY-75W90-GLS	—
Dana S135 Rear Axle: SAE 75W-90 Synthetic Rear Axle Lubricant F1TZ-19580-B	WSL-M2C192-A
Additive Friction Modifier C8AZ-19B546-A	EST-M2C118-A
Driveshaft Slip-Yoke	
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Capacities	
Front Axle Liters (Pints)	2.8 (5.9)
Ford Rear Axle Liters (Pints)	3.26 (7.0) ^a
Dana 80 Rear Axle (Conventional Differential) Liters (Pints)	4.0 (8.5)
Dana 80 Rear Axle (Trac-Lok®) Liters (Pints)	3.8 (8)
Dana S135 Rear Axle Liters (Pints)	11.6 (24.5)
Friction Modifier ML (Ounces)	236.56 (8)
Sealants	
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Devcon Aluminum Liquid F2	M-3D35A(E)
Stud and Bearing Mount EOAZ-19554-BA	WSK-M2G349-A1

^a Service refill capacities are determined by filling the axle to the bottom of the filler hole. On Traction-Loc® axles, always add friction modifier first.

Rear Driveline Angle Specifications — Excursion							
Wheel Base (inch)	Engine (L)	Trans.	Axle Ratio	Angles at Maximum GVWR (Deg) Trans.	Angles at Maximum GVWR (Deg) Pinion	Angles at Curb (Deg) Trans.	Angles at Curb (Deg) Pinion
4 x 2							
137	5.4	4R100	3.73	1.43	2.00	0.19	2.00
137	5.4	4R100	4.10	1.43	2.00	0.19	2.00
137	6.8	4R100	3.73	1.44	1.99	0.19	2.00
137	6.8	4R100	4.30	1.44	1.99	0.19	2.00
137	7.3	4R100	3.73	1.50	1.93	0.20	2.01
4 x 4							
137	5.4	4R100	3.73/4.10	0.17	0.94	2.21	0.52
137	6.8	4R100	3.73/4.30	0.17	0.94	2.21	0.52
137	7.3	4R100	3.73	0.17	0.94	2.32	0.41

Driveline System

Driveline Component Locations



DE2051-B

Item	Part Number	Description
1	3001	Front Axle Assy
2	4001	Rear Axle Assy
3	4602	Driveshaft
4	4635	Universal Joints

The driveline transfers engine torque to the drive wheels. On 2-wheel drive vehicles, power is transmitted through the transmission to the driveshaft (4602) and then to the rear axle assembly (4006).

On 4-wheel drive vehicles, power is transmitted through the transmission and the transfer case (7A195). The transfer case directs the power through the rear driveshaft and then to the rear axle (4001). When engaged, it also transmits power through the front driveshaft to the front axle assembly (3001).

A two-piece driveshaft is used in some longer wheelbase light truck models. As compared with a one-piece installation, the two-piece design includes a front or "coupling" shaft, a rubber-insulated frame-mounted driveshaft center bearing bracket, a splined slip joint and an intermediate universal joint at the front of the rear driveshaft.

For additional information on the front axle assembly, refer to [Section 205-03](#).

For additional information on the driveshaft, refer to [Section 205-01](#).

For additional information on the rear axle, refer to [Section 205-02A](#), [Section 205-02B](#) or [Section 205-02D](#).

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

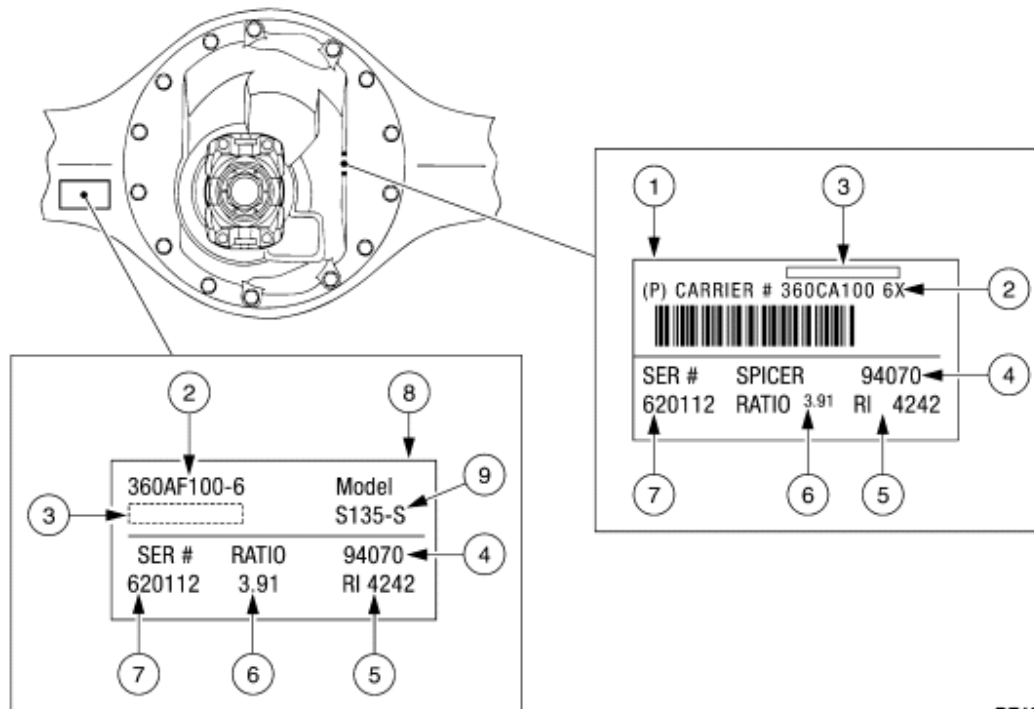
MFD. BY FORD MOTOR CO. IN U.S.A.						
DATE: 2/91 GVWR: 6600 LB/2994 KG						
FRONT GAWR: 3320 LB			REAR GAWR: 4004 LB			
1506KG	WITH		1816KG	WITH		
LT 215/85R 16D	TIRES		LT 215/85R 16D	TIRES		
16 x 6K	RIMS		16 x 6K	RIMS		
AT 51 PSI COLD			AT 58 PSI COLD			
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.						
VIN: 1FTBF25H5MLA00000						
TYPE: (a) (b) (c) (d) (e) (f) (g) (h)						F0083 T0112
						
7N	9M				48	DSO
EXTERIOR PAINT COLORS						
WB	TYPE-GVW	BODY	TRANS	AXLE	TAPE	SPRING
133	F251	LG4	E	342	B	2 D 2 9 (04) (51) (03) (04)



DE1344-A

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

Dana S135 Rear Axle Identification Tag



DE1879-A

Item	Description
1	Carrier Identification Tag
2	Dana Part Number
3	Customer Part Number (Optional)
4	Julian Date Code
5	Line Set Number (Optional)
6	Axle Ratio
7	Last Six Digits of the Vehicle Serial Number (Optional)
8	Axle Assembly Identification Tag
9	Model

Dana 80 Rear Axle Identification Tag