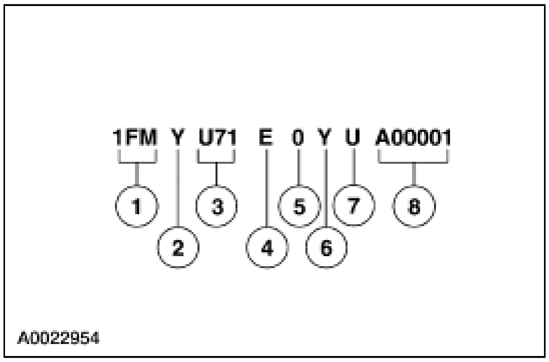
Identification Codes

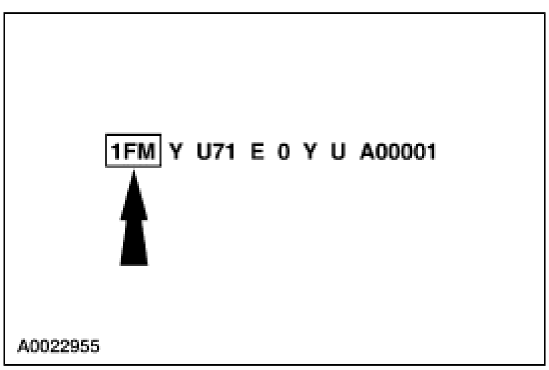
The vehicle identification number (VIN) is a 17-digit combination of letters and numbers. The VIN is stamped on a metal tab riveted on the instrument panel, top upper left of the dash. The VIN number is also found on the vehicle certification (VC) label.



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

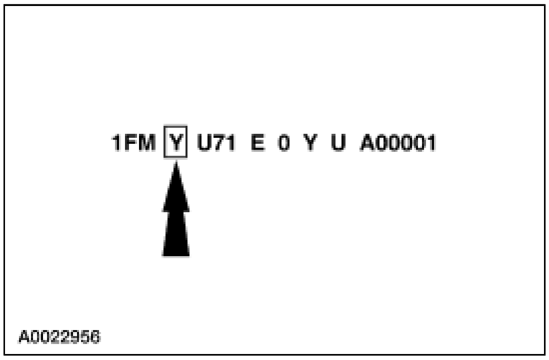
World Manufacturer Identifier



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

- 1FM — Ford Motor Company, USA, multi-purpose vehicle
- 1FC — Ford Motor Company, USA, stripped chassis
- 4M2 — Mercury, USA, multi-purpose vehicle

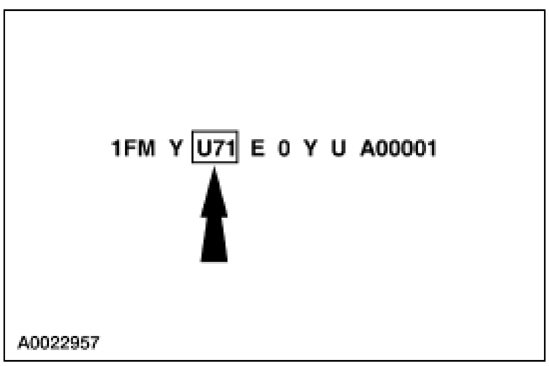
GVWR Code



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

- Y — 4,001-5,000 pounds GVWR, Explorer/Mountaineer (less side impact air bags)
- Z — 5001-6000 pounds GVWR, Explorer/Mountaineer (less side impact air bags)
- M — 5,001-6,000 pounds GVWR, US Postal stripped chassis (less air bags)
- C — 4,001-5,000 pounds GVWR, Explorer/Mountaineer (with side impact air bags)
- D — 5,001-6,000 pounds GVWR, Explorer/Mountaineer (with side impact air bags)

Line, Series and Body Type Code

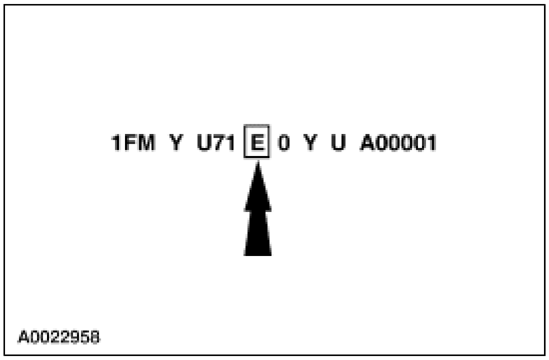


Positions 5 through 7 indicate vehicle line, series and body type.

- U60 — Explorer, 4x2, two-door, Sport
- U70 — Explorer, 4x4, two-door, Sport
- U61 — Explorer, 4x2, four-door, XL
- U71 — Explorer, 4x4, four-door, XL
- U62 — Explorer, 4x2, four-door, XLS
- U72 — Explorer, 4x4, four-door, XLS
- U63 — Explorer, 4x2, four-door, XLT
- U73 — Explorer, 4x4, four-door, XLT
- U83 — Explorer, AWD, four-door, XLT
- U64 — Explorer, 4x2, four-door, Eddie Bauer

- U74 — Explorer, 4x4, four-door, Eddie Bauer
- U84 — Explorer, AWD, four-door, Eddie Bauer
- U65 — Explorer, 4x2, four-door, Limited
- U75 — Explorer, 4x4, four-door, Limited
- U85 — Explorer, AWD, four-door, Limited
- U66 — Mountaineer, 4x2, four-door
- U76 — Mountaineer, 4x4, four-door
- U86 — Mountaineer, AWD, four-door
- U69 — US Postal stripped chassis, RHD

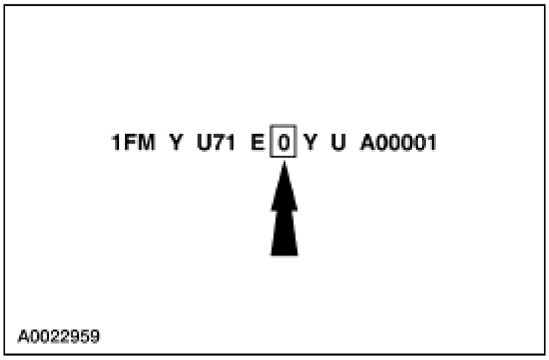
Engine Code



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

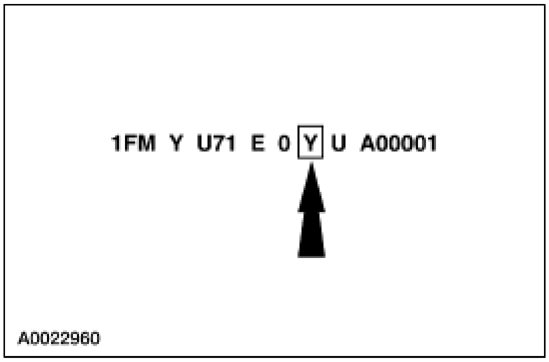
- X — 4.0L, EFI, OHV, six cylinder
- E — 4.0L, EFI, SOHC, six cylinder
- P — 5.0L, EFI, eight cylinder
- K — 4.0L, EFI, SOHC, six cylinder, flex fuel

Check Digit



The ninth VIN position is a check digit.

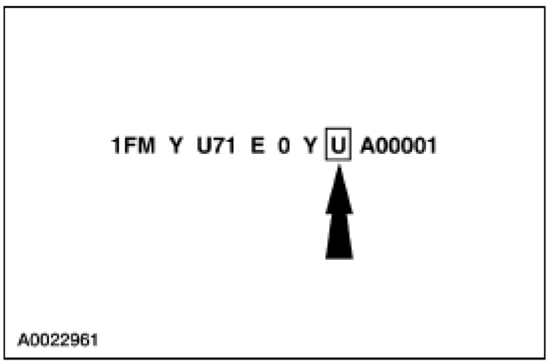
Model Year Code



The tenth VIN position is the model year code.

- Y — 2000

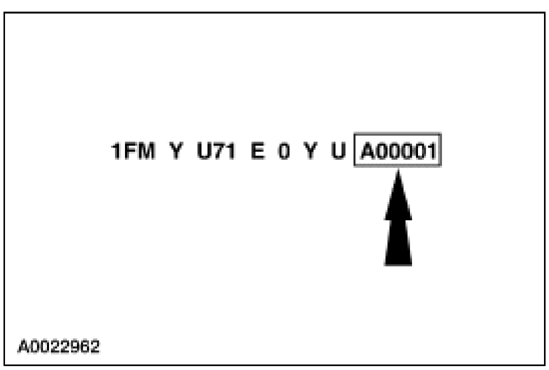
Assembly Plant Code



The eleventh VIN position is the assembly plant code.

- U — Louisville (Louisville, Kentucky)
- Z — St. Louis (Hazlewood, Missouri)

Build Sequence

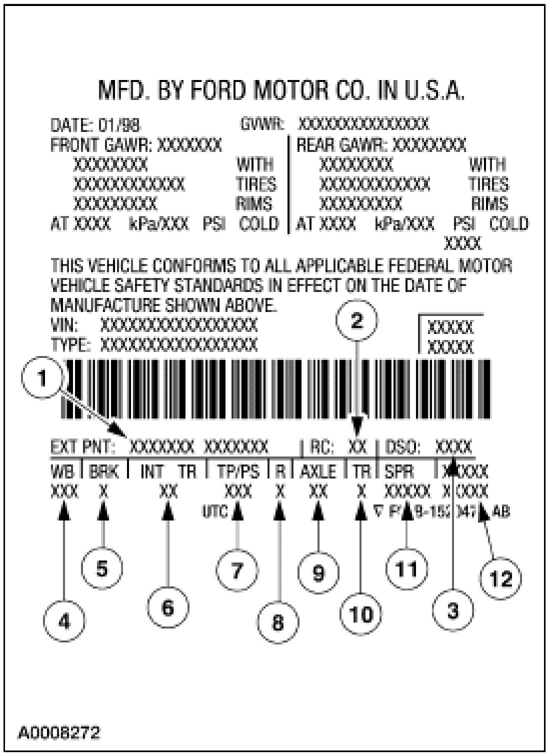


The last six VIN positions are an alphanumeric code for the vehicle build sequence. This is also the vehicle serial and warranty number.

- A00001-E99999 — Ford Division

- J00001-L99999 — Mercury Division

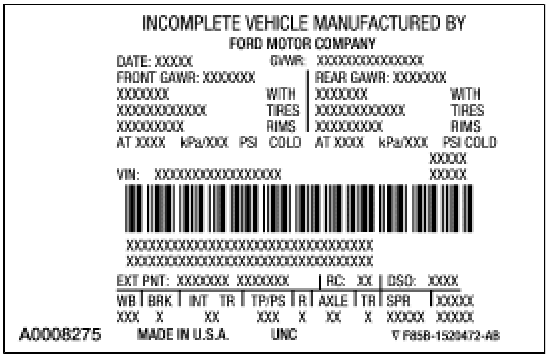
Vehicle Certification (VC) Label



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
12	Powertrain calibration information

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 — Incomplete Vehicle (Typical)



Paint Codes

NOTE: The first set of codes list the primary body color, the second set of codes list the lower body two-tone paint code (if applicable).

The following lists the exterior paint codes:

Primary body color codes

- B2 — Harvest Gold
- B4 — Autumn Brown
- FL — Medium Toreador Red
- FS — Spruce Green
- LD — Medium Wedgewood Blue
- LL — Deep Wedgewood Blue
- SU — Amazon Green
- UA — Ebony
- WF — White Pearl, tri-coat (St. Louis build only)
- YZ — Oxford White

Lower two-tone exterior paint codes:

- RC — Medium Platinum
- BA — Medium Prairie Tan (Mountaineer Appearance Package)
- JL — Dark Toreador Red
- LD — Medium Wedgewood Blue
- ST — Estate Green

Radio Codes

- Y — Delete radio system
- R — Delete radio chassis, all other components installed
- 9 — M100C AM/FM stereo with cassette and clock
- 8 — P100LL AM/FM premium stereo with cassette
- Z — AM/FM stereo with compact disc player
- K — Luxury AM/FM stereo with cassette, compact disc player and digital sound processing (DSP)

Axle Codes

The following lists the gear ratios on axles.

- 41 — 3.27 non-limited slip
- 45 — 3.55 non-limited slip
- 46 — 3.73 non-limited slip
- 42 — 4.10 non-limited slip
- D1 — 3.27 limited slip
- D5 — 3.55 limited slip
- D4 — 3.73 limited slip
- D2 — 4.10 limited slip

Transmission Codes

- D — Five-speed automatic overdrive, A5LDE
- M — Five-speed manual, Mazda
- U — Four-speed automatic overdrive, 4R70W

Spring Codes

The following lists available spring codes.

Front Springs

- B — 5B326 (RH), 5B327 (LH) torsion bar
- D — 5B326 (RH), 5B327 (LH) torsion bar
- E — 5B326 (RH), 5B327 (LH) torsion bar
- F — 5B326 (RH), 5B327 (LH) torsion bar
- G — 5B326 (RH), 5B327 (LH) torsion bar
- H — 5B326 (RH), 5B327 (LH) torsion bar
- J — 5B326 (RH), 5B327 (LH) torsion bar
- L — 5B326 (RH), 5B327 (LH) torsion bar
- 1 — 5B326 (RH), 5B327 (LH) torsion bar
- 2 — 5B326 (RH), 5B327 (LH) torsion bar

Rear Springs

- F — 5560 spring
- H — 5560 spring
- L — 5560 spring

Interior Trim Codes

The following lists the interior trim and interior color codes.

Interior Trim

- A — Vinyl bucket seats
- J — Premium Tweed cloth bucket seats
- Y — Premium Amay cloth bucket seats
- Z — Cloth bucket seats with power

- G — Cloth sport bucket seats
- F— Leather sport bucket seats
- M — Cloth split bench seat
- 1 — Leather sport bucket seats (Limited)
- Blank — No seat installed (US Postal stripped chassis, RHD)

Interior Color Codes

- X — Medium Prairie Tan
- 2 — Medium Graphite
- T — Dark Graphite

Tape Stripe Codes

- L — Light Prairie Tan (Limited)

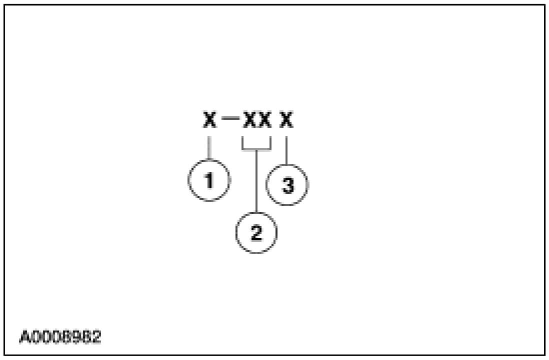
Powertrain Calibration Information

NOTE: Powertrain calibration information is limited to a maximum of five characters per line on the vehicle certification label. Because of this, calibration identification consisting of more than five characters will wrap to the second line on the VC label.

Powertrain calibration information is printed in the lower right corner of the vehicle certification label. Only the base calibration information is printed. Revision levels will not appear, however, they can be found in On Line Automotive Service Information System (OASIS). For the current model year, Ford Motor Company is using three different protocols which describe powertrain base calibration. These protocols are designed to provide worldwide standardization for vehicle calibration. If the electronic calibration strategy has been used since 1998 and carried into the current model year, Protocol 1 will be used. Refer to Protocol 1 below. If the electronic calibration strategy has been used since 1999 and is carried into the current model year, Protocol

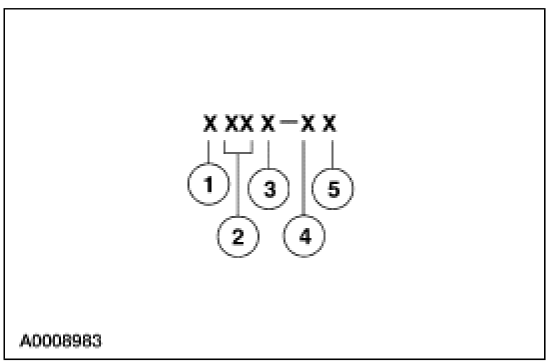
2 will be used. Refer to Protocol 2 below. For new electronic calibration strategies for the current model year, use Protocol 3. Refer to Protocol 3 below.

Protocol 1



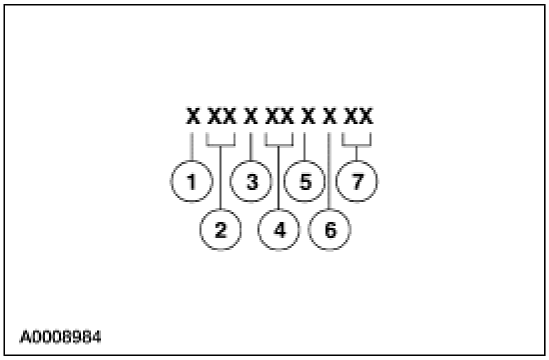
Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code
3	Engine revision level

Protocol 2



Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code
3	Transmission code
4	Emission standard (designates the specific country emission standard)
5	Design level (design level assigned to the engine)

Protocol 3



Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Vehicle code
3	Transmission code
4	Unique calibration (designates different hardware to similar vehicles). Example: tires, drive ratios, etc.
5	Fleet code (describes fleet to which the vehicle belongs). Example: 6 – evaporative emissions
6	Certification region (lead region where multiple regions are included in one calibration). Example: A – U.S. federal
7	Revision level (will advance as revisions occur). Not printed on label

Jacking

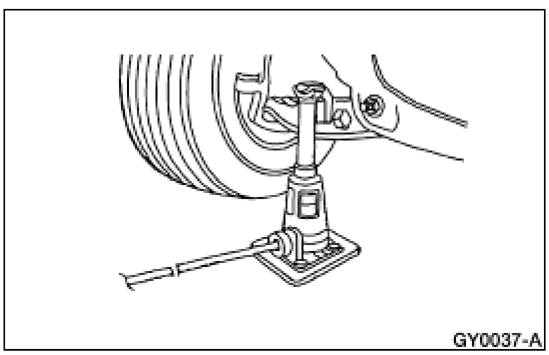
WARNING: Do not run the engine when jacking the vehicle. The wheels contacting the ground could cause the vehicle to move.

WARNING: Make sure the jack and jack stands are properly located to prevent the vehicle from falling.

WARNING: Wheel chocks should be used to prevent the vehicle from rolling and falling off the jack.

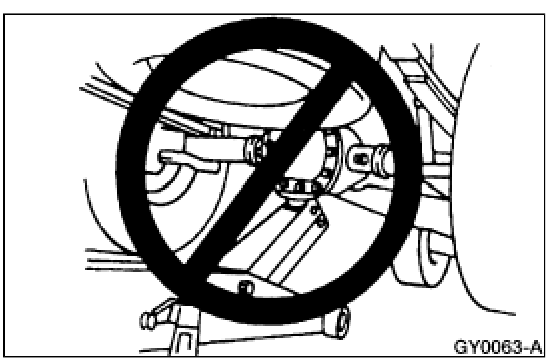
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

Jacking Points — Front



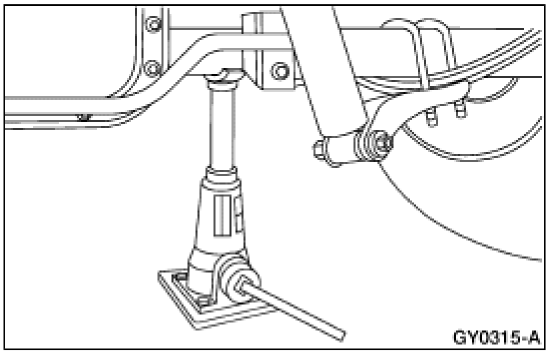
1. The front jacking point is a tab that extends from the lower control arm.

Jacking Points — Rear



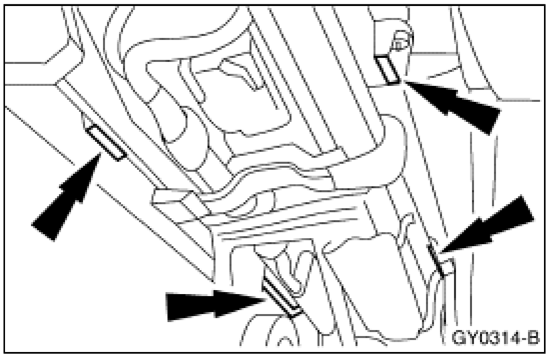
1. **CAUTION: Do not use the differential housing as a lift point. Leaks or damage to the rear axle cover and adjoining differential housing surface may occur if a floor jack or any lifting device is allowed to contact the cover at any point where the cover joins the housing.**

   The rear jacking points are located on the rear axle tube.



Lifting

Lifting Points



1.  **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.**

    **CAUTION: Do not use the differential housing as a lift point. Leaks or damage to the rear axle cover and adjoining differential housing surface may occur if a floor jack or any lifting device is allowed to contact the cover at any point where the cover joins the housing.**

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

   Locate front hoist adapters and rear hoist adapters (top of frame arc) as indicated.

Noise, Vibration And Harshness (NVH)

Noise is any undesirable sound, usually unpleasant in nature. Vibration is any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down. Harshness is a ride quality issue where the vehicle's response to the road transmits sharply to the customer. Harshness normally describes a firmer than usual response from the suspension system. Noise, vibration and harshness (NVH) is a term used to describe these conditions, which result in varying degrees of dissatisfaction. Although, a certain level of NVH caused by road and environmental conditions is normal. This section is designed to aid in the diagnosis, testing and repair of NVH concerns.

Acceptable Noise, Vibration and Harshness

All internal combustion engines and drivelines produce some noise and vibration; operating in a real world environment adds noise that is not subject to control. Vibration isolators, mufflers and dampers reduce these to acceptable levels. A driver who is unfamiliar with a vehicle can think that some sounds are abnormal when actually the sounds are normal for the vehicle type. For example, Traction-Lok® differentials produce a slight noise on slow turns after extended highway driving. This is acceptable and has no detrimental effect on the locking axle function. As a technician, it is very important to be familiar with vehicle features and know how they relate to NVH concerns and their diagnosis. For example, if the vehicle has automatic overdrive, it is important to test drive the vehicle both 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 possible sources.
- 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 or system 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 or system test to make sure the concern has been corrected or brought back to within an acceptable range.

Glossary of Terms

Acceleration-Light

An increase in speed at less than half throttle.

Acceleration-Medium

An increase in speed at half to nearly full throttle, such as 0-97 km/h (0-60 mph) in approximately 30 seconds.

Acceleration-Heavy

An increase in speed at one-half to full throttle, such as 0-97 km/h (0-60 mph) in approximately 20 seconds.

Ambient Temperature

The surrounding or prevailing temperature.

Amplitude

The quantity or amount of energy produced by a vibrating component (G force). An extreme vibration has a high amplitude. A mild vibration has a low amplitude.

Backlash

Gear teeth clearance.

Boom

Low frequency or low pitched noise often accompanied by a vibration. Also refer to Drumming.

Bound Up

An overstressed isolation (rubber) mount that transmits vibration/noise instead of absorbing it.

Brakes Applied

When the service brakes are applied with enough force to hold the vehicle against movement with the transmission in gear.

Buffet/Buffeting

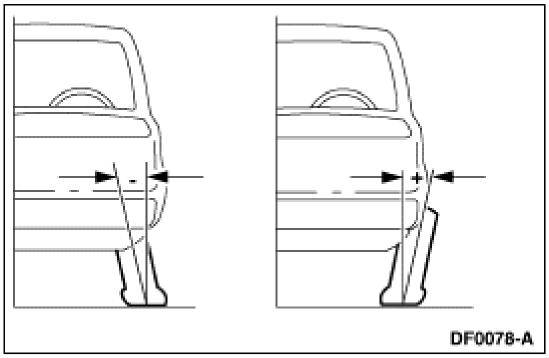
Strong noise fluctuations (less than 1000 Hz) caused by gusting winds. An example would be wind gusts against the side glass.

Buzz

A low-pitched sound like (200-5000 Hz) that from a bee. Often a metallic or hard plastic humming sound. Also describes a high frequency (200-800 Hz) vibration. Vibration feels similar to an electric razor.

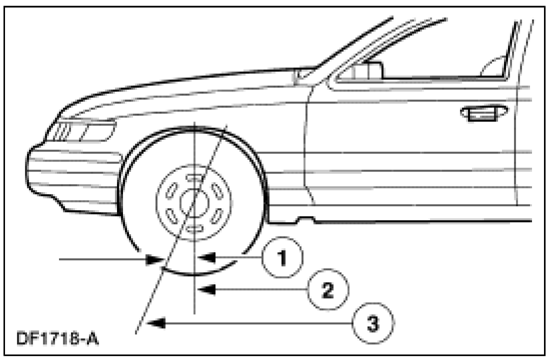
Camber

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.



Item	Description
1	Positive caster
2	True vertical
3	Steering axis

Chatter

A pronounced series of rapidly repeating rattling or clicking sounds.

Chirp

A short-duration high-pitched noise associated with a slipping drive belt.

Chuckle

A repetitious low-pitched sound. A loud chuckle is usually described as a knock.

Click

A sharp, brief, non-resonant sound, similar to actuating a ball point pen.

Clonk

A hydraulic knocking sound. Sound occurs with air pockets in a hydraulic system. Also described as hammering.

Clunk/Driveline Clunk

A heavy or dull, short-duration, low-frequency sound. Occurs mostly on a vehicle that is accelerating or decelerating abruptly. Also described as a thunk.

Coast/Deceleration

Releasing the accelerator pedal at cruise, allowing the engine to reduce vehicle speed without applying the brakes.

Coast/Neutral Coast

Placing the transmission range selector in NEUTRAL (N) or depressing the clutch pedal while at cruise.

Constant Velocity (CV) Joint

A joint used to absorb vibrations caused by driving power being transmitted at an angle.

Controlled Rear Suspension Height

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

Coupling Shaft

The shaft between the transfer case and the front drive axle or, in a two-piece rear driveshaft, the front section.

CPS

Cycles per second. Same as hertz (Hz).

Cracks

A mid-frequency sound, related to squeak. Sound varies with temperature conditions.

Creak

A metallic squeak.

Cruise

Constant speed on level ground; neither accelerating nor decelerating.

Cycle

The process of a vibrating component going through a complete range of motion and returning to the starting point.

Decibel

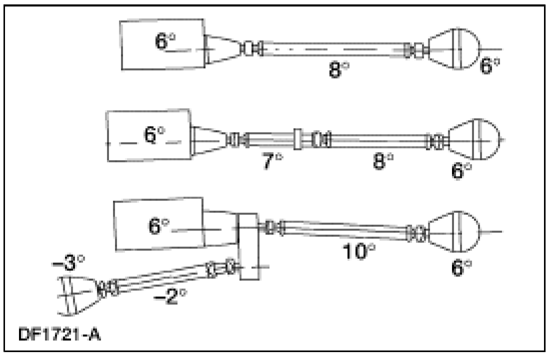
A unit of measurement, referring to sound pressure level, abbreviated dB.

Drive Engine Run-Up (DERU) Test

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

Driveline Angles

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



Driveshaft

The shaft that transmits power to the rear axle input shaft (pinion shaft). In a two-piece driveshaft, 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 transfer case, the driveshaft, and the front or rear 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.

Drone

A low frequency (100-200 Hz) steady sound, like a freezer compressor. Also described as a moan.

Drumming

A cycling, low-frequency (20-100 Hz), rhythmic noise often accompanied by a sensation of pressure on the ear drums. Also described as a low rumble, boom, or rolling thunder.

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.

Engine Imbalance

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

Engine Misfire

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

Engine Shake

An exaggerated engine movement or vibration that directly increases in frequency as the engine speed increases. It is caused by non-equal distribution of mass in the rotating or reciprocating components.

Flexible Coupling

A flexible joint.

Float

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

Flutter

Mid to high (100-2000 Hz) intermittent sound due to air flow. Similar to a flag flapping in the wind.

Frequency

The rate at which a cycle occurs within a given time.

Gravelly Feel

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

Grind

An abrasive sound, similar to using a grinding wheel, or rubbing sand paper against wood.

Hiss

Steady high frequency (200-800 Hz) noise. Vacuum leak sound.

Hoot

A steady low frequency tone (50-500 Hz), sounds like blowing over a long neck bottle.

Howl

A mid-range frequency (200-800 Hz) noise between drumming and whine. Also described as a hum.

Hum

Mid-frequency (200-800 Hz) steady sound, like a small fan motor. Also described as a howl.

Hz

Hertz; a frequency measured in cycles per second.

Imbalance

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

Inboard

Toward the centerline of the vehicle.

Intensity

The physical quality of sound that relates to the strength of the vibration (measured in decibels). The higher the sound's amplitude, the higher the intensity and vice versa.

Isolate

To separate the influence of one component to another.

Knock

A heavy, loud, repetitious sound, like a knock on the door.

Moan

A constant, low-frequency (100-200 Hz) tone. Also described as a hum.

Neutral Engine Run-Up (NERU) 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 return to an unstressed position. Used to describe mounts. Refer to Bound Up.

Outboard

Away from the centerline of the vehicle.

Ping

A short duration, high-frequency sound, which has a slight echo.

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.

Pitch

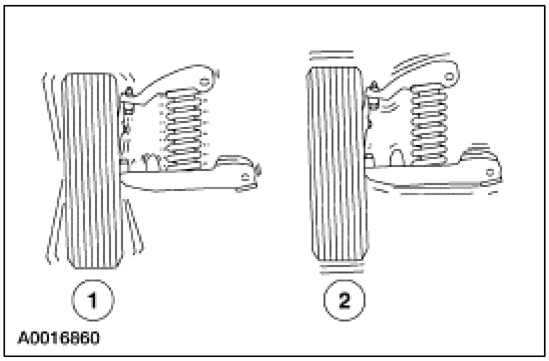
The physical quality of sound that relates to its frequency. Pitch increases as frequency increases and vice versa.

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.



Item	Description
1	Lateral runout
2	Radial runout

Rattle

A random and momentary or short duration noise.

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.

Roughness

A medium-frequency vibration. A slightly higher frequency (20 to 50 Hz) than a shake. This type of vibration is usually related to drivetrain components.

Runout

Lateral runout means measuring the movement or "wobble" of a wheel or tire at the sidewall. Radial runout means measuring the out-of-round at the tread surface.

Rustling

Intermittent sound of varying frequency (100-2000 Hz), sounds similar to shuffling through leaves.

Shake

A low-frequency vibration (5-20 Hz), usually with visible component movement. Usually relates to tires, wheels, brake drums or brake discs if it is vehicle speed sensitive, or engine if it is engine speed sensitive. Also referred to as a shimmy or wobble.

Shimmy

An abnormal vibration or wobbling, felt as a side-to-side motion of the steering wheel in the driveshaft rotation. Also described as waddle.

Shudder

A low-frequency vibration that is felt through the steering wheel or seat during light brake application.

Slap

A resonance from flat surfaces, such as safety belt webbing or door trim panels.

Slip Yoke/Slip Spline

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

Squeak

A high-pitched transient sound, similar to rubbing fingers against a clean window.

Squeal

A long-duration, high-pitched noise.

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.

Tap

A light, rhythmic, or intermittent hammering sound, similar to tapping a pencil on a table edge.

Thump

A dull beat caused by two items striking together.

Tick

A rhythmic tap, similar to a clock noise.

Tip-In Moan

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

TIR

The acronym for total indicated runout is TIR.

Tire Deflection

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

Tire Flat Spots

A condition commonly caused by letting the vehicle stand while the tires cool off. This condition can be corrected by driving the vehicle until the tires are warm. Also, irregular tire wear patterns in the tire tread resulting from wheel-locked skids.

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 can be present on perfectly round tires because of variations in the inner tire construction. This condition can occur at wheel rotation frequency or twice rotation frequency.

Transient

A noise or vibration that is momentary, a short duration.

Two-Plane Balance

Radial and lateral balance.

Vibration

Any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down.

Whine

A constant, high-pitched noise. Also described as a screech.

Whistle

High-pitched noise (above 500 Hz) with a very narrow frequency band. Examples of whistle noises are a turbocharger or airflow around an antenna.

Wind Noise

Any noise caused by air movement in, out or around the vehicle.

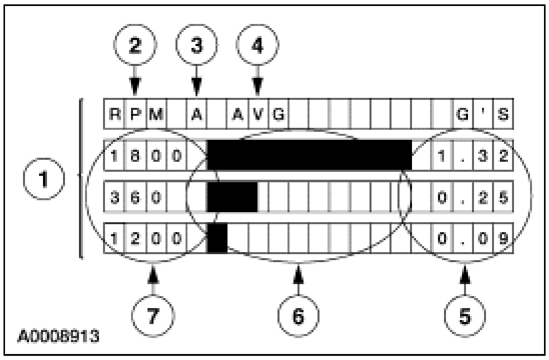
WOT

The acronym for wide open throttle is WOT.

Tools and Techniques

Electronic Vibration Analyzer (EVA)

The EVA is a hand-held electronic diagnostic tool which will assist in locating the source of unacceptable vibrations. The vibration sensor can be remotely mounted anywhere in the vehicle for testing purposes. The unit displays the three most common vibration frequencies and their corresponding amplitudes simultaneously. A bar graph provides a visual reference of the relative signal strength (amplitude) of each vibration being displayed and its relative G force. The keypad is arranged to make the EVA simple to program and use. Some of the functions include the ability to average readings as well as record, play back and freeze readings. The EVA has a strobe balancing function that can be used to detect imbalance on rotating components such as a driveshaft or engine accessories.



Item	Description
1	EVA screen
2	Frequency mode displayed in rpm or Hz
3	Active sensor input (A or B)
4	Current active mode
5	G force indicators or the strongest frequencies in descending strength of each vibration
6	Strength of each vibration
7	Frequency in rpm/Hz of each vibration

The EVA allows for a systematic collection of information that is necessary to accurately diagnose and repair NVH problems. For the best results, carry out the test as follows:

a. Test drive the vehicle with the vibration sensor inside the vehicle.
b. Place the sensor in the vehicle according to feel.
   - If the condition is felt through the steering wheel, the source is most likely in the front of the vehicle.
   - A vibration that is felt in the seat or floor only will most likely be found in the driveline, drive axle or rear wheels and tires.
c. Record the readings. Also note when the condition begins, when it reaches maximum intensity, and if it tends to diminish above/below a certain speed.
   - Frequencies should be read in the "average" mode.
   - Frequencies have a range of plus or minus 2. A reading of 10 Hz can be displayed as an 8 Hz through 12 Hz.
d. Place the vibration sensor on or near the suspect area outside the vehicle.
e. Continue the road test, driving the vehicle at the speed the symptom occurs, and take another reading.
f. Compare the readings.

  - A match in frequency indicates the problem component or area.
  - An unmatched test could indicate the concern is caused by the engine, torque converter, or engine accessory. Use the EVA in the rpm mode and check if concern is rpm related.
  - Example: A vibration is felt in the seat. Place the sensor on the console. Record the readings. Place the vibration sensor on the rear axle. Compare the readings. If the frequencies are the same, the axle is the problem component.

Vibrate Software®

Vibrate Software® (Rotunda tool number 215-00003) is a diagnostic aid which will assist in pinpointing the source of unacceptable vibrations. The engine's crankshaft is the point of reference for vibration diagnosis. Every rotating component will have an angular velocity that is faster, slower, or the same as the engine's crankshaft. Vibrate Software® calculates the angular velocity of each component and graphically represents these velocities on a computer screen and on a printed vibration worksheet. The following steps outline how Vibrate Software® helps diagnose a vibration concern:

- Enter the vehicle information. Vibrate will do all the calculations and display a graph showing tire, driveshaft and engine vibrations.
- Print a Vibration Worksheet graph. The printed graph is to be used during the road test.
- Road test the vehicle at the speed where the vibration is most noticeable. Record the vibration frequency (rpm) and the engine rpm on the worksheet graph. The point on the graph where the vibration frequency (rpm) reading and the engine rpm reading intersect indicates the specific component group causing the concern.
  - An EVA or equivalent tool capable of measuring vibration frequency and engine rpm will be needed.
- Provide pictures of diagnostic procedures to aid in testing components.

Combination EngineEAR/ChassisEAR

An electronic listening device used to quickly identify noise and the location under the chassis while the vehicle is being road tested. The ChassisEARs can identify the noise and location of damaged/worn wheel bearings, CV joints, brakes, springs, axle bearings or driveshaft carrier bearings.

EngineEAR Basic Unit

An electronic listening device used to detect even the faintest noises. The EngineEARs can detect the noise of damaged/worn bearings in generators, water pumps, A/C compressors and power steering pumps. They are also used to identify noisy lifters, exhaust manifold leaks, chipped gear teeth and for detecting wind noise. The EngineEAR has a sensing tip, amplifier, and headphones. The directional sensing tip is used to listen to the various components. Point the sensing tip at the suspect component and adjust the volume with the amplifier. Placing the tip in direct contact with a component will reveal structure-borne noise and vibrations, generated by or passing through, the component. Various volume levels can reveal different sounds.

Ultrasonic Leak Detector

The Ultrasonic Leak Detector is used to detect wind noises caused by leaks and gaps in areas where there is weather-stripping or other sealing material. It is also used to identify A/C leaks, vacuum leaks and evaporative emission noises. The Ultrasonic Leak Detector includes a multi-directional transmitter (operating in the ultrasonic range) and a hand-held detector. The transmitter is placed inside the vehicle. On the outside of the vehicle, the hand-held detector is used to sweep the area of the suspected leak. As the source of the leak is approached, a beeping sound is produced which increases in both speed and frequency.

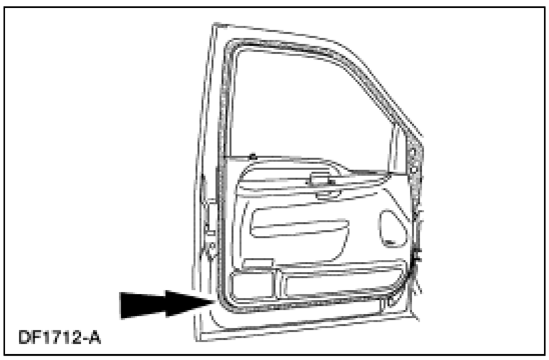
Squeak and Rattle Repair Kit

The squeak and rattle repair kit (Rotunda tool number 164-R4900) contains lubricants and self-adhesive materials that can be used to eliminate interior and exterior squeaks and rattles. The kit consists of the following materials:

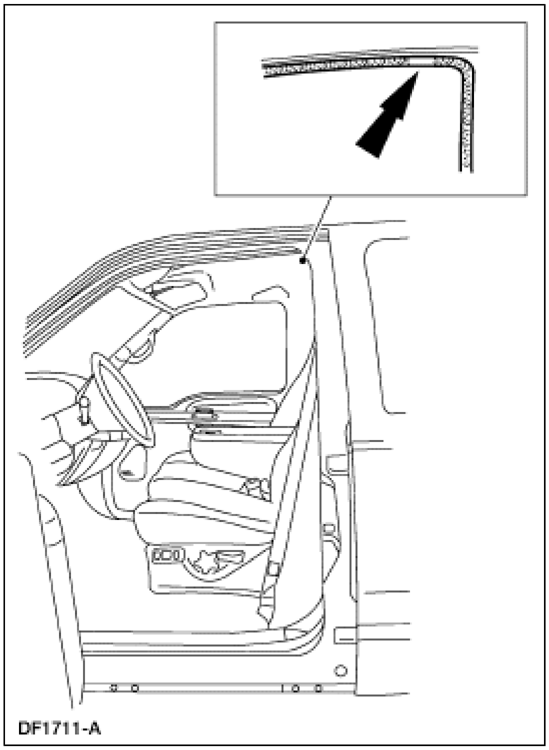
- PVC (soft foam) tape
- Urethane (hard foam) tape
- Flocked (black fuzzy) tape
- UHMW (frosted) tape
- Squeak and rattle oil tube
- Squeak and rattle grease tube

Tracing Powder

Tracing powder is used to check both the uniformity of contact and the tension of a seal against its sealing surface. These tests are usually done when a suspected air leak/noise appears to originate from the seal area or during the alignment and adjustment of a component to a weatherstrip. Tracing powder can be ordered from Crest Industries as ATR Leak Trace. Carry out the tracing powder test as follows:

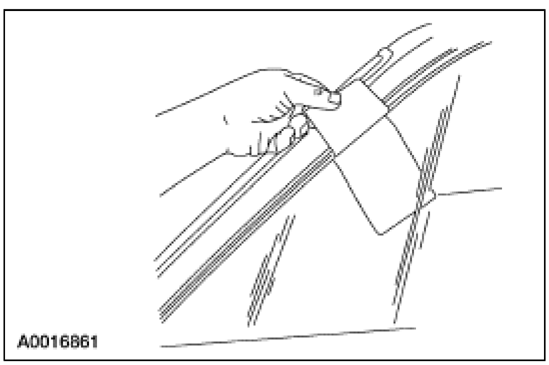


a. Clean the weatherstrip.
b. Spray the tracing powder on the mating surface only.
c. Close the door completely. Do not slam the door.
d. Open the door. An imprint is made where the weatherstrip contacted the mating surface seal. Gaps or a faint imprint will show where there is poor contact with the weatherstrip.



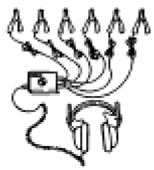
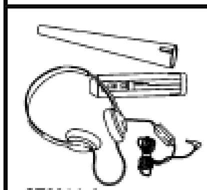
Index Card

Place an index card or a piece of paper between the weatherstrip and the sealing surface, then close the door. Slowly withdraw the index card or paper after the door is closed and check the amount of pressure on the weatherstrip. There should be a medium amount of resistance as it is withdrawn. Continue around the entire seal area. If there is little or no resistance, this indicates insufficient contact to form a good seal. At these points, the door, the glass, or the weatherstrip is out of alignment.



Noise, Vibration And Harshness (NVH)

Special Tool(s)

 ST2048-A	ChassisEAR 107-R2102 or Equivalent
 ST2311-A	Vibration Analyzer 100-F027 (014-00344) or Equivalent
 ST2312-A	EngineEAR 107-R2100 or Equivalent
 ST2314-A	Ultrasonic Leak Detector 134-R0135 or Equivalent

To assist the service advisor and the technician, a Write-up Job Aid and an NVH Diagnostic Guide are included with this material. The Write-up Job Aid serves as a place to record all important symptom information. The NVH Diagnostic Guide serves as a place to record information reported on the Write-up Job Aid as well as data from the testing to be carried out.

To begin a successful diagnosis, fill out the NVH Diagnostic Guide, record the reported findings, then proceed to each of the numbered process steps to complete the diagnosis.

"WRITE-UP" JOB AID

REPAIR ORDER # ____________________

CUSTOMER CONCERN # ____________________

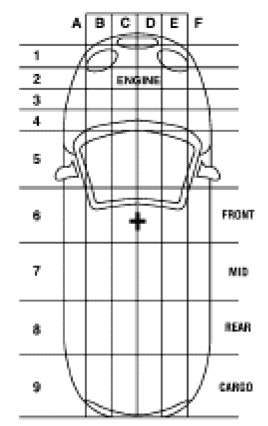
SPECIFIC SENSE IDENTIFICATION AND LOCATION ON VEHICLE OF CUSTOMER SYMPTOM(S)

INSTRUCTIONS: Check below sense affected and location of concern on the generic vehicle illustration (darken the vehicle area). Plus circle appropriate responses to the right.

NOTE: Shaded backgrounds indicate caution areas. Selection of two or more caution areas "flag" difficult repairs. In general, shaded areas are the more difficult to verify and repair, and require all applicable columns to be completed.

SEE YES ☐ FEEL YES ☐

HEAR YES ☐ SMELL YES ☐



VEHICLE SYMPTOM AREA	HOW OFTEN?	VEHICLE OPERATING MODE	VEHICLE CONDITIONS	VEHICLE SPEED(mph)	WHEN VEHICLE IS?	AMBIENT CONDITION
Front of Vehicle	Always	Start Up	Accessories On	0	Turning Left	____° Below Zero
Engine Compartment	Daily A.M. P.M.	Idle	(define below)	1-9	Turning Right	Below Freezing (0°-19°)
Dash	Conditional	Gear Selection	Windows Open	10-19	Over Bumps	Below Freezing (20°-32°)
Steering Wheel	Weekly	Accel Light	4x4	20-29	Up Hills	33°-49°
Accelerator Pedal	Monthly	Accel Moderate	Hauling	30-39	Down Hills	50°-69°
Brake Pedal	Intermittent	Accel Heavy	Towing	40-49	Shifting	70°-89°
Clutch Pedal	Unknown	Steady Speed	Snow Plowing	50-59	Parked	90°+
Seat		Deceleration	Other	60-69	In Traffic	Sunny
Rear of Vehicle		Neutral	(define below)	70+		Dry
Top of Vehicle		Reverse		ENGINE		Windy
Floor Pan		Stopping/Braking		TEMP		Wet/Humid
Under Vehicle				Cold		Rain
Other (define below)				Normal		Snow
				Hot		Ice

DEALER VERIFICATION

	YES	NO
SERVICE ADVISOR	☐	☐
SHOP FOREMAN	☐	☐
SERVICE MANAGER	☐	☐
QC MANAGER	☐	☐
TECHNICIAN	☐	☐
VERIFIED WITH CUSTOMER	☐	☐

WHAT THE CUSTOMER SAID

OASIS SYMPTOM CODE(S)

VIN NUMBER

A0017007

NVH DIAGNOSTIC GUIDE

Dealer: ______________________________ Date: ________

P.A. Code: ________ Order No. ____________ Technician: ____________

Owner's Name: ______________ Address: ______________

Phone No. Home: ______________ Work: ______________

Vehicle Make: ________ Model: ______________ Year: ______

VIN: ________ Mileage: ______ Engine: ______ Trans: ______ Axle: ____

OWNER'S DESCRIPTION OF COMPLAINT:

Did Condition Exist When Vehicle Was New? **Yes / No** (circle one)

How Did Condition Begin? Gradually ☐ Suddenly ☐

At What Mileage Did It Occur Or Begin Occuring? ______________

Which Driving Conditions Affect The Vehicle?

Light Accel ☐ Closed Throttle Decel ☐ Brakes Applied/Released ☐

Medium Accel ☐ Coast (Float) ☐ Driving The Vehicle: Straight ☐

Heavy Accel ☐ Constant Speed ☐ Cornering ☐

Is Vibration Noticed? If So, Where:

Seat ☐ Steering Wheel ☐ Instrument Panel ☐ Floor ☐ Body Panels ☐ Ft/Rr of Vehicle ☐

Is There Sound Or Sensation Of Sound? **Yes / No** (circle one)

If So, Describe The Sound :

Boom ☐ Hum ☐ Whine ☐ Growl ☐ Other: ____________

Drone ☐ Tip-In-Moan ☐ Squeak ☐ Rattle ☐

PREDRIVE CHECKS

Tire Condition/Pressure: ______________

Vehicle Body Damage? ______________

Other: ______________

ROAD TEST:

Vibration/Noise Occurs:

Vehicle Speed ________ Accel ________ Vibration Frequency ________ Hz/RPM

Gear Range ________ Decel/Coast ________ Engine Speed ________ RPM

ENGINE RUN-UP TESTS

Neutral Engine Run-Up (NERU) **Yes / No** Engine RPM ______ Vibration/Frequency ______ Hz/RPM

Drive Engine Run-Up (DERU) **Yes / No** Engine RPM ______ Vibration/Frequency ______ Hz/RPM

Drivetrain Run-Up (DTRU) **Yes / No** Engine RPM ______ Vibration/Frequency ______ Hz/RPM

Indicate Suspected Area of Concern:

Tire/Wheel/Brakes ☐ Engine/Accessory ☐ Rear ☐

Driveline/Axle ☐ Susp/Steering ☐ Right ☐

Body ☐ Front ☐ Left ☐

Other ______________

Equipment Used:

Reed Tachometer ☐ Electronic Noise Detector ☐ Tape ☐

Engine Tachometer ☐ Ultrasonic Leak Detector ☐ Other ________

DF1688-A

WHEEL/TIRE/BRAKES CHECK:

Balance Check **Yes / No**

Maximum Runout Allowed:

Wheel: Radial ________ Lateral ________

Tire: Radial ________ Lateral ________

Measured Runout:

Tire/Wheel	Radial:	LF ________	LR ________	RF ________	RR ________
	Lateral:	LF ________	LR ________	RF ________	RR ________
Wheel Only	Radial:	LF ________	LR ________	RF ________	RR ________
	Lateral:	LF ________	LR ________	RF ________	RR ________

SUSPENSION INSPECTION:

Can Cause: Shimmy ☐ Clunk ☐ Squeak ☐ Harshness ☐

Suspension Bushings: Loose ☐ Worn ☐ Missing ☐ OK ☐

Front Upper Control Arm ☐ Stabilizer (sway bar) ☐ Rear Lower Control Arm ☐

Front Lower Control Arm ☐ Rear Upper Control Arm ☐ Rear Upper Control Arm ☐

Other ________________________________

Suspension/Steering Components: Loose Worn Missing OK

Ball Joints ☐ Idler Arm ☐ Pitman Arm ☐

Shock Absorbers F/R ☐ Center Link ☐ Steering Gear ☐

Springs F/R ☐ Tie Rod Ends/Sleeve ☐ Steering Coupler ☐

DRIVESHAFT CONDITION: Noise ☐ Vibration ☐

Balance Weights Missing/Other Visual Defects? **Yes / No**

Maximum Allowable Runout: ________________

Actual Runout: Front ________ Middle ________ Rear ________

Two-Piece Driveshaft Runout: Front ________ Rear ________

Middle Support Bearing: Loose ☐ Damaged ☐ Worn ☐ Other ________

Suspect Driveshaft Balanced? **Yes / No**

Pinion Angle: Engine Height: Specification ________ Actual ________

Pinion Angle: Specification ________ Actual ________

Driveline Angle - Truck: Specification ________ Actual ________

ENGINE/ACCESSORY CHECK:

Visual Inspection for Damage or Grounded Condition:

Powertrain Mounts ☐ Fuel Lines ☐ A/C Lines ☐ Power Steering/Cooler Lines ☐

Air Intake ☐ Accessories ☐ Exhaust ☐ Radiator/Condensor ☐

BODY (NOISE/RATTLE)

Indicate Suspected Area of Concern: Doors ☐ Windows ☐ Dash Panel ☐ Other ________

Tests Used to Isolate

NVH Concern: Vacuum/Leak Detector ☐ Ultrasonic Leak Detector ☐ Tracing Powder ☐

Electronic Noise Detector ☐ Other ________________

ROAD/ENGINE RUN-UP TESTS: Improved? **Yes / No** Vehicle Acceptable? **Yes / No**

Comments: ________________________________

A0008914

1: Customer Interview

The diagnostic process starts with the customer interview. The service advisor must obtain as much information as possible about the problem and take a test drive with the customer. There are many ways a customer will describe NVH concerns and this will help minimize confusion arising from descriptive language differences. It is important that the concern is correctly interpreted and the customer descriptions are recorded. During the interview, ask the following questions:

- When was it first noticed?
- Did it appear suddenly or gradually?
- Did any abnormal occurrence coincide with or proceed its appearance?

Use the information gained from the customer to accurately begin the diagnostic process.

2: Pre-Drive Check

It is important to do a pre-drive check before road testing the vehicle. A pre-drive check verifies that the vehicle is relatively safe to drive and eliminates any obvious faults on the vehicle.

The pre-drive check consists of a brief visual inspection. During this brief inspection, take note of anything that will compromise safety during the road test and make those repairs/adjustments before taking the vehicle on the road.

3: Preparing for the Road Test

Observe the following when preparing for the road test:

- Review the information recorded on the NVH Diagnostic Guide. It is important to know the specific concern the customer has with the vehicle.
- Do not be misled by the reported location of the noise/vibration. The cause can actually be some distance away.
- Remember that the vibrating source component (originator) may only generate a small vibration. This small vibration can in turn cause a larger vibration/noise to emanate from another receiving component (reactor), due to contact with other components (transfer path).
- Conduct the road test on a quiet street where it is safe to duplicate the vibration/noise. The ideal testing route is an open, low-traffic area where it is possible to operate the vehicle at the speed in which the condition occurs.
- If possible, lower the radio antenna in order to minimize turbulence. Identify anything that could potentially make noise or be a source of wind noise. Inspect the vehicle for add-on items that create vibration/noise. Turn off the radio and the heating and cooling system blower.
- The engine speed is an important factor in arriving at a final conclusion. Therefore, connect an accurate tachometer to the engine, even if the vehicle has a tachometer. Use a tachometer that has clearly defined increments of less than 50 rpm. This ensures an exact engine speed reading.

4: Verify the Customer Concern

Verify the customer concern by carrying out a road test, an engine run-up test, or both.

The decision to carry out a road test, an engine run-up test, or both depends on the type of NVH concern. A road test may be necessary if the symptom relates to the suspension system or is sensitive to torque. A Drive Engine Run-Up (DERU) or a Neutral Engine Run-Up (NERU) Test identifies noises and vibrations relating to engine and drivetrain rpm. Remember, a condition will not always be identifiable by carrying out these tests, however, they will eliminate many possibilities if carried out correctly.

5: Road Test

NOTE: It may be necessary to have the customer ride along or drive the vehicle to point out the concern. During the road test, take into consideration the customer's driving habits and the driving conditions. The customer's concern just may be an acceptable operating condition for that vehicle.

The following is a brief overview of each test in the order in which it appears. A review of this information helps to quickly identify the most appropriate process necessary to make a successful diagnosis. After reviewing this information, select and carry out the appropriate test(s), proceeding to the next step of this process.

- The Slow Acceleration Test is normally the first test to carry out when identifying an NVH concern, especially when a road test with the customer is not possible.
- The Heavy Acceleration Test helps to determine if the concern is torque-related.
- The Neutral Coast Down Speed Test helps to determine if the concern is vehicle speed-related.
- The Downshift Speed Test helps to determine if the concern is engine speed-related.
- The Steering Input Test helps to determine how the wheel bearings and other suspension components contribute to a vehicle speed-related concern.
- The Brake Test helps to identify vibrations or noise that are brake related.
- The Road Test Over Bumps helps isolate a noise that occurs when driving over a rough or bumpy surface.
- The Engine Run-Up Tests consist of the Neutral Run-Up Test and the Engine Load Test. These tests help to determine if the concern is engine speed-related.
- The Neutral Run-Up Test is used as a follow-up test to the Downshift Speed Test when the concern occurs at idle.
- The Engine Load Test helps to identify vibration/noise sensitive to engine load or torque. It also helps to reproduce engine speed-related concerns that cannot be duplicated when carrying out the Neutral Run-Up Test or the Neutral Coast Down Test.
- The Engine Accessory Test helps to locate faulty belts and accessories that cause engine speed-related concerns.
- The Vehicle Cold Soak Procedure helps to identify concerns occurring during initial start-up and when an extended time lapse occurs between vehicle usage.

Slow Acceleration Test

To carry out this test, proceed as follows:

- Slowly accelerate to the speed where the reported concern occurs. Note the vehicle speed, the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify from what part of the vehicle the concern is coming.
- Attempt to identify the source of the concern.
- Proceed as necessary.

Heavy Acceleration Test

To carry out this test, proceed as follows:

- Accelerate hard from 0-64 km/h (0-40 mph).
- Decelerate in a lower gear.

- The concern is torque related if duplicated while carrying out this test.
- Proceed as necessary.

Neutral Coast Down Speed Test

To carry out this test, proceed as follows:

- Drive at a higher rate of speed than where the concern occurred when carrying out the Slow Acceleration Test.
- Place the transmission in NEUTRAL and coast down past the speed where the concern occurs.
- The concern is vehicle speed-related if duplicated while carrying out this test. This eliminates the engine and the torque converter as sources.
- If the concern was not duplicated while carrying out this test, carry out the Downshift Speed Test to verify if the concern is engine speed related.
- Proceed as necessary.

Downshift Speed Test

To carry out this test, proceed as follows:

- Shift into a lower gear than the gear used when carrying out the Slow Acceleration Test.
- Drive at the engine rpm where the concern occurs.
- The concern is engine speed related if duplicated while carrying out this test. This eliminates the tires, wheels, brakes and the suspension components as sources.
- If necessary, repeat this test using other gears and NEUTRAL to verify the results.
- Proceed as necessary.

Steering Input Test

To carry out this test, proceed as follows:

- Drive at the speed where the concern occurs, while making sweeping turns in both directions.
- If the concern goes away or gets worse, the wheel bearings, hubs, U-joints (contained in the axles of 4WD applications), and tire tread wear are all possible sources.
- Proceed as necessary.

Brake Test

To carry out this test, proceed as follows:

- Warm the brakes by slowing the vehicle a few times from 80–32 km/h (50–20 mph) using light braking applications. At highway speeds of 89–97 km/h (50–60 mph), apply the brake using a light pedal force.
- Accelerate to 89–97 km/h (55–60 mph).

- Lightly apply the brakes and slow the vehicle to 30 km/h (20 mph).
- A brake vibration noise can be felt in the steering wheel, seat or brake pedal. A brake noise can be heard upon brake application and diminish when the brake is released.

Road Test Over Bumps

To carry out this test, proceed as follows:

- Drive the vehicle over a bump or rough surface one wheel at a time to determine if the noise is coming from the front or the back and the left or the right side of the vehicle.
- Proceed as necessary.

Neutral Engine Run-Up (NERU) Test

To carry out this test, proceed as follows:

- Install a tachometer.
- Increase the engine rpm up from an idle to approximately 4000 rpm while in PARK on front wheel drive vehicles with automatic transmissions, or NEUTRAL for all other vehicles. Note the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify what part of the vehicle the concern is coming from.
- Attempt to identify the source of the concern.
- Proceed as necessary.

Drive Engine Run-Up (DERU) Load Test

To carry out this test, proceed as follows:

- **WARNING: Block the front and rear wheels, and apply the parking brake and the service brake, or injury to personnel can result.**

  CAUTION: Do not carry out the Engine Load Test for more than five seconds or damage to the transmission or transaxle can result.

  Block the front and rear wheels.
- Apply the parking brake and the service brake.
- Install a tachometer.
- Shift the transmission into DRIVE, and increase and decrease the engine rpm between an idle to approximately 2000 rpm. Note the engine rpm and, if possible, determine the vibration frequency.
- Repeat the test in REVERSE.
- If the vibration/noise is duplicated when carrying out this test, inspect the engine and transmission or transaxle mounts.
- If the concern is definitely engine speed-related, carry out the Engine Accessory Test to narrow down the source.
- Proceed as necessary.

Engine Accessory Test

To carry out this test, proceed as follows:

- **WARNING: Block the front and rear wheels, and apply the parking brake and the service brake, or injury to personnel can result.**

  CAUTION: Limit engine running time to one minute or less with belts removed or serious engine damage will result.

  NOTE: A serpentine drive belt decreases the usefulness of this test. In these cases, use a vibration analyzer, such as the VA, to pinpoint accessory vibrations. An electronic listening device, such as an EngineEAR, will also help to identify noises from specific accessories.

  Remove the accessory drive belts.
- Increase the engine rpm to where the concern occurs.
- If the vibration/noise is duplicated when carrying out this test, the belts and accessories are not sources.
- If the vibration/noise was not duplicated when carrying out this test, install each accessory belt, one at a time, to locate the source.

Vehicle Cold Soak Procedure

To carry out this procedure, proceed as follows:

- Test preparations include matching customer conditions (if known). If not known, document the test conditions: gear selection and engine rpm. Monitor the vibration/noise duration with a watch for up to three minutes.
- Park the vehicle where testing will occur. The vehicle must remain at or below the concern temperature (if known) for 6-8 hours.
- Before starting the engine, conduct a visual inspection under the hood.
- Turn the key on, but do not start the engine. Listen for the fuel pump, anti-lock brake system (ABS) and air suspension system noises.
- Start the engine.
- **CAUTION: Never probe moving parts.**

  Isolate the vibration/noise by carefully listening. Move around the vehicle while listening to find the general location of the vibration/noise. Then, search for a more precise location by using a stethoscope or EngineEAR.
- Refer to Idle Noise/Vibration in the Symptom Chart to assist with the diagnosis.

6: Check OASIS/TSBs/Repair History

After verifying the customer concern, check for OASIS reports, TSBs and the vehicle repair history for related concerns. If information relating to a diagnosis/repair is found, carry out the procedure(s) specified in that information.

If no information is available from these sources, carry out the vehicle preliminary inspection to eliminate any obvious faults.

7: Diagnostic Procedure

Qualifying the concern by the particular sensation present can help narrow down the concern. Always use the "symptom" to "system" to "component" to "cause" diagnosis technique. This diagnostic method divides the problem into related areas to correct the customer concern.

- Verify the "symptom".
- Determine which "system(s)" can cause the "symptom".
  - If a vibration concern is vehicle speed related, the tire and wheel rpm/frequency or driveshaft frequency should be calculated.
  - If a vibration concern is engine speed related, the engine, engine accessory or engine firing frequencies should be calculated.
- After determining the "system", use the diagnostic tools to identify the worn or damaged "components".
- After identifying the "components", try to find the "cause" of the failure.

Once the concern is narrowed down to a symptom/condition, proceed to NVH Condition and Symptom Categories.

NVH Condition and Symptom Categories

A good diagnostic process is a logical sequence of steps that lead to the identification of a causal system. Use the condition and symptom categories as follows:

- Identify the operating condition that the vehicle is exhibiting.
- Match the operating condition to the symptom.
- Verify the symptom.
- Identify which category or system could cause the symptom.
- Refer to the diagnostic symptom chart that is referred to.

Operating Condition—Vehicle is Not Moving

1. Static operation
   - Noise occurs during component/system functioning. GO to Symptom Chart — Squeak and Rattle .

2. While cranking
   1. Grinding or whine, differential ring gear or starter motor pinion noise. GO to Symptom Chart — Engine Noise/Vibration .
   2. Rattle. Exhaust hanger, exhaust heat shield or A/C line noise. GO to Symptom Chart — Squeak and Rattle .
   3. Vibration. Acceptable condition.

3. At idle

- Idle noise. GO to Symptom Chart — Idle Noise/Vibration .
- Idle vibration or shake. GO to Symptom Chart — Idle Noise/Vibration .

4. During Gear Selection
    1. Vehicle parked on a steep incline. Acceptable noise.
    2. Vehicle parked on a flat surface. GO to Symptom Chart — Driveline Noise/Vibration .
    3. Vehicle with a manual transmission. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .

Operating Condition—Vehicle is Moving

1. Depends more on how the vehicle is operated
    1. Speed related
        - Related to vehicle speed
            - Pitch increases with vehicle speed. GO to Symptom Chart — Tire Noise/Vibration .
            - Noise occurs at specific vehicle speed. A high-pitched noise (whine). GO to Symptom Chart — Driveline Noise/Vibration .
            - Loudness proportional to vehicle speed. Low-frequency noise at high speeds, noise and loudness increase with speed. GO to Symptom Chart — Driveline Noise/Vibration .
            - A low-pitched noise (drumming). GO to Symptom Chart — Engine Noise/Vibration .
            - Vibration occurs at a particular speed (mph) regardless of acceleration or deceleration. GO to Symptom Chart — Tire Noise/Vibration .
            - Noise varies with wind/vehicle speed and direction. GO to Symptom Chart — Air Leak and Wind Noise .
        - Related to engine speed
            - Noise varies with engine rpm. GO to Symptom Chart — Engine Noise/Vibration .
            - Vibration occurs at a particular speed (mph) regardless of engine speed (rpm).
    2. Acceleration
        - Wide open throttle (WOT)
            - Engine induced contact between components. Inspect and repair as necessary.
            - Noise is continuous throughout WOT. Exhaust system or engine ground out. GO to Symptom Chart — Engine Noise/Vibration .
        - Light/moderate acceleration
            - Tip-in moan. Engine/exhaust noise. GO to Symptom Chart — Engine Noise/Vibration .
            - Knock-type noise. GO to Symptom Chart — Engine Noise/Vibration .
            - Driveline shudder. GO to Symptom Chart — Driveline Noise/Vibration .
            - Engine vibration. GO to Symptom Chart — Engine Noise/Vibration .
    3. Turning noise. GO to Symptom Chart —Steering Noise/Vibration .
    4. Braking
        - Clicking sound is signaling ABS is active. Acceptable ABS sound.
        - A continuous grinding/squeal. GO to Symptom Chart — Brake Noise/Vibration .
        - Brake vibration/shudder. GO to Symptom Chart — Brake Noise/Vibration .
    5. Clutching
        - A noise occurring during clutch operation. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
        - Vibration. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
    6. Shifting
        - Noise or vibration condition related to the transmission (automatic). GO to Symptom Chart — Transmission (Automatic) Noise/Vibration .

        - Noise or vibration related to the transmission (manual). GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
    7. Engaged in four-wheel drive. GO to Symptom Chart — Transmission (Manual) and Transfer Case Noise/Vibration .
    8. Cruising speeds
        - Accelerator pedal vibration. GO to Symptom Chart — Engine Noise/Vibration .
        - Driveline vibration. GO to Symptom Chart — Driveline Noise/Vibration .
        - A shimmy or shake. GO to Symptom Chart — Tire Noise/Vibration .
    9. Driving at low/medium speeds
        - A wobble or shudder. GO to Symptom Chart — Tire Noise/Vibration .

2. Depends more on where the vehicle is operated
    1. Bump/pothole, rough road or smooth road. GO to Symptom Chart — Suspension Noise/Vibration .
        - Noise is random or intermittent occurring from road irregularities. GO to Symptom Chart — Squeak and Rattle .
        - Noise or vibration changes from one road surface to another. Normal sound changes.
        - Noise or vibration associated with a hard/firm ride. GO to Symptom Chart — Suspension Noise/Vibration .

Symptom Charts

Symptom Chart — Air Leak and Wind Noise

Condition	Possible Sources	Action
• Air leak around door perimeter	• Loose fit seal.	• PINCH the seal carrier to improve retention on the seal flange.
	• Seal installed incorrectly.	• REINSTALL the seal.
	• Door misaligned.	• REALIGN the door. CHECK door gaps and fit in the door opening and ADJUST as necessary.
	• Scuff plate installed incorrectly.	• REINSTALL the scuff plate.
	• Seal or seal push pins damaged.	• INSTALL a new seal.
• Air leak around glass run	• Door glass misaligned.	• ADJUST the door glass.
	• Glass run installed incorrectly.	• ADJUST the glass run. INSERT foam in the glass run carrier.
	• Leak path behind glass run.	• INSTALL foam rope behind the glass run.
	• Glass run channel spread wide.	• PINCH the glass run channel to reduce the size of the opening.
	• Blow-out clip bent or contacting door glass.	• ADJUST the blow-out clip or INSTALL a new glass

		run/blow-out clip molding assembly.
	• Glass run damaged.	• INSTALL a new glass run.
• Air leak at inner belt line	• Belt line seal installed incorrectly on flange.	• ADJUST the seal. (Do not bend the flange.)
	• Belt line seal integrated with door trim installed incorrectly (no glass contact).	• REINSTALL the door trim.
	• No contact with side glass.	• ADJUST the door glass.
	• No contact with glass runs at both ends of belt line seal.	• ADJUST the belt line seal or ADD foam at the seal ends.
	• Belt line seal damaged.	• INSTALL a new seal.
• Air leak at outer belt line	• Belt line seal installed incorrectly on flange (no glass contact).	• ADJUST the seal.
	• Belt line seal does not contact the glass.	• ADJUST the door glass.
	• No contact with glass runs at both ends of belt line seal.	• ADJUST the belt line seal/ADD foam at the seal ends.
	• Belt line seal damaged.	• INSTALL a new seal.
• Draft at inner door handle/speaker opening	• Hole in watershield.	• SEAL the hole with a suitable tape.
	• Watershield misaligned.	• REALIGN the watershield. INSTALL a new watershield if the pressure sensitive adhesive fails.
	• Exterior door handle seal misaligned/damaged.	• REALIGN or INSTALL a new seal as necessary.
• Wind noise from side view mirror	• Outside mirror housing misaligned.	• REALIGN with the edges shingled correctly and no gaps.
	• Mirror sail gasket folded/misaligned.	• REINSTALL with the gasket unfolded and aligned correctly.
	• Mirror housing trim cap installed incorrectly.	• REINSTALL with the edges shingled to the air flow.
	• Air leak through mirror housing hinge.	• Fully ENGAGE the mirror into its operating position/USE foam to block the air path through the hinge.
	• Inner sail trim installed incorrectly.	• REINSTALL the sail trim/ADJUST the door trim.
	• Inner sail gasket/barrier installed incorrectly.	• REINSTALL the trim cover with the gasket/barrier aligned correctly.

	• Air path through wiring bundle/fastener access holes. • Exposed fastener access hole on mirror housing/sail.	• BLOCK the air path(s) with foam/tape. • INSTALL a new cap if it is missing.
• Air leak around perimeter of fixed glass	• Gaps in the sealant bead. • Air traveling up windshield molding along A-pillar. • Windshield/backlite misaligned or not installed correctly. • Rear hood seal at base of windshield misaligned/damaged.	• APPLY approved sealant. • INSTALL foam rope the full length of the A-pillar. • REINSTALL the windshield/backlite. • REALIGN or INSTALL a new seal as necessary.
• Air leak at cowl	• Cowl gasket misaligned/damaged.	• REALIGN or INSTALL a new seal as necessary.
• Air leak around liftgate perimeter	• Loose fit seal. • Seal misaligned. • Liftgate misaligned. • Scuff plate misaligned. • Seal or seal push pins damaged.	• PINCH the seal carrier to improve retention on the seal flange or INSERT foam in the carrier. • REINSTALL the seal. • REALIGN the liftgate. CHECK the liftgate fit in the body opening and ADJUST as necessary. • REINSTALL the scuff plate. • INSTALL a new seal.
• Air leak around the liftgate flip window perimeter	• Loose fit seal. • Seal misaligned. • Glass misaligned. • Seal damaged.	• PINCH the seal carrier to improve the retention to the seal flange. • REINSTALL the seal. • REALIGN the glass. • INSTALL a new seal.
• Wind noise from antenna	• Shape of antenna. • Air leak around antenna cable access hole.	• INSTALL an antenna boot or a spiral antenna. • INSPECT the antenna access hole grommet. REPAIR as necessary.
• Air leak from closed roof opening panel	• Seal installed incorrectly. • Roof opening panel glass/door misaligned. • Roof opening panel damaged.	• REINSTALL the seal. • REALIGN the roof opening panel glass/door. • INSTALL a new roof opening panel.

• Buffeting from an open roof opening panel	• Wind deflector inoperative/damaged. • Wind deflector height incorrect.	• REPAIR or INSTALL a new wind deflector as necessary. • ADJUST the wind deflector higher.
• Wind noise created by airflow over or behind body panels	• Fender splash shield misaligned. • Body panel misaligned (exposed edge). • Hood misaligned (front margin). • Front grille edge noise.	• REALIGN the fender splash shield. • REALIGN the appropriate body panel. • CHECK hood gaps and fit. ADJUST the hood as necessary. • APPLY foam in the hollow areas behind the louvers.
• Wind noise created by grille opening panel	• Grille relationship to leading edge on hood. • Sharp edges due to material imperfections.	• ADJUST the grille opening panel forward to eliminate wind noise. • REMOVE the sharp edges (no damage to visible surface).
• Wind noise from air extractor	• Air extractor housing seated incorrectly. • Air extractor housing or flaps damaged.	• REINSTALL the air extractor housing. • INSTALL a new air extractor.
• Air leak at top of A-pillar — vehicles with a convertible top	• Seal at windshield header installed incorrectly. • Seal pinched. • Gap between side rail and header seal at A-pillar.	• REINSTALL the seal. • FILL the seal with foam to reshape it. • ADJUST the J-hook/vinyl top.
• Air leak at rear quarter glass (division bar) — vehicles with a convertible top	• No contact between front side glass and quarter glass division bar.	• ADJUST the front side glass regulator and the rear quarter glass regulator.
• Air leak or wind noise from top of side glass — vehicles with a convertible top	• Gap between side rail and vinyl top. • Seal at windshield header installed incorrectly. • Seal damaged between side rail and vinyl top. • Vinyl top damaged.	• ADD additional foam tape to seal between the side rail and the vinyl top. • REINSTALL the seal. • INSTALL a new seal. • INSPECT the vinyl top.

		INSTALL a new vinyl top as necessary.
• Air leak or wind noise at windshield header — vehicles with a convertible top	• Vinyl top not flush with header.	• ADJUST the J-hook to lower the top to achieve a flush condition.
	• Seal at windshield header installed incorrectly.	• REINSTALL the seal.
	• Header seal not flush with header.	• REINSTALL the seal.
• Convertible top flapping with the top up	• Vinyl top contacting interior headliner.	• Working from front to back, INSTALL a 6.35 mm (0.25 in) foam sheet between the headliner and the vinyl top at the suspected area. Allow a clearance of 50 mm (2 in) - 75 mm (3 in) away from the roof bows and the side rails.
• Noise from roof rack	• Roof rack rails or crossbars loose.	• TIGHTEN the fasteners.
	• Roof rack fasteners missing.	• INSTALL the approved fasteners.
	• Roof rack crossbars installed backward.	• REINSTALL the crossbars.
	• Roof rack rub strips partially lifting from roof.	• REAPPLY adhesive or fasteners or INSTALL new rub strips as necessary.
	• Roof rack gaskets loose or misaligned.	• REINSTALL the gasket.
• Wind noise from bug shield/exterior windshield sun visor	• Turbulence created by location and shape.	• REMOVE per customer direction if it is a dealer installed option.

Symptom Chart—Brake Noise/Vibration

Condition	Possible Sources	Action
• Rattling noise	• Caliper mounting bolts loose.	• CHECK the caliper bolts. TIGHTEN to specifications. REFER to Section 206-03 for the front disc brake pads or Section 206-04 for the rear disc brake pads.
	• Damaged or worn caliper pins or retainers.	• CHECK the caliper pins and retainers for lubrication and correct fit. LUBRICATE or INSTALL new components as necessary. REFER to Section 206-03 for the front disc brake pads or Section 206-04 for the rear disc brake pads.

	• Missing or damaged anti-rattle clips or springs.	• CHECK the brake pads for missing clips or broken springs. INSTALL new components as necessary. REFER to Section 206-03 for the front disc brakes pads or Section 206-04 for the rear disc brake pads.
	• Loose brake disc shield.	• TIGHTEN the brake disc shield bolts to specification. REFER to Section 206-03 .
• Clicking noise—with brakes applied with ABS brakes	• ABS hydraulic control unit.	• Acceptable condition.
• Squealing noise—occurs on first (morning) brake application	• Disc brake pads.	• Acceptable condition. Caused by humidity and low disc brake pad temperature.
• Squealing noise—a continuous squeal	• Disc brake pads or linings worn below minimum thickness.	• INSTALL new disc brake pads. REFER to Section 206-03 for the front disc brake pads or Section 206-04 for the rear disc brake pads.
• Squealing noise—an intermittent squeal brought on by cold, heat, water, mud or snow	• Disc brake pad.	• Acceptable condition.
• Groaning noise—occurs at low speeds with brake lightly applied (creeping)	• Disc brake pads.	• Acceptable condition.
• Grinding noise—continuous	• Disc brake pads or linings worn below minimum thickness.	• INSPECT the disc brake pads, brake discs/drums and attaching hardware for damage. REPAIR or INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Moaning noise	• Brake linings contaminated with grease or oil.	• INSPECT the brake pads and shoes for contamination. REPAIR or INSTALL new components as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Brake vibration/shudder—occurs when brakes are applied	• Uneven disc or drum wear. • Uneven disc brake pad or lining transfer. • Suspension components.	• Go To Pinpoint Test A .

• Brake vibration/shudder—occurs when the brake pedal is released	• Brake drag.	• INSPECT the disc brake pads or linings for premature wear. REPAIR or INSTALL a new caliper or wheel cylinder as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.

Symptom Chart—Driveline Noise/Vibration

Condition	Possible Sources	Action
• Axle howling or whine—front or rear axle	• Axle lubricant low.	• CHECK the lubricant level. FILL the axle to specification.
	• Axle housing damage.	• INSPECT the axle housing for damage. REPAIR or INSTALL a new axle as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
	• Damaged or worn wheel bearings or axle bearings.	• CHECK for abnormal wheel bearing play or roughness. Refer to Wheel Bearing Check in this section. ADJUST or INSTALL new wheel bearings as necessary.
	• Damaged or worn differential ring and pinion.	• INSPECT the ring and pinion ring for abnormal wear patterns or broken teeth. INSTALL a new ring and pinion as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
	• Damaged or worn differential side or pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
	• Damaged or worn differential side gears and pinion gears.	• DISASSEMBLE the differential carrier. INSPECT the side and pinion gears for abnormal wear patterns or broken teeth. INSTALL new gears as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Driveline clunk—loud clunk when shifting from reverse to drive	• Incorrect axle lubricant level.	• CHECK the lubricant level. FILL the axle to specification.
	• Excessive backlash in the	• CARRY OUT a total backlash check. REFER to Section 205-

	axle or transmission.	00 .
	• Damaged or worn pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary. REFER to Section 205-02 .
	• Damaged or worn universal joints (U-joints).	• INSPECT the U-joints for wear or damage. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Loose suspension components.	• INSPECT the suspension for damage or wear. REPAIR or INSTALL new components as necessary.
	• Broken powertrain mounts.	• INSPECT the powertrain mounts. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines Section 303-01C for 5.0L engines, Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. INSTALL new mounts as necessary.
	• Idle speed too high.	• CHECK for the correct idle speed.
• Driveline clunk—occurs as the vehicle starts to move forward following a stop	• Worn or galled driveshaft slip-yoke splines.	• CLEAN and INSPECT the splines of the yoke for a worn or galled condition. INSTALL a new yoke as necessary. REFER to Section 205-01 .
	• Worn or galled driveshaft and coupling shaft splines.	• CLEAN and INSPECT the splines of the driveshaft and coupling shaft for a worn or galled condition. INSTALL a new driveshaft assembly as necessary. REFER to Section 205-01 .
	• Loose rear leaf spring U-bolts.	• CHECK the U-bolts for loose nuts. TIGHTEN to specification. REFER to Section 204-02 .
• Driveline clunk (FWD vehicles)—occurs during acceleration or from cruise to coast/deceleration	• Damaged or worn inboard constant velocity (CV) joint.	• INSPECT the inboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary. REFER to Section 205-04 .
• Driveline clunk (4WD vehicles)—occurs during shift-on-the-fly engagement	• Clutch relay. • Shift motor. • Transfer case. • GEM.	• CHECK the 4WD engagement system. REPAIR or INSTALL new components as necessary. REFER to Section 308-07A or Section 308-07B .
• Clicking, popping or grinding—occurs while	• Inadequate or contaminated	• CHECK the CV boots and joints for wear or damage.

vehicle is turning	lubrication in the (CV) joints. • Another component contacting the halfshaft • Brake components. • Steering components. • Suspension components. • Damaged or worn wheel bearings.	REPAIR or INSTALL new components as necessary. REFER to Section 205-04 . • CHECK the halfshafts and the area around the halfshafts. REPAIR as necessary. • INSPECT the front brakes for wear or damage. REPAIR as necessary. REFER to Section 206-03 . • INSPECT the drag link, inner and outer tie-rods or idler arm for wear or damage. REPAIR as necessary. REFER to Section 211-02 . • INSPECT the upper and lower ball joints for wear or damage. REPAIR as necessary. REFER to Section 204-01A for 2-wheel drive or Section 204-01B for 4-wheel drive. • CHECK for abnormal wheel bearing play or roughness. Refer to Wheel Bearing Check in this section. ADJUST or INSTALL new wheel bearings as necessary.
• Clicking or snapping—occurs when accelerating around a corner	• Damaged or worn outboard CV joint.	• INSPECT the outboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary. REFER to Section 205-04 .
• High pitched chattering—noise from the rear axle when the vehicle is turning	• Incorrect or contaminated lubricant. • Damaged or worn differential (differential side gears and pinion gears).	• CHECK the vehicle by driving in tight circles (5 clockwise, 5 counterclockwise). FLUSH and REFILL with the specified rear axle lubricant and friction modifier as necessary. • DISASSEMBLE the differential assembly. INSPECT the differential case, pin and gears for wear or damage. REPAIR or INSTALL a new differential as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Buzz—buzzing noise is the same at cruise or coast/deceleration	• Damaged or worn tires. • Incorrect driveline angles.	• CHECK for abnormal tire wear or damage. INSTALL a new tire as necessary. REFER to Section 204-04 . • CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .

• Rumble or boom—noise occurs at coast/deceleration, usually driveshaft speed related and noticeable over a wide range of speeds	• Driveshaft is out-of-balance.	• CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK the driveshaft balance. CARRY OUT a driveline vibration test. REFER to Section 205-00 .
	• U-joints binding or seized.	• ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Excessive pinion flange runout.	• CARRY OUT a runout check. REPAIR as necessary. REFER to Section 205-00 .
• Grunting—normally associated with a shudder experienced during acceleration from a dead stop	• Driveshaft slip yoke binding.	• CLEAN and LUBRICATE the male and female splines.
	• Loose rear spring U-bolts.	• INSPECT the rear suspension. TIGHTEN the U-bolt nuts to specification. REFER to Section 204-02 .
• Howl—can occur at various speeds and driving conditions. Affected by acceleration and deceleration	• Incorrect ring and pinion contact, incorrect bearing preload or gear damage.	• CHECK the ring and pinion and bearings for damage. INSPECT the ring and pinion wear pattern. REFER to Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. ADJUST or INSTALL new components as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Chuckle—heard at coast/deceleration. Also described as a knock	• Incorrect ring and pinion contact or by damaged teeth on the coast side of the ring and pinion.	• CHECK the ring and pinion for damage. INSPECT the ring and pinion wear pattern. REFER to Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. ADJUST or INSTALL new components as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Knock—noise occurs at various speeds. Not affected by acceleration or deceleration	• Gear tooth damage to the drive side of the ring and pinion.	• CHECK the differential case and ring and pinion for damage. INSTALL new components as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.

	• Excessive axle shaft end play. (Vehicles with integral axles).	• CHECK the axle end play using a dial indicator. INSTALL a new axle shaft or side gears as necessary. REFER to Section 205-02 .
• Scraping noise—a continuous low pitched noise starting at low speeds	• Worn or damaged pinion bearings.	• CHECK the pinion bearings. INSTALL new pinion bearings as necessary. REFER to Section 205-02 for the rear axle or Section 205-03 for the front axle.
• Driveline shudder—occurs during acceleration from a slow speed or stop	• Rear drive axle assembly mispositioned.	• CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary.
	• Loose rear spring U-bolts.	• INSPECT the U-bolts. TIGHTEN the U-bolt nuts to specification. REFER to Section 204-02 .
	• Incorrect or high CV joint operating angle.	• CHECK vehicle ride height is within limits. REPAIR as necessary.
	• Damaged or worn front suspension components.	• CHECK for a loose stabilizer bar, damaged or loose strut/strut bushings or loose or worn ball joints. INSPECT the steering linkage for wear or damage. REPAIR or INSTALL new components as necessary.
	• Driveline angles out of specification.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
	• U-joints binding or seized.	• ROTATE the driveshaft and CHECK for rough operation or seized U-joints. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Binding, damaged or galled splines on the driveshaft slip-yoke.	• CLEAN and INSPECT the splines of the slip-yoke, driveshaft and coupling shaft for a worn, damaged or galled condition. INSTALL a new slip-yoke or driveshaft assembly as necessary. REPAIR as necessary. REFER to Section 205-01 .
• Driveline vibration—occurs at cruising speeds	• U-joints are worn.	• CHECK for wear or incorrect seating. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Worn or damaged driveshaft center bearing support.	• CHECK the insulator for damage or wear. ROTATE the driveshaft and CHECK for rough operation. INSTALL a new center bearing support as

		necessary. Section 205-01 .
	• Loose axle pinion flange bolts	• INSPECT the axle pinion flange. TIGHTEN the pinion flange bolts to specification. REFER to Section 205-01 .
	• Excessive axle pinion flange runout.	• CARRY OUT a Runout Check. REPAIR as necessary. REFER to Section 205-01 .
	• Driveshaft is out-of-balance.	• CHECK the driveshaft for damage, missing balance weights or undercoating. CHECK driveshaft balance. CARRY OUT a driveline vibration test. REFER to Section 205-00 . REPAIR as necessary.
	• Binding or damaged splines on the driveshaft slip-yoke	• CLEAN and INSPECT the splines of the slip-yoke, driveshaft and coupling shaft for wear or damage. INSTALL a new slip-yoke or driveshaft assembly as necessary. REFER to Section 205-01 . REPAIR as necessary.
	• Driveshaft runout.	• CARRY OUT a Runout Check. REFER to Section 205-00 . REPAIR as necessary.
	• Incorrect lateral and radial tire/wheel runout.	• INSPECT the tire and wheels. MEASURE tire runouts. REPAIR or INSTALL new components as necessary. REFER to Section 204-04 .
	• Driveline angles out of specification.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
	• Incorrectly seated CV joint in the front wheel hub.	• CHECK the outer CV joint for correct seating into the hub. REPAIR as necessary.

Symptom Chart — Engine Noise/Vibration

Condition	Possible Sources	Action
• Grinding noise—occurs during engine cranking	• Incorrect starter motor mounting.	• INSPECT the starter motor for correct mounting. REPAIR as necessary. REFER to Section 303-06 .
	• Starter motor.	• CHECK the starter motor. REPAIR or INSTALL a new starter motor as necessary. REFER to Section 303-06 .
	• Incorrect starter motor drive engagement.	• INSPECT the starter motor drive and flywheel/flexplate for wear or damage. INSTALL a

		new starter motor drive or flywheel/flexplate as necessary.
• Engine ticking noise	• Fuel injector. • Fuel line. • Oil pump. • Valve lifter. • Belt tensioner. • Water pump. • Obstruction of cooling fan.	• Go To Pinpoint Test B .
• Engine drumming noise—normally accompanied by vibration	• Powertrain mount.	• CARRY OUT Powertrain/Drivetrain Mount Neutralizing in this section.
	• Damaged or misaligned exhaust system.	• INSPECT the exhaust system for loose or broken clamps and brackets. CARRY OUT Exhaust System Neutralizing in this section.
• Whistling noise—normally accompanied with poor idle condition	• Air intake system.	• CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. REFER to Section 303-12 .
• Clunking noise	• Water pump has excessive end play or imbalance.	• CHECK the water pump for excessive end play. INSPECT the water pump with the drive belt off for imbalance. INSTALL a new water pump as necessary. REFER to Section 303-03 .
	• Generator has excessive end play.	• CHECK the generator for excessive end play. REPAIR or INSTALL a new generator. REFER to Section 414-02 .
• Pinging noise	• Exhaust system leak.	• INSPECT the exhaust system for leaks. REPAIR as necessary.
	• Gasoline octane too low.	• VERIFY with customer the type of gasoline used. CORRECT as necessary.
	• Knock sensor operation.	• CHECK the knock sensor. INSTALL a new knock sensor as necessary. REFER to Section 303-14 .
	• Incorrect spark timing.	• CHECK the spark timing. REPAIR as necessary.
	• High operating temperature.	• INSPECT cooling system for leaks. CHECK the coolant level. REFILL as necessary. CHECK the coolant for the correct mix ratio. DRAIN and

		REFILL as needed. CHECK engine operating temperature is within specifications. REPAIR as necessary.
	• Foul-out spark plug.	• CHECK the spark plugs. REPAIR or INSTALL new spark plugs as necessary.
	• Catalytic converter.	• Acceptable noise.
• Knocking noise—light knocking noise, also described as piston slap. Noise is most noticeable when engine is cold with light to medium acceleration. Noise disappears as engine warms	• Excessive clearance between the piston and the cylinder wall.	• Engine cold and at high idle. Using an EngineEAR, pull a spark plug or fuel injector connector until the noise goes away. CARRY OUT a cylinder bore clearance to piston check. INSTALL a new piston. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Knocking noise—light double knock or sharp rap sound. Occurs mostly with warm engine at idle or low speeds in DRIVE. Increases in relation to engine load. Associated with poor lubrication history	• Excessive clearance between the piston and the piston pin.	• INSTALL a new piston or piston pin. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Knocking noise—light knocking noise is most noticeable when engine is warm. Noise tends to decrease when vehicle is coasting or in neutral	• Excessive clearance between the connecting rod bearings and the crankshaft.	• Engine warm and at idle. Using an EngineEAR, PULL a spark plug or fuel injector connector until the noise goes away. INSTALL new bearings. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Knocking—deep knocking noise. Noise is most noticeable when engine is warm, at lower rpm and under a light load and then at float	• Worn or damaged crankshaft main bearings.	• CARRY OUT DERU test. CHECK for noise with vehicle at operating temperature, during medium to heavy acceleration. CHECK at idle with injector disconnected, noise does not change. INSTALL new main bearings. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.

• Knocking noise—occurs mostly with warm engine at light/medium acceleration	• Spark plugs.	• CHECK the spark plug for damage or wear. INSTALL new spark plugs as necessary.
	• Carbon accumulation in combustion chamber.	• REMOVE carbon from combustion chamber.
• Whine or moaning noise	• Air intake system.	• CHECK the air cleaner and ducts for correct fit. INSPECT the air intake system for leaks or damage. REPAIR as necessary.
	• Generator electrical field or bearings.	• CARRY OUT generator load test. REPAIR or INSTALL a new generator as necessary. REFER to Section 414-02 .
• Drone type noise	• Exhaust system.	• CARRY OUT Exhaust System Neutralizing in this section. REPAIR as necessary.
	• A/C compressor.	• CHECK for noise with vehicle at constant speeds. CYCLE the compressor on and off and listen for a change in pitch. REPAIR as necessary. REFER to Section 412-03 .
	• Powertrain mounts.	• CARRY OUT Powertrain/Drivetrain Mount Neutralizing in this section.
• Sputter type noise—noise worse when cold, lessens or disappears when vehicle is at operating temperature	• Damaged or worn exhaust system components.	• INSPECT the exhaust system for leaks or damage. REPAIR as necessary. REFER to Section 309-00 .
• Rattling noise—noise from the upper engine (valve train). Worse when engine is cold	• Low oil level.	• CHECK oil level. FILL as necessary.
	• Thin or diluted oil.	• INSPECT the oil for contamination. If oil is contaminated, CHECK for the source. REPAIR as necessary. CHANGE the oil and filter.
	• Low oil pressure.	• CARRY OUT an oil pressure test. If not within specifications, REPAIR as necessary. REFER to Section 303-00 .
	• Worn rocker arms/fulcrums or	• CARRY OUT a valve train analysis. INSTALL new valve

	followers.	train components as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
	• Worn valve guides.	• CARRY OUT a valve train analysis. INSTALL new valve guides as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
	• Excessive runout of valve seats on the valve face.	• CARRY OUT a valve seat runout test. INSPECT the valve face and seat. INSTALL new valves as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Rattling noise—from the bottom of the vehicle	• Loose muffler shields or catalytic converter shields.	• CHECK the exhaust system for loose exhaust shields. REPAIR as necessary.
• Thumping noise—from the bottom of the vehicle, worse at acceleration	• Exhaust pipe/muffler grounded to chassis.	• CHECK the exhaust system to chassis clearance. CHECK the exhaust system hangers for damage. REPAIR as necessary. REFER to Section 309-00 .
• Whoosh—occurs during light vehicle acceleration. Heard inside the vehicle	• Throttling late, creating turbulence transmitted through the plastic manifold.	• CHECK for leaks or missing seal in the dash panel.
• Engine vibration—increases intensity as engine rpm is increased	• Engine out-of-balance.	• CARRY OUT Neutral Engine Run-Up (NERU) Test. ROTATE the torque converter, 120° for 3 bolt and 180° for 4 bolt. INSPECT the torque converter pilot outer diameter to crankshaft pilot inner diameter. REPAIR as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
• Engine vibration—is felt with increases and decreases in engine rpm	• Strain on exhaust mounts.	• CARRY OUT Exhaust System Neutralizing in this section. REPAIR as necessary.

	• Damaged or worn powertrain/drivetrain mounts.	• CHECK the powertrain/drivetrain mounts for damage. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines, Section 303-01C for 5.0L engines, Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Engine or transmission grounded to chassis.	• INSPECT the powertrain/drivetrain for correct clearances. REPAIR as necessary.
• Engine vibration—vibration felt at all times	• Excessive engine pulley runout.	• CARRY OUT Engine Accessory Test. INSTALL a new engine pulley as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines.
	• Damaged or worn accessory component.	• CARRY OUT Engine Accessory Test. REPAIR or INSTALL a new component as necessary.
• Accelerator pedal vibration—felt through the pedal as a buzz	• Throttle cable loose or misrouted.	• INSPECT the throttle cable. REPAIR as necessary. REFER to Section 310-02 .
• Engine vibration—mostly at coast/neutral coast. Condition improves with vehicle accelerating	• Combustion instability.	• CHECK the ignition system. INSTALL new components as necessary.
• Engine vibration or shudder—occurs with light to medium acceleration above 56 km/h (35 mph)	• Worn or damaged spark plugs.	• INSPECT the spark plugs for cracks, high resistance or broken insulator. INSTALL a new spark plug(s) as necessary.
	• Plugged fuel injector.	• REPAIR or INSTALL a new injector as necessary.
	• Damaged spark plug wire.	• INSPECT the spark plug wires for damage. INSTALL a new spark plug wire(s) as necessary.
	• Contaminated fuel.	• INSPECT the fuel for contamination. DRAIN the fuel system and refill.
	• Worn or damaged	• CHECK the torque converter.

	torque converter.	INSTALL a new torque converter as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions.

Symptom Chart—Idle Noise/Vibration

Condition	Possible Sources	Action
• Idle air control (IAC) valve moan — occurs on throttle tip-out	• IAC valve is contaminated with oil.	• GO to Component Tests in this section.
• Accessory drive belt chirp — occurs at idle or high idle, cold or hot. Most common occurrence is during humid weather.	• Accessory drive belt worn, or pulley is misaligned or loose.	• INSPECT for loose or misaligned pulleys. CHECK the drive belt for wear or damage. INSTALL new pulley (s)/accessory drive belt, as necessary. REFER to Section 303-05 .
• Accessory drive bearing hoot — occurs at idle or high idle in cold temperatures of approximately +4°C (+40°F) or colder at first start of the day	• Accessory drive idler or tensioner pulley bearing is experiencing stick/slip between ball bearings and bearing race.	• Go To Pinpoint Test C .
• Power steering moan — occurs at high idle and possibly at idle during the first cold start of the day in temperatures of approximately -18°C (0° F) or colder. Noise can even be a severe screech for less than one minute in very cold temperatures of approximately -29°C (-20°F) or colder	• High fluid viscosity, or plugged reservoir screen in power steering reservoir starves pump causing cavitation.	• Go To Pinpoint Test D .
• Generator whine — during high electrical loads at idle or high idle, a high pitch whine or moan is emitted from the generator	• Generator electrical field noise.	• Using an EngineEAR, PROBE near the generator housing. LISTEN for changes in the noise level while changing electrical loads (such as rear defrost, headlamps, etc.). CARRY OUT a generator load test. If the system passes the load test, the noise is from the generator bearings, INSTALL new bearings. If the system fails the load test, INSTALL a new generator. REFER to Section 414-02 .
• Engine-driven cooling	• The viscous	• Go To Pinpoint Test E .

fan moan — occurs during the first start of the day. It is most objectionable near idle speeds up to 2000 rpm. The noise increases with rpm	cooling fan clutch engages until the fluid in the clutch reaches normal operating temperature, causing the fan to fully engage.	
• Drumming noise — occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent	• Exhaust system vibration excites the body resonances inducing interior noise. • Engine vibration excites the body resonances inducing interior noise.	• Go To Pinpoint Test F .
• Hissing noise — occurs during idle or high idle that is apparent with the hood open	• Vacuum leak or idle air control (IAC) valve flow noise.	• Use the Ultrasonic Leak Detector/EngineEAR to locate the source. Scan the air intake system from the inlet to each cylinder intake port. DISCARD the leaking parts, and INSTALL a new component.
	• Vehicles with a plastic intake manifold.	• Acceptable condition. Some plastic manifolds exhibit this noise, which is the effect of the plastic manifold.
• Automatic transmission buzz or hiss	• Incorrect driveline angles.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 .
	• Worn or damaged main control solenoids or valves.	• Using a transmission tester, activate the solenoids to duplicate sound. INSTALL new components as necessary. REFER to .
• Manual Transmission Clutch throw-out bearing whine. A change in noise pitch or loudness while depressing the clutch pedal	• Worn throw-out bearing.	• INSTALL a new throw-out bearing. REFER to Section 308-01 .
• Heating, vacuum and air conditioning (HVAC) system chirp — most audible inside the vehicle. Listen for a change in noise pitch or loudness while changing the HVAC system blower speed	• Damaged or worn HVAC blower bearing.	• INSTALL a new blower motor. REFER to Section 412-02 .

• Air conditioning (A/C) clutch ticking — occurs when the compressor clutch engages	• Acceptable noise. • Incorrect air gap.	• LISTEN to the clutch to determine if the noise occurs with clutch engagement. A small amount of noise is acceptable. If the noise is excessive, CHECK the A/C clutch air gap. INSPECT the A/C clutch for wear or damage. INSTALL a new clutch as necessary. REFER to Section 412-03 .
• Intermittent rattle, or scraping/rubbing noise	• Loose exhaust heat shield(s).	• INSPECT the exhaust system for loose parts using a glove or clamps to verify cause. REPAIR as necessary. REFER to Section 309-00 .
	• Wiring, hose or other part interfering with accessory drive, drive belt or pulley.	• INSPECT accessory drive system closely verifying there is adequate clearance to all rotating components. REPAIR as necessary.
• Engine ticking or knocking noise — occurs during idle or high idle during the first cold start of the day	• Piston noise or valvetrain noise (bled down lifter/lash adjuster).	• Go To Pinpoint Test G .
• A continuous, speed-dependent rattle from the engine — occurs during idle or high idle during the first cold start of the day and disappears as the engine warms up	• Piston noise or valvetrain noise (bled down lifter/lash adjuster).	• Go To Pinpoint Test G .
• Idle vibration—a low-frequency vibration (5-20 Hz) or mild shake that is felt through the seat/floorpan	• Cylinder misfire.	• Using the NGS, CHECK the ignition system. CARRY OUT a cylinder power test. REFER to Section 303-00 .
	• Engine or torque converter out of balance.	• VERIFY the torque converter to crankshaft pilot clearance is correct, REPAIR as necessary. RE-INDEX the torque converter on the flex plate by 120° on a 3 bolt converter or 180° for a 4 bolt converter. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary. RETEST the vehicle.
• Idle vibration—a high-frequency vibration (20–80 Hz) or buzz, that is	• Exhaust system mounts bound up.	• VERIFY concern occurs at engine firing frequency. CHECK that the exhaust

felt through the steering wheel or seat		system vibrates at the same frequency as the engine. ADD 9–14 km (20–30 lb.) to the tail pipe to test, CARRY OUT Exhaust System Neutralizing in this section.
	• Body mounts loose.	• INSPECT the body mounts. CARRY OUT a Neutral Engine Run-Up (NERU) Test. REPAIR as necessary
	• Power steering lines grounded out.	• INSPECT that the power steering lines are not contacting the chassis or each other. REPAIR as necessary.

Symptom Chart—Squeak and Rattle

Condition	Possible Sources	Action
• Squeak—heard inside the vehicle when closing/opening the door	• Insufficient lubrication on the door hinge or check strap.	• LUBRICATE the hinge or check strap.
	• Internal door components loose, rubbing or misaligned.	• CHECK the inside of the door. TIGHTEN or ALIGN as necessary. USE the Rotunda Squeak and Rattle Kit to isolate any rubbing components.
• Squeak—heard inside the vehicle when closing/opening the window	• Worn or damaged glass run/channel.	• REPAIR or INSTALL a new glass run/channel. REFER to Section 501-11 .
• Squeak—heard outside of vehicle when closing/opening the door	• Exhaust shield rubbing against the chassis or exhaust pipe.	• CHECK the exhaust system. REPAIR as necessary. Section 309-00 .
• Squeak—occurs with initial brake pedal application	• Disc brake pads.	• Under certain conditions, asbestos free pads can generate a squeak noise. This noise is normal and does not indicate a concern.
• Squeak—a constant noise that occurs with brake pedal applications	• Damaged or worn disc brake pads.	• INSPECT the pads for oil, grease or brake fluid contamination. CHECK for glazed linings. A brake disc with hard spots will also cause a squeak type noise. REPAIR or INSTALL new pads as necessary. REFER to Section 206-03 for front disc brakes or Section 206-04 for rear disc brakes.
• Squeak—noise occurs over bumps or when	• Worn control arm bushings.	• INSPECT the control arm bushings. Spray with lubricant and CARRY OUT a "bounce test" to determine

turning		which bushing. REPAIR as necessary. REFER to Section 204-01A for 2-wheel drive or Section 204-01B for 4-wheel drive.
	• Worn or damaged shock absorber/strut.	• INSPECT the shock absorber for damage. CARRY OUT a "bounce test" to isolate the noise. INSTALL a new shock absorber/strut as necessary. REFER to Section 204-01A for 2-wheel drive vehicles, Section 204-01B for 4-wheel drive vehicles for the front shock absorber/strut or Section 204-02 for the rear shock absorber/strut.
• Rattle—heard when closing/opening the door or window	• Loose internal door mechanism, bracket or attachment.	• REPEAT the motion or CARRY OUT a "tap test" to duplicate the noise. INSPECT the door for loose components. TIGHTEN loose components or USE the Rotunda Squeak and Rattle Kit to isolate any rattling components.
• Squeak or rattle—heard inside the vehicle over rough roads/bumps	• Misaligned glove compartment door/hinge.	• ALIGN the glove compartment door.
	• Instrument panel trim loose or misaligned.	• INSPECT the instrument panel trim for missing or loose clips or screws. REPAIR as necessary.
	• Loose interior component or trim.	• CARRY OUT a "touch test". ELIMINATE the noise by pressing or pulling on interior trim and components. USE the Rotunda Squeak and Rattle Kit to isolate any rattling/squeaking components.
• Squeak or rattle—noise with a vibration concern	• Damaged or worn body mounts.	• INSPECT the upper and lower absorbers and washers for damage or wear. CHECK the body mount brackets for damage. CHECK the nuts and bolts are tightened to specifications. TIGHTEN as necessary.
	• Damaged or worn sub-frame mounts.	• INSPECT the upper and lower absorbers for damage or wear. CHECK the sub-frame for damage. CHECK the nuts and bolts are tightened to specifications. TIGHTEN as necessary.

Symptom Chart—Steering Noise/Vibration

Condition	Possible Sources	Action
• Steering grunt or shudder — occurs when turning into or out of a turn at low	• Steering gear or power steering hoses.	• GO to Steering Gear Grunt/Shudder Test component test in this section.

speeds (temperature sensitive)		
• Steering System clonk—hydraulic knocking sound	• Air in the steering hydraulic system.	• CHECK for leaks in the system. PURGE the air from the system. REFER to Section 211-00 .
• Power steering pump moan — loud humming noise occurs when the steering wheel is rotated to the stop position. Produces a 120-600 Hz frequency that changes with rpm	• Power steering hose grounded out to chassis.	• INSPECT the power steering hoses. REPAIR as necessary.
	• Aerated fluid.	• CHECK for leaks in the system. PURGE the air from the system. REFER to Section 211-00 .
	• Steering gear isolators.	• INSPECT the isolators for wear or damage. REPAIR as necessary.
	• Low fluid.	• CHECK the fluid level. REFILL as necessary.
	• Power steering pump brackets loose or misaligned.	• CHECK bolts, brackets and bracket alignment. TIGHTEN bolts to specification. REPAIR or INSTALL new brackets as necessary.REFER to Section 211-02 .
• Steering gear clunk — occurs only while cornering over a bump (can be temperature sensitive)	• Steering gear.	• INSPECT the steering gear for loose mounting bolts. TIGHTEN as necessary. REFER to Section 211-02 .
• Feedback (rattle, chuckle or knocking noise in the steering gear) — a condition where roughness is felt in the steering wheel when the vehicle is driven over rough surfaces	• Column intermediate/flexible shaft joints damaged or worn.	• INSTALL a new intermediate/flexible shaft. REFER to Section 211-04 .
	• Loose, damaged or worn tie-rod ends.	• TIGHTEN the nuts to specification or INSTALL new tie-rod ends as necessary. REFER to Section 211-02 .
	• Steering gear insulators or mounting bolts loose	• TIGHTEN the bolts or INSTALL new bolts as

	or damaged.	necessary. REFER to Section 211-02 .
	• Steering column intermediate shaft bolts are loose.	• TIGHTEN the bolts to specification. REFER to Section 211-04 .
	• Steering column damaged or worn.	• REPAIR or INSTALL a new steering column as necessary. REFER to Section 211-04 .
	• Loose suspension bushings, bolts or ball joints.	• INSPECT the suspension system. TIGHTEN or INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive or Section 204-01B for 4-wheel drive.
• Feedback (nibble at the steering wheel) — a condition where slight rotational movement is felt in the steering wheel when the vehicle is driven over rough or grooved surfaces	• Lateral runout in the tire or wheel.	• GO to Pinpoint Test H .
	• Yoke spring in the steering gear.	• CHECK TSBs for revised yoke spring for applicable vehicles.
• Accessory drive belt squeal/chirp—when rotating the steering wheel from stop to stop	• Loose or worn accessory drive belt.	• ADJUST or INSTALL a new accessory drive belt as necessary. REFER to Section 303-05 .
• Power steering gear hiss	• Steering column intermediate/flexible shaft-to-steering gear is binding or misaligned.	• REPAIR or INSTALL a new intermediate/flexible shaft as necessary. REFER to Section 211-04 .
	• Grounded or loose steering column boot at the dash panel.	• REPAIR as necessary.
	• Damaged or worn steering gear input shaft and valve.	• REPAIR or INSTALL a new steering gear as necessary. REFER to Section 211-02 .
• Steering column rattle	• Loose bolts or attaching brackets.	• TIGHTEN the bolts to specifications.
	• Loose, worn or insufficiently lubricated column bearings.	• LUBRICATE or INSTALL new steering column bearings as necessary. REFER to Section 211-04 .
	• Steering shaft insulators	• INSTALL new insulators.

	damaged or worn. • Intermediate/flexible shaft compressed or extended.	REFER to Section 211-04 . • INSPECT the rubber spider coupling for damage. INSTALL a new intermediate/flexible shaft. REFER to Section 211-04 .
• Steering column squeak or cracks	• Insufficient lubricated steering shaft bushings. • Loose or misaligned steering column shrouds. • Steering wheel rubbing against steering column shrouds. • Insufficient lubricated speed control slip ring. • Upper or lower bearing sleeve out of position.	• LUBRICATE the steering shaft and shaft tube seals. • TIGHTEN or ALIGN the steering column shrouds. • REPOSITION the steering column shrouds. • LUBRICATE the speed control slip ring. • REPOSITION the bearing sleeves.
• Power steering pump noisy	• Incorrect assembly of components. • Imperfections on the outside diameter or end surface of the power steering pump rotor. • Damaged or worn power steering pump rotor splines. • A crack on the inner surface of the power steering pump cam. • Interference between the power steering pump rotor and cam. • Damaged or worn power steering pump rotor and pressure plates.	• REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .
• Power steering pump swish noise	• Power steering fluid flow into the bypass valve of the pump valve housing with fluid temperature below 54°C (130°F).	• Acceptable condition.
• Power steering pump whine noise	• Aerated fluid. • Damaged power steering pump cam. • Damaged valve cover O-ring seal.	• CHECK for a leak in the system. PURGE the air from the system. REFER to Section 211-00 . • REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 . • REPAIR or INSTALL a new power steering pump

		as necessary. REFER to Section 211-02 .
• Power steering pump clicking (mechanical) noise	• Power steering pump rotor slippers too long, excessive rotor slipper-to-slot clearance or damaged or worn rotor assembly.	• REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .
• Power steering pump clatter noise	• Damaged corners on the outside diameter or the power steering rotor or distorted rotor slipper ring.	• REPAIR or INSTALL a new power steering pump as necessary. REFER to Section 211-02 .

Symptom Chart—Suspension Noise/Vibration

Condition	Possible Sources	Action
• Squeak or grunt—noise from the front suspension, occurs more in cold ambient temperatures. More noticeable over rough roads or when turning	• Front stabilizer bar insulators.	• Under these conditions, the noise is acceptable. CHECK TSBs.
• Clunk—noise from the front suspension, occurs in and out of turns	• Loose front struts or shocks.	• INSPECT for loose nuts or bolts. TIGHTEN to specifications. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
• Clunk—noise from the rear suspension, occurs when shifting from reverse to drive	• Loose rear suspension components.	• INSPECT for loose or damaged rear suspension components. REPAIR or INSTALL new components as necessary. REFER to Section 204-02 .
• Click or pop—noise from the front suspension. More noticeable over rough roads or over bumps	• Worn or damaged ball joints.	• CARRY OUT a ball joint inspection. INSTALL new ball joints or control arms as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
• Click or pop (FWD vehicles)—noise occurs when vehicle is turning	• Worn or damaged ball joints.	• CARRY OUT a ball joint inspection. INSTALL new ball joints or control arms as necessary.
• Click or snap—occurs when accelerating around a corner	• Damaged or worn outboard CV joint.	• INSPECT the outboard CV joint and boot. REPAIR or INSTALL a new CV joint as necessary.
• Front suspension noise—a squeak, creak or rattle	• Steering components.	• Go To Pinpoint Test H .

noise. Occurs mostly over bumps or rough roads	• Loose or bent front struts or shock absorbers. • Damaged spring or spring mounts. • Damaged or worn control/radius arm bushings. • Worn or damaged stabilizer bar bushings or links.	
• Rear suspension noise—a squeak, creak or rattle noise. Occurs mostly over bumps or rough roads	• Loose or bent rear shock absorbers. • Damaged spring or spring mounts. • Damaged or worn control arm bushings. • Worn or damaged stabilizer bar bushings or links.	• Go To Pinpoint Test I .
• Shudder—occurs during acceleration from a slow speed or stop	• Rear drive axle assembly mispositioned.	• CHECK the axle mounts and the rear suspension for damage or wear. REPAIR as necessary.
	• Incorrect or high CV joint operating angle.	• CHECK vehicle ride height is within limits. REPAIR as necessary.
	• Damaged or worn front suspension components.	• CHECK for a loose stabilizer bar, damaged or loose strut/strut bushings or loose or worn ball joints. INSPECT the steering linkage for wear or damage. REPAIR or INSTALL new components as necessary.
• Shimmy—most noticeable on coast/deceleration. Also hard steering condition	• Excessive positive caster.	• CHECK the caster alignment angle. CORRECT as necessary. REFER to Section 204-00 .

Symptom Chart—Tire Noise/Vibration

Condition	Possible Sources	Action
• Tire noise—hum/moan at constant	• Abnormal wear patterns.	• SPIN the tire and CHECK for tire wear. INSTALL a new tire as

speeds		necessary. INSPECT for damaged/worn suspension components. CARRY OUT wheel alignment.
• Tire noise—noise tone lowers as the vehicle speed is lowered	• Out-of-balance tire.	• BALANCE the tire and road test. INSTALL a new tire as necessary. REFER to Section 204-04 .
• Tire noise — ticking noise, changes with speed	• Nail puncture or stone in tire tread.	• INSPECT the tire. REPAIR as necessary.
• Wheel and tire—vibration and noise concern is directly related to vehicle speed and is not affected by acceleration, coasting or decelerating	• Damaged or worn tire.	• Go To Pinpoint Test J .
• Tire wobble or shudder — occurs at lower speeds	• Damaged wheel bearings.	• SPIN the tire and CHECK for abnormal wheel bearing play or roughness. ADJUST or INSTALL new wheel bearings as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
	• Damaged wheel.	• INSPECT the wheel for damage. INSTALL a new wheel as necessary. REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles.
	• Damaged or worn suspension components.	• INSPECT the suspension components for wear or damage. REPAIR as necessary.
	• Loose wheel nuts.	• CHECK the wheel nuts. TIGHTEN to specification. REFER to Section 204-04 .
	• Damaged or uneven tire wear.	• SPIN the tire and CHECK for abnormal tire wear or damage. INSTALL a new tire as necessary. REFER to Section 204-04 .
• Tire shimmy or shake— occurs at lower speeds	• Wheel/tire out of balance.	• BALANCE the wheel/tire assembly.
	• Uneven tire wear.	• CHECK for abnormal tire wear. INSTALL a new tire as necessary. REFER to Section 204-04 .
	• Excessive radial runout of wheel or tire.	• CARRY OUT a radial runout test of the wheel and tire. INSTALL a new tire as

		necessary. REFER to Section 204-04 .
	• Worn or damaged wheel studs or elongated stud holes.	• INSPECT the wheel studs and wheels. INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive vehicles and Section 204-01B for 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels.
	• Excessive lateral runout of the wheel or tire.	• CARRY OUT a lateral runout test of the wheel and tire. CHECK the wheel, tire and hub. REPAIR or INSTALL new components as necessary.
	• Foreign material between the brake disc and hub or in the brake disc fins.	• CLEAN the mounting surfaces of the brake disc and hub. CHECK the brake disc fins for material.
• High speed shake or shimmy—occurs at high speeds	• Excessive wheel hub runout. • Damaged or worn tires. • Damaged or worn wheel bearings. • Worn or damaged suspension or steering linkage components. • Brake disc or drum imbalance.	• Go To Pinpoint Test K .

Symptom Chart—Transmission (Manual) and Transfer Case Noise/Vibration

Condition	Possible Sources	Action
• Clutch rattling noise—occurs with clutch engaged, noise changes/disappears with clutch pedal depressed	• Flywheel bolts, clutch housing bolts or clutch pressure plate bolts loose.	• TIGHTEN the bolts to specifications. CHECK the bolts for damage.
• Clutch squeaking noise—noise is heard when the clutch is operated. Vehicle moves slowly or creeps when the clutch is disengaged. Can also be difficult to shift into first and reverse gear	• Pilot bearing seized or damaged.	• INSTALL a new pilot bearing. REFER to Section 308-01 .
• Clutch squeaking noise—occurs with clutch pedal	• Worn clutch pedal shaft or bushings.	• INSPECT the clutch pedal for wear or damage. REPAIR as necessary.

depressed/released		
• Clutch whirring/rattle noise—occurs when clutch pedal is depressed	• Worn, damaged or misaligned clutch release bearing.	• INSTALL a new clutch release bearing. REFER to Section 308-01 .
• Clutch grating/grinding noise—occurs when clutch pedal is depressed	• Clutch pressure plate fingers bent or worn.	• INSPECT the clutch pressure plate release fingers. INSTALL a new pressure plate as necessary. REFER to Section 308-01 .
	• Contact surface of clutch release bearing worn or damaged.	• INSTALL a new clutch release bearing. REFER to Section 308-01 .
• Clutch chatter—a small amount of noise when clutch pedal is released at initial take-off	• Clutch engagement.	• Acceptable operating condition.
• Clutch chatter/grabs—in some cases a shudder is felt. Occurs with clutch pedal depressed/released	• Damaged or worn powertrain/driveline mounts.	• INSPECT the powertrain/drivetrain mounts. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines or Section 303-01C for 5.0L engines. INSTALL new mounts as necessary.
	• Binding or dragging plunger of the clutch master cylinder or slave cylinder.	• CHECK the master and slave cylinder operation. INSPECT the components for damage or wear. INSTALL a new master or slave cylinder as necessary. REFER to Section 308-02 .
	• Grease or oil on the clutch disc facing.	• CHECK the input shaft seal and rear main oil seal. REPAIR as necessary. INSTALL a new clutch disc. REFER to Section 308-01 .
	• Clutch disc surface glazed or damaged.	• INSPECT the clutch disc surface for a glazed, hardened or damage condition. CARRY OUT a disc check. INSTALL a new clutch disc as necessary. REFER to Section 308-01 .
	• Damaged or worn clutch pressure plate.	• INSPECT the clutch pressure plate for wear or damage. INSTALL a new clutch pressure plate as

		necessary. REFER to Section 308-01
	• Flywheel surface damaged or glazed.	• INSPECT the flywheel for damage or wear. CARRY OUT a flywheel runout check. INSTALL a new flywheel as necessary. REFER to Section 308-00 .
• Clutch chatter noise—noise when clutch pedal is released at initial take-off. Clutch is hard to engage and disengage	• Pilot bearing worn, damaged or not correctly aligned in bore.	• INSPECT the clutch pressure plate release fingers for uneven wear, clutch components burnt or a seized pilot bearing. INSTALL a new pilot bearing as necessary. REFER to Section 308-01 .
• Clutch vibration	• Loose flywheel bolts. • Damaged or loose clutch pressure plate. • Excessive flywheel runout.	• Go To Pinpoint Test L .
• Transmission rattling/clattering noise—noise at idle or on light acceleration from a stop. Gear selection difficult	• Gearshift lever joint worn or damaged.	• INSTALL a new gearshift lever. REFER to Section 308-03 .
	• Gearshift lever loose.	• TIGHTEN the bolts to specification. REFER to Section 308-03 .
	• Gearshift linkage rods worn or damaged.	• CHECK the linkage bushings for wear. INSTALL new linkage rods as necessary. REFER to the appropriate workshop manual for the service procedures.
• Transmission rattling/clattering noise—occurs in neutral or in gear, at idle	• Incorrect fluid level or fluid quality.	• CHECK that the transmission is filled to the correct level and with the specified fluid. REFER to Section 308-03 .
• Transmission rattling/clattering noise—noise at idle in neutral	• Worn or rough reverse idler gear.	• CHECK the reverse idler gear. REPAIR as necessary. REFER to Section 308-03 .
	• Rough running engine, cylinder misfire.	• CHECK the ignition system. CARRY OUT a cylinder power test. REPAIR as necessary.
	• Excessive backlash in gears.	• CHECK the gear backlash. ADJUST as

		necessary. REFER to Section 308-03 .
	• Worn countershaft gears.	• REPAIR as necessary. REFER to Section 308-03 .
• Transmission whine—a mild whine at extreme speeds or high rpm	• Rotating gears/geartrain.	• Acceptable noise.
• Transmission whine—a high pitched whine, also described as a squeal	• Transmission gears are worn (high mileage vehicle).	• Result of normal gear wear. REPAIR as necessary. REFER to Section 308-03 .
	• Mismatched gear sets.	• INSPECT the gear sets for an uneven wear pattern on the face of the gear teeth. REPAIR as necessary. REFER to Section 308-03 .
	• Damaged or worn transmission bearing.	• INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
• Transmission growling/humming—noise occurs in the forward gears. The noise is more prominent when the gear is loaded. The problem gear can be located as the noise occurs in a specific gear position	• Gear is cracked, chipped or rough.	• INSPECT the transmission gears for damage or wear. INSTALL new gears as necessary. REFER to Section 308-03 .
• Transmission hissing—noise in neutral or in forward gears. As bearings wear or break up, the noise changes to a thumping noise	• Damaged or worn bearings.	• INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
• Transmission knocking/thudding—noise at low speeds in forward gears	• Bearings with damaged balls or rollers or with pitted and spalled races.	• INSPECT the transmission bearings. INSTALL new bearings as necessary. REFER to Section 308-03 .
• Transmission rumble/growl—noise at higher speeds in forward gears, more pronounced in a coast/deceleration condition	• Incorrect driveline angle.	• CHECK the driveline angle. REPAIR as necessary. REFER to Section 205-00 .
	• Driveshaft out of balance or damaged.	• CHECK the driveshaft for damage, missing balance weights or undercoating. Using the vibration

		analyzer (VA), CHECK the driveshaft balance. CARRY OUT a driveline vibration test. For additional information, REFER to Section 205-00 . REPAIR as necessary.
• Transmission rumble/growl—noise at all speeds in forward gears, more pronounced in a heavy acceleration condition	• Damaged or worn transmission bearing or gears (high mileage vehicles).	• CHECK transmission fluid for excessive metal particles. REPAIR as necessary. REFER to Section 308-03 .
• Transfer case whine—noise at all ranges	• Incorrect fluid level or fluid quality.	• CHECK that the transfer case is filled to the correct level and with the specified fluid. REFER to Section 308-07B .
	• Worn oil pump.	• DISASSEMBLE the transfer case. CHECK the oil pump for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
	• Under-inflated or oversized tires.	• CONFIRM that the tires and wheels are correct for the vehicle. CHECK that the tire inflation pressures are correct.
• Transfer case growl/rumble—noise at all ranges (A small amount of planetary noise can be heard when the transfer case is operated in low range.)	• Damaged or worn bearings or planetary gear.	• DISASSEMBLE the transfer case. CHECK the bearings or planetary gear for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case scraping/grating—noise at all ranges	• Excessively stretched drive chain hitting the case.	• DISASSEMBLE the transfer case. CHECK the drive chain for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case howl/hum—noise at all ranges or high range only	• Worn or damaged sun (input) gear, clutch pack (intermediate) gear or output shaft gear.	• DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary. REFER to Section 308-07B .
• Transfer case howl/hum—noise at low range only	• Worn or damaged intermediate gear and sliding gears (clutch pack).	• DISASSEMBLE the transfer case. CHECK the gears for wear or damage. REPAIR as necessary. REFER to Section 308-07B .

• Transfer case vibration—vibration felt with vehicle in 4WD	• Transfer case mounting. • Driveshaft out of balance. • Excessive pinion flange runout.	• Go To Pinpoint Test M .

Symptom Chart—Transmission (Automatic) Noise/Vibration

Condition	Possible Sources	Action
• Rattle—occurs at idle or at light acceleration from a stop	• Damaged engine or transmission mounts.	• CHECK the powertrain/drivetrain mounts for damage. INSTALL new mounts as necessary. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines, Section 303-01C for 5.0L engines, Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• A loose front exhaust pipe heat shield.	• REPAIR or INSTALL a new heat shield as necessary.
	• Loose inspection plate or dust cover plate.	• CHECK for loose bolts. TIGHTEN to specifications. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Loose flexplate to converter nuts.	• CHECK for loose nuts. TIGHTEN to specifications. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Whine—pitch increases with vehicle speed. Starts in first and second gear, decreases or goes away at higher gears	• Damaged or worn low one-way clutch. • Damaged or worn intermediate one-way clutch. • Friction elements. • Damaged or worn planetary or sun gear.	• INSPECT the transmission for wear or damage. REPAIR or INSTALL new components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Whine—the pitch changes with engine speed	• A worn or damaged accessory drive component.	• CARRY OUT the Engine Accessory Test. REPAIR or INSTALL new components as necessary.
	• Incorrect fluid level.	• CHECK that the transmission is filled to the correct level. ADD fluid as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-

		01B for 5R55E transmissions. REPAIR as necessary.
	• Partially blocked filter.	• INSPECT the filter. CLEAN or INSTALL a new filter as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Worn or damaged torque converter.	• CARRY OUT the torque converter service and replacement check. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Worn or damaged front pump.	• INSPECT the front pump. INSTALL a new front pump as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Whine—pitch changes with vehicle speed	• Speedometer cable or gears.	• REPAIR or INSTALL new cables or gears as necessary.
• Whine/moan type noise—pitch increases or changes with vehicle speed	• Damaged engine or transmission mount.	• CHECK the powertrain/drivetrain mounts for damage. REFER to Section 303-01A for 4.0L push rod engines, Section 303-01B for 4.0L SOHC engines, Section 303-01C for 5.0L engine, Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary
	• U-joints worn or damaged.	• INSPECT the U-joints for wear or damage. INSTALL new U-joints as necessary. REFER to Section 205-01 .
	• Damaged or worn differential ring and pinion.	• INSPECT the differential ring and pinion for damage. CARRY OUT the Checking Tooth Contact Pattern and Condition of the Ring and Pinion component test in this section. REPAIR or INSTALL a new differential ring and pinion as necessary. REFER to Section 205-02 for the rear drive axle or Section 205-03 for the front drive axle.
	• Planetary gears nicked or chipped.	• CHECK the planetary gears for damage. INSTALL new components as necessary.

		REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary
• Whistle—noise is high pitched, constant. Changes in pitch with throttle position	• Hydraulic pressure in the main control.	• INSPECT the main control. REPAIR or INSTALL new components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary
	• Incorrect band/clutch apply pressure.	• CARRY OUT the line pressure tests. REPAIR or INSTALL components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
	• Worn or damaged torque converter.	• CARRY OUT the torque converter service and replacement check. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Clunk—occurs when shifting from PARK to a drive or reverse position	• Damaged powertrain mounts.	• INSPECT the powertrain mounts for damage. INSTALL new mounts as necessary.
	• Damaged or worn pinion bearings.	• CHECK for abnormal bearing play or roughness. INSTALL new bearings as necessary.REFER to Section 205-02 for the rear drive axle or Section 205-03 for the front drive axle.
	• Worn or galled driveshaft slip yoke splines.	• CLEAN and INSPECT the splines of the yoke. INSTALL a new slip yoke as necessary. REFER to Section 205-01 .
	• Worn friction elements or excessive clutch pack end plate play.	• INSPECT the transmission for wear. CHECK that all end play and clearances are within specification. REPAIR or INSTALL new components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Bump—occurs	• Initial gear engagement.	• Acceptable condition.

when shifting from PARK to a drive or reverse position. Similar to Clunk but with no sound		
• Buzz or hiss	• Incorrect driveline angles. • Worn or damaged main control solenoids or valves.	• CHECK for correct driveline angles. REPAIR as necessary. REFER to Section 205-00 . • Using a transmission tester, ACTIVATE the solenoids to duplicate sound. INSTALL new components as necessary. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary.
• Vibration—a high frequency (20–80 Hz) that is felt through the seat or gear shifter. Changes with engine speed	• Transmission cooler lines grounded out. • Flexplate to torque converter nuts loose. • Fluid filler tube grounded out. • Shift cable incorrectly routed, grounded out or loose.	• CHECK the transmission cooler lines. REPAIR as necessary. • CHECK the flexplate nuts. TIGHTEN to specification. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary. • CHECK the fluid filler tube. REPAIR as necessary. • CHECK the shift cable. REPAIR as necessary. Section 307-05 .
• Shutter or chatter—occurs with light to medium acceleration from low speeds or a stop	• Electrical inputs/outputs. • Vehicle wiring harness. • Incorrect inputs/outputs from the powertrain control module (PCM), digital transmission range (TR) sensor, brake pedal position (BPP) sensor, throttle position (TP) sensor, transmission speed sensor (TSS), output speed shaft (OSS) sensor or the torque converter clutch (TCC).	• CARRY OUT a Torque Converter Clutch Operation Test. RUN on-board diagnostics or self-test. REFER to Section 307-01A for 4R70W transmissions or Section 307-01B for 5R55E transmissions. REPAIR as necessary. CLEAR the DTC's, road test and rerun on-board diagnostics or self–test.

Pinpoint Tests

The pinpoint tests are a step-by-step diagnostic process designed to determine the cause of a condition. It may not always be necessary to follow a pinpoint test to its conclusion. Carry out only the steps necessary to correct the condition. Then, test the system for normal operation. Sometimes, it is necessary to remove various vehicle components to gain access to the component requiring testing. Reinstall all components after verifying system operation is normal.

PINPOINT TEST A: BRAKE VIBRATION/SHUDDER

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 ROAD TEST THE VEHICLE—LIGHT BRAKING	
	1 Check that the wheel and tires are correct for the vehicle. Inspect the tires for abnormal wear patterns. 2 Road test the vehicle. Warm the brakes by slowing the vehicle a few times from 80–32 km/h (50-20 mph) using light braking applications. At highway speeds of 89–97 km/h (55-60 mph), apply the brake using a light pedal force. • **Is there a vibration/shudder felt in the steering wheel, seat or brake pedal?** → **Yes** GO to A4 . → **No** GO to A2 .
A2 ROAD TEST THE VEHICLE—MODERATE TO HEAVY BRAKING	
	1 Road test the vehicle. At highway speeds of 89–97 km/h (55-60 mph), apply the brake using a moderate to heavy pedal force. • **Is there a vibration/shudder?** → **Yes** For vehicles with ABS, GO to A3 . For vehicles with standard brakes, GO to A4 . → **No** Vehicle is OK. VERIFY condition with customer. TEST the vehicle for normal operation.
A3 NORMAL ACTUATION OF THE ABS SYSTEM	
	1 During moderate to heavy braking, noise from the hydraulic control unit (HCU) and pulsation in the brake pedal can be observed. Pedal pulsation coupled with noise during heavy braking or on loose gravel, bumps, wet or snowy surfaces is acceptable and indicates correct functioning of the ABS system. Pedal pulsation or steering wheel nibble (frequency is proportioned to the vehicle speed) indicates a concern with a brake or suspension component. • **Is the vibration/shudder vehicle speed sensitive?**

→ **Yes**
GO to A5 .

→ **No**
The brake system is operating correctly.

A4 APPLICATION OF THE PARKING BRAKE

1 **NOTE:** Begin at the front of the vehicle unless the vibration or shudder has been isolated to the rear.

This test is not applicable to vehicles with drum-in-hat type parking brakes. For vehicles with drum-in-hat parking brakes, proceed to the next test. For all other vehicles, apply the parking brake to identify if the problem is in the front or rear brake. At highway speeds of 89–97 km/h (55-60 mph), lightly apply the parking brake until the vehicle slows down. Release the parking brake immediately after the test.

- **Is there a vibration/shudder?**

→ **Yes**
GO to A8 .

→ **No**
GO to A5 .

A5 CHECK THE FRONT WHEEL BEARINGS

1 Check the front wheel bearings. Refer to Wheel Bearing Check in this section.

- **Are the wheel bearings OK?**

→ **Yes**
GO to A6 .

→ **No**
INSPECT the wheel bearings. ADJUST or REPAIR as necessary. TEST the system for normal operation.

A6 CHECK THE FRONT SUSPENSION

1 Check the front suspension for:

- Broken or loose bolts.
- Damaged springs.
- Worn or damaged upper and lower control arm bushings.
- Loose or rough front bearings.
- Uneven tire wear.

- **Are all the suspension components in satisfactory condition?**

→ **Yes**
GO to A7 .

→ **No**

	REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
A7 RESURFACE THE FRONT BRAKE DISCS	
	1 **CAUTION: Do not use a bench lathe to machine brake discs.** **NOTE:** Follow the manufacturer's instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification. Resurface the front brake discs. Refer to Brake Disc Machining in this section. Road test the vehicle. • **Is the vibration/shudder present?** → **Yes** GO to A8 . → **No** Vehicle is OK.
A8 CHECK THE REAR SUSPENSION	
	1 Check the rear suspension for: • Broken or loose bolts. • Damaged or worn springs or spring bushings. • Worn or damaged upper and lower control arm bushings. • Worn or damaged trailing arms. • Loose or rough rear bearings. • Uneven tire wear. • **Are all the suspension components in satisfactory condition?** → **Yes** GO to A9 . → **No** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
A9 RESURFACE THE REAR BRAKE DISC OR DRUM	
	1 **CAUTION: Do not use a bench lathe to machine brake discs.** **NOTE:** Follow the manufacturers instructions to machine the brake discs. After machining, make sure the brake disc meets the thickness specification. Resurface the rear brake discs or drums. Refer to Brake Disc Machining in this section. Road test the vehicle. • **Is the vibration/shudder present?** → **Yes**

	CHECK the front suspension for wear or damage, RESURFACE the front brake discs. TEST the system for normal operation. → **No** Vehicle is OK.

PINPOINT TEST B: ENGINE TICKING NOISE

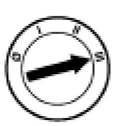
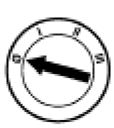
CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CHECK FOR TICKING NOISE AT THE FUEL RAIL	
	1 Disconnect the first fuel line clip. • **Is the ticking noise gone?** → **Yes** CHECK for TSB for applicable vehicle. REPAIR as necessary. TEST the system for normal operation. → **No** GO to B2 .
B2 CHECK FOR TICKING NOISE AT THE FUEL INJECTOR	
	1 Using an EngineEAR, listen at the fuel injectors by placing a probe on each injector. To isolate the faulty injector, disconnect the injector electrical connector and listen for the noise. • **Is the fuel injector the source of the ticking noise?** → **Yes** INSTALL a new fuel injector. REFER to Section 303-04A for 4.0L push rod engines, Section 303-04B for 4.0L SOHC engines or Section 303-04C firo 5.0L engines. TEST the system for normal operation. → **No** GO to B3 .
B3 CHECK THE BELT TENSIONER FOR TICKING NOISE	
	1 Inspect the accessory drive. Check for the belt tensioner bottoming at end of travel or not at end of stroke. 2 Using an EngineEAR, listen at the belt tensioner. • **Is the belt tensioner the source of the noise?** → **Yes** INSTALL a new belt tensioner. TEST the system for normal operation. → **No** GO to B4 .
B4 CHECK THE WATER PUMP FOR TICKING NOISE	

	1 Using an EngineEAR, listen at the water pump for ticking noise. • **Is the water pump the source of the noise?** → **Yes** INSTALL a new water pump. REFER to Section 303-03 . TEST the system for normal operation. → **No** GO to B5 .
B5 CHECK FOR AN OBSTRUCTION OF THE COOLING FAN	
	1 Inspect the cooling fan for obstructions. 2 Check the cooling fan and shroud for wear or damage. • **Was there an obstruction or does the cooling fan show signs of damage?** → **Yes** REPAIR or INSTALL a new cooling fan. REFER to Section 303-03 . TEST the system for normal operation. → **No** GO to B6 .
B6 CHECK THE OIL PUMP FOR TICKING NOISE	
	1 Check the oil pump using EngineEARs and probe at the oil filter adapter to verify the oil pump as a source. • **Is the oil pump the source of the noise?** → **Yes** INSTALL a new oil pump. TEST the system for normal operation. → **No** GO to B7 .
B7 CHECK VALVE LIFTERS OR LASH ADJUSTERS FOR CORRECT OPERATION	
	1 Check valve lifter/lash adjuster for correct operation, using EngineEARs. • **Are the valve lifters/lash adjusters operating correctly?** → **Yes** VERIFY customer concern. CONDUCT a diagnosis of other suspect components. → **No** INSTALL a new valve lifter/lash adjuster(s). TEST the system for normal operation.

PINPOINT TEST C: ACCESSORY DRIVE BEARING HOOT

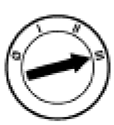
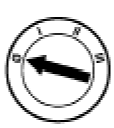
CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CHECK THE ACCESSORY DRIVE IDLER AND TENSIONER PULLEY BEARINGS	
	1 Carry out the Vehicle Cold Soak Procedure in this section.
2 	
	3 Place an EngineEAR probe directly on the pulley center post or bolt to verify which bearing is making the noise.
4 	
	• **Is either bearing making the noise?** → **Yes** INSTALL a new pulley/idler. CARRY OUT the Vehicle Cold Soak Procedure and TEST the system for normal operation. → **No** CONDUCT a diagnosis on other suspect accessory drive components.

PINPOINT TEST D: POWER STEERING MOAN

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CHECK THE POWER STEERING SYSTEM	
	1 Carry out the Vehicle Cold Soak Procedure in this section.
2 	
	3 Turn the steering wheel while the noise is occurring and listen for changes in sound pitch or loudness.
4 	
	• **Does the sound pitch or loudness change while turning the steering wheel?** → **Yes** GO to D2 .

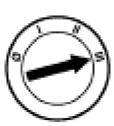
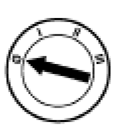
	→ **No** CONDUCT a diagnosis on other suspect accessory drive components.
D2 VERIFY THE SOURCE	
1 	
	2 Place an EngineEAR probe near the power steering pump/reservoir while the noise is occurring. While an assistant turns the steering wheel, listen for changes in sound pitch or loudness.
3 	
	• **Does the sound pitch or loudness change while turning the steering wheel?**
	→ **Yes** VERIFY that the supply tube to the pump is unobstructed. CHECK the fluid condition and level. DRAIN the fluid and REFILL. CARRY OUT the Vehicle Cold Soak Procedure and TEST the system for normal operation.
	→ **No** Normal system operation.

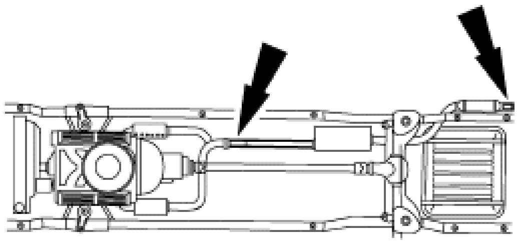
PINPOINT TEST E: ENGINE DRIVEN COOLING FAN MOAN

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CHECK THE ENGINE DRIVEN COOLING FAN AFTER A COLD SOAK	
	1 Carry out the Vehicle Cold Soak Procedure in this section.
2 	
	3 Assess the airflow.
	4 Raise the engine speed to 1500 rpm while listening for the moan to increase in proportion to the airflow.
5 	
	• **Does the moan increase in proportion to the airflow?**

	→ **Yes** TEST the fan for normal operation. If the fan tests normal, GO to E2 . Otherwise, REPAIR as necessary. → **No** Normal system operation.
E2 CHECK THE ENGINE DRIVEN COOLING FAN AT NORMAL OPERATING TEMPERATURE	
1  3 	2 Run the engine to normal operating temperature while listening for the moan to stop. • **Does the moan stop?** → **Yes** Normal clutch operation. → **No** INSTALL a new fan clutch. REFER to Section 303-03 . TEST the system for normal operation.

PINPOINT TEST F: DRUMMING NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CHECK THE EXHAUST SYSTEM	
1  3  4	2 Increase the engine rpm until the noise is the loudest. Note the engine rpm. 4 Add approximately 9 kg (20 lb) of weight to the exhaust system. First place the weight at the tail pipe and test, then at the front pipe.



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5

6 Increase the engine rpm and listen for the drumming noise. Note the engine rpm if the noise occurs.

7

8 Using a vibration analyzer (VA), determine the amount of vibration that occurs with the drumming noise.

- **Is the noise/vibration reduced or eliminated, or does the noise/vibration occur at a different rpm?**

→ **Yes**
CARRY OUT Exhaust System Neutralizing in this section. TEST the system for normal operation.

→ **No**
GO to F2 .

F2 POWERTRAIN/DRIVETRAIN MOUNT NEUTRALIZING

1 Carry out Powertrain/Drivetrain Mount Neutralizing in this section. Test the system for normal operation.

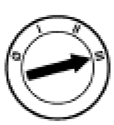
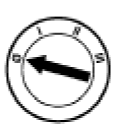
- **Is the noise reduced or eliminated?**

→ **Yes**
Vehicle OK. TEST the system for normal operation.

→ **No**
CONDUCT diagnosis of other suspect

	components.

PINPOINT TEST G: ENGINE TICKING, KNOCKING OR CONTINUOUS RATTLE

CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CHECK FOR NOISE AT THE VALVE COVERS AND THE FRONT COVERS (OHC ENGINES)	
2  4 	1 Carry out the Vehicle Cold Soak Procedure in this section. 3 **NOTE:** For a short-duration ticking noise, multiple engine starts may be necessary. Using an EngineEAR, listen closely at the valve covers and the front covers (OHC engines) by placing the probe near the surface of the valve cover and then on the surface front cover. • **Is the noise source apparent?** → **Yes** REMOVE the appropriate cover and INSPECT for loose, worn/broken components. REPAIR as necessary. TEST the system for normal operation. → **No** GO to G2 .
G2 CHECK FOR NOISE AT THE CYLINDER BLOCK	
1  3 	2 Using an EngineEAR, listen closely at the cylinder block by placing a probe on or near each freeze plug. • **Is the noise source apparent?** → **Yes**

	REPAIR or INSTALL new components as necessary. → **No** GO to G3 .
G3 CHECK FOR NOISE WHILE DISCONNECTING EACH FUEL INJECTOR ELECTRICAL CONNECTOR, ONE AT A TIME	
1  3 	2 Disconnect each fuel injector electrical connector, one at a time, to decrease piston force and listen for the noise. • **Is the noise reduced or eliminated?** → **Yes** INSTALL a new fuel injector. TEST the system for normal operation. → **No** INSPECT accessory drive or the transmission as a possible source.

PINPOINT TEST H: FRONT SUSPENSION NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 ROAD TEST THE VEHICLE	
	1 Test drive the vehicle. 2 **NOTE:** An assistant will be needed for this road test. During the road test, drive the vehicle over a rough road. Using ChassisEARs, determine from which area/component the noise is originating. • **Is there a squeak, creak or rattle noise?** → **Yes** GO to H2 . → **No** The suspension system is OK. CONDUCT a diagnosis on other suspect systems.
H2 INSPECT THE STEERING SYSTEM	
	1 ⚠ **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This**

	can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations. Raise and support the vehicle. 2 Check the steering system for wear or damage. Carry out a steering linkage test. Refer Section 211-00 . 3 Inspect the tire wear pattern. Refer to Tire Wear Patterns chart in this section. • **Are the steering components worn or damaged?** → **Yes** REPAIR the steering system. INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to H3 .
H3 FRONT SHOCK ABSORBER/STRUT CHECK	
	1 Check the front shock absorbers/strut mounts for loose bolts or nuts. 2 Check the front shock absorbers/struts for wear or damage. Carry out a "bounce test". • **Are the front shock absorbers/struts loose or damaged?** → **Yes** TIGHTEN to specifications if loose. INSTALL new front shock absorbers/struts if damaged. TEST the system for normal operation. → **No** GO to H4 .
H4 CHECK THE FRONT SPRINGS	
	1 Check the front spring and front spring mounts/brackets for wear or damage. • **Are the front springs or spring mounts/brackets worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to H5 .
H5 CHECK THE CONTROL ARMS/RADIUS ARMS	
	1 Inspect the control arm bushings for wear or damage. 2 Inspect for twisted or bent control arm/radius arm. • **Are the control arm/radius arms damaged or worn?**

	→ **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to H6 .
H6 CHECK THE STABILIZER BAR/TRACK BAR	
	1 Check the stabilizer bar/track bar bushings and links for damage or wear. 2 Check the stabilizer bar/track bar for damage. 3 Check for loose or damaged stabilizer bar isolators or brackets. • **Are the stabilizer bar/track bar components loose, worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** Suspension system OK. CONDUCT diagnosis on other suspect systems.

PINPOINT TEST I: REAR SUSPENSION NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
I1 ROAD TEST THE VEHICLE	
	1 Test drive the vehicle. 2 **NOTE:** An assistant will be needed for this road test. During the road test, drive the vehicle over a rough road. Using ChassisEARs, determine from which area/component the noise is originating. • **Is there a squeak, creak or rattle noise?** → **Yes** GO to I2 . → **No** The suspension system is OK. Conduct a diagnosis on other suspect systems.
I2 REAR SHOCK ABSORBER/STRUT CHECK	
	1 **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.** Raise and support the vehicle.

	2 Check the rear shock absorber/strut mounts for loose bolts or nuts. 3 Check the rear shock absorbers/struts for damage. Carry out a shock absorber check. • **Are the rear shock absorbers/struts loose or damaged?** → **Yes** TIGHTEN to specifications if loose. INSTALL new rear shock absorbers/struts if damaged. TEST the system for normal operation. → **No** GO to I3 .
I3 CHECK THE REAR SPRINGS	
	1 Check the rear springs and rear spring mounts/brackets for wear or damage. • **Are the rear springs or spring mounts/brackets worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to I4 .
I4 CHECK THE CONTROL ARMS/TRAILING ARMS	
	1 Inspect the control arm/trailing arm bushings for wear or damage. Check for loose control arm/trailing arm bolts. 2 Inspect for twisted or bent control arm/trailing arms. • **Are the control arm/trailing arms loose, damaged or worn?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** GO to I5 .
I5 CHECK THE STABILIZER BAR/TRACK BAR	
	1 Check the stabilizer bar/track bar bushings and links for damage or wear. 2 Check the stabilizer bar/track bar for damage. 3 Check for loose or damaged stabilizer bar isolators or brackets. • **Are the stabilizer bar/track bar components loose, worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. Test the system for normal operation.

	→ **No** Suspension system OK. CONDUCT diagnosis on other suspect systems.

PINPOINT TEST J: WHEEL AND TIRE

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 ROAD TEST THE VEHICLE	
	1 **NOTE:** Wheel or tire vibrations felt in the steering wheel are most likely related to the front wheel or tire. Vibration felt through the seat are most likely related to the rear wheel or tire. This may not always be true, but it can help to isolate the problem to the front or rear of the vehicle. Test drive the vehicle at different speed ranges. 2 During the road test, if the vibration can be eliminated by placing the vehicle in neutral or is affected by the speed of the engine, the cause is not the wheels or tires. • **Is there a vibration and noise?** → **Yes** GO to J2 . → **No** The wheel and tires are OK. CONDUCT a diagnosis on other suspect systems.
J2 CHECK THE FRONT WHEEL BEARINGS	
	1 Check the front wheel bearings. Refer to Wheel Bearing Check in this section. • **Are the wheel bearings OK?** → **Yes** GO to J3 . → **No** INSPECT the wheel bearings. ADJUST or REPAIR as necessary. TEST the system for normal operation.
J3 INSPECT THE TIRES	
	1 Check the tires for missing weights. 2 Check the wheels for damage.

3 Inspect the tire wear pattern. Refer to the Tire Wear Patterns chart in this section.

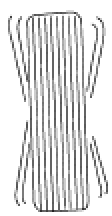
- **Do the tires have an abnormal wear pattern?**

→ **Yes**
CORRECT the condition that caused the abnormal wear. INSTALL new tire(s). TEST the system for normal operation.

→ **No**
GO to J4 .

J4 TIRE ROTATION DIAGNOSIS

1



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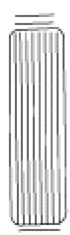
1 Spin the tires slowly and watch for signs of lateral runout.

2



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2 Spin the tires slowly and watch for signs of radial runout.

- **Are there signs of visual runout?**

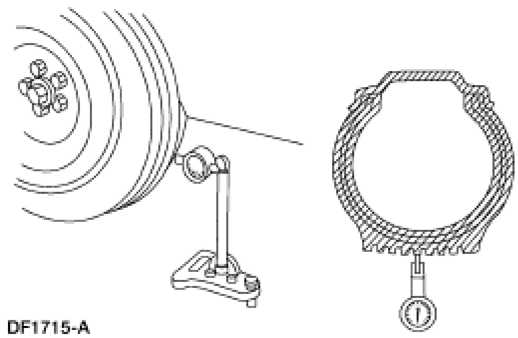
→ **Yes**
GO to J5 .

→ **No**
CHECK the wheel and tire balance. CORRECT as necessary. TEST the system for normal operation.

J5 RADIAL RUNOUT CHECK ON THE TIRE

1

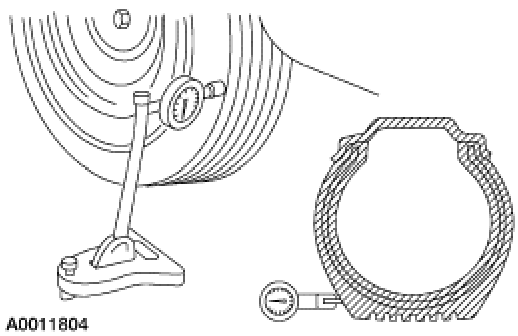
1 Measure the radial runout of the wheel and tire assembly. A typical specification for total radial runout is 1.14 mm (0.045 in).

	• **Is the radial runout within specifications?** → **Yes** GO to J8 . → **No** GO to J6 .
J6 RADIAL RUNOUT CHECK ON THE WHEEL	
	1 Measure the radial runout of the wheel. A typical specification for total radial runout is 1.14 mm (0.045 in). • **Is the radial runout within specifications?** → **Yes** INSTALL a new tire. TEST the system for normal operation. → **No** GO to J7 .
J7 CHECK THE HUB/BRAKE DISC OR DRUM PILOT RUNOUT OR BOLT CIRCLE RUNOUT	
	1 Measure the pilot or bolt circle runout. A typical specification for radial runout is: • Pilot runout— less than 0.15 mm (0.006 inch). • Bolt circle runout— less than 0.38 mm (0.015 inch). • **Is the radial runout within specifications?** → **Yes** INSTALL a new wheel. TEST the system for normal operation.

→ **No**
REPAIR or INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive vehicles and Section 204-01B for 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels.

J8 LATERAL RUNOUT CHECK ON THE TIRE

1



1 Measure the lateral runout of the wheel and tire assembly. A typical specification for total lateral runout is 1.14 mm (0.045 inch).

- **Is the lateral runout within specifications?**

→ **Yes**
Wheel and tires OK. CONDUCT diagnosis on other suspect systems.

→ **No**
GO to J9 .

J9 LATERAL RUNOUT CHECK ON THE WHEEL

1 Measure the lateral runout of the wheel. A typical specification for total radial runout is 1.14mm (0.045 inch.

- **Is the lateral runout within specifications?**

→ **Yes**
INSTALL a new tire. TEST the system for normal operation.

→ **No**
GO to J10 .

J10 CHECK THE FLANGE FACE LATERAL RUNOUT

1 Measure the flange face lateral runout. A typical specification for lateral runout is:

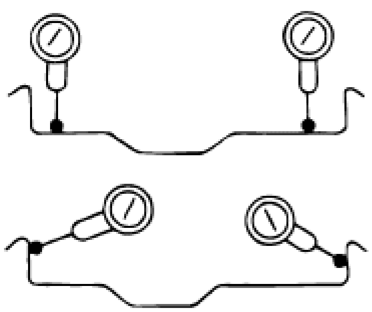
- Hub/brake disc— less than 0.13 mm (0.005 inch).
- Axle shaft— less than 0.25 mm

	(0.010 inch). • **Is the lateral runout within specifications?** → **Yes** INSTALL a new wheel. TEST the system for normal operation. → **No** REPAIR or INSTALL new components as necessary. REFER to Section 204-01A for 2-wheel drive vehicles and Section 204-01B for 4-wheel drive vehicles for the front wheels or Section 204-02 for the rear wheels.

PINPOINT TEST K: HIGH SPEED SHAKE OR SHIMMY DIAGNOSIS

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CHECK FOR FRONT WHEEL BEARING ROUGHNESS	
	1 Chock the rear wheels. 2 Raise and support the front end of the vehicle so that the front wheel and tire assemblies can spin. 3 Spin the front tires by hand. Refer to Wheel Bearing Check in this section. • **Do the wheel bearings feel rough?** → **Yes** INSPECT the wheel bearings. REPAIR as necessary. TEST the system for normal operation. → **No** GO to K2 .
K2 CHECK THE END PLAY OF THE FRONT WHEEL BEARINGS	
	1 Check the end play of the front wheel bearings. Refer to REFER to Section 204-01A for 2-wheel drive vehicles or Section 204-01B for 4-wheel drive vehicles. • **Is the end play OK?** → **Yes** GO to K3 . → **No**

	ADJUST or REPAIR as necessary. TEST the system for normal operation.
K3 MEASURE THE LATERAL RUNOUT AND THE RADIAL RUNOUT OF THE FRONT WHEELS ON THE VEHICLE	
	1 Measure the lateral runout and the radial runout of the front wheels on the vehicle. Refer to Pinpoint Test J. • **Are the measurements within specifications?** → **Yes** GO to K4 . → **No** INSTALL new wheels as necessary and BALANCE the assembly. TEST the system for normal operation.
K4 MEASURE THE LATERAL RUNOUT OF THE FRONT TIRES ON THE VEHICLE	
	1 Measure the lateral runout of the front tires on the vehicle. Refer to Pinpoint Test J. • **Is the runout within specifications?** → **Yes** GO to K5 . → **No** INSTALL new tires as necessary and BALANCE the assembly. TEST the system for normal operation.
K5 MEASURE THE RADIAL RUNOUT OF THE FRONT TIRES ON THE VEHICLE	
	1 Measure the radial runout of the front tires on the vehicle. Refer to Pinpoint Test J. • **Is the runout within specifications?** → **Yes** BALANCE the front wheel and tire assemblies. If any tire cannot be balanced, INSTALL a new tire. TEST the system for normal operation. → **No** GO to K6 .
K6 MATCH MOUNT THE TIRE AND WHEEL ASSEMBLY	
	1 Mark the high runout location on the tire and also on the wheel. Break the assembly down and rotate the tire 180 degrees (halfway around) on the wheel. Inflate the tire and

	measure the radial runout. • **Is the runout within specifications?** → **Yes** BALANCE the assembly. TEST the system for normal operation. → **No** If the high spot is not within 101.6 mm (4 inches) of the first high spot on the tire, GO to K7 .
K7 MEASURE THE WHEEL FLANGE RUNOUT	
1  DG0199-A	1 Dismount the tire and mount the wheel on a wheel balancer. Measure the runout on both wheel flanges. Refer to Section 204-04 . • **Is the runout within specifications?** → **Yes** LOCATE and MARK the low spot on the wheel. INSTALL the tire, matching the high spot on the tire with the low spot on the wheel. BALANCE the assembly. TEST the system for normal operation. If the condition persists,GO to K8 . → **No** INSTALL a new wheel. CHECK the runout on the new wheel. If the new wheel is within limits, LOCATE and MARK the low spot. INSTALL the tire, matching the high spot on the tire with the low spot on the wheel. BALANCE the assembly. TEST the system for normal operation. If the condition persists, GO to K8 .
K8 CHECK FOR VIBRATION FROM THE FRONT OF THE VEHICLE	
WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since 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 or differential failure, which can cause serious personal injury and extensive vehicle damage.	
	1 Spin the front wheel and tire assemblies with

	a wheel balancer while the vehicle is raised on a hoist. Feel for vibration in the front fender or while seated in the vehicle. • **Is the vibration present?** → **Yes** SUBSTITUTE known good wheel and tire assemblies as necessary. TEST the system for normal operation. → **No** GO to K9 .

K9 CHECK FOR VIBRATION FROM THE REAR OF THE VEHICLE

WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since 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 or differential failure, which can cause serious personal injury and extensive vehicle damage.

	1 Chock the front wheels. 2 Raise and support the rear end of the vehicle so that the rear wheel and tire assemblies can spin. 3 Engage the drivetrain and carefully accelerate the drive wheels while checking for vibration. • **Is the vibration present?** → **Yes** GO to K10 . → **No** TEST the system for normal operation.

K10 CHECK THE DRIVETRAIN

WARNING: If only one drive wheel is allowed to rotate, speed must be limited to 55 km/h (34 mph) using the speedometer reading, since 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 or differential failure, which can cause serious personal injury and extensive vehicle damage.

	1 Remove the rear wheel and tire assemblies. 2 Secure the brake drums (if so equipped), by installing wheel hub bolt nuts, reversed. 3 Carefully accelerate the drivetrain while checking for vibration. • **Is the vibration present?**

	→ **Yes** CHECK/TEST the drivetrain and driveline components. TEST the system for normal operation. → **No** SUBSTITUTE known good wheel and tire assemblies as necessary. TEST the system for normal operation.

PINPOINT TEST L: CLUTCH VIBRATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CHECK ENGINE COMPONENTS FOR GROUNDING	
	1 **NOTE:** Make sure the clutch is the cause of the vibration concern. The vibration should occur during clutch operation. The clutch can also be difficult to engage or disengage. Eliminate all related systems before checking the clutch components. **NOTE:** Check the driveline angles and driveshaft runout before disassembling the clutch system. Refer to Section 205-00 . Check the powertrain/drivetrain mounts, exhaust manifolds or other engine components for grounding on the chassis. • **Are any mounts or engine components grounded?** → **Yes** REPAIR as necessary. TEST the system for normal operation. → **No** GO to L2 .
L2 CHECK THE ACCESSORY DRIVE	
	1 Remove the accessory drive belt. • **Does the vibration stop with the accessory drive belt removed?** → **Yes** DIAGNOSE the accessory drive components. → **No** GO to L3 .
L3 CHECK FOR LOOSE CLUTCH PRESSURE PLATE BOLTS	
	1 Check for loose clutch pressure plate bolts. Inspect the clutch pressure plate for damage or for material between the pressure plate and flywheel. • **Are there any loose bolts or damage?**

	→ **Yes** TIGHTEN the bolts to specifications or if damaged, INSTALL a new clutch pressure plate. REFER to Section 308-01 . TEST the system for normal operation. → **No** GO to L4 .
L4 CHECK THE CLUTCH DISC SPRINGS	
	1 Check for worn, broken or loose clutch disc springs. • **Are the clutch springs worn, broken or loose?** → **Yes** INSTALL a new clutch disc. REFER to Section 308-01 . TEST the system for normal operation. → **No** GO to L5 .
L5 CHECK THE CLUTCH DISC SPLINES	
	1 Inspect the clutch disc splines for damage or wear. • **Is there damage or wear?** → **Yes** INSTALL a new clutch disc. REFER to Section 308-01 . TEST the system for normal operation. → **No** GO to L6 .
L6 CHECK THE FLYWHEEL BOLTS	
	1 Check for loose flywheel bolts. • **Are the bolts loose?** → **Yes** TIGHTEN the bolts to specifications. TEST the system for normal operation. → **No** GO to L7 .
L7 CHECK THE FLYWHEEL SURFACE	
	1 Inspect the flywheel surface for wear or damage. Check the flywheel runout. • **Is there any damage or excessive wear?** → **Yes** INSTALL a new flywheel. TEST the system for normal operation. → **No**

	Clutch system normal. CONDUCT a diagnosis on other suspect systems.

PINPOINT TEST M: TRANSFER CASE VIBRATION

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 INSPECT THE TRANSFER CASE	
	1 **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.** Inspect the transfer case for loose or missing mounting bolts. Check for fluid seepage between the transfer case and the transmission. • **Are the mounting bolts missing or loose?** → **Yes** TIGHTEN to specifications or INSTALL new bolts as necessary. TEST the system for normal operation. → **No** GO to M2 .
M2 INSPECT THE REAR DRIVESHAFT	
	1 **NOTE:** Verify that the driveshaft and pinion flange index marks are aligned. Inspect the driveshaft for missing weights, damage or undercoating. 2 Inspect the U-joints for freedom of movement. 3 Check driveshaft runout and, if necessary, check the pinion flange runout. • **Is the driveshaft or U-joints worn or damaged or misaligned?** → **Yes** REPAIR or INSTALL a new driveshaft as necessary. TEST the system for normal operation. → **No** GO to M3 .
M3 CHECK THE DRIVELINE ANGLES	
	1 Measure the rear driveshaft and pinion angles. Refer to Section 205-02 . 2 Measure the front driveshaft and pinion angles. Refer to Section 205-00 . • **Are the driveline angles incorrect?** → **Yes**

REPAIR as necessary. TEST the system for normal operation.

→ **No**
GO to M4 .

M4 INSPECT THE FRONT DRIVESHAFT

1 **NOTE:** Verify that the driveshaft and pinion flange index marks are aligned.

Inspect the front driveshaft for missing weights, damage or undercoating.

2 Inspect the U-joints and slip yoke for freedom of movement.

3 Check driveshaft runout and, if necessary, check the pinion flange runout.

- **Is the driveshaft or U-joints worn or damaged?**

→ **Yes**
REPAIR or INSTALL a new driveshaft as necessary. TEST the system for normal operation.

→ **No**
GO to M5 .

M5 ROAD TEST WITH THE FRONT DRIVESHAFT ONLY

1 **NOTE:** Index mark the driveshaft to the pinion flange and to the output shaft before removal.

Remove the rear driveshaft.

2 Plug the transfer case with an output shaft seal plug.

3 **NOTE:** Shift the transfer case into 4WD high so the vehicle is driven by the front driveshaft only.

Test drive the vehicle.

- **Is the vibration gone?**

→ **Yes**
INSTALL and BALANCE the rear driveshaft. TEST the system for normal operation.

→ **No**
GO to M6 .

M6 ROAD TEST WITH THE REAR DRIVESHAFT ONLY

1 **NOTE:** Index mark the front driveshaft to the pinion flange.

Remove the front driveshaft.

2 Test drive the vehicle.

- **Is the vibration gone?**

	→ **Yes** INSTALL and BALANCE the front driveshaft. TEST the system for normal operation. → **No** GO to M7 .
M7 TRANSFER CASE TAIL SHAFT INSPECTION	
	1 Inspect the splines of the output shaft for wear or damage. 2 Inspect the splines of the driveshaft slip yoke for wear or damage. • **Are the splines worn or damaged?** → **Yes** REPAIR or INSTALL new components as necessary. TEST the system for normal operation. → **No** The transfer case is OK. CONDUCT a diagnosis on other suspect systems.

Component Tests

Idle Air Control (IAC) Valve

1. Open the hood.
2. **NOTE:** Key symptom is elevated idle speed while noise is occurring.

   NOTE: "Snapping" the throttle can induce the noise.

   Verify the condition by operating the vehicle for a short time.
3. Inspect the IAC valve. If physical evidence of contamination exists, install a new IAC valve.
4. While the noise is occurring, either place an EngineEAR probe near the IAC valve and the inlet tube, or create a 6.35 mm (0.25 in)-12.7 mm (0.50 in) air gap between the inlet tube and the clean air tube. If the IAC valve is making the noise, install a new IAC valve.
5. Test the vehicle for normal operation.

Steering Gear Grunt/Shudder Test

1. Start and run the vehicle to operating temperature.
2. Set engine idle speed to 1200 rpm.
3. **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

   Rotate the steering wheel to the RH stop, then turn the steering wheel 90° back from that position.

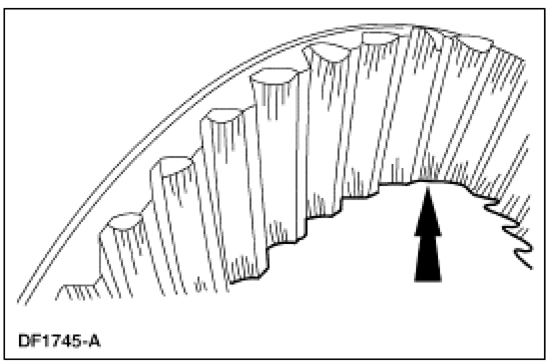
Turn the steering wheel slowly in a 15° to 30° arc.

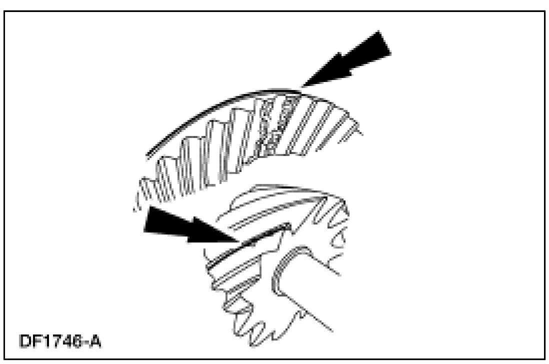
4. Turn the steering wheel another 90°. Turn the steering wheel slowly in a 15° to 30° arc.
5. Repeat the test with power steering fluid at different temperatures.
6. If a light grunt is heard or a low (50-200 Hz) shudder is present, this is a normal steering system condition.
7. If a loud grunt is heard, or a strong shudder is felt, fill and purge the power steering system.

Checking Tooth Contact Pattern and Condition of the Ring and Pinion

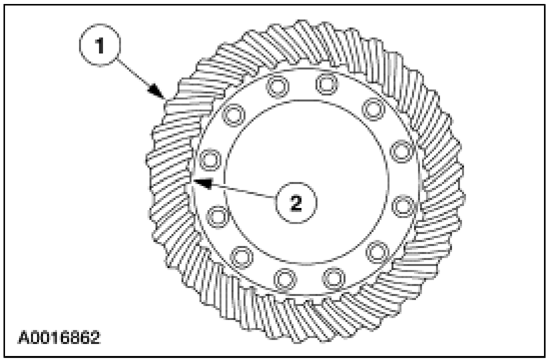
There are two basic types of conditions that will produce ring and pinion noise. The first type is a howl or chuckle produced by broken, cracked, chipped, scored or forcibly damaged gear teeth and is usually quite audible over the entire speed range. The second type of ring and pinion noise pertains to the mesh pattern of the gear pattern. This gear noise can be recognized as it produces a cycling pitch or whine. Ring and pinion noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the axle lubricant. Refer to Section 205-02 for rear axles or Section 205-03 for front axles.
3. Remove the carrier assembly or the axle housing cover depending on the axle type. Refer to Section 205-02 for rear axles or Section 205-03 for front axles.
4. Inspect the gear set for scoring or damage.





5. In the following steps, the movement of the contact pattern along the length is indicated as toward the" heel" or "toe" of the differential ring gear.

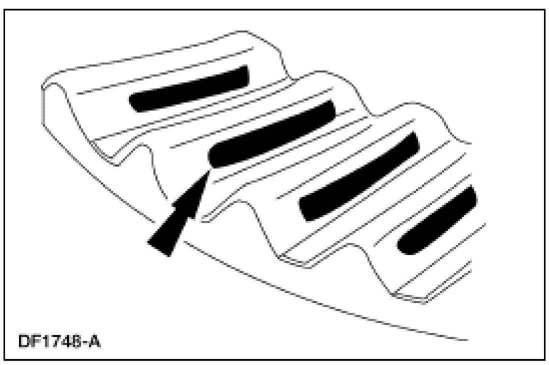


Item	Description
1	Heel
2	Toe

6. Apply a marking compound to a third of the gear teeth on the differential ring gear. Rotate the differential ring gear several complete turns in both directions until a good, clear tooth pattern is obtained. Inspect the contact patterns on the ring gear teeth.

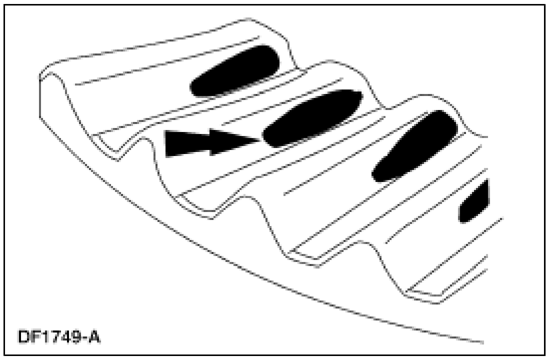
7. A good contact pattern should be centered on the tooth. It can also be slightly toward the toe. There should always be some clearance between the contact pattern and the top of the tooth.

- Tooth contact pattern shown on the drive side of the gear teeth.



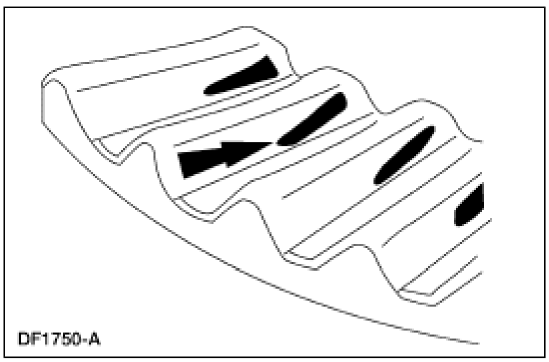
8. A high, thick contact pattern that is worn more toward the toe.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The high contact pattern indicates that the drive pinion is not installed deep enough into the carrier.
- The differential ring gear backlash is correct, a thinner drive pinion shim is needed. A decrease will move the drive pinion toward the differential ring gear.



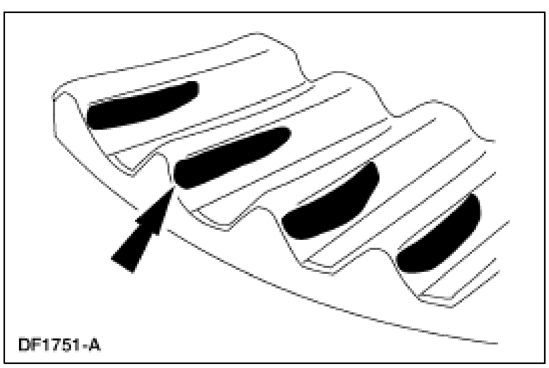
9. A high, thin contact pattern that is worn toward the toe.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The drive pinion depth is correct. Increase the differential ring gear backlash.



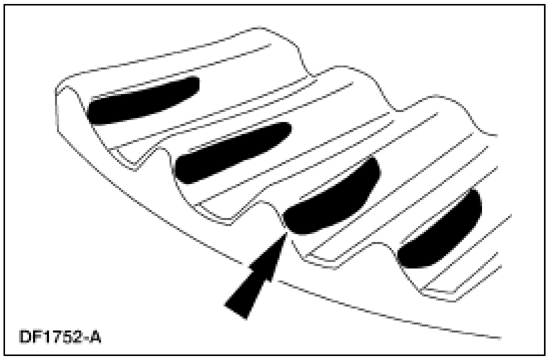
10. A contact pattern that is worn in the center of the differential ring gear tooth toward the heel.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The low contact pattern indicates that the drive pinion is installed too deep into the carrier.
- The differential ring gear backlash is correct. A thicker drive pinion shim is needed.



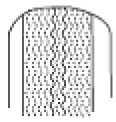
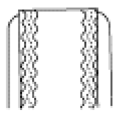
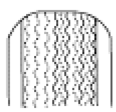
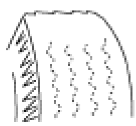
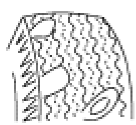
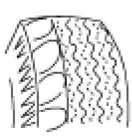
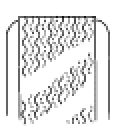
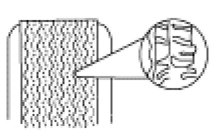
11. A contact pattern that is worn at the top of the differential ring gear tooth toward the heel.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The pinion gear depth is correct. Decrease the differential ring gear backlash.



Tire Wear Patterns and frequency calculations

Tire Wear Chart

TIRE WEAR	CONDITION	POSSIBLE CAUSES
	• Rapid wear at both shoulders.	• Tires underinflated. • Worn suspension components. • Excessive cornering speeds. • Lack of rotation.
	• Rapid wear at the center.	• Tires overinflated. • Lack of rotation. • Excessive toe on drive wheels. • Heavy acceleration on drive wheels.
	• Wear at one shoulder.	• Toe adjustment out of specification. • Camber out of specification. • Damaged strut. • Damaged lower control arm.
	• Feather edges.	• Toe adjustment out of specification. • Damaged or worn tie rods. • Damaged spindle or knuckle.
	• Bald spots or cupping.	• Unbalanced wheel. • Excessive radial runout. • Worn strut or shock absorber.
	• Tire scalloped.	• Toe adjustment out of specification. • Camber out of specification. • Worn or damaged suspension components.
	• Wear pattern - FWD vehicles.	• Excessive toe on non-drive wheels. • Lack of rotation.
	• Wear pattern - FWD vehicles. Edge of thread blocks worn.	• Excessive toe on non-drive wheels. • Lack of rotation.

DF1717-A

Wheel and tire NVH concerns are directly related to vehicle speed and are not generally affected by acceleration, coasting or decelerating. Also, out-of-balance wheel and tires can vibrate at more than one speed. A vibration that is affected by the engine rpm, or is eliminated by placing the transmission in NEUTRAL is not related to the tire and wheel. As a general rule, tire and wheel vibrations felt in the steering wheel are related to the front tire and wheel assemblies. Vibrations felt in the seat or floor are related to the rear tire and wheel assemblies. This can initially isolate a concern to the front or rear.

Careful attention must be paid to the tire and wheels. There are several symptoms that can be caused by damaged or worn tire and wheels. Carry out a careful visual inspection of the tires and wheel assemblies.

Spin the tires slowly and watch for signs of lateral or radial runout. Refer to the tire wear chart to determine the tire wear conditions and actions.

For a vibration concern, use the vehicle speed to determine tire/wheel frequency and rpm. Calculate tire and wheel rpm and frequency by carrying out and following:

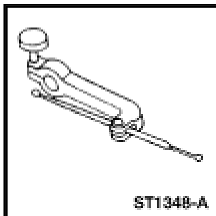
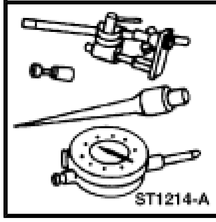
- Measure the diameter of the tire.
- Record the speed at which the vibration occurs.
- Obtain the corresponding tire and wheel rpm and frequency from the Tire Speed and Frequency Chart.
  - If the vehicle speed is not listed, divide the vehicle speed at which the vibration occurs by 16 (km/h (10 mph). Multiply that number by 16 km/h (10 mph) tire rpm listed for that tire diameter in the chart. Then divide that number by 60. For example: a 40 mph vibration with 835 mm (33 in) tires. 40 ÷10 = 4. Multiply 4 by 105 = 420 rpm. Divide 420 rpm by 60 seconds = 7 Hz at 40 mph.

Tire Speed and Frequency Chart

Tire Diameter	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz
mm (inch)	@ 16 km/h (10 mph)	@ 80 km/h (50 mph)	@ 97 km/h (60 mph)	@ 113 km/h (70 mph)
483 (19)	182	910/15	1092/18	1274/21
508 (20)	173	865/14	1038/17	1211/20
533 (21)	165	825/14	990/16	1155/19
560 (22)	158	790/13	948/16	1106/18
585 (23)	151	755/13	906/15	1057/18
610 (24)	145	725/12	870/14	1015/17
635 (25)	139	695/12	834/14	973/16
660 (26)	134	670/11	804/13	938/16
685 (27)	129	645/11	774/13	903/15
710 (28)	124	620/10	744/12	868/14
735 (29)	119	595/10	714/12	833/14
760 (30)	115	575/10	690/11	805/13
785 (31)	111	555/9	666/11	777/13
810 (32)	108	540/9	648/11	756/13
835 (33)	105	525/9	630/10	735/12
864 (34)	102	510/8	612/10	714/12

Brake Disc Machining

Special Tool(s)

	Gauge, Clutch Housing 308-021 (T75L-4201-A)
	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent	ESE-M12A4-A

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

CAUTION: Do not install brake discs that are less than the minimum thickness specified. Do not machine a brake disc below the minimum thickness specification.

1. Check wheel bearing end-play and correct as necessary.
2. **NOTE:** Begin at the front of the vehicle unless the vibration has been isolated to the rear.

   Remove the tire and wheel assembly.
3. Remove the brake caliper and the brake caliper anchor plate. Refer to the appropriate section in Group 206 for the procedure.
4. Inspect the brake linings. Install new brake linings if below specification. For additional information, refer to the appropriate brake section.

5. Measure and record the brake disc thickness. Install a new brake disc if the thickness after machining will be at or below specification. The specification is molded into the brake disc.
   - Do not machine a new brake disc.

6. For vehicles with a two-piece hub and brake disc assembly:
   - Match-mark before disassembly.
   - Remove the brake disc.
   - Clean the hub and brake disc mounting surfaces with metal surface cleaner.
   - Using a die grinder with a mild abrasive (Scotch Brite® type), remove any rust or corrosion from the hub and brake disc mounting surfaces.
   - Align the match-marks and reinstall the brake disc on the hub.

7. ⚠ **CAUTION: Do not use a bench lathe to machine brake discs.**

   NOTE: The depth of cut must be between 0.10 and 0.20 mm (0.004 and 0.008 inch). Lighter cuts will cause heat and wear. Heavier cuts will cause poor brake disc surface finish.

   Using an on-car brake lathe, machine the brake discs. Follow the manufacturer's instructions. After machining, make sure the brake disc still meets the thickness specification.

8. Using the special tools, verify that the brake disc lateral runout is now within specification. For additional information, refer to Section 206-00 .

9. Remove the special tool hub adapter.

10. Remove any remaining metal chips from the machining operation.

11. For vehicles with a two-piece hub and brake disc assembly:
    - Remove the brake disc from the hub.
    - Remove any remaining metal chips from hub and brake disc mounting surfaces and from the ABS sensor.
    - Apply a liberal amount of lubricant to the hub flange, pilot area and to the brake disc-to-hub mounting surface.
    - Using the match marks, mount the brake disc on the hub.

12. Install the brake caliper anchor plate and the brake caliper.

13. Install the tire and wheel assembly.

14. Test the system for normal operation.

Powertrain/Drivetrain Mount Neutralizing

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. Raise and support the vehicle.
2. Loosen, but do not remove, the powertrain/drivetrain mount fasteners.
3. Lower the vehicle.
4. **CAUTION: Do not twist or strain the powertrain/drivetrain mounts.**

   Move the vehicle in forward and reverse 0.6-1.2 meters (2-4 ft).
5. Raise and support the vehicle.
6. Tighten the powertrain/drivetrain mount fasteners.
7. Lower the vehicle.
8. Test the system for normal operation.

SECTION 100-04: Noise, Vibration and Harshness 2000 Explorer/Mountaineer Workshop Manual
GENERAL PROCEDURES

Exhaust System Neutralizing

WARNING: Exhaust gases contain carbon monoxide, which is harmful to health and potentially lethal. Repair exhaust system leaks 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 can be sufficiently bound up to transmit vibration as if grounded.

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   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.

2. Loosen all exhaust hanger attachments and reposition the hangers until they hang free and straight.

3. Loosen all exhaust flange joints.

4. Place a stand to support the muffler parallel to the vehicle frame with the muffler pipe bracket free of stress.

5. Tighten the muffler connection.

6. Tighten all the exhaust hanger clamps and flanges (tighten the exhaust manifold flange joint last).
   - Verify there is adequate clearance to prevent grounding at any point in the system. Make sure that the catalytic converter and heat shield do not contact the frame rails.
   - After neutralization, the rubber in the exhaust hangers should show some flexibility when movement is applied to the exhaust system.
   - With the exhaust system installed securely and cooled, the rear hanger should be angled forward.

7. Lower the vehicle.

8. Test the exhaust system for normal operation.

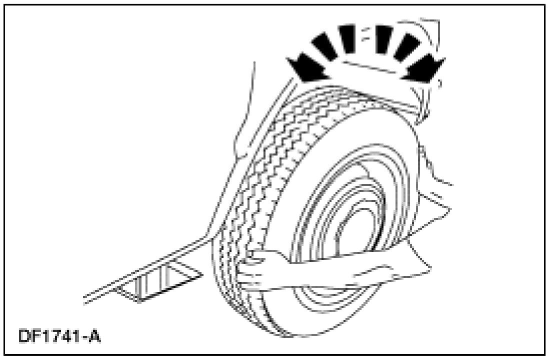
Wheel Bearing Check

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

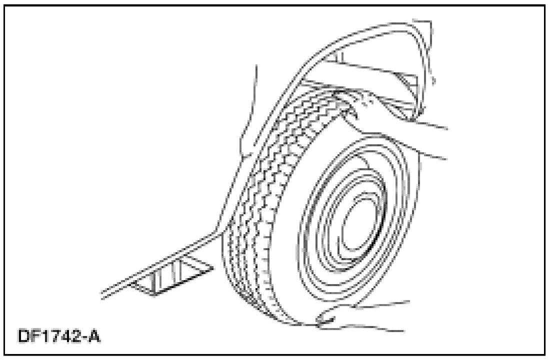
   Raise the vehicle until the front tires are off the floor.
   - Make sure the wheels are in a straight forward position.

2. **NOTE:** Make sure the wheel rotates freely and that the brake pads are retraced sufficiently to allow free movement of the tire and wheel assembly.

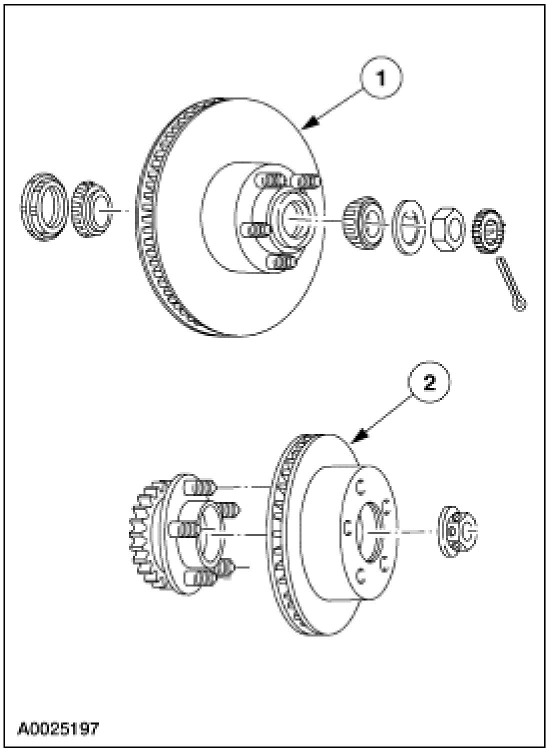
   Spin the tire by hand to check the wheel bearings for roughness.

3. Grip 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.

4. If the tire and wheel (hub) is loose on the spindle, does not rotate freely, or has a rough feeling when spun, carry out one of the following:
   1. On vehicles with inner and outer bearings, inspect the bearings and cups for wear or damage. Adjust or install new bearings and cups as necessary.
   2. On vehicles with one sealed bearing, install a new wheel hub.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2
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SECTION 204-00: Suspension System — General Information *2000 Explorer/Mountaineer Workshop Manual*
SPECIFICATIONS

Item	LH	RH	Total/Split
Alignment Specifications — All Vehicles			
Caster — 0° Frame Angle (If vehicle is higher in the rear, add the frame angle to the measured caster. If vehicle is lower in the rear, subtract the frame angle from the measured caster. Compare the total to the specification.)	4.2° - 1.0°	4.2° - 1.0°	-0.7° ± 0.5°
Camber	-0.5° ± 0.5°	-0.5° ± 0.5°	0° ± 0.7°
Toe @ Curb Ride Height (positive value is toe-in, negative value is toe-out)	—	—	0.12° ± 0.25°

General Specifications

Item	Specification
Wheel Track	
Wheel track	0.6 mm (0.02 in.)
Dogtracking	
Dogtracking — maximum (centerline of front tires compared to centerline of rear tires)	30 mm (1.18 in.)
Clear Vision	
Clear vision (negative value is counterclockwise)	-2.4° ± 3.0°
Ride Height — All Vehicles	
Front — new vehicles with less than 500 miles	113 mm ± 11 mm (4.4 in. ± 0.4 in.)
Front — original parts	101 mm ± 11 mm (4.0 in. ± 0.4 in.)
Front — replacement parts	113 mm ± 3 mm (4.4 in. ± 0.1 in.)
Rear — 4 door vehicles without air suspension	128-149 mm (5-5.8 in.)
Rear — 4 door vehicles with air suspension	110-123 mm (4.3-4.8 in.)
Rear — 2 door vehicles	110-123 mm (4.3-4.8 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)	
Front wheel opening— maximum	16 mm (0.6 in.)
Rear wheel opening— maximum	20 mm (0.78 in.)

Torque Specifications

Description	Nm	lb-ft
Caster set jam nuts	175	129
Front suspension upper arm cam nuts	133	98
Toe set jam nuts	80	59

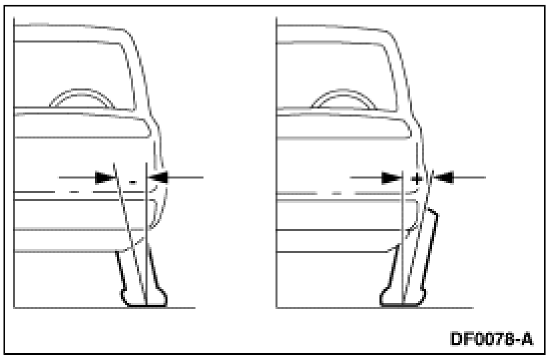
SECTION 204-00: Suspension System — General Information 2000 Explorer/Mountaineer Workshop Manual
DESCRIPTION AND OPERATION

Wheel Alignment Angles

Caster and camber are adjusted by means of eccentric cams on the upper control arm mounting bolts. Toe is adjusted by the use of the front wheel spindle tie-rod (3280).

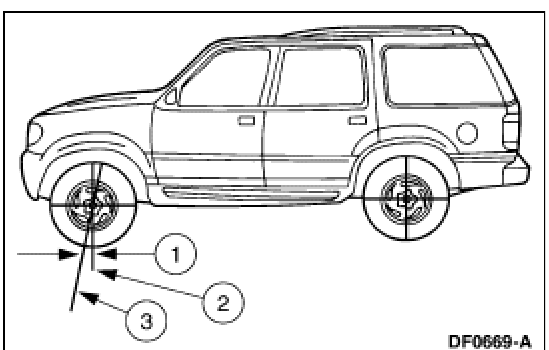
Camber

Negative and Positive Camber



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

Caster

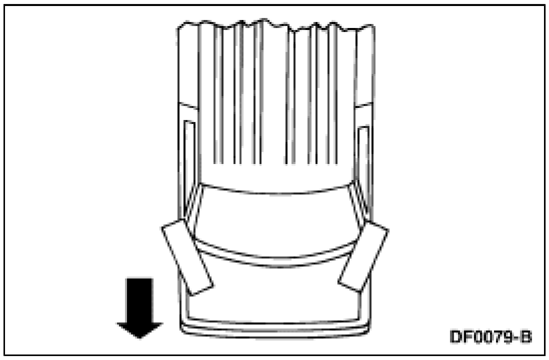


Item	Part Number	Description
1	—	Positive caster
2	—	True vertical
3	—	Steering axis

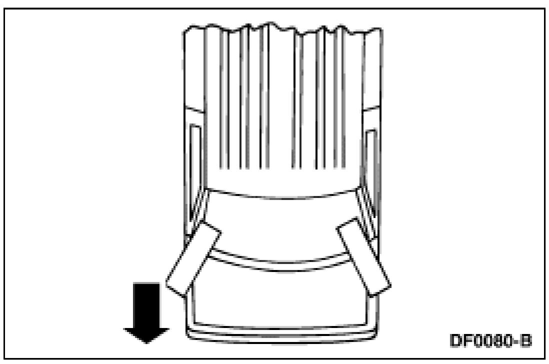
Caster is the deviation from vertical of an imaginary line drawn through the ball joints when viewed from the side. The caster specifications in this section will give the vehicle the best directional stability characteristics when loaded and driven. The caster setting is not related to tire wear.

Toe

Positive Toe (Toe In)



Negative Toe (Toe Out)

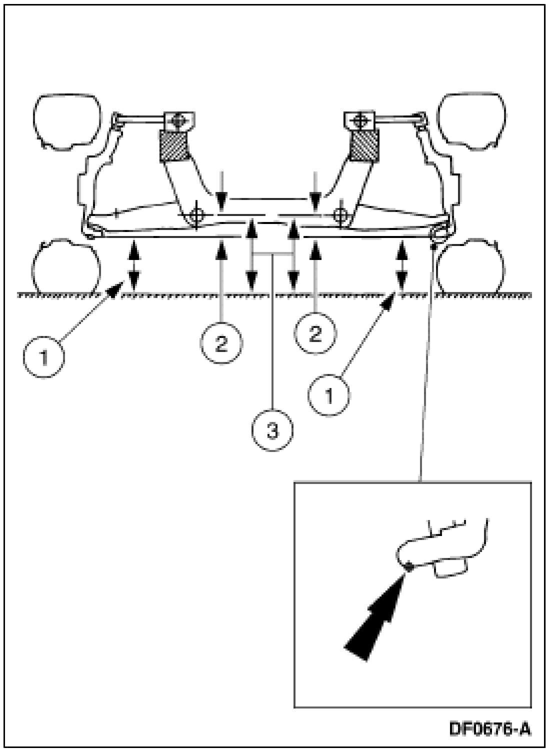


The vehicle toe setting:

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

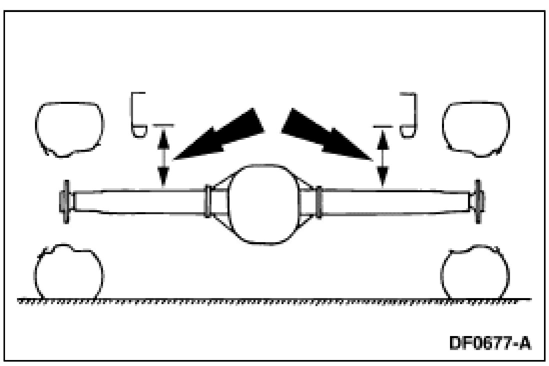
Ride Height

Front Ride Height Measurement

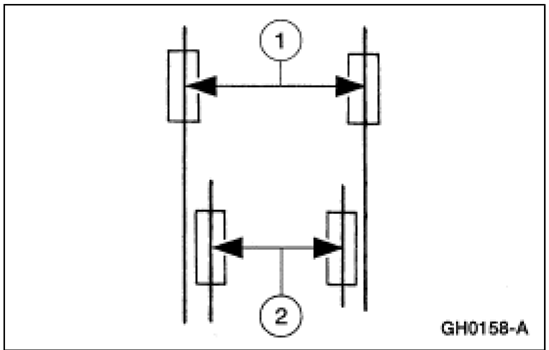


Item	Description
1	Measurement A
2	Ride height = B-A
3	Measurement B

Rear Ride Height Measurement

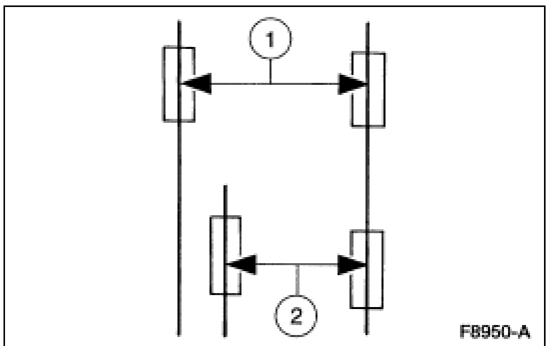


Wheel Track



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

Dogtracking



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, refer to Section 100-04 .

2. Inspect tires.
   - Check the tire pressure with all normal loads in the vehicle and the tires cold. Refer to the vehicle certification (VC) label.
   - Verify that all tires are sized to specification. Refer to Section 204-04 .
   - Inspect the tires for incorrect wear and damage. 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
• Front wheel bearing(s) • Loose or damaged front or rear suspension components • Loose, damaged or missing suspension fastener(s) • Loose or damaged shackle(s) • Incorrect spring usage • Damaged or sagging spring(s) • Incorrect torsion bar usage • Damaged or sagging torsion bar(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
• Dogtracking	• Excessive rear thrust angle.	• ADJUST as necessary.
	• Front or rear suspension components.	• INSPECT the front and rear suspension system. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01A (4x2), or Section 204-01B (4x4 or AWD) or Section 204-02 .
	• Drive axle damaged.	• REPAIR as necessary. REFER to the appropriate section in Group 2.
• Drift/Pull	• Unequal tire pressure.	• ADJUST tire pressure.
	• Excessive side-to-side difference in caster or camber.	• CHECK the wheel alignment. ADJUST as necessary.
	• Tire forces.	• ROTATE tires front to rear.
	• Unevenly loaded or overloaded vehicle.	• NOTIFY the customer of incorrect vehicle loading.
	• Steering components.	• REFER to Section 211-00 .
	• Brake drag.	• REFER to Section 206-00 .
• Front Bottoming or Riding Low	• Torsion bar(s).	• ADJUST the ride height or INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 and AWD).
	• Incorrect torsion bar(s).	• INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 and AWD).
	• Front suspension bumper(s).	• INSTALL new suspension bumper (s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 and AWD).
	• Front shock absorber(s).	• INSTALL new shock absorber(s) as necessary.
	• Suspension load leveling control system.	• REFER to suspension load leveling control system diagnosis and testing in Section 204-05 .
• Incorrect Tire Wear	• Incorrect tire pressure (rapid center rib or inner and outer edge wear).	• ADJUST tire pressure.
	• Excessive front or rear toe (rapid inner	• CHECK the wheel alignment. ADJUST as necessary.

	• or outer edge wear).	
	• Excessive negative or positive camber (rapid inner or outer edge wear).	• CHECK the wheel alignment. ADJUST as necessary.
	• Tires out of balance (tires cupped or dished).	• BALANCE tires.
• Rear Spring Squeak	• Rear spring(s).	• INSTALL new rear spring anti-squeak inserts (tip liners).
	• Shackle bushing(s).	• INSTALL new shackle bushings as necessary.
• Rough Ride	• Shock absorber(s).	• INSTALL new shock absorbers as necessary.
	• Spring(s).	• INSTALL new spring(s) as necessary. REFER to Section 204-02 .
	• Torsion bar(s).	• ADJUST the ride height or INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD).
• Shimmy or Wheel Tramp	• Loose lug nut(s).	• TIGHTEN to specification. REFER to Section 204-04 .
	• Loose front suspension fasteners.	• TIGHTEN to specification. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD).
	• Front wheel bearing adjustment.	• REFER to Wheel Bearing Inspection in this section.
	• Wheel or tire concerns.	• REFER to Section 204-04 .
	• Spring(s).	• INSTALL new spring(s) as necessary. REFER to Section 204-02 .
	• Torsion bar(s).	• ADJUST the ride height or INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD).
	• Loose, worn or damaged ball joint (s).	• GO to the Ball Joint Inspection component test in this section.
	• Loose, worn or damaged steering components.	• REFER to Section 211-00 .
	• Front wheel alignment.	• CHECK the wheel alignment. ADJUST as necessary.
• Sticky Steering, Poor Returnability	• Ball joints.	• GO to the Ball Joint Inspection component test in this section.

	• Steering components.	• REFER to Section 211-00 .
• Steering Wheel Off-Center	• Unequal front or rear toe settings (side-to-side). • Steering components.	• CHECK the wheel alignment. ADJUST as necessary. • REFER to Section 211-00 .
• Sway or Roll	• Overloaded, unevenly or incorrectly loaded vehicle. • Loose lug nut(s). • Shock absorber(s). • Loose stabilizer assembly. • Worn stabilizer assembly bushing (s). • Sagging torsion bar (s). • Worn spring(s).	• NOTIFY the customer of incorrect vehicle loading. • TIGHTEN to specification. REFER to Section 204-04 . • INSTALL new shock absorbers as necessary. • TIGHTEN to specification. REFER to Section 204-01A (4x2), Section 204-01B (4x4 or AWD) or Section 204-02 . • INSTALL new stabilizer assembly bushings as necessary. REFER to Section 204-01A (4x2), Section 204-01B (4x4 or AWD) or Section 204-02 . • INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) Section 204-01B (4x4 or AWD). • INSTALL new as necessary. REFER to Section 204-02 .
• Vehicle Leans to One Side	• Unevenly loaded or overloaded vehicle. • Front or rear suspension components. • Rear spring(s). • Torsion bars. • Incorrect drive axle (s) ride height. Lateral tilt out of specification.	• NOTIFY the customer of incorrect vehicle loading. • INSPECT the front and rear suspension systems. REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01A (4x2), Section 204-01B (4x4 or AWD) or Section 204-02 . • INSTALL new spring(s) or components as necessary. REFER to Section 204-02 . • ADJUST the ride height or INSTALL new torsion bar(s) as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD). • INSPECT the front and rear suspension systems. ADJUST, REPAIR or INSTALL new suspension components as necessary. REFER to Section 204-01B (4x4 or AWD) or Section 204-

		02 .
	• Suspension load leveling control system.	• REFER to suspension load leveling control system diagnosis and testing in Section 204-05 .
• Vibration/Noise	• Tire and wheel concerns. • Wheel bearings. • Wheel hubs. • Brake components. • Suspension components. • Steering components.	• REFER to Section 100-04 .
	• Worn Kevlar patch on torsion bar adjuster.	• INSTALL a new torsion bar adjuster. REFER to Section 204-01A .
• Wander	• Unevenly loaded or overloaded vehicle.	• NOTIFY the customer of incorrect vehicle loading.
	• Ball joint(s).	• GO to the Ball Joint Inspection component test in this section.
	• Loose, worn or damaged front wheel bearing(s).	• REFER to Wheel Bearing Inspection in this section.
	• Loose, worn or damaged suspension components(s).	• INSTALL new as necessary. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD).
	• Loose suspension fasteners.	• TIGHTEN to specification. REFER to Section 204-01A (4x2) or Section 204-01B (4x4 or AWD).
	• Steering components.	• REFER to Section 211-00 .
	• Wheel alignment (excessive total front toe out).	• ADJUST as necessary.

Component Tests

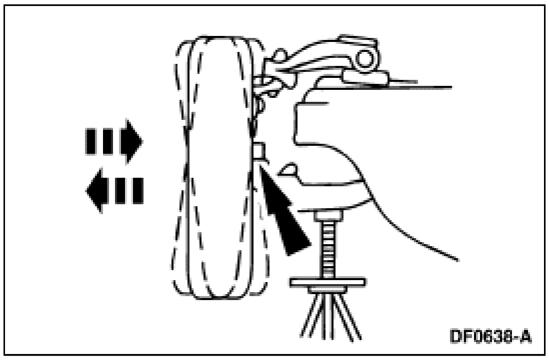
Ball Joint Inspection

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

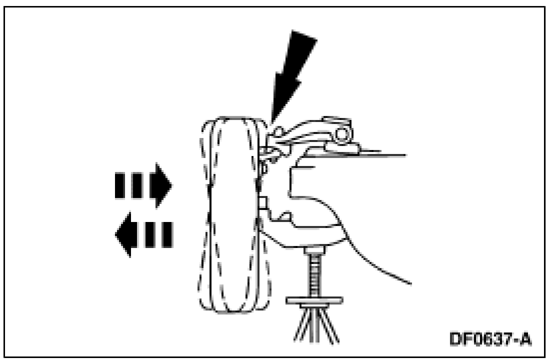
   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Prior to performing any inspection of the ball joints, inspect the front wheel bearings (1216).

3. Position a safety stand beneath the front suspension lower arm (3079) to be tested.



4. While an assistant pulls and pushes the bottom of the tire, measure the relative movement between the lower spindle arm and the front suspension lower arm ball joint using a suitable dial indicator. Any movement at or exceeding the specification indicates a worn or damaged lower ball joint. Install a new lower arm 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, measure the relative movement between the upper spindle arm and the front suspension upper ball joint using a suitable dial indicator. Movement at or exceeding the specification indicates a worn or damaged upper ball joint. Install a new upper arm as necessary. For additional information, refer to Section 204-01A or Section 204-01B .

Wheel Bearing Inspection

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Raise the vehicle until the tire is off the floor. For additional information, refer to Section 100-02 .

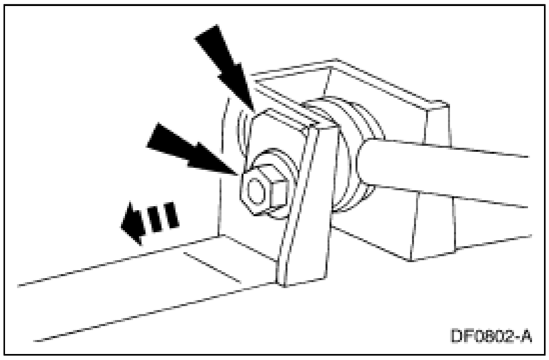
2. **NOTE:** Make sure the wheel rotates freely and the brake pads are retracted sufficiently to allow movement of the tire and wheel assembly.

   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.

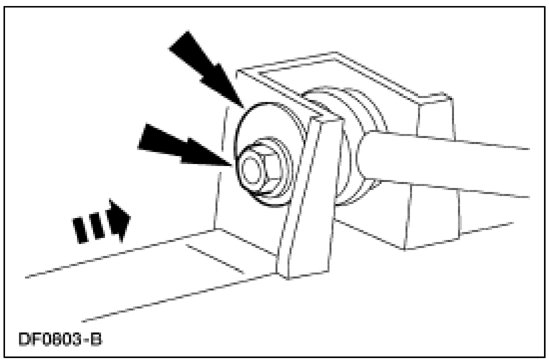
3. If the tire and wheel (hub) is loose on the wheel spindle or does not rotate freely, perform one of the following actions.
   - On 4x2 vehicles, adjust the front wheel bearings. For additional information, refer to Section 204-01A .
   - On 4x4 vehicles, install a new wheel hub (1104). For additional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

Camber and Caster Adjustment

1. Remove the nuts and alignment plates.

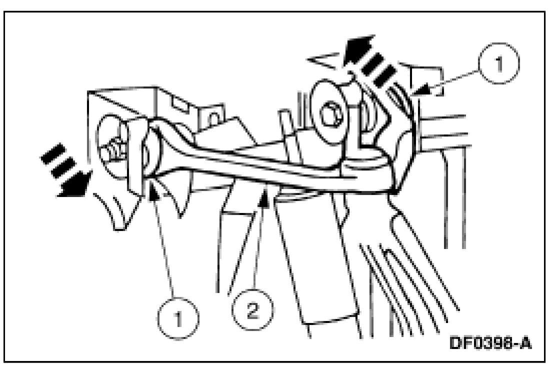


2. Install the cams and the nuts.

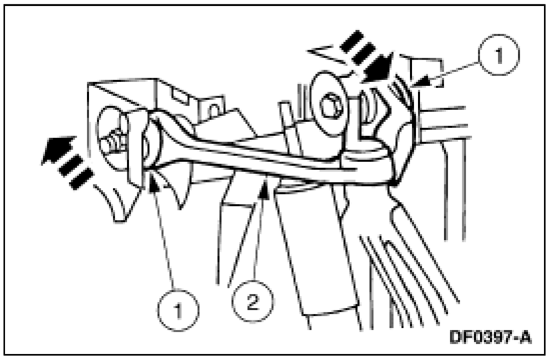


3. **NOTE:** A pry bar can be used between the front suspension arm bushing joint and the frame pocket to aid in moving the arm.

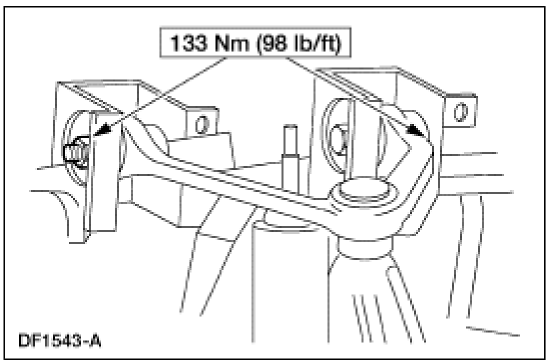
   To increase the LF caster and camber, use the following steps.
   1. To increase caster, move the front of the front suspension arm bushing joint outboard and move the rear of the front suspension arm bushing joint inboard.
   2. To increase camber, move the front suspension arm bushing joint outboard equally.



4. To decrease the LF caster and camber, use the following steps.
    1. To decrease caster, move the front of the front suspension arm bushing joint inboard and move the rear of the front suspension arm bushing joint outboard.
    2. To decrease camber, move the front suspension arm bushing joint inboard equally.

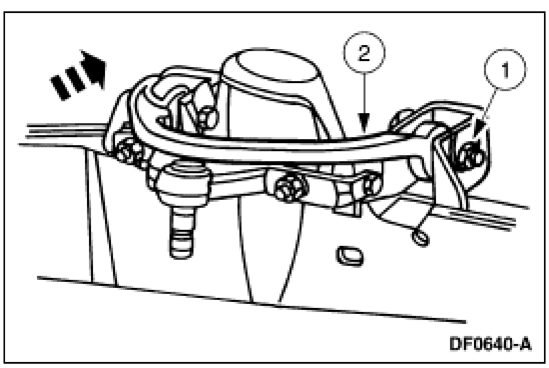


5. Tighten the nuts.

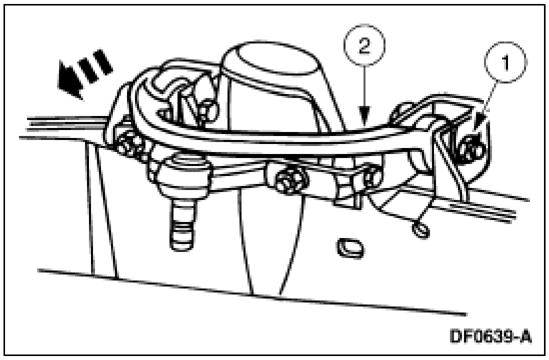


6. **NOTE:** A pry bar can be used between the front suspension arm bushing joint (3084) and the frame pocket to aid in moving the arm.

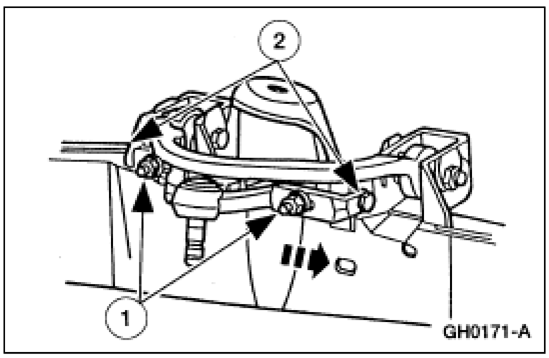
   To increase RF caster and camber, use the following steps.
    1. To increase caster, move the front of the front suspension arm bushing joint outboard and move the rear of the front suspension arm bushing joint inboard.
    2. To increase camber, move the front suspension arm bushing joint outboard equally.



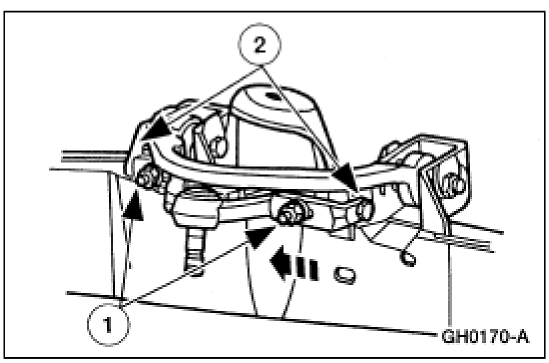
7. To decrease the RF caster and camber, use the following steps.
    1. To decrease caster, move the front of the front suspension arm bushing joint inboard and move the rear of the front suspension arm bushing joint outboard.
    2. To decrease camber, move the front suspension arm bushing joint inboard equally.



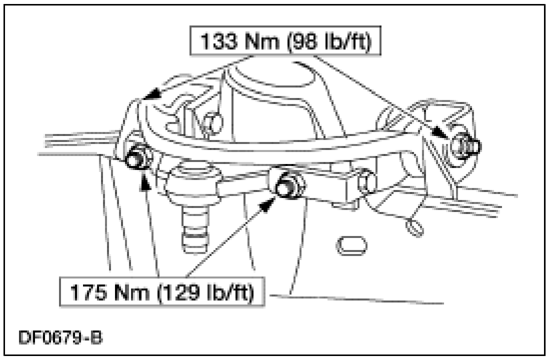
8. Increase the caster split.
    1. Loosen the nuts.
    2. Adjust the caster set bolts forward.



9. Decrease the caster split.
    1. Loosen the nuts.
    2. Adjust the caster set bolts rearward.

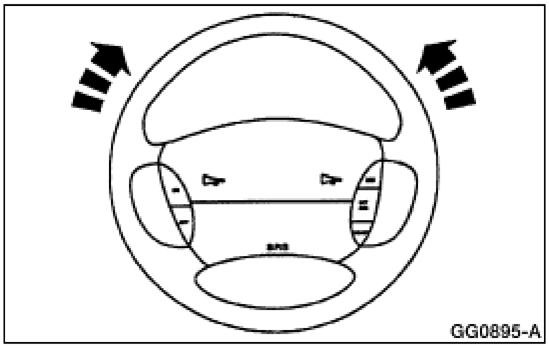


10. Tighten the nuts.


133 Nm (98 lb/ft)
175 Nm (129 lb/ft)
DF0679-B

Toe Adjustment

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

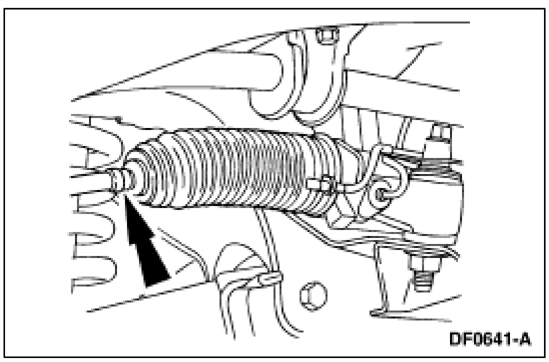


2. Turn the engine off, and hold the steering wheel in the "straight forward" position by attaching a rigid link from the steering wheel to the brake pedal.

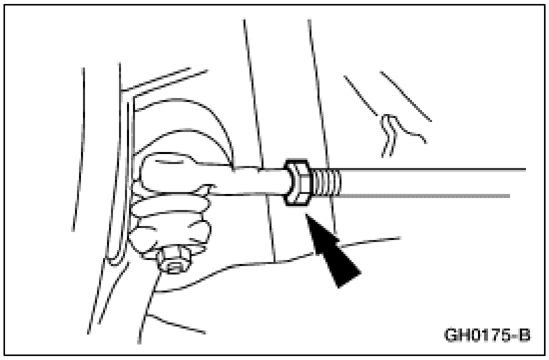
3. Check the toe settings; follow the manufacturer's instructions.

4. **NOTE:** Do not allow the steering gear bellows to twist when the front wheel spindle tie-rod (3280) is rotated.

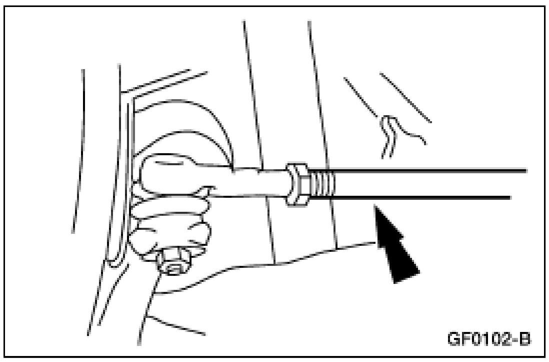
   Remove the clamps.



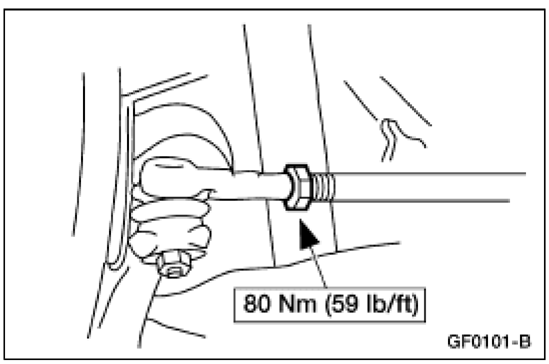
5. Loosen the nuts.
   - Clean and lubricate the nut(s) and front wheel spindle tie-rod threads.



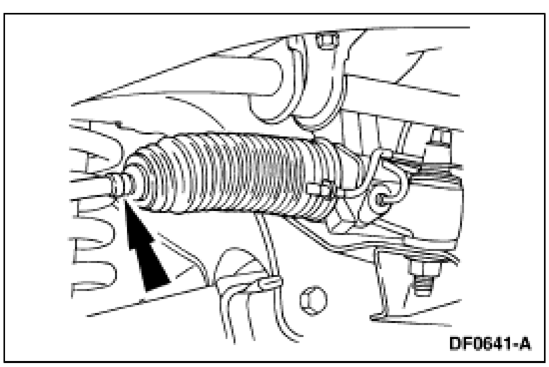
6. Rotate the front wheel spindle tie-rods.



7. Tighten the nuts.



8. Install the clamps.



9. Recheck the toe settings; follow the manufacturer's instructions.

General Specifications

Item	Specification
Ride Height with Original Suspension Components mm (in)	90-111 (3.58-4.37)
Ride Height with New Suspension Components mm (in)	110-116 (4.33-4.56)

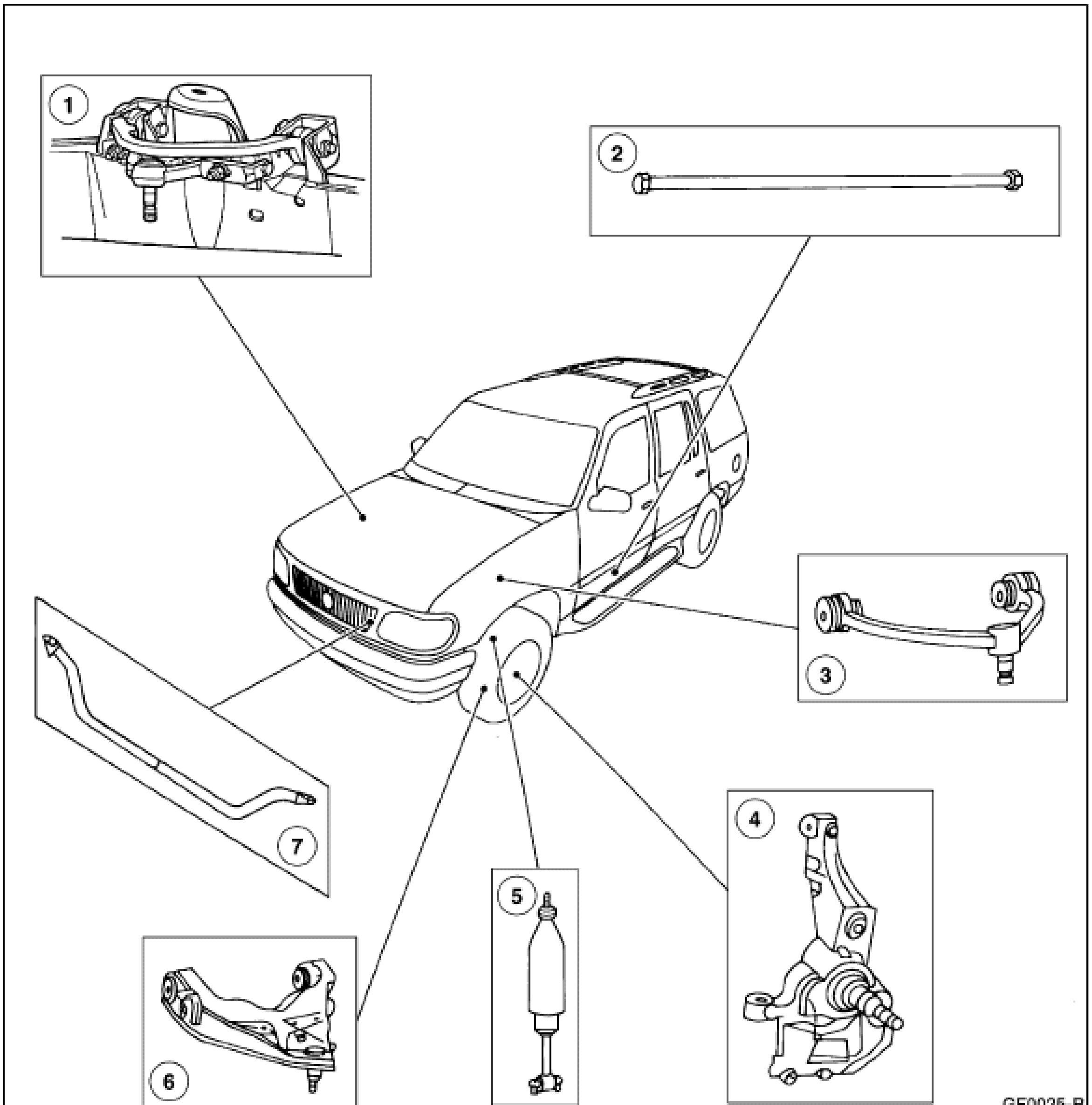
Torque Specifications

Description	Nm	lb-ft	lb-in
Front Suspension Lower Arm Pivot Bolts and Nuts	150-200	111-148	—
Front Shock Absorber to Lower Arm Nuts	21-29	15-21	—
Front Wheel Spindle to Lower Ball Joint Nut	113-153	83-113	—
Front Wheel Spindle to Upper Ball Joint Nut	47-63	35-46	—
Front Stabilizer Bar Bracket Bolts	34-46	25-34	—
Tie Rod End Nut	60-80	44-59	—
Front Brake Anti-Lock Sensor Bolt	7-11	—	62-97
Torsion Bar Cover Plate Bolts	47-63	35-46	—
Front Stabilizer Bar Link Nuts	21-29	15-21	—
Front Suspension Upper Arm Bolts and Nuts	113-153	83-112	—
Lug Nuts	135	100	—

SECTION 204-01A: Front Suspension — 4x2 2000 Explorer/Mountaineer Workshop Manual
DESCRIPTION AND OPERATION

Front Suspension

Front Suspension Components



Item	Part Number	Description
1	3084	Front suspension upper arm (RH)
2	5B326/5B327	Torsion bar (RH/LH)
3	3091	Front suspension upper arm (LH)
4	3106	Front wheel spindle (LH)
5	18124	Front shock absorber

6	3051	Front suspension lower arm (LH)
7	5494	Front stabilizer bar

Front Suspension

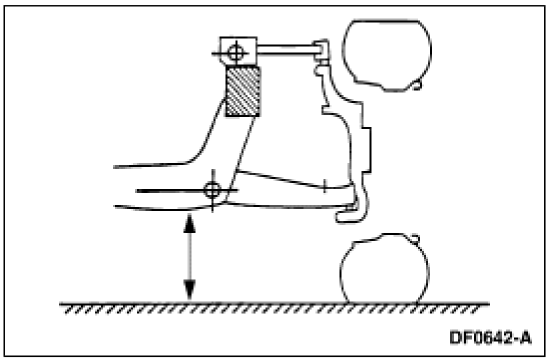
Refer to Section 204-00 .

Ride Height

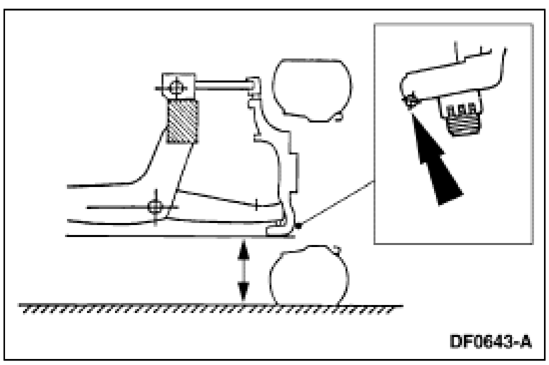
1. Drive the vehicle onto a drive-on lift.

2. Jounce the vehicle's front and rear suspension to normalize the vehicle static ride height.

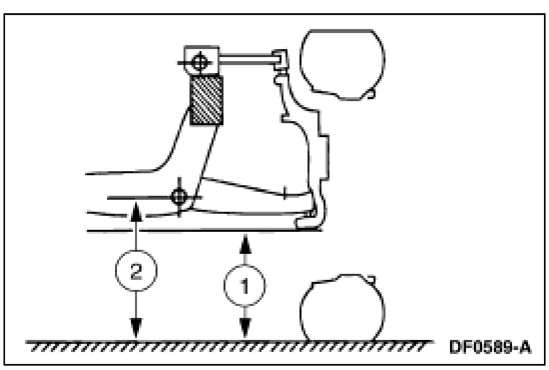
3. Measure the distance between the center line of the front suspension lower arm bushing bolt and the lift. Record the measurement.



4. Measure the distance between the front wheel spindle (lowest point) and the lift. Record the measurement.

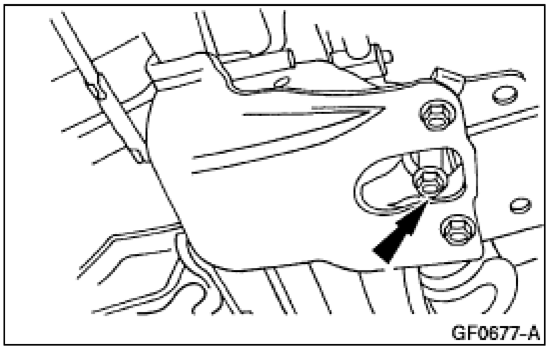


5. Determine ride height.
   - Subtract measurement 1 from measurement 2. This is the ride height.



6. **NOTE:** The torsion bar adjusting bolt is coated with adhesive that wears off after disassembly. If the torsion bar system is ever disassembled or the torsion bar adjusting bolt is ever removed, use a new torsion bar adjusting bolt when re-assembling.

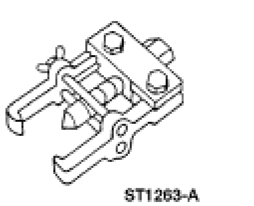
   Adjust the torsion bars (height) as necessary by tightening or loosening the torsion bar adjusting bolt.
   - Tighten the torsion bar adjusting bolt to increase the torque or raise the height.
   - Loosen the torsion bar adjusting bolt to decrease the torque or lower the height.



SECTION 204-01A: Front Suspension — 4x2 *2000 Explorer/Mountaineer Workshop Manual*
REMOVAL AND INSTALLATION

Arm —Lower

Special Tool(s)

	Pitman Arm Puller 211-003 (T64P-3590-F)

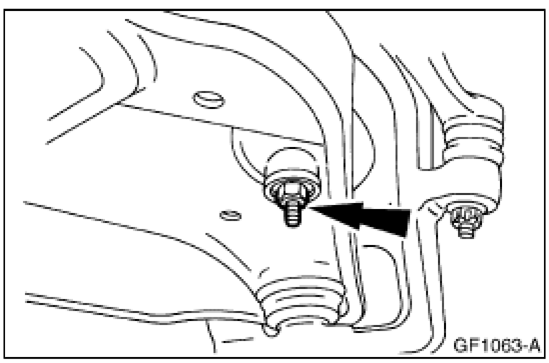
Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs or shocks, which can result in shifting of the vehicle during these operations.**

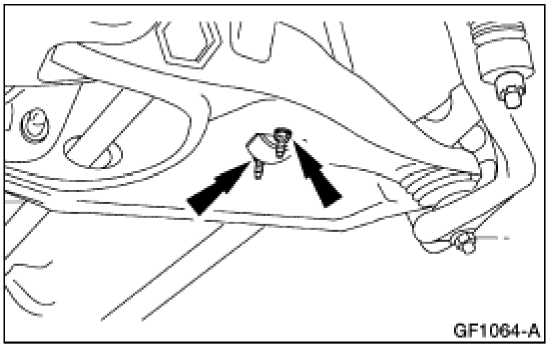
   Raise the vehicle on a hoist; for additional information, refer to Section 100-02 .

2. Remove the wheel and tire assembly; for additional information, refer to Section 204-04 .

3. Remove the stabilizer link nut, washer and bushing.

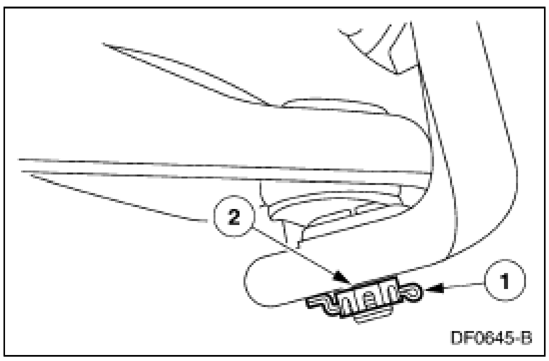


4. Remove the front shock absorber-to-front suspension lower arm nuts.

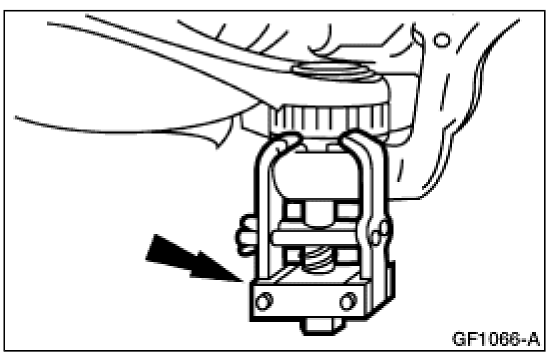


5. Remove the torsion bar; for additional information, refer to Bar—Torsion in this section.

6. Remove the lower ball joint castellated nut.
   1. Remove the lower ball joint cotter pin.
   2. Remove the lower ball joint castellated nut.

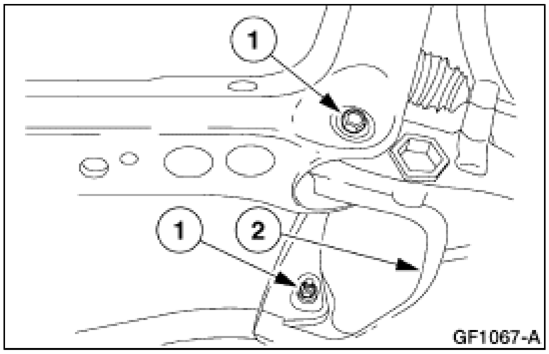


7. Use the Pitman Arm Puller to separate the front suspension lower arm from the front wheel knuckle/spindle.



8. **CAUTION: For 4x4 vehicles, support the front suspension arm bushing joint (3085), axle shaft and front wheel knuckle (3K185) before separating the front wheel knuckle from the front suspension lower arm (3079). Failure to do so can cause damage to the front axle shaft assembly.**

   Remove the front suspension lower arm.
   1. Remove the front suspension lower arm bolts and nuts.
   2. Remove the front suspension lower arm.

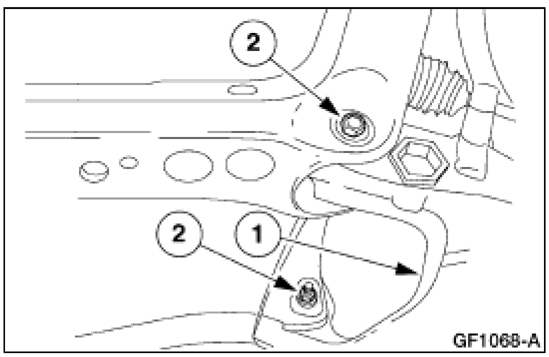


Installation

1. **NOTE:** Tighten the front suspension lower arm pivot bolts and nuts until snug. Do not tighten to specification until the installation procedure is complete.

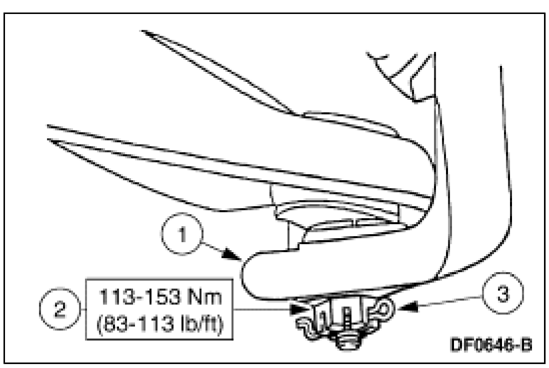
   NOTE: Inspect the front suspension lower arm ball joints (3050) and boot seals for damage.

   Install the front suspension lower arm.
   1. Position the front suspension lower arm to the front suspension crossmember.
   2. Install the pivot bolts and nuts and tighten until snug.

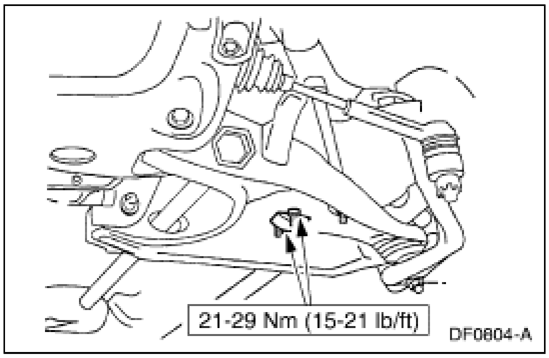


2. **CAUTION: Install the cotter pin into the lower ball joint from outboard to inboard with the fingers bent together at a right angle. Failure to do so will cause damage to the wheel and tire assembly.**

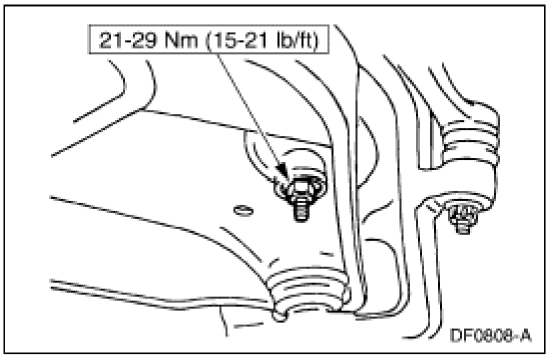
   Connect the front suspension lower arm to the front wheel knuckle/spindle.
   1. Position the lower ball joint into the front wheel knuckle/spindle.
   2. Install the new castellated nut.
   3. Install a new cotter pin.



3. Install the front shock absorber-to-front suspension lower arm nuts.



4. Install the stabilizer link bushing, washer, and nut.



5. **NOTE:** Whenever the torsion bar or torsion bar adjuster is removed, the vehicle ride height must be checked. For additional information, refer to Ride Height in this section.

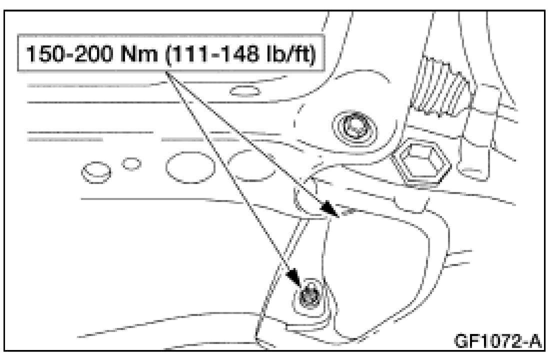
   Install the torsion bar; for additional information, refer to Bar—Torsion in this section.

6. Install the tire and wheel assembly; for additional information, refer to Section 204-04 .

7. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Lower the vehicle.

8. Tighten the front suspension lower arm nuts.



9. Inspect and adjust the front end alignment; for additional information, refer to Section 204-00 .

Arm —Upper

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs or shocks, which can result in shifting of the vehicle during these operations.**

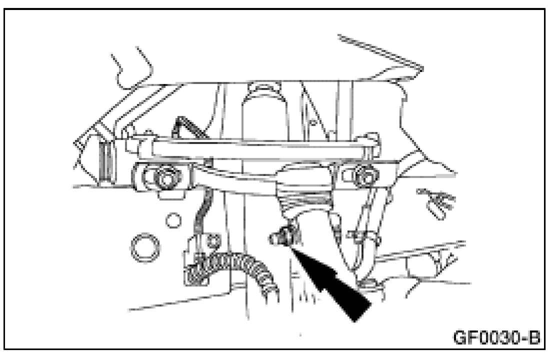
   Raise the vehicle on a hoist; for additional information, refer to Section 100-02 .

2. Remove the wheel and tire assembly; for additional information, refer to Section 204-04 .

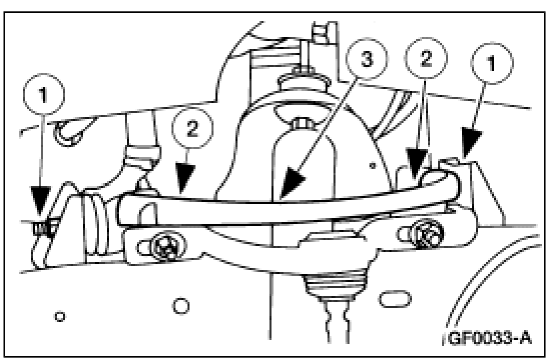
3. Use a suitable jack stand to support the front suspension lower arm (3078).

4. **CAUTION: To avoid possible damage to the front wheel spindle (3105) , secure the spindle to keep it from tilting before removing the pinch bolt and nut.**

   Remove the pinch bolt and nut from the front wheel spindle.

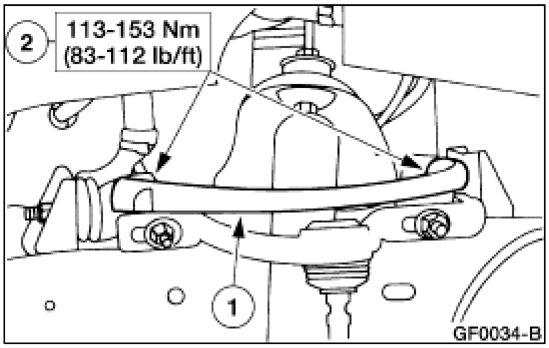


5. Remove the front suspension upper arm.
   1. Remove the two nuts.
   2. Remove the two bolts.
   3. Remove the front suspension upper arm.

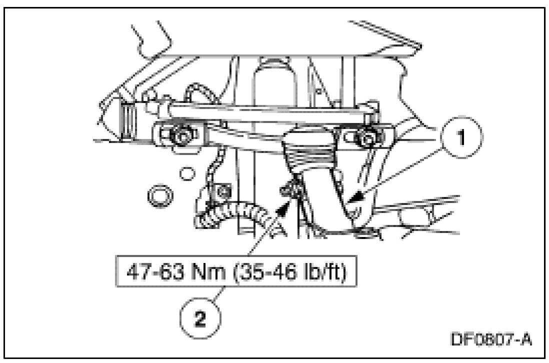


Installation

1. Install the front suspension upper arm.
   1. Position the front suspension upper arm.
   2. Install the two bolts and two nuts.



2. Install the pinch bolt and nut to the front wheel spindle.
   1. Position the front wheel spindle.
   2. Install the pinch bolt and nut.



3. Remove the jack stand from under the front suspension lower arm.

4. Install the tire and wheel assembly; for additional information, refer to Section 204-04 .

5. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

   Lower the vehicle.

6. Inspect the front end ride height; for additional information, refer to Ride Height in this section.

7. Inspect and adjust the front end alignment; for additional information, refer to Section 204-00 .

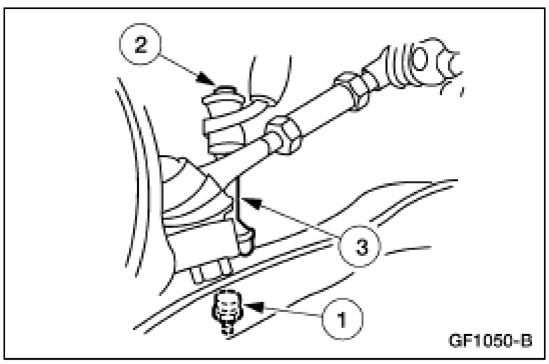
Bar and Link —Front

Removal

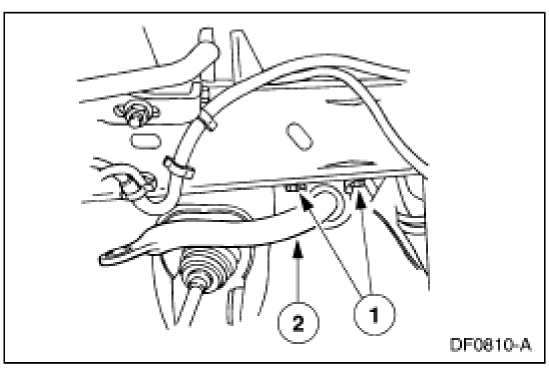
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs or shocks, which can result in shifting of the vehicle during these operations.**

   Raise the vehicle on a hoist; for additional information, refer to Section 100-02 .

2. Remove the front stabilizer bar links.
   1. Remove the front stabilizer bar link nut.
   2. Remove the front stabilizer bar link bolt.
   3. Remove the front stabilizer bar spacer.



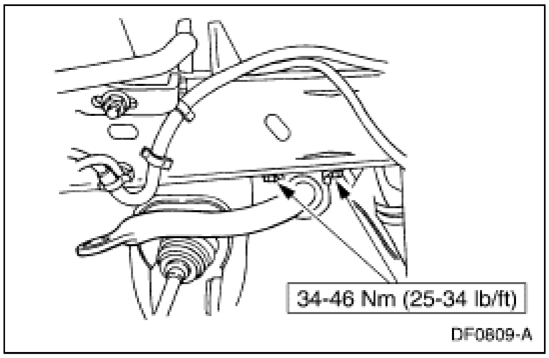
3. Remove the front stabilizer bar (5482).
   1. Remove the four (two each side) stabilizer bar bracket bolts.
   2. Remove the stabilizer bar.

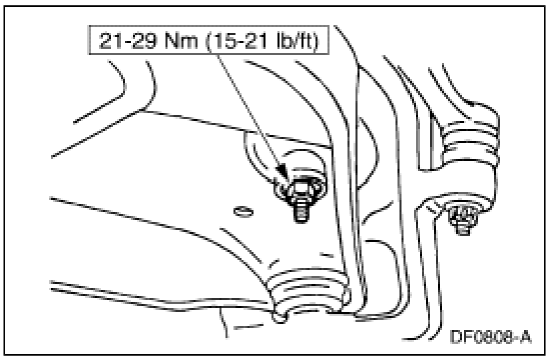


Installation

1. **NOTE:** In the event the self-tapping bolts cannot be installed in the frame, there is a kit available with flag nuts; consult your parts department for further information.

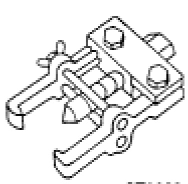
Follow the removal procedure in reverse order.





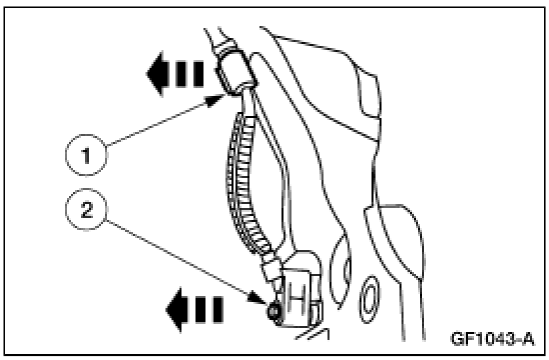
Spindle

Special Tool(s)

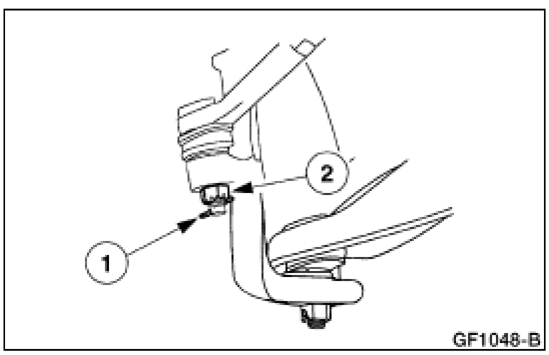
 ST1263-A	Pitman Arm Puller 211-003 (T64P-3590-F)

Removal

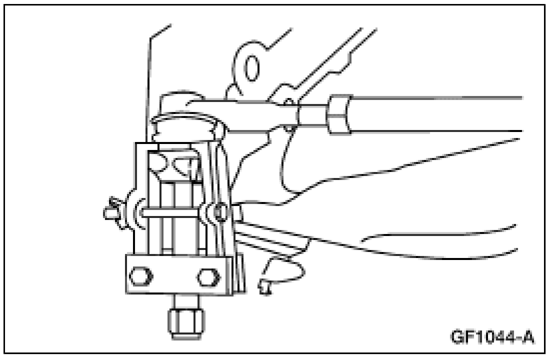
1. Remove the brake disc and hub (1102). For additional information, refer to Section 206-03 .
2. Remove the front brake anti-lock sensor (2C204).
   1. Remove the anti-lock sensor electrical wire from the clamp.
   2. Remove the bolt and position the sensor aside.



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



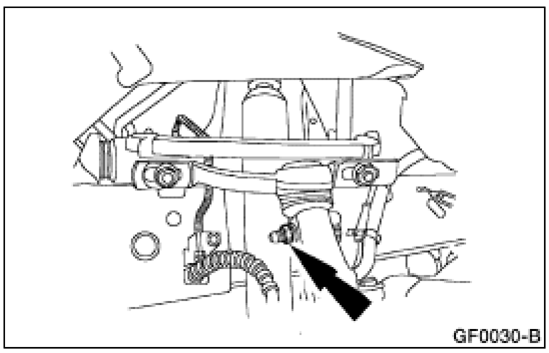
4. Use the Pitman Arm Puller to separate the tie-rod end (3A130) from the front wheel spindle.



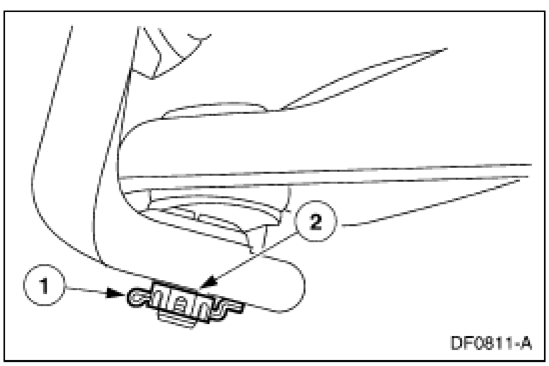
5. Use a suitable jack stand to support the front suspension lower arm (3078/3051).

6. **CAUTION: To avoid possible damage to the front wheel spindle, secure the spindle to keep it from tilting before removing the pinch bolt and nut.**

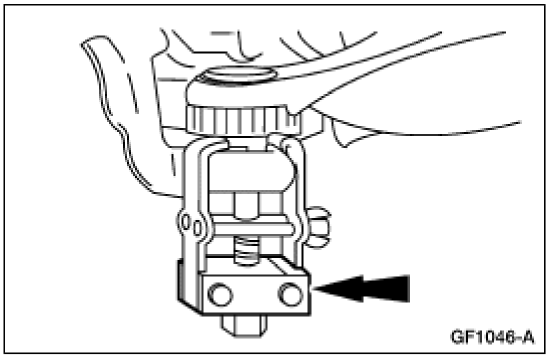
   Remove the pinch bolt and nut from the front wheel spindle.



7. Remove the lower ball joint castellated nut.
   1. Remove the lower ball joint cotter pin.
   2. Remove the lower ball joint castellated nut.



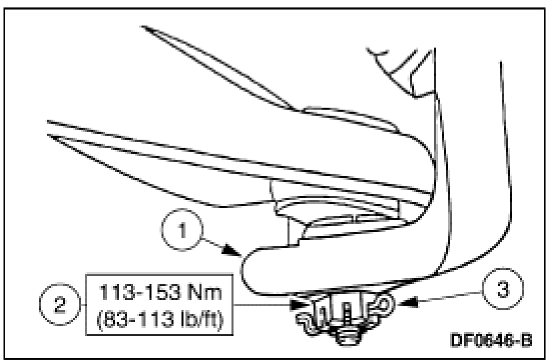
8. Use the Pitman Arm Puller to remove the front wheel spindle.



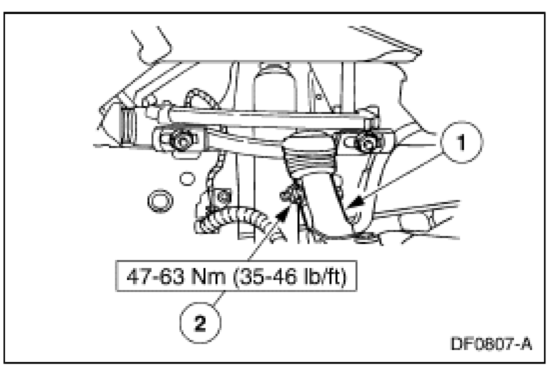
Installation

1. **NOTE:** Install the cotter pin into the lower ball joint from outboard to inboard with the fingers bent together at a right angle. Failure to do so can cause damage to the wheel and tire assembly.

   Install the lower ball joint castellated nut.
    1. Position the front wheel spindle to the lower ball joint.
    2. Install the lower ball joint castellated nut.
    3. Install a new cotter pin.



2. Install the pinch bolt and nut.
    1. Position the front wheel spindle.
    2. Install the pinch bolt and nut.



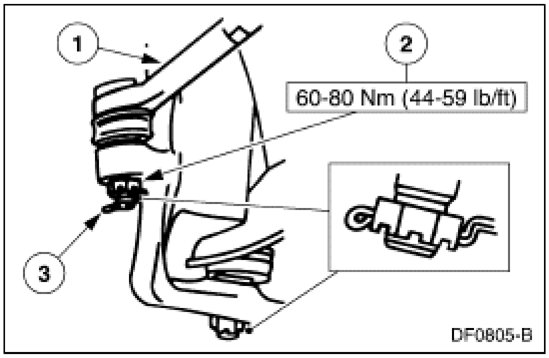
3. Remove the jack from under the front suspension lower arm.

4.  **CAUTION: Install the cotter pin into the lower ball joint from outboard to inboard with the fingers bent together at a right angle. Failure to do so can cause damage to the wheel and tire**

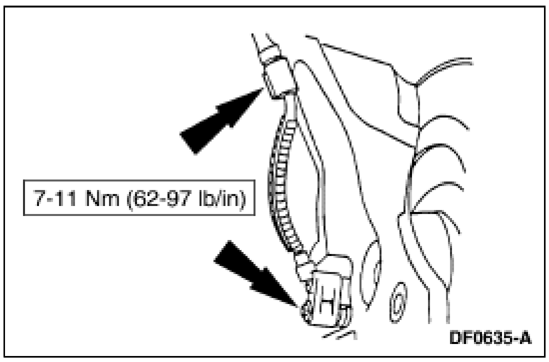
assembly.

Connect the tie-rod end to the front wheel spindle.

1. Position the tie-rod end.
2. Install the tie-rod end castellated nut.
3. Install a new cotter pin.



5. Install the front brake anti-lock sensor and position the anti-lock sensor electrical wire in the clamp.



6. Install the brake disc and hub. For additional information, refer to Section 206-03 .

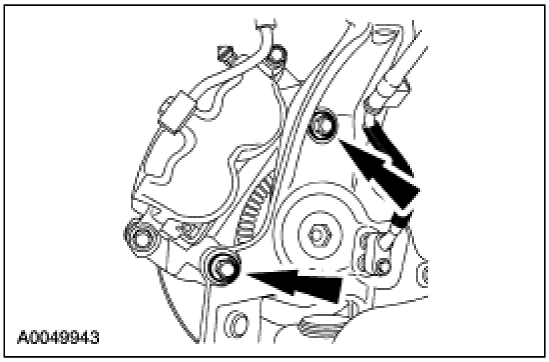
Wheel Studs

Removal

1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

2. **CAUTION: When removing the disc brake caliper (2B120), never allow it to hang from the brake hose. Provide a suitable support.**

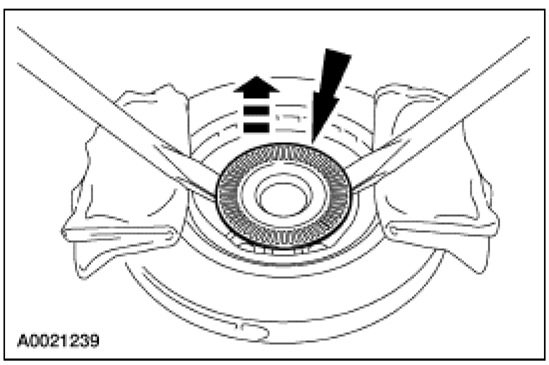
   Remove the brake caliper and anchor plate as an assembly.



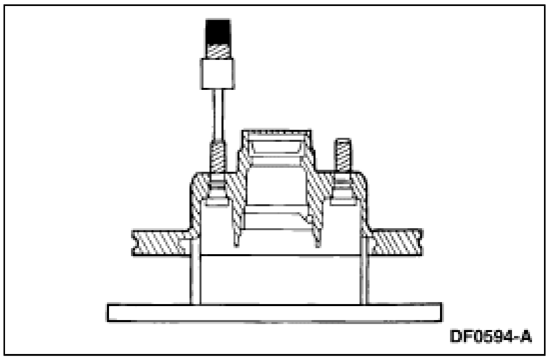
3. Remove the brake disc and hub as follows:
   1. Remove the hub grease cap (1131).
   2. Remove the cotter pin.
   3. Remove the nut retainer.
   4. Remove the spindle nut.
   5. Remove the front wheel outer bearing retainer washer (1195).
   6. Remove the outer front wheel bearing (1216).
   7. Remove the brake disc and hub.

4. **CAUTION: Place shop towels between the pry bars and the brake disc to prevent damage to the disc surface.**

   Using two pry bars, remove the ABS sensor ring.
   - Discard the ABS sensor ring.

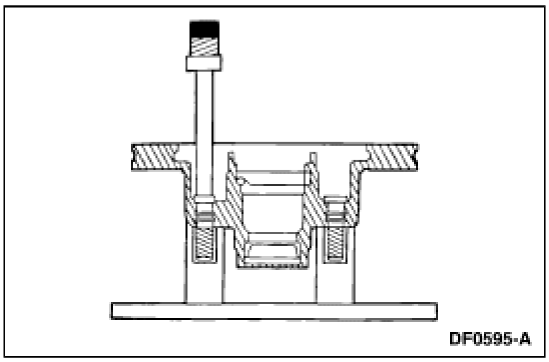


5. Using a suitable press, remove the wheel stud (1107) from the brake disc and hub.



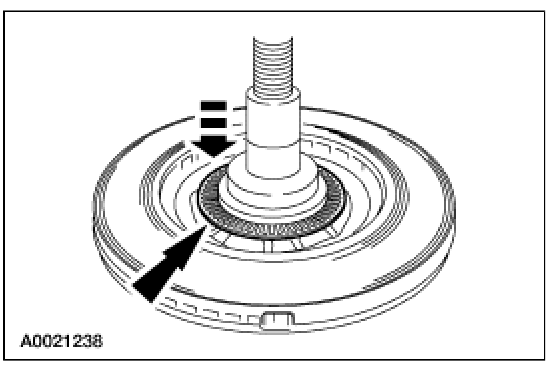
Installation

1. Using a suitable press, install the wheel stud in the brake disc and hub.

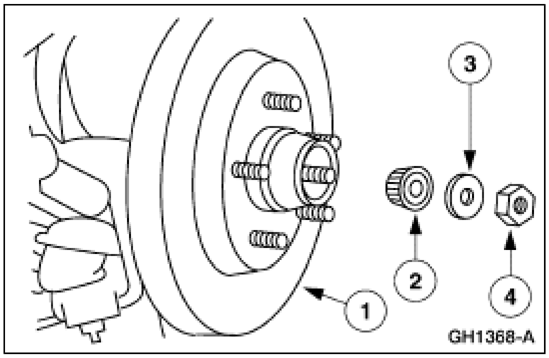


2. **CAUTION: When installing the ABS sensor ring, make sure the sensor ring is pressed on straight.**

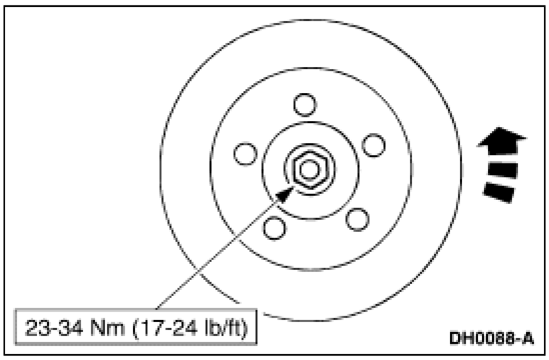
   Position a new ABS sensor ring on the hub. Using a cylinder with 79 mm (3.16 in) inside diameter and 96 mm (3.84 in) outside diameter, press the ring onto the hub until the ring seats against the shoulder in the hub.



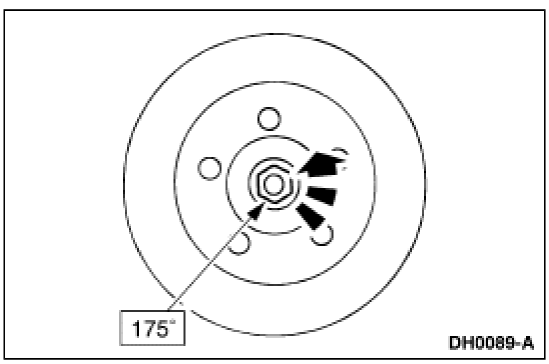
3. Install the brake disc and hub.
   1. Position the brake disc and hub.
   2. Install the outer front wheel bearing.
   3. Install the front wheel outer bearing retainer washer.
   4. Install the spindle nut.



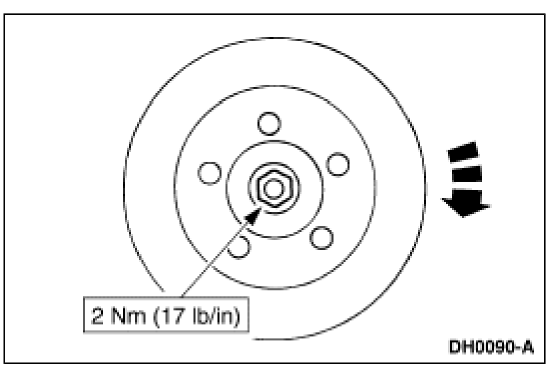
4. Tighten the spindle nut while rotating the brake disc and hub.



5. Loosen the spindle nut.

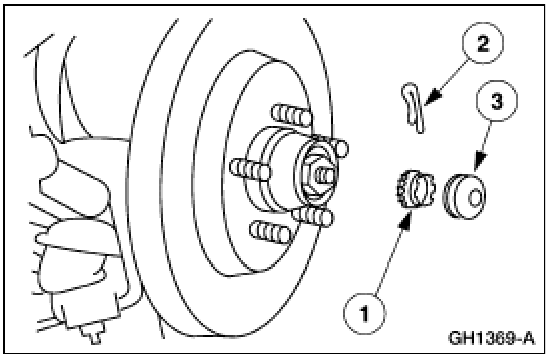


6. Tighten the spindle nut while rotating the brake disc and hub.

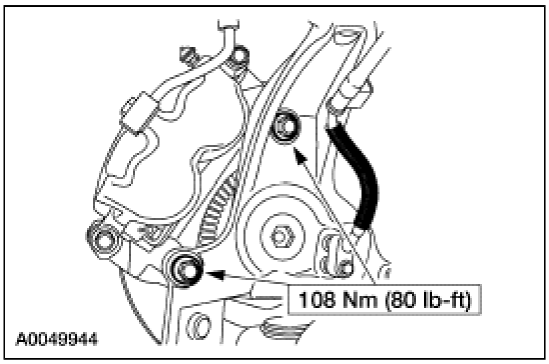


7. Install the following components:

1. Install the nut retainer.
2. Install the cotter pin.
3. Install the hub grease cap.



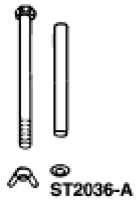
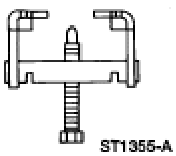
8. Install the caliper and anchor plate assembly.



9. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

Bar —Torsion

Special Tool(s)

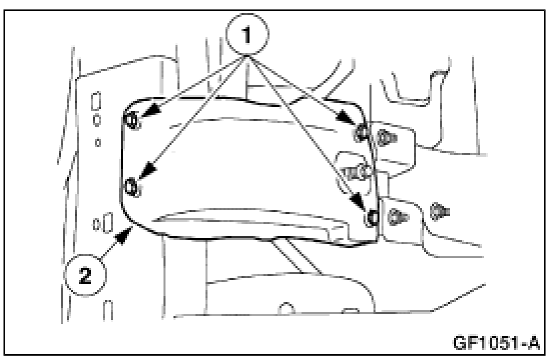
	Bolt Set T96T-5310-B
	Torsion Bar Tool T95T-5310-AR

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air springs or shocks, which can result in shifting of the vehicle during these operations.**

   Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

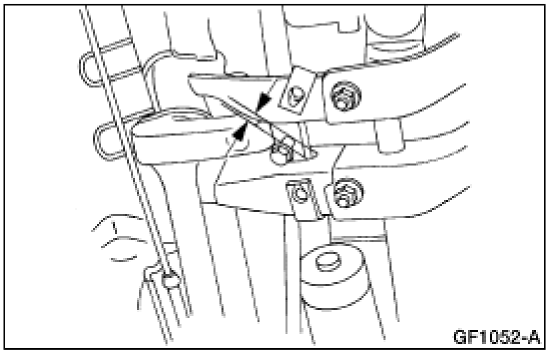
2. Remove the torsion bar cover plate.
   1. Remove the torsion bar cover plate bolts.
   2. Remove the torsion bar cover plate.



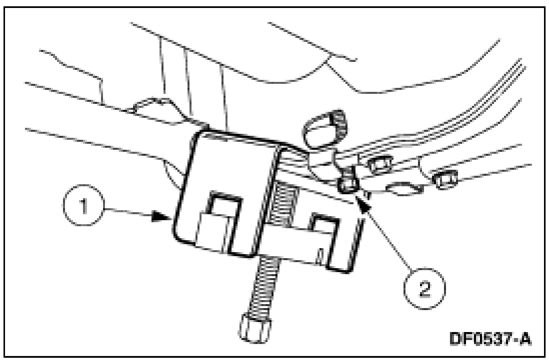
3. **NOTE:** Before relieving the torsion bar tension, measure and record the measurement of the torsion bar adjustment bolt. This measurement will be used as the preset depth for the new torsion bar adjustment bolt during installation.

   Make preliminary adjustment references.

- Measure and record the length where indicated.

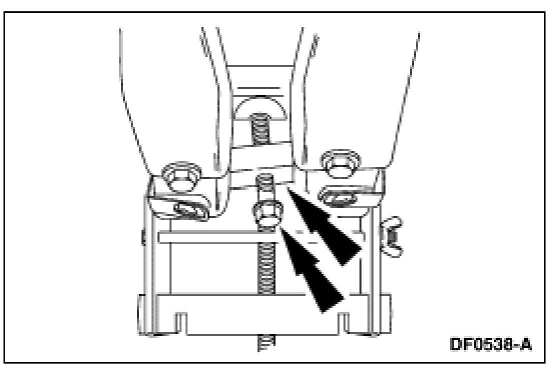


4. Relieve the torsion bar tension.
    1. Position the Torsion Bar Tool and adapters.
    2. Tighten the Torsion Bar Tool until the torsion bar adjuster lifts off the adjustment bolt.

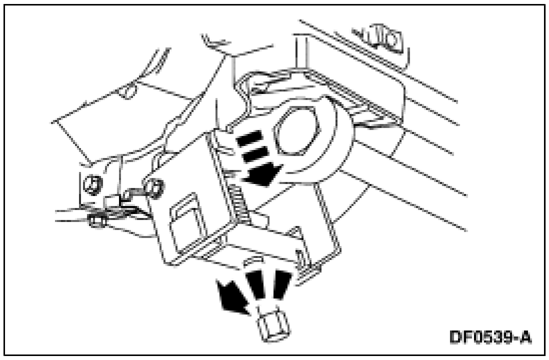


5. **CAUTION: The torsion bar adjustment bolt is coated with dry adhesive and must be replaced if it is backed off or removed. Failure to do so can cause the adjustment bolt to loosen during operation and cause a loss of vehicle alignment.**

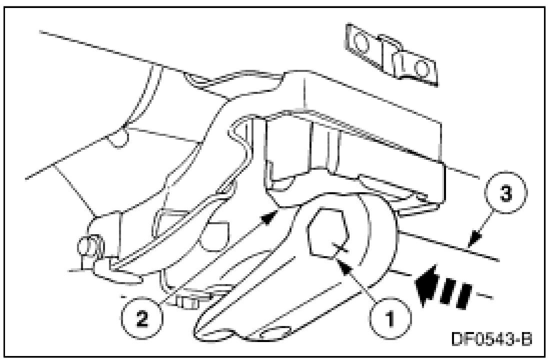
    Remove the torsion bar adjustment bolt and nut.



6. Loosen the Torsion Bar Tool until the tension is removed from the torsion bar.

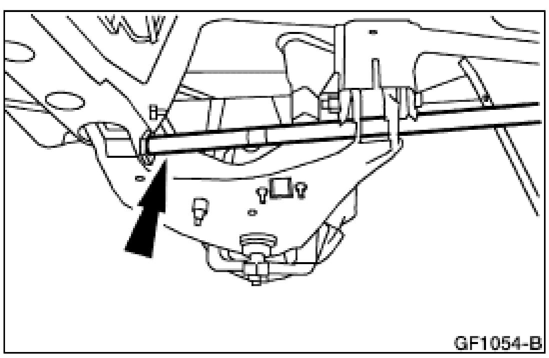


7. Remove the torsion bar.
    1. Mark the torsion bar and the adjuster for proper installation.
    2. Remove the torsion bar insulator.
    3. Grasp the torsion bar and pull it free from the front suspension lower arm.

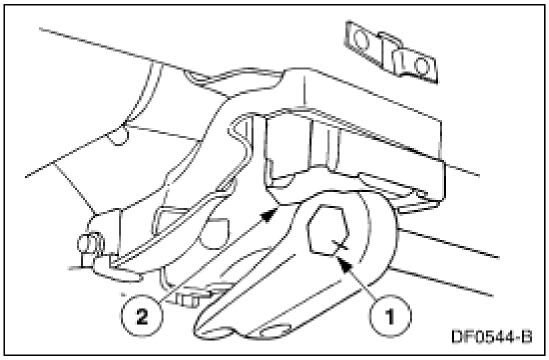


Installation

1. Position the torsion bar and the torsion bar adjuster.

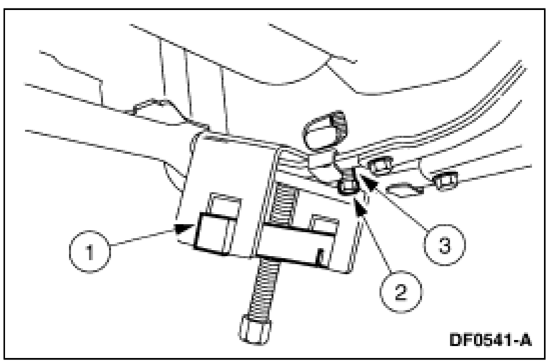


2. Install the torsion bar adjuster.
    1. Align the marks on the torsion bar and the torsion bar adjuster, then install the torsion bar adjuster.
    2. Position the torsion bar insulator.



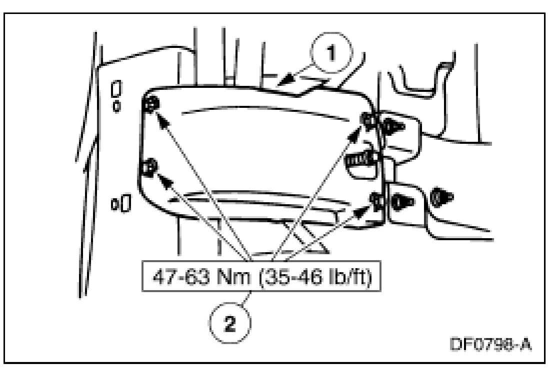
3. **CAUTION: The torsion bar adjustment bolt is coated with dry adhesive and must be replaced if it is backed off or removed. Failure to do so can cause the adjustment bolt to loosen during operation and cause a loss of vehicle alignment.**

   Preload the torsion bar.
   1. Install the Torsion Bar Tool and the adapters.
   2. Tighten the Torsion Bar Tool until the new adjustment bolt and nut can be installed.
   3. Turn the adjustment bolt until the preliminary adjustment measurement (recorded length of the old adjustment bolt) is reached.



4. Remove the tool.

5. Install the torsion bar cover plate.
   1. Position the torsion bar cover plate.
   2. Install the torsion bar cover plate bolts.



6. **NOTE:** If equipped with air suspension, reactivate the system by turning on the air suspension switch.

Lower the vehicle.

7. Adjust the ride height. For additional information, refer to Ride Height in this section.
8. Check the alignment. For additional information, refer to Section 204-00 .

SECTION 204-01B: Front Suspension — 4x4 *2000 Explorer/Mountaineer Workshop Manual*
SPECIFICATIONS

General Specifications

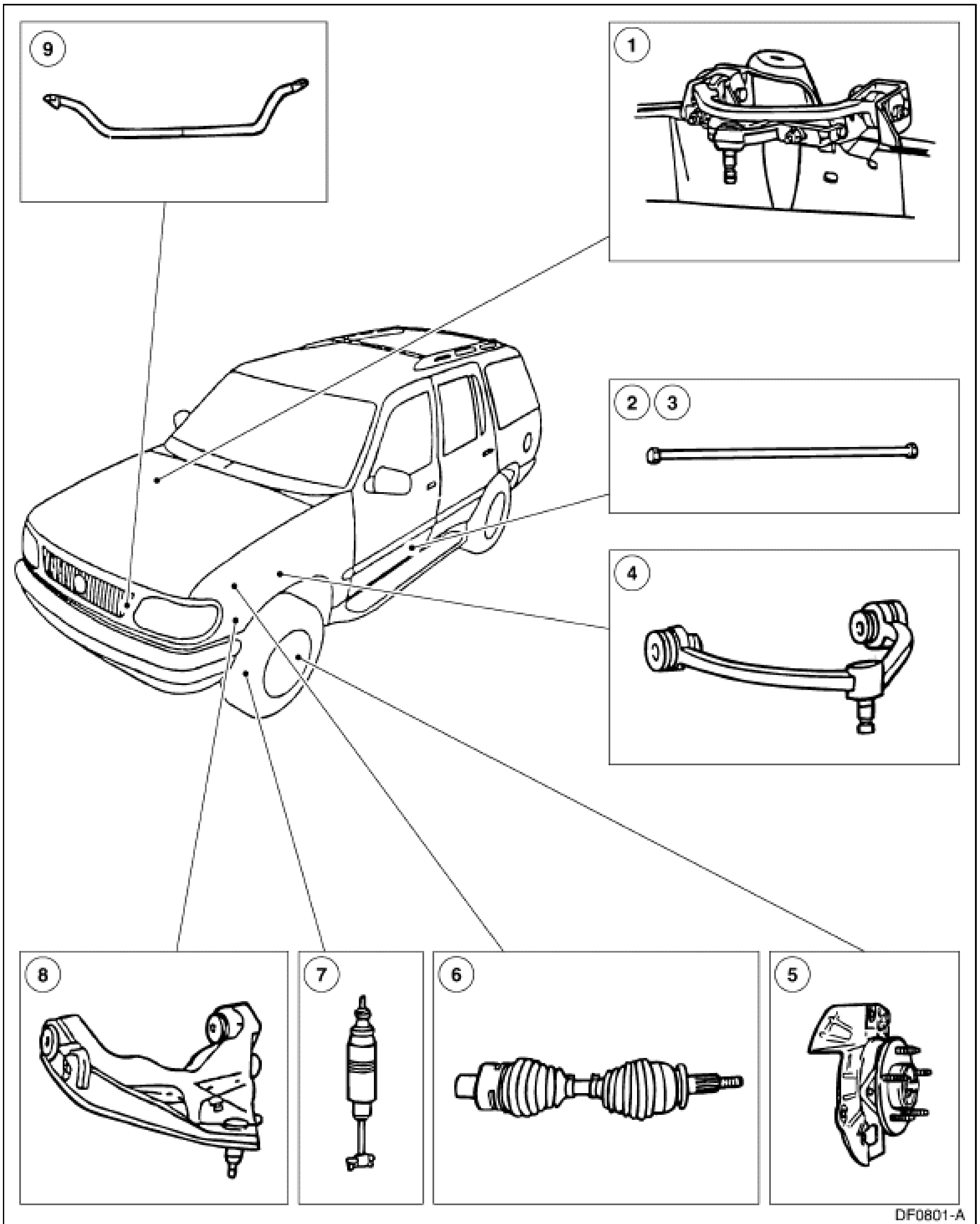
Item	Ride Height
4x4 Ride Height with Original Suspension Components mm (in)	90-111 (3.58-4.37)
4x4 Ride Height with New Suspension Components mm (in)	110-116 (4.33-4.56)
AWD Ride Height with Original Suspension Components mm (in)	90-111 (3.58-4.37)
AWD Ride Height with New Suspension Components mm (in)	110-116 (4.33-4.56)
4x4 w/Automatic Ride Control Ride Height with Original Suspension Components mm (in)	68-90 (2.67-3.54)
4x4 w/Automatic Ride Control Ride Height with New Suspension Components mm (in)	83-89 (3.26-3.5)

Torque Specifications

Description	Nm	lb-ft	lb-in
Dust Shield Bolts	10-14	—	89-124
Front Brake Anti-Lock Sensor Bolt	7-11	—	62-97
Front Shock Absorber to Lower Arm Nuts	21-29	15-21	—
Front Suspension Arm Lower Ball Joint Nut	113-153	83-112	—
Front Wheel Hub to Knuckle Bolts	100-130	74-96	—
Pinch Bolt	47-63	35-46	—
Tie Rod End Nut	60-80	44-59	—
Wheel Hub Nut	212-288	157-213	—
Torsion Bar Cover Plate Bolts	47-63	35-46	—
Upper Control Arm to Frame Mounting Bolts and Nuts	113-153	83-113	—
Lower Control Arm to Frame Mounting Bolts and Nuts	150-200	111-148	—
Front Stabilizer Bar to Frame Mounting Bolts and Nuts	34-46	25-34	—
Front Stabilizer Bar Link to Lower Control Arm Mounting Nut	21-29	15-21	—
Front Shock to Frame Mounting Nut	40-55	30-41	—
Jounce Bumper to Frame Nut	25-35	18-26	—

Front Suspension —AWD (4x4)

Front Suspension Components — AWD (4x4)



Item	Part Number	Description
1	3084	Front suspension upper arm (RH)
2	5B327	Torsion bar (LH)
3	5B326	Torsion bar (RH)
4	3091	Front suspension upper arm (LH)
5	3K207	Front wheel hub and knuckle
6	3B437	Front wheel driveshaft and joint (LH)
7	18045	Front shock absorber
8	3051	Front suspension lower arm (LH)
9	5494	Front stabilizer bar

Front Suspension —4x4

Refer to Section 204-00 .

SECTION 204-01B: Front Suspension — 4x4 *2000 Explorer/Mountaineer Workshop Manual*
GENERAL PROCEDURES

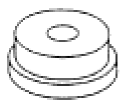
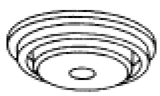
Ride Height

For additional information, refer to Section 204-01A .

SECTION 204-01B: Front Suspension — 4x4 2000 Explorer/Mountaineer Workshop Manual
REMOVAL AND INSTALLATION

Wheel Hub

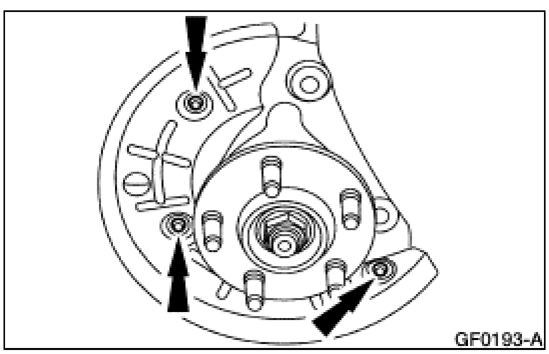
Special Tool(s)

 ST1359-A	Hub Bearing Cup Replacer 205-147 (T80T-4000-P)
 ST1153-A	Knuckle Seal Replacer 205-361 (T96T-1175-A)
 ST1360-A	Threaded Drawbar 204-029 (T77F-1176-A)

Removal

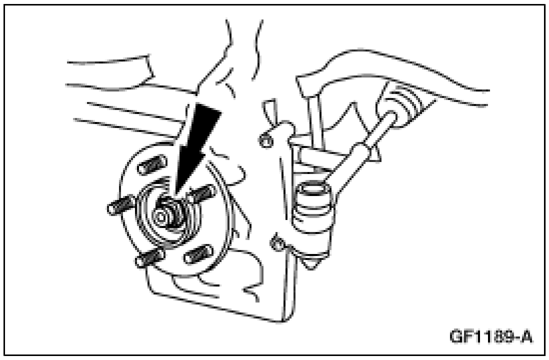
1. Remove the brake disc (1125). For additional information, refer to Section 206-03 .

2. Remove the three bolts and the dust shield.

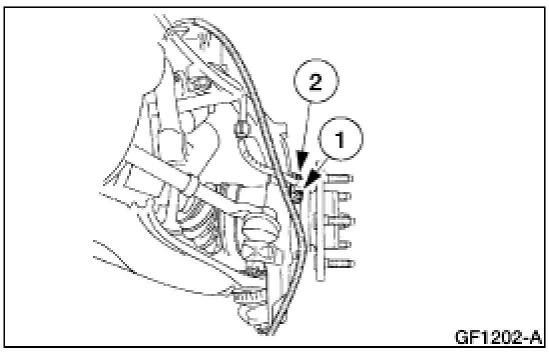


3. **CAUTION: Discard the wheel hub retainer nut and washer assembly. It is a torque prevailing design and cannot be reused.**

   Remove the wheel hub retainer nut and washer assembly.



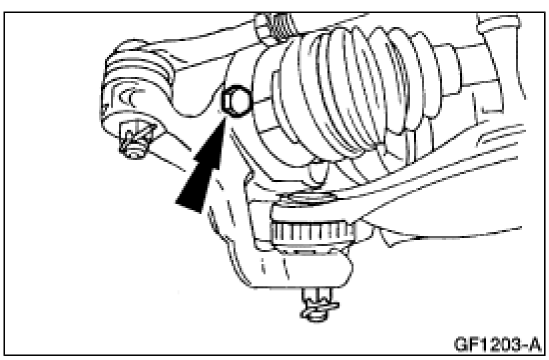
4. Remove the front brake anti-lock sensor (2C204).
    1. Remove the bolt.
    2. Remove the front brake anti-lock sensor.



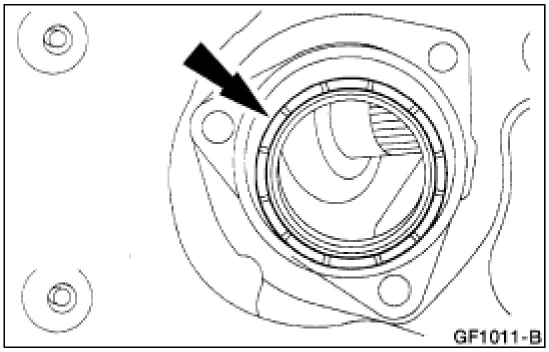
5. **CAUTION: Do not overextend CV joint and boots when removing the hub and bearing assembly.**

   NOTE: The CV joint is a slip fit into the wheel hub and bearing. A puller will not normally be required.

   Remove the three bolts and the wheel hub (1104).

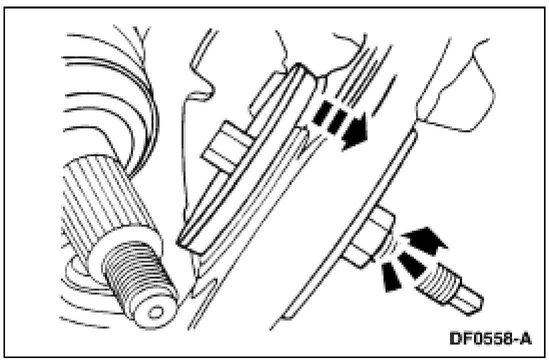


6. Remove the seal.

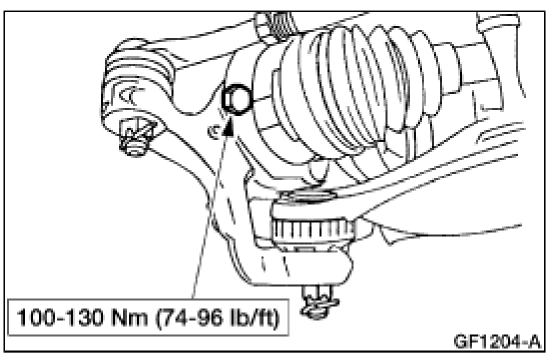


Installation

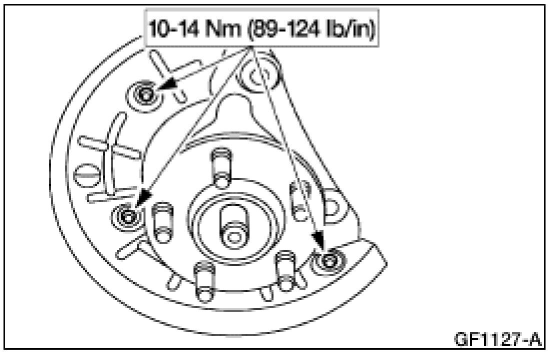
1. Install the seal.
   - Using the Knuckle Seal Replacer, Threaded Drawbar and Hub Bearing Cup Replacer, install the seal.



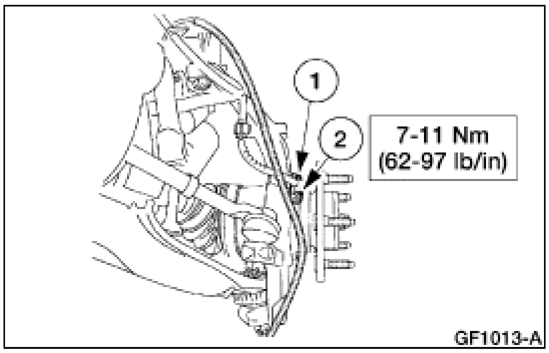
2. Install the wheel hub.
   - Position the wheel hub on the front wheel driveshaft and joint (3B437) and into the front wheel knuckle (3K185). Install the three bolts.



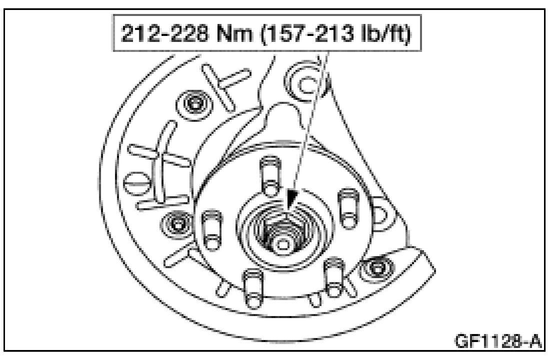
3. Install the dust shield.



4. Install the front brake anti-lock sensor.
    1. Position the front brake anti-lock sensor.
    2. Install the bolt.



5. Install the wheel hub retainer nut and washer assembly.



6. Install the brake disc. For additional information, refer to Section 206-03 .

SECTION 204-01B: Front Suspension — 4x4 *2000 Explorer/Mountaineer Workshop Manual*
REMOVAL AND INSTALLATION

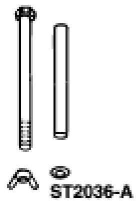
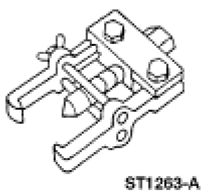
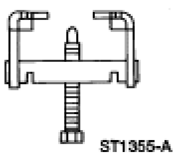
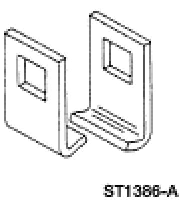
Wheel Studs

For additional information, refer to Section 204-01A .

SECTION 204-01B: Front Suspension — 4x4 2000 Explorer/Mountaineer Workshop Manual
REMOVAL AND INSTALLATION

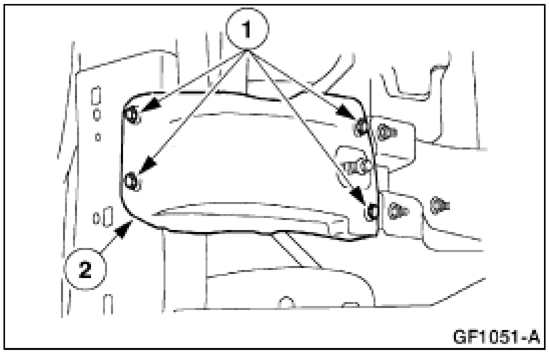
Wheel Knuckle

Special Tool(s)

	Torsion Bar Tool Spacer 204-204 (T96T-5310-B)
	Pitman Arm Puller 211-003 (T64P-3590-F)
	Torsion Bar Tool 204-185 (T95T-5310-AR)
	Torsion Bar Tool Adapters 204-203 (T96T-5310-A)

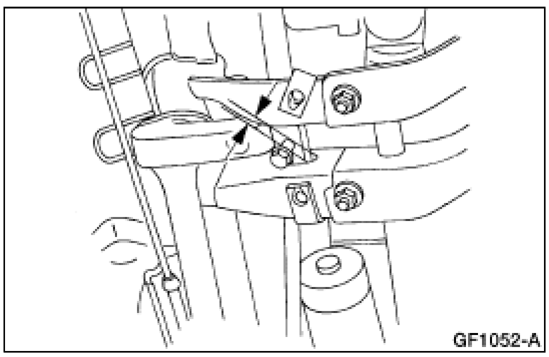
Removal

1. Remove the wheel hub (1104). For additional information, refer to Wheel Hub in this section.
2. Remove the torsion bar cover plate.
    1. Remove the retaining bolts.
    2. Remove the torsion bar cover plate.

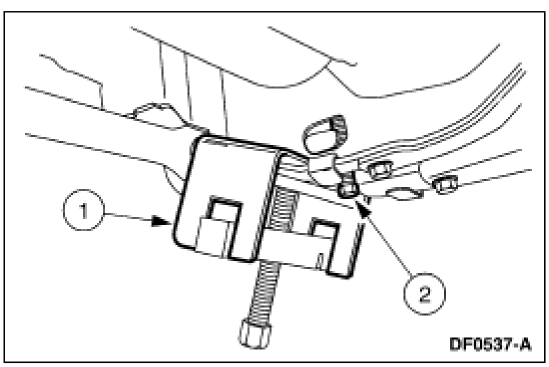


3. **NOTE:** Before relieving the torsion bar tensions, measure and record the measurement of the torsion bar adjustment bolt. This measurement will be used as the preset depth for the new torsion bar adjustment bolt during installation.

   Measure and record the length where indicated.

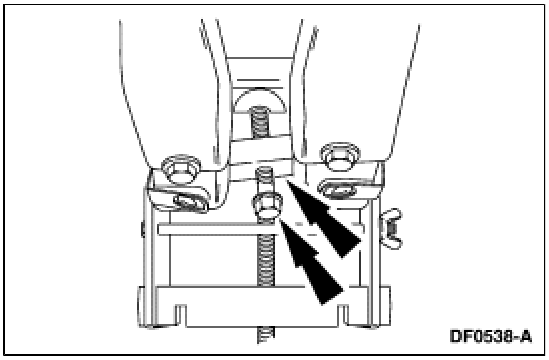


4. Relieve the torsion bar tension.
   1. Position the Torsion Bar Tool and the adapters.
   2. Tighten the Torsion Bar Tool until the torsion bar adjuster lifts off of the adjustment bolt.

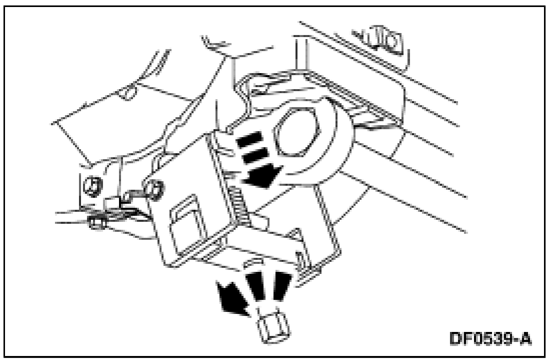


5. **CAUTION: The torsion bar adjustment bolt is coated with dry adhesive. A new bolt must be installed if it is backed off or removed. Failure to do so can cause the adjustment bolt to loosen during operation and result in a loss of vehicle alignment.**

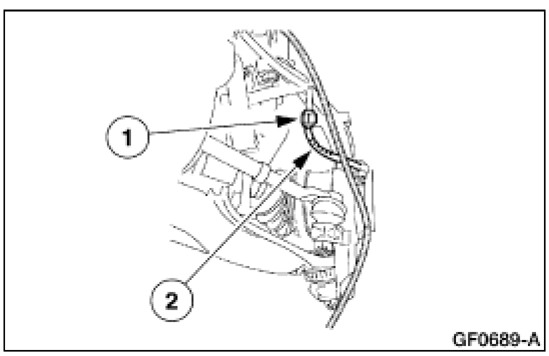
   Remove the torsion bar adjustment bolt and nut.



6. Loosen the torsion bar adjustment tool until the tension is off the torsion bar.



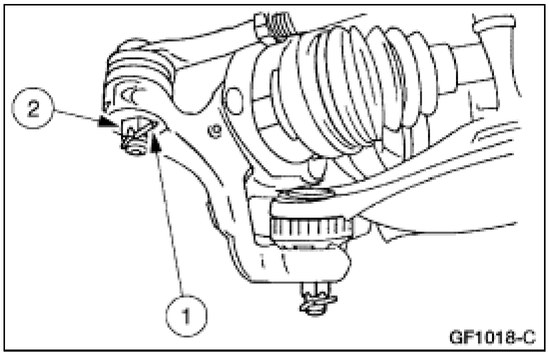
7. Reposition the anti-lock sensor wire.
    1. Remove the front brake anti-lock sensor wire bracket bolt.
    2. Reposition the anti-lock sensor wire.



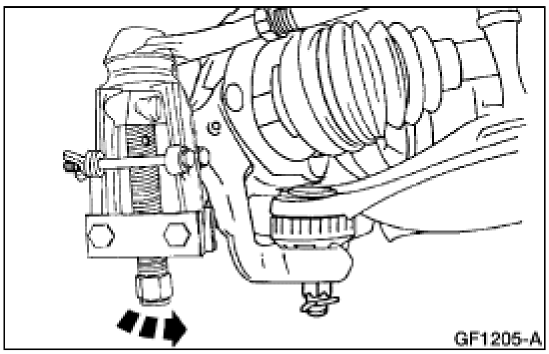
8. **CAUTION: Secure the front axle shaft to prevent it from overextending. Failure to do so can cause damage to the front axle shaft.**

   Suspend the front axle shaft with wire.

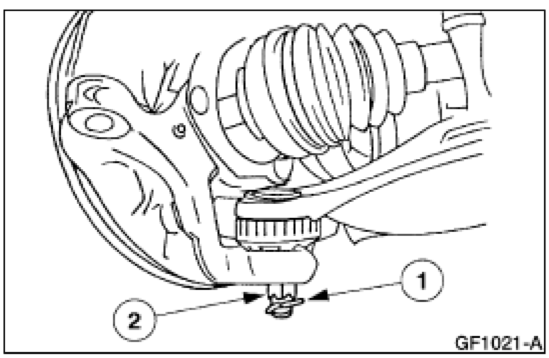
9. Remove the tie-rod end castellated nut.
    1. Remove the tie-rod end cotter pin.
    2. Remove the tie-rod end castellated nut.



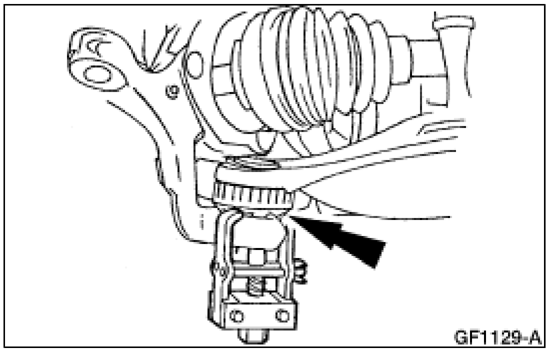
10. Use the Pitman Arm Puller to separate the tie-rod end (3A130).
    - Separate the tie-rod end from the front wheel knuckle (3K185).



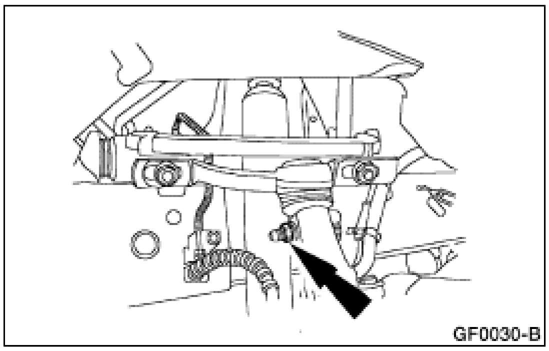
11. Remove the lower ball joint castellated nut.
    1. Remove the lower ball joint cotter pin.
    2. Remove the lower ball joint castellated nut.



12. Use the Pitman Arm Puller to separate the front wheel knuckle from the front suspension lower arm.



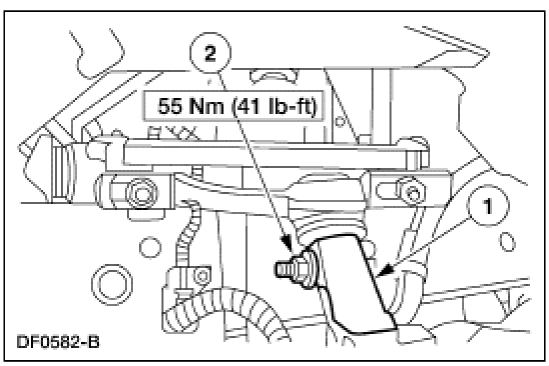
13. Remove the pinch bolt.



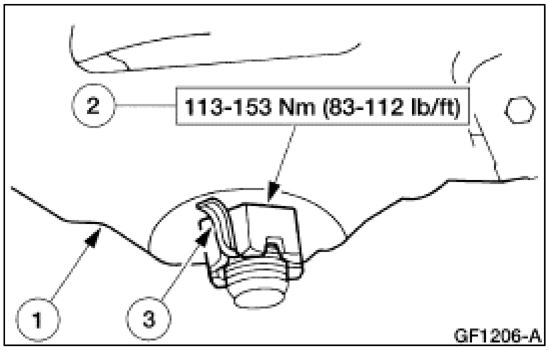
14. Remove the front wheel knuckle.

Installation

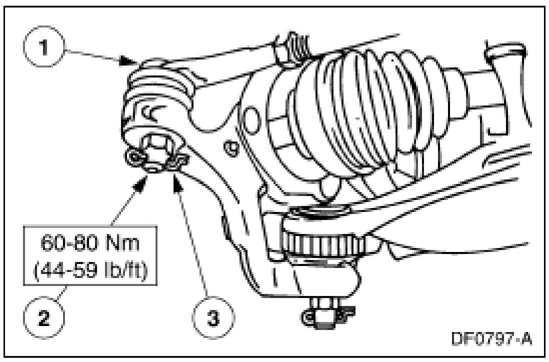
1. Install the front wheel knuckle pinch bolt and nut.
    1. Position the front wheel knuckle on the front suspension upper arm.
    2. Install the pinch bolt and nut.



2. Install the front suspension arm lower ball joint castellated nut.
    1. Position the front wheel knuckle.
    2. Install the castellated nut.
    3. Install a new cotter pin.

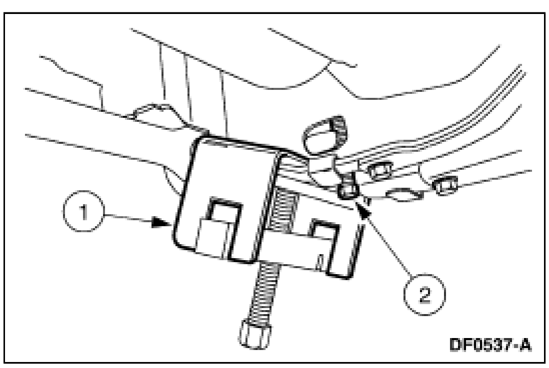


3. Install the tie-rod end castellated nut.
    1. Position the tie-rod end.
    2. Install the tie-rod end castellated nut.
    3. Install a new cotter pin.



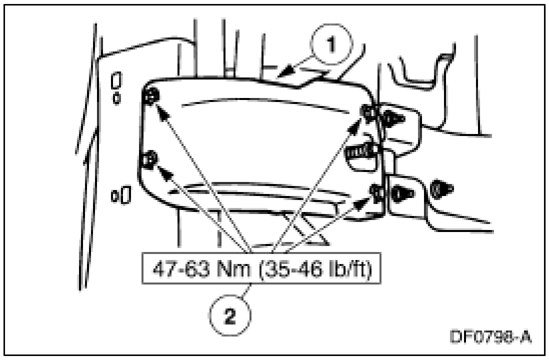
4. **CAUTION: The torsion bar adjustment bolt is coated with dry adhesive. A new bolt must be installed if it is backed off or removed. Failure to do so can cause the adjustment bolt to loosen during operation and result in a loss of vehicle alignment.**

    Preload the torsion bar.
    1. Tighten the Torsion Bar Tool until the new adjustment bolt and nut can be installed.
    2. Turn the adjustment bolt until preliminary adjustment marks are aligned.



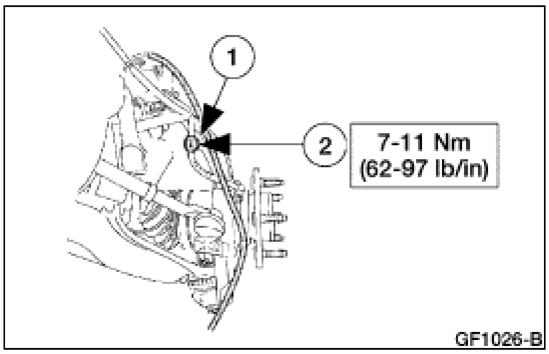
5. Remove the Torsion Bar Tool and adapters.

6. Install the torsion bar cover plate.
    1. Position the torsion bar cover plate.
    2. Install the retaining bolts.



7. Install the wheel hub. For additional information, refer to Wheel Hub in this section.

8. Install the anti-lock sensor wire bracket bolt.
   1. Position the anti-lock sensor wire.
   2. Install the bolt.



9. Adjust the ride height. For additional information, refer to Ride Height in this section.

10. Check the alignment. For additional information, refer to Section 204-00 .

Bushing —Control Arm

Removal and Installation

NOTE: The control arm bushings are not serviced separately. If the bushings require service, the front suspension lower arm or the front suspension upper arm will have to be installed new.

For additional information, refer to Arm—Lower in this section.

Removal and Installation

NOTE: The control arm bushings are not serviced separately. If the bushings require service, the front suspension lower arm or the front suspension upper arm will have to be installed new.

For additional information, refer to Arm—Upper in this section.

SECTION 204-01B: Front Suspension — 4x4 *2000 Explorer/Mountaineer Workshop Manual*
REMOVAL AND INSTALLATION

Bar —Stabilizer

Removal and Installation

For additional information, refer to Section 204-01A .

Ball Joint

Removal and Installation

NOTE: The ball joint is not serviced separately. If the ball joint requires service, the front suspension lower arm or the front suspension upper arm will have to be installed new.

For additional information, refer to Arm—Lower in this section.

Removal and Installation

NOTE: The ball joint is not serviced separately. If the ball joint requires service, the front suspension lower arm or the front suspension upper arm will have to be installed new.

For additional information, refer to Arm—Upper in this section.

Arm —Lower

For additional information, refer to Section 204-01A .

SECTION 204-01B: Front Suspension — 4x4 *2000 Explorer/Mountaineer Workshop Manual*
REMOVAL AND INSTALLATION

Arm —Upper

For additional information, refer to Section 204-01A .

SECTION 204-01B: Front Suspension — 4x4 *2000 Explorer/Mountaineer Workshop Manual*
REMOVAL AND INSTALLATION

Bar —Torsion

For additional information, refer to Section 204-01A .

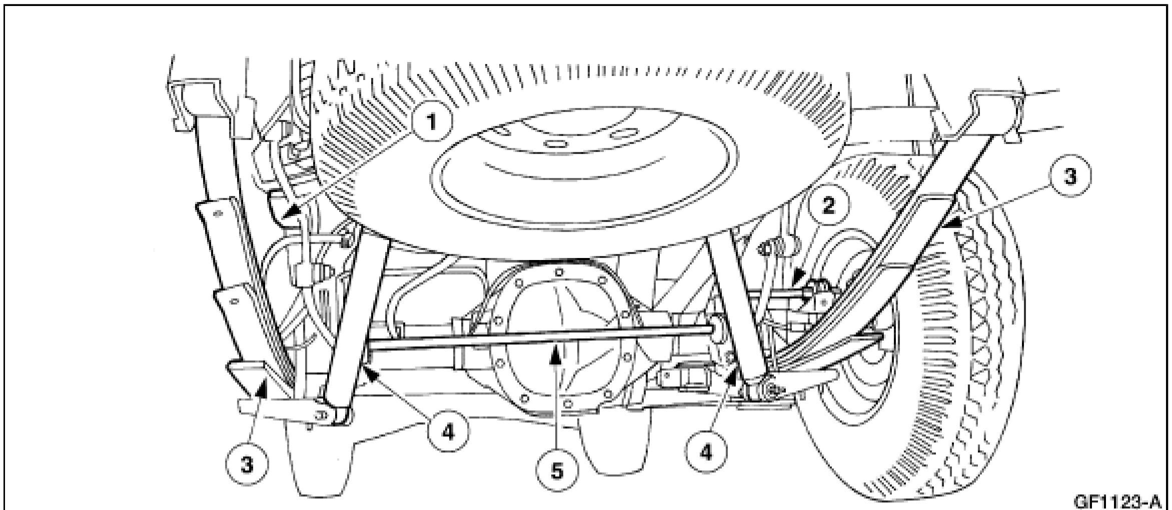
Torque Specifications

Description	Nm	lb-ft
Anti-windup bar bolt	113-153	83-112
Rear spring shackle lower bolt and nut	115	85
Rear spring to front frame bracket bolt and nut	90	66
Rear spring U-bolt nut	103	76
Rear stabilizer bar mounting bracket nuts	40-55	30-40
Rear stabilizer bar-to-link nut	68-92	50-68
Wheel nuts	135	100
Jounce bumper nut	21-29	15-21
Shock absorber-to-frame nuts	23	17
Shock absorber lower bolt	63	46

SECTION 204-02: Rear Suspension *2000 Explorer/Mountaineer Workshop Manual*
DESCRIPTION AND OPERATION

Rear Suspension

Rear Suspension Components



Item	Part Number	Description
1	4730	Rear axle bumper
2	4A479	Anti-windup bar
3	5560	Rear spring
4	18080	Shock absorber
5	5A772	Rear stabilizer bar

Anti-Windup Bar (5.0L Only)

The anti-windup bar compensates for rotational torque placed on the rear axle (4001) during acceleration and braking by preventing the rear axle and rear spring (5560) from twisting (winding up).

The anti-windup bar minimizes noise and vibration issues caused by excessive pinion-to-driveshaft angles during acceleration and braking.

Rear Axle Bumpers

The rear axle bumpers (4730) are used to prevent metal-to-metal contact between the rear axle and the frame.

Rear Spring

Semi-elliptic, leaf-type rear springs are used for the rear suspension.

Shock Absorbers

The shock absorbers (18080) provide the necessary suspension dampening control.

Stabilizer Bar

The rear stabilizer bar (5A772) transmits forces to control vehicle roll during cornering.

Suspension Fasteners

New fasteners must be installed if the old fasteners are loosened or removed. They must be installed new with the same part number or an equivalent part if installation is necessary. Do not use a replacement part of lesser quality or substitute design. The specified torque value must be used during assembly to ensure correct part retention.

Load Leveling

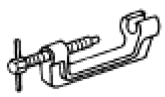
The load leveling system adjusts the suspension to accommodate quickly changing road conditions. The load leveling system is available on 4x4 vehicles. For additional information regarding the load leveling system, refer to Section 204-05 .

Rear Suspension

Refer to Section 204-00 .

Wheel Studs

Special Tool(s)

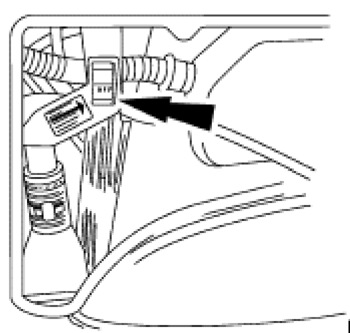
 ST1494-A	C-Frame and Clamp Assembly 211-023 (T74P-3044-A1)

Removal

CAUTION: Never use a hammer to remove the wheel stud. Damage to the axle flange, hub flange, wheel bearing or hub bearing can result.

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air shocks, which can result in shifting of the vehicle during these operations.**

   Turn the air suspension service switch off, if so equipped.

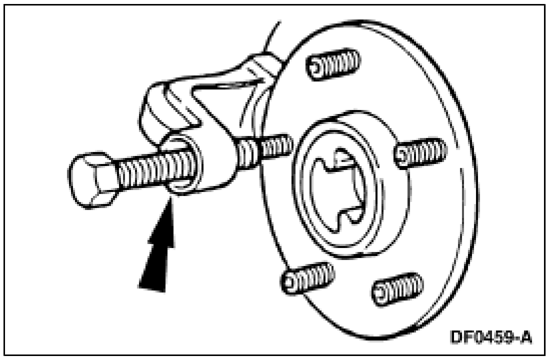
   DF0806-A

2. Raise the vehicle and install safety stands. For additional information, refer to Section 100-02 .

3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

4. Remove the rear disc brake caliper (2552), rear disc support bracket (2B511) and brake disc (2C026) if so equipped. For additional information, refer to Section 206-04 . Support the rear disc brake caliper with safety wire.

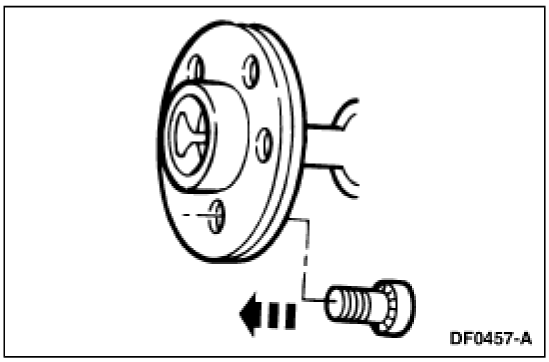
5. Using the C-Frame and Clamp Assembly Tool, press the wheel stud from its seat and discard.



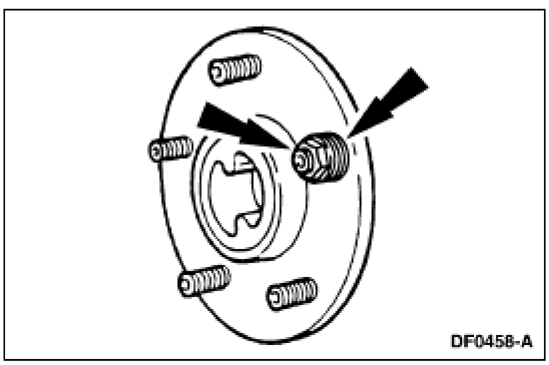
Installation

CAUTION: Never use air tools to install wheel studs. The serrations can be stripped from the stud.

1. Insert a new wheel stud in the hole in the axle flange, making sure the serrations are aligned with those made by the original wheel stud.



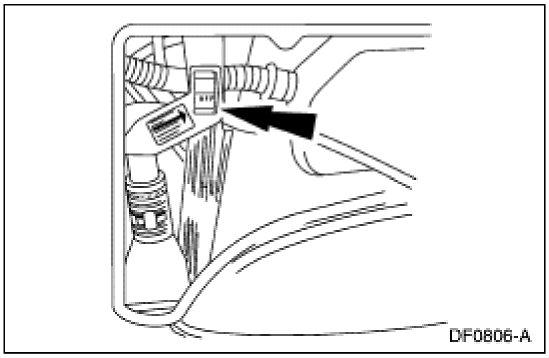
2. Seat new wheel studs in axle flange.
   - Place four flatwashers over the outside end of the wheel stud.
   - Thread a standard wheel nut with the flat side against the washers.
   - Tighten the wheel nut until the wheel stud head seats against the back side of the flange.



3. Remove the wheel nut and flatwashers.

4. Install the brake disc, rear disc support bracket and the rear disc brake caliper, if so equipped. For additional information, refer to Section 206-04 .

5. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .
6. Lower the vehicle.
7. Turn the air suspension service switch on, if so equipped.

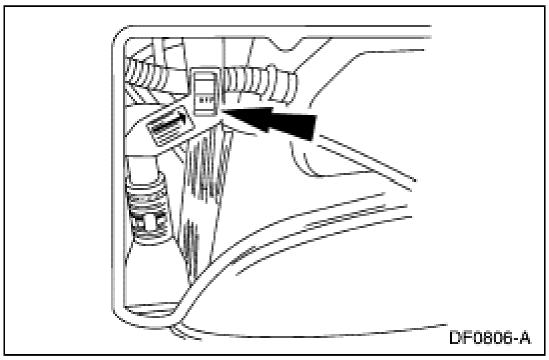


Bar and Link

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air shocks, which can result in shifting of the vehicle during these operations.**

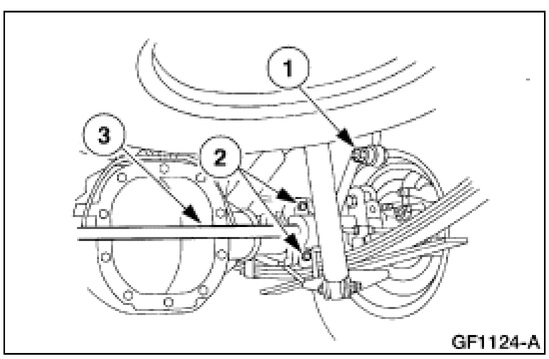
   Turn the air suspension service switch off, if so equipped.



2. Raise the vehicle and install safety stands. For additional information, refer to Section 100-02 .

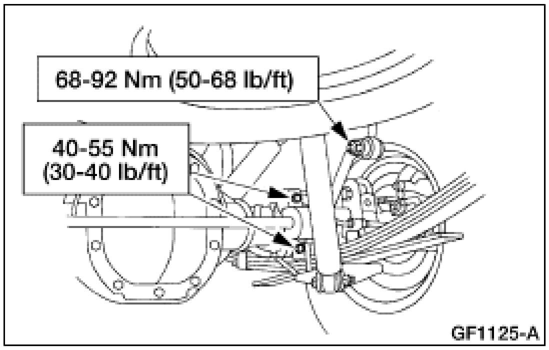
3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

4. Remove the rear stabilizer bar (5A772).
   1. Remove the rear stabilizer bar link nut.
   2. Remove the two rear stabilizer bar mounting bracket nuts, and remove the bracket.
      - Repeat for the other side.
   3. Remove the rear stabilizer bar.



Installation

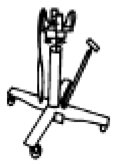
1. Follow the removal procedure in reverse order.


68-92 Nm (50-68 lb/ft)
40-55 Nm
(30-40 lb/ft)
GF1125-A

SECTION 204-02: Rear Suspension 2000 Explorer/Mountaineer Workshop Manual
REMOVAL AND INSTALLATION

Spring

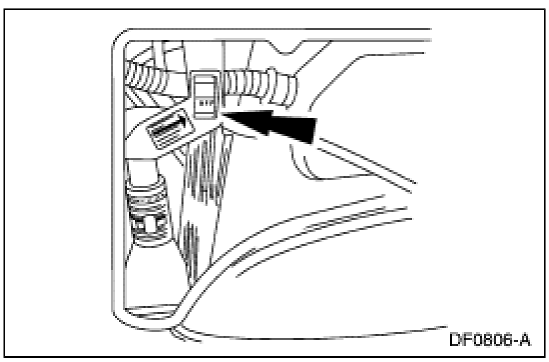
Special Tool(s)

 ST1130-A	Hi-Lift Jack 014-00942 or Equivalent

Removal

1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so can result in unexpected inflation or deflation of the air shocks, which can result in shifting of the vehicle during these operations.**

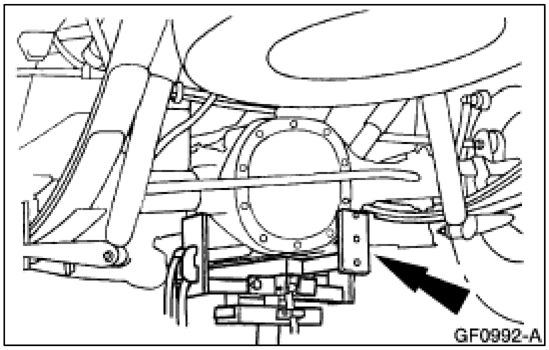
   Turn the air suspension service switch off, if so equipped.

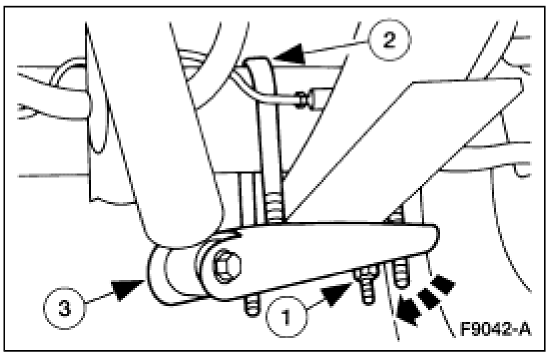
2. Raise the vehicle and install safety stands. For additional information, refer to Section 100-02 .

3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

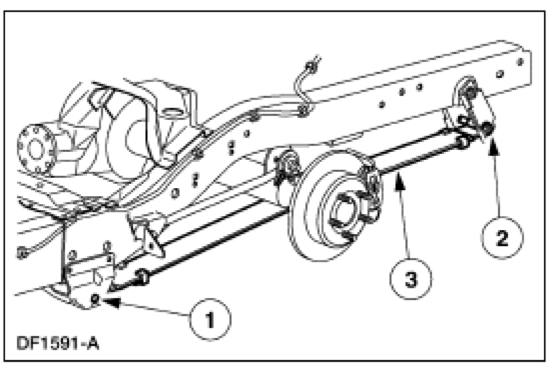
4. Use the Hi-Lift Jack to support the rear axle (4001).



5. Separate the rear spring (5560) from the rear axle.
   1. Remove the four nuts.
   2. Remove the two U-bolts.
   3. Position the rear spring plate (5796) aside.

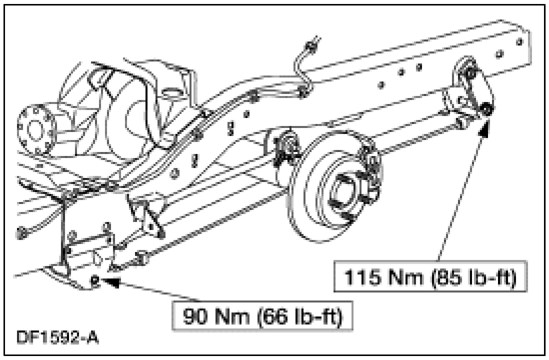


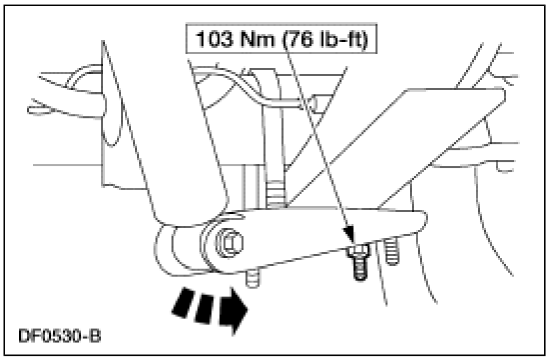
6. Remove the rear spring.
   1. Remove the bolt and nut.
   2. Remove the bolt and nut.
   3. Remove the rear spring.



Installation

1. To install, reverse the removal procedure.


115 Nm (85 lb-ft)
90 Nm (66 lb-ft)
DF1592-A


103 Nm (76 lb-ft)
DF0530-B

General Specifications

Item	Specification
Wheel stud and lug nuts (in)	1/2-20-19 mm hex
Tire Tread Depth	
P225/70R15 A/S	9.4 mm (0.37 in)
P235/75R15 A/T	10.7 mm (0.42 in)
P255/70R16 A/T	10.7 mm (0.42 in)
Wheel	
Machined aluminum	16x7
Chrome steel	15x7
Deep dish aluminum	15x7
Full face steel	15x7
Limited aluminum	16x7
Luxury aluminum	15x7
Maximum balance weight (total of inner and outer wheel flange)	170 g (6.0 oz)
Wheel offset	12 mm (0.48 in)
Wheel bolt circle runout	0.50 mm (0.02 in)
Tire Inflation	
Tires	See safety certification sticker located on driver door jamb.
Cleaners — Wheel	
Custom Bright Metal Cleaner 8A-19522-A	ESR-M5B194-B
Lubricant	Any silicon, lithium or graphite type

Wheel Rim Runout

Type Wheel	Max. Radial Runout	Max. Lateral Runout
Aluminum	1.14 mm (0.045 in)	1.14 mm (0.045 in)
Steel	1.14 mm (0.045 in)	1.14 mm (0.045 in)

Tire Runout Specifications

Type Wheel	Max. Radial Runout	Max. Lateral Runout
Aluminum	1.02 mm (0.040 in)	1.02 mm (0.040 in)
Steel	1.02 mm (0.040 in)	1.02 mm (0.040 in)

Torque Specifications

Description	Nm	lb-ft
Lug nuts	135	100

SECTION 204-04: Wheels and Tires 2000 Explorer/Mountaineer Workshop Manual
GENERAL PROCEDURES

Wheel Leaks

1. Pinhole leaks in cast aluminum wheels compromise wheel integrity. Install a new wheel.

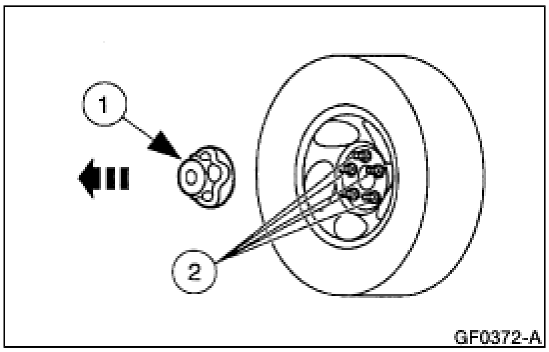
Wheel And Tire

Removal

1. **CAUTION: Do not use heat to loosen a seized wheel nut (1012). Heat can damage the wheel and wheel bearings.**

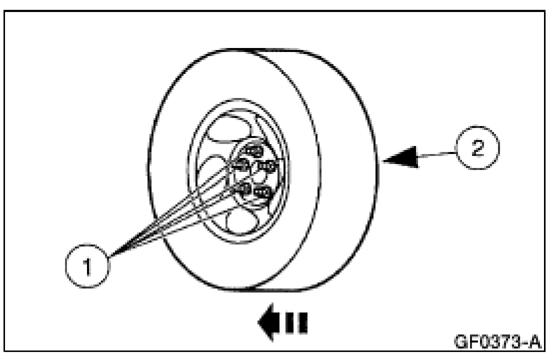
   NOTE: To avoid damage or scratching to the center cap, place facing up when removed.

   Loosen the wheel nuts.
   1. Remove the center cap.
   2. With the weight of the vehicle on the wheels, loosen the wheel nuts.

2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Remove the wheel and tire assembly.
   1. Remove the wheel nuts.
   2. Remove the wheel and tire assembly, using a side-to-side rocking motion.

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 wheel hub, brake drum or brake disc 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, causing loss of control.

⚠ **WARNING: Retighten at 800 km (500 miles) after any wheel change or any time the wheel nuts are loosened.**

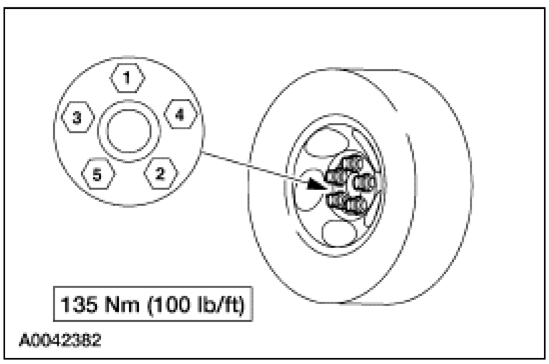
⚠ **WARNING: Failure to retighten wheel nuts at the mileage specified could allow wheels to come off while the vehicle is in motion, possibly causing loss of vehicle control and collision.**

Clean the wheel hub mounting surface and wheel pilot.

2. Install the tire and wheel assembly.
   1. Position the tire and wheel assembly.
   2. Install the wheel nuts hand-tight, then lower the vehicle.

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

   Tighten the wheel nuts in a star pattern, using a torque wrench or torque sticks.



4. Install the center cap.

Torque Specifications

Description	Nm	lb-ft	lb-in
Air compressor assembly to frame mounting bolts	17-23	13-17	—
Air suspension switch mounting screw	10.2-13.8	—	91-123
Air suspension control module mounting screws	2-3	—	18-27
Air compressor drier screws	2-3	—	18-27
Rear height sensor upper and lower bracket nuts	7.5-10.5	—	67-93
Rear shock absorber lower mounting nut	53-72	39-53	—
Rear shock absorber upper nuts	19-26	14-19	—

Vehicle Dynamic Suspension

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking, or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

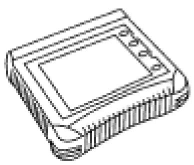
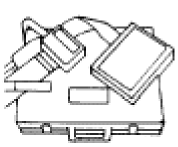
The vehicle dynamic suspension system consists of the following components:

- Air compressor (5319)
- Air suspension control module (5A919)
- Air line
- Air suspension height sensor (5359)
- Air suspension switch (5K761)
- Brake pedal position (BPP) switch (13840)
- Compressor relay (14B193)
- Drier
- Generic electronic module (GEM)(14B205)
- Message center indicator (10D898)
- Powertrain control module (PCM)(12A650)
- Rear air shock absorbers (18080)
- Solenoid valves (5311)
- Steering sensor (18B015)

Vehicle Dynamic Suspension

Refer to Wiring Diagrams Cell 41 , Rear Load Leveling for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1391-A	EEC-V 104-Pin Breakout Box or equivalent 418-049 (014-00950)
 ST1176-A	Vacuum Tester or equivalent 014-R1054
 ST1137-A	73 Digital Multimeter or equivalent 105-R0051
 ST1177-A	88 Digital Multimeter or equivalent 105-R0053

Principles of Operation

Rear load leveling maintains rear vehicle height. The system uses one height sensor, a steering sensor, and other vehicle sensors to measure driver and road inputs. The system maintains vehicle height on the rear axle through the use of an air compressor, two air solenoids, various air lines, and the use of an air spring integrated inside each shock.

Driver inputs include braking, throttle position, steering rate and position.

The rear load leveling system regulates the pressure in each air shock by compressing and venting the system air. Increasing air pressure (compressing) raises the vehicle. Conversely, decreasing air pressure (venting) lowers the vehicle.

The sensor sends a voltage signal to the air suspension control module. The output ranges from approximately 4.75 volts at minimum height (when the vehicle is low or in full jounce), to 0.25 volts at maximum height (when the vehicle is high or in full rebound). The sensor has useable range of 80 mm (3 inches) compared to total suspension travel of 200-250 mm (8 to 10 inches) at the wheel. Therefore, the sensor is mounted inside the wheels at a point where full suspension travel at the wheel is relative to 80 mm (3 in) of travel at the height sensor. The height sensor is not repairable.

NOTE: The compressor motor contains a thermal overload circuit breaker. The circuit breaker automatically turns the compressor off if tripped by excessive temperature. The air compressor will operate normally after it is allowed to cool.

The air compressor assembly:

- Consists of a single cylinder, electric motor driven compressor pump and vent solenoid; neither are repairable.
- Is mounted above the spare tire in the rear of the vehicle.
- Is powered by a relay, controlled by the air suspension control module.
- Passes pressurized air through the air compressor drier that contains silica gel (a drying agent). Moisture is then removed from the air compressor drier when vented air passes through the drier and out of the system during vent operation.

The vent solenoid valve:

- Is enclosed in the air pump head casting, which forms an integral valve housing that allows the valve tip to enter the pressurized side of the system.
- Opens when the air suspension control module determines lowering is required.
- Releases pressurized air when system pressures exceed safe operating levels.

The air suspension switch provides power to the control module in the ON (closed) position only. When OFF, the rear load leveling system will not function.

The steering sensor is mounted inside the passenger compartment on the steering column. It provides steering rate and position to the control module through two signals: Steering Sensor A and Steering Sensor B.

The rear fill solenoid connects the output of the compressor assembly to the two rear air shocks. When energized along with the rear gate solenoid, air pressure to the rear air shocks can be modified, affecting axle height relative to the body. The rear gate solenoid provides pneumatic isolation of the left and right sides of the vehicle, when lateral loads are detected by the air suspension control module and in response to steering and vehicle speed.

A microcontroller-based electronic air suspension control module controls the air compressor motor and all system solenoids. The module also provides power to the rear height sensor. The air suspension control module controls vehicle height adjustments by monitoring one height sensor, vehicle speed, a steering sensor, acceleration input, the door ajar signal, two transfer case signals, and the brake pedal position (BPP) switch. The module also conducts all failsafe and diagnostic strategies and contains self-test and communication software for testing of the vehicle and module.

Inspection and Verification

1. Verify the customer concern.

2. Visually inspect for the following obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Restricted suspension movement
• Excessive vehicle load
• Crimped, kinked, or leaking air line
	• Air suspension switch is OFF
	• Battery junction box (BJB) Fuse:
	  ■ 8 (20A)
	  ■ 9 (40A)
	• Central junction box (CJB) Fuse:
	  ■ 9 (7.5A)
	  ■ 10 (7.5A)
	• Loose connectors
	• Corroded connectors
	• Damaged solenoid valve

3. If the inspection reveals an obvious concern that is readily repaired, correct the concern before continuing with Inspection and Verification.

4. If the concern remains after the inspection, use scan tool connected to the data link connector (DLC) (located below the steering column) to retrieve continuous diagnostic trouble codes (DTCs) and to execute the air suspension control module diagnostics.
   - If the air suspension control module diagnostics passed and no DTCs are retrieved, go to Symptom Chart to continue diagnostics.
   - If DTCs are retrieved, go to Air Suspension Control Module Diagnostic Trouble Code (DTC) Index in this section.
   - If the air suspension control module cannot be accessed by scan tool, go to Pinpoint Test A.

Rear Load Leveling System Does Not Seem To Be Working

This test is used to determine if all inputs to the air suspension control module are connected and functioning. If one or any combination of inputs is not connected correctly, the vehicle may feel excessively harsh or bouncy. Also, the system may not raise or lower the vehicle correctly.

To set up the vehicle for the test, carry out the following:

5. Connect scan tool to the data link connector (DLC).

6. Monitor the following PIDS using the scan tool PID Monitor screen:
   - VSS_ARC.
   - IGN_RUN.
   - STEER_A.
   - STEER_B.
   - BOO_ARC.
   - DR_OPEN.
   - PCM_ACC.

7. Configure the air suspension control module:

- Vehicle stopped.
- Ignition switch in the ON position.
- Regular brake not applied.
- All doors closed, including rear tailgate and tailgate glass.
- No throttle.

Air Suspension Control Module Diagnostics

1. Connect Battery Charger to the vehicle. Use of the air compressor will drain the battery if it runs for extended times.
2. Prepare the vehicle.
   - Open any door.
3. Connect scan tool to the DLC.
4. Run the On-Demand Self-Test.
5. Retrieve all DTCs.
6. Clear all DTCs.
7. **CAUTION: If the air compressor runs in this test, do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.**

   Use the following active commands to raise the vehicle. Run the compressor for 30 seconds.
   - REAR FILL.
   - GATEVALVE.
   - COMPRESSR.
8. Use the following active commands to lower the vehicle. Lower the vehicle for 30 seconds.
   - REAR FILL.
   - GATEVALVE.
   - VENT.
9. Retrieve all DTCs.
10. Clear all DTCs.

Air Suspension Control Module Diagnostic Trouble Code (DTC) Index

Air Suspension Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1318	Battery Voltage Low	Air Suspension Control Module	GO to Pinpoint Test J .

B1342	ECU Is Defective	Air Suspension Control Module	GO to Pinpoint Test K .
B1485	Brake Pedal Position Switch Input Short to Battery	Air Suspension Control Module	GO to Pinpoint Test L .
B1565	Door Ajar Input Short to Power	Air Suspension Control Module	GO to Pinpoint Test M .
C1439	Acceleration Input Signal Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test B .
C1724	Height Sensor Power Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test C .
C1726	Rear Pneumatic Failure	Air Suspension Control Module	GO to Pinpoint Test D .
C1760	Rear Height Sensor Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test E .
C1770	Vent Solenoid Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test F .
C1830	Air Compressor Relay Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test G .
C1865	Rear Fill Solenoid Circuit Failure	Air Suspension Control Module	GO to Pinpoint Test H .
C1869	Rear Gate Solenoid	Air Suspension Control Module	GO to Pinpoint Test I .

Air Suspension Control Module Parameter Identification (PID) Index

Air Suspension Control Module Parameter Identification (PID) Index

PID	Description	Expected Values
AS_COMP	Compressor Relay Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G
AS_GATE	Front Gate Solenoid Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G
AS_VENT	Vent Solenoid Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G
BOO_ARC	Brake Pedal Position Switch Input	ON, OFF
CCNTARC	Number Of Continuous DTCs Counted by the air suspension control Module	one count per bit
DR_OPEN	Door Ajar Input	OPEN, CLOSED
HGTSENS	Height Sensor	ON, OFF
IGN_RUN	Detection of Ignition Switch in the RUN Position	RUN, notRUN
OFF ROAD	Vehicle Off Road Status	ON, OFF
PCM_ACC	Acceleration Signal From the Powertrain Control Module (PCM)	YES, NO
R_FILL	Rear Fill Solenoid Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G

RASGATE	Rear Gate Solenoid Status	ON---, ONO--, ON-B-, ON--G, OFF---, OFFO--, OFF-B-, OFF--G
RHGTSEN	Rear Height Sensor	#.## VDC
STEER_A	Steering Rotation Sensor A	LOW, HIGH
STEER_B	Steering Rotation Sensor B	LOW, HIGH
VBATARC	Battery Voltage Value	##.# VDC
VSS_ARC	Vehicle Speed Signal Input	### MPH

Air Suspension Control Module Active Command Index

Air Suspension Control Module Active Command Index

Active Command	Display	Action
AIR SUSPENSION MODULE	COMPRESSR	ON, OFF
	GATEVALVE	ON, OFF
	LR SMOTOR	ON, OFF
	LRSH FIRM	ON, OFF
	PWR CTRL	ON, OFF
	REAR FILL	ON, OFF
	RR SMOTOR	ON, OFF
	RRSH FIRM	ON, OFF
	VENT	ON, OFF

Intermittent Circuit Check

NOTE: The Intermittent Circuit Check cannot be started without erasing all stored DTCs. Record all DTCs or repair the fault(s) before starting the Intermittent Circuit Check.

1. Configure the vehicle:
   - Open any door.
   - Ignition switch is in the RUN position.
   - The vehicle is in PARK.
   - The brake pedal is fully depressed.
   - The accelerator pedal is fully depressed.

2. Connect scan tool.

3. Enter the PID monitor and select the following PIDs (make sure that the listed states are displayed before continuing):

PID	State
IGN_RUN	RUN
STEER_A	HIGH
STEER_B	HIGH
BOO_ARC	ON

DR_OPEN	AJAR
PCM_ACC	YES

4. Enter scan tool "I/O Circuit Check" in the air suspension control module menu. All inputs should indicate NO CHANGE. If not, then restart the I/O Circuit Check.
5. Wiggle the wire harness for the selected circuits, without disturbing the vehicle configuration.
6. If any PIDs indicate CHANGED, an intermittent fault exists near the location of the wiggling of the wire harness. REPAIR the circuits as necessary.

Symptom Chart

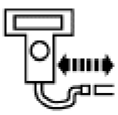
Symptom Chart

Condition	Possible Sources	Action
• No communication with the air suspension control module	• Circuitry. • Wiring connector. • Air suspension switch. • Ignition switch. • CJB Fuse 10 (7.5A) • BJB Maxi-Fuse 8 (20A)	• GO to Pinpoint Test A .
• Uneven vehicle height	• Rear pneumatic fault. • Rear height sensor(s). • Rear fill solenoids. • Rear gate solenoid. • Air compressor assembly. • Rear shock absorber.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test D .
• Vehicle rises too slowly	• Rear pneumatic fault. • Air compressor assembly.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test D .
• Vehicle drops too slowly	• Rear pneumatic fault. • Air compressor assembly.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test D .
• The air suspension system is inoperative	• Circuitry. • Ignition switch. • Steering wheel rotation sensor.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to

	• Brake pedal position (BPP) switch. • Door ajar switch. • PCM acceleration signal. • Anti-lock brake control module. • Anti-lock brake sensors.	Pinpoint Test N .
• The air suspension system is inoperative — ride height changes unexpectedly	• Circuitry. • Ignition switch. • Steering wheel rotation sensor. • BPP switch. • Door ajar switch. • PCM acceleration signal. • Anti-lock brake control module. • Anti-lock brake sensors.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test N .
• The air suspension system is inoperative — vehicle changes height with the door open	• Circuitry. • Ignition switch. • Steering wheel rotation sensor. • BPP switch. • Door ajar switch. • PCM acceleration signal. • Anti-lock brake control module. • Anti-lock brake sensors.	• RETRIEVE and REPAIR any DTCs. RUN On-Demand Self-Test. If no DTCs are found, GO to Pinpoint Test N .
• The air suspension system operates with the air suspension switch in the OFF position	• Circuitry. • Air suspension control module. • Air Suspension Switch.	• GO to Pinpoint Test O .
• The air compressor continuously cycles with the ignition switch in the OFF position	• Circuitry. • Air compressor relay.	• GO to Pinpoint Test P .
• Excessive air compressor noise	• Compressor assembly wiring. • Air compressor mounting and bracket. • Air compressor assembly.	• GO to Pinpoint Test Q .

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE AIR SUSPENSION CONTROL MODULE

CONDITIONS	DETAILS/RESULTS/ACTIONS
A1 CHECK WIRING HARNESS AND CONNECTORS	
1  Scan Tool	2 Check the wiring harness and connector on scan tool and data link connector (DLC) for damage. • **Is the connector and wiring okay?** → **Yes** GO to A2 . → **No** REPAIR C291 or wiring to scan tool. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
A2 CHECK AIR SUSPENSION SWITCH POSITION	
	1 Check the position of the air suspension switch. • **Is the air suspension switch in the ON position?** → **Yes** GO to A3 . → **No** TURN the air suspension switch to the ON position. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
A3 CHECK IGNITION SWITCH POSITION	
NOTE: Air suspension control module will provide communication for 40 minutes after the ignition switch is turned off.	
	1 Check the position of the ignition switch.

- **Is the ignition switch in the RUN position?**

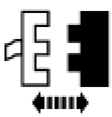
→ **Yes**
GO to A4 .

→ **No**
TURN the ignition switch to the RUN position. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

A4 CHECK AIR SUSPENSION SWITCH

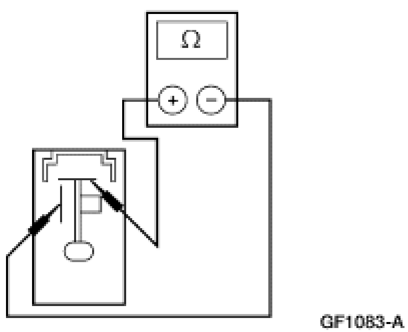
1

2



Air Suspension Switch C412

3



3 Measure the resistance between air suspension switch Pin 1 (component side), and air suspension switch Pin 2 (component side), with the switch in both positions.

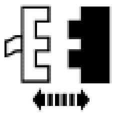
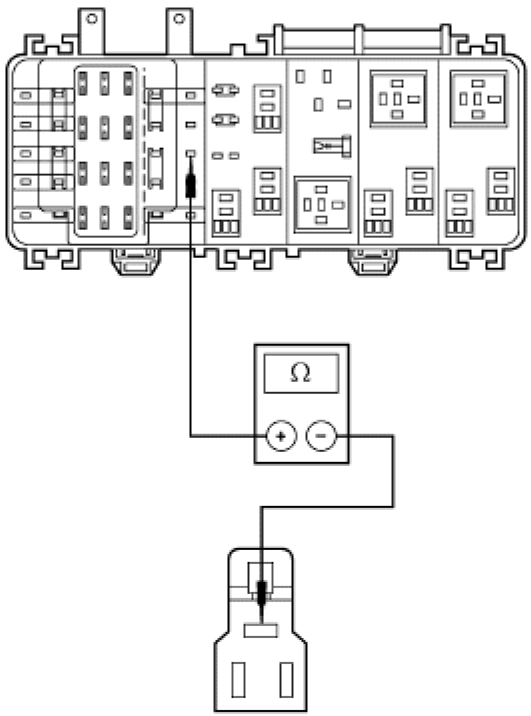
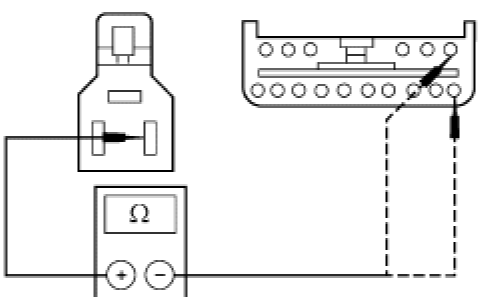
- **Is the resistance with the air suspension switch ON, less than 5 ohms; and greater than 10,000 ohms with the air suspension switch OFF?**

→ **Yes**
GO to A5 .

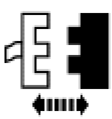
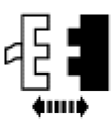
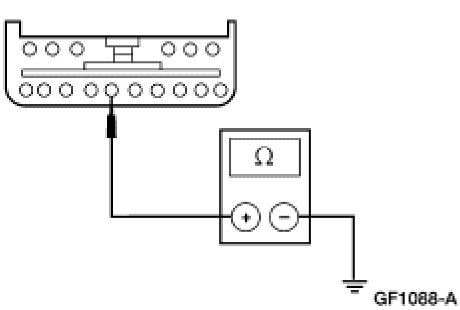
→ **No**
INSTALL a new air suspension switch; REFER to Module . REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

A5 CHECK CIRCUIT 418 (DG/YE) FOR AN OPEN

1

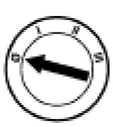
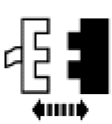
 Air Suspension Control Module	
2  GF1870-A	2 Measure the resistance between BJB Maxi-Fuse 8 (20A) Pin 2, Circuit 418 (DG/YE), harness side and air suspension switch C412 Pin 1, Circuit 418 (DG/YE), harness side.
3  GF1231-A	3 Measure the resistance between air suspension switch C412 Pin 2, Circuit 418 (DG/YE), harness side and air suspension control module C2001 Pin 1, Circuit 418 (DG/YE), harness side; and between air suspension switch C412 Pin 2, Circuit 418 (DG/YE), harness side and air suspension control module C2001 Pin 21, Circuit 418 (DG/YE), harness side.
	• **Are the resistances less than 5 ohms?** → **Yes** REFER to Section 418-00 . → **No** REPAIR the circuit. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

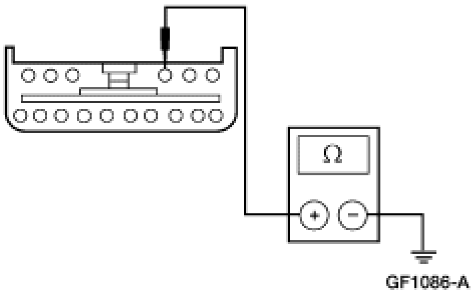
PINPOINT TEST B: DTC C1439, ACCELERATION INPUT SIGNAL CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
B1 CARRY OUT ON-DEMAND SELF-TEST	
NOTE: The accelerator pedal should not be touched during On-Demand Self-Test.	
2  On-Demand Self-Test	1 Open any door. • **Is DTC C1439 retrieved?** → **Yes** GO to B2 . → **No** REPEAT On-Demand Self-Test and REPAIR any DTCs. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
B2 CHECK CIRCUIT 394 (OG/BK) SHORT TO GROUND	
1  2  Air Suspension Control Module C2001 3  PCM C202 4 	4 Measure the resistance between air suspension control module C2001 Pin 6, Circuit 394 (OG/BK), harness side and ground.

	• **Is the resistance greater than 10,000 ohms?** → **Yes** REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

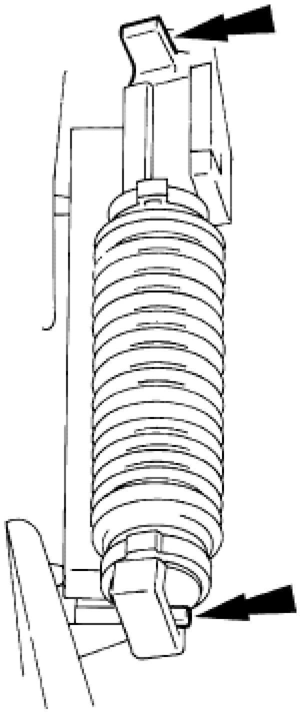
PINPOINT TEST C: DTC C1724, HEIGHT SENSOR POWER CIRCUIT FAILURE

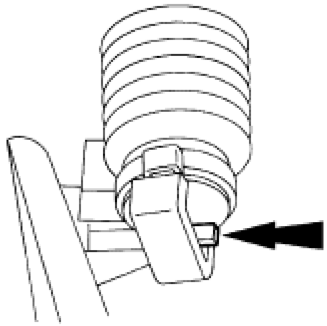
CONDITIONS	DETAILS/RESULTS/ACTIONS
C1 CARRY OUT ON-DEMAND SELF-TEST	
	1 Open any door.
2  On-Demand Self-Test	
	• **Is DTC C1724 retrieved?** → **Yes** GO to C2 . → **No** CHECK for intermittent short to ground in circuit 431 (PK/WH); GO to Intermittent Circuit Check. TEST the system for normal operation.
C2 CHECK CIRCUIT 431 (PK/WH) FOR SHORT TO GROUND	
1 	
	2 Turn the air suspension switch to the OFF position.
3  Air Suspension Control Module C2000	
4	4 Measure the resistance between air

	suspension control module C2000 Pin 28, Circuit 431 (PK/WH), harness side and ground. • **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST D: DTC C1726, REAR PNEUMATIC FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
D1 CARRY OUT REAR COMPONENT INSPECTION	
	1 Inspect the rear suspension components for damage, obstructions, or other mechanical failures. • **Are any components damaged or obstructed?** → **Yes** REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to D2 .
D2 INSPECT REAR HEIGHT SENSOR	
1	1 Inspect the rear height sensor for correct installation at the upper and lower ball stud brackets.

 GF1098-B	2 Inspect the upper and lower mounting brackets for damage. • **Is the height sensor and mounting bracket installed correctly and undamaged?** → **Yes** GO to D3 . → **No** REPAIR or INSTALL a new rear height sensor and mounting bracket as needed. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
D3 CHECK REAR HEIGHT SENSOR GROUND	
1  Scan Tool	2 Monitor the air suspension control module PID RHGTSEN.
3	3 Disconnect the rear height sensor from the lower mounting ball stud.



GF0845-B

4 Slowly extend and compress the rear height sensor over the full range of travel.

- **Does the voltage increase as the rear height sensor is compressed, and decrease as the rear height sensor is extended?**

→ **Yes**
GO to D4 .

→ **No**
REPAIR circuit 570 (BK/WH). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

D4 VERIFY REAR PNEUMATIC CIRCUIT CAN RISE

CAUTION: Do not let the air compressor run for more than three minutes at a time.

1

2 Toggle the air suspension control module active commands REAR FILL ON, GATEVALVE ON, and COMPRESSR ON.

3 Allow the rear of the vehicle to rise for 30 seconds.

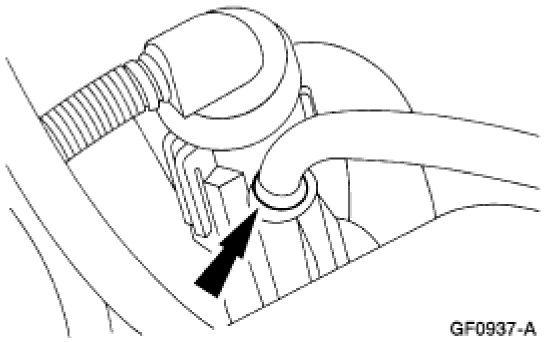
4 Toggle the air suspension control module active commands REAR FILL OFF, GATEVALVE OFF, and COMPRESSR OFF.

- **Does the rear of the vehicle rise and hold the higher position?**

→ **Yes**
GO to D5 .

→ **No**

	GO to D6 .
D5 VERIFY REAR PNEUMATIC CIRCUIT CAN LOWER	
NOTE: There must be air in the rear shocks for this test to work.	
	1 Toggle the air suspension control module active commands REAR FILL ON, GATEVALVE ON, and VENT ON. 2 Allow the rear of the vehicle to lower for 30 seconds. • **Does the rear of the vehicle lower?** → **Yes** CHECK and RESET rear mechanical ride height. CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** Toggle the air suspension control module active commands REAR FILL OFF, GATEVALVE OFF, and VENT OFF. GO to D14 .
D6 CHECK OPERATION OF AIR COMPRESSOR	
CAUTION: If the air compressor runs in this test, do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
	1 Toggle the air suspension control module active command COMPRESSR ON. • **Does the compressor run (slight buzzing noise from the rear of the vehicle)?** → **Yes** Toggle the air suspension control module active command COMPRESSR OFF. GO to D7 . → **No** Toggle the air suspension control module active command COMPRESSR OFF. GO to Pinpoint Test R .
D7 CARRY OUT AIR COMPRESSOR LEAK TEST	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
1	1 Disconnect the air line at the inlet to the rear



fill solenoid.

2 Connect an air pressure gauge with common fitting to the air line.

3 Toggle the air suspension control module active command COMPRESSR ON.

4 **NOTE:** Within 30 seconds, the pressure should reach 896 kPa (130 psi).

Monitor the air pressure gauge.

5 Toggle the air suspension control module active command COMPRESSR OFF.

6 **NOTE:** The pressure should hold steady.

Monitor the air pressure gauge for five minutes.

7 Toggle the air suspension control module active command VENT ON.

- **Did the air compressor reach and hold a minimum air pressure of 896 kPa (130 psi)?**

→ **Yes**
RECONNECT the air line. Toggle the air suspension control module active command VENT OFF. GO to D9 .

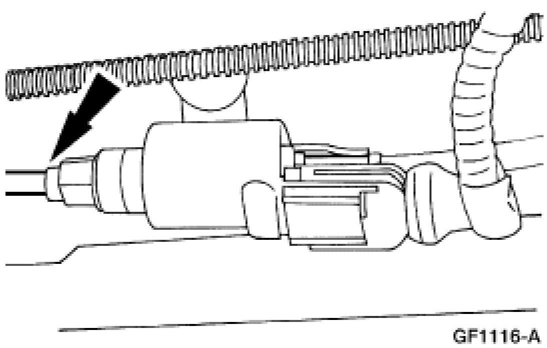
→ **No**
RECONNECT the air line. Toggle the air suspension control module active command VENT OFF. GO to D8 .

D8 CHECK AIR LINE TO FILL SOLENOIDS FOR LEAKS

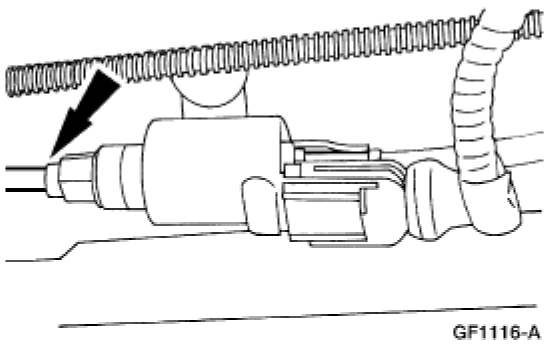
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.

1 Toggle the air suspension control module active command COMPRESSR ON.

2 Check the air line between the air compressor and the two fill solenoids for air leaks.

	3 Toggle the air suspension control module active command COMPRESSR OFF. • **Do any of the air lines leak?** → **Yes** REPAIR or INSTALL new air lines as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new air compressor; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
D9 CHECK REAR FILL SOLENOID OPERATION	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
1 	1 Disconnect the air line from the rear fill solenoid outlet. 2 Toggle the air suspension control module active commands REAR FILL ON and COMPRESSR ON. 3 Check for a smooth flow of air at the outlet of the rear fill solenoid. 4 Toggle the air suspension control module active commands REAR FILL OFF and COMPRESSR OFF. • **Is there a smooth flow of air without fluid flowing from the rear fill solenoid?** → **Yes** RECONNECT the air line. GO to D10 . → **No** If there is no air flow, INSTALL a new rear fill solenoid; REFER to Solenoid Valve—Rear Fill . CLEAR all DTCs. REPEAT the Air Suspension

	Control Module Diagnostics. TEST the system for normal operation. If fluid (oil or water) is present in the air flow, PURGE the fluid from the system; REFER to Air Line Fluid Purge . If necessary, RECONNECT the air line. GO to D10 .
D10 CHECK REAR FILL SOLENOID AIR LINES	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
	1 Toggle the air suspension control module active commands REAR FILL ON and COMPRESSR ON. 2 Check for air leaks, bends and kinks in the air lines. 3 Toggle the air suspension control module active commands REAR FILL OFF and COMPRESSR OFF. • **Are there any bends, kinks, or air leaks in the rear air lines?** → **Yes** REPAIR or INSTALL a new air line(s) as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to D11 .
D11 CHECK RIGHT REAR SHOCK ABSORBER OPERATION	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
	1 Toggle the air suspension control module active commands REAR FILL ON and COMPRESSR ON. 2 Observe the right rear corner of the vehicle. 3 Toggle the air suspension control module active commands REAR FILL OFF and COMPRESSR OFF. • **Does the right rear corner of the vehicle rise?** → **Yes** GO to D12 .

	→ **No** INSTALL a new RR air shock absorber; REFER to Air Shock Absorber—Rear . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
D12 CHECK REAR GATE SOLENOID OPERATION	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.	
1  GF1116-A	1 Disconnect the air line from the rear gate solenoid outlet. 2 Toggle the air suspension control module active commands REAR FILL ON, GATEVALVE ON, and COMPRESSR ON. 3 Check for a smooth flow of air at the outlet of the rear gate solenoid. 4 Toggle the air suspension control module active commands REAR FILL OFF, GATEVALVE OFF, and COMPRESSR OFF. • **Is there a smooth flow of air without fluid flowing from the rear gate solenoid?** → **Yes** RECONNECT the air line. GO to D13 . → **No** If there is no air flow, INSTALL a new rear gate solenoid. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. If fluid (oil or water) is present in the air flow, PURGE the fluid from the system; REFER to Air Line Fluid Purge . If necessary, RECONNECT the air line. GO to D13 .
D13 CHECK REAR GATE SOLENOID AIR LINE	
CAUTION: Do not allow the air compressor to run for more than three minutes. The air	

compressor could overheat and stop operating due to an internal temperature sensitive thermal breaker.

	1 Toggle the air suspension control module active commands REAR FILL ON, GATEVALVE ON, and COMPRESSR ON. 2 Check for air leaks, bends and kinks in the air line between the rear gate solenoid and LR air shock absorber. 3 Toggle the air suspension control module active commands REAR FILL OFF, GATEVALVE OFF, and COMPRESSR OFF. • **Are there any bends, kinks, or air leaks in the rear air line?** → **Yes** REPAIR or INSTALL a new air line as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new LR air shock absorber; REFER to Air Shock Absorber—Rear . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
D14 CHECK FOR RESTRICTED AIR LINE (COMPRESSOR)	
NOTE: If fluid (water or oil) is present when disconnecting the air lines, purge the air line.	
	1 Disconnect the air line between the air compressor air drier and the rear fill solenoid. 2 Connect Vacuum Tester to the air line and try to draw a vacuum. • **Can a vacuum be drawn and held?** → **Yes** REPAIR or INSTALL a new air line as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to D15 .
D15 CHECK FOR RESTRICTED AIR LINE (RR AIR SHOCK)	
NOTE: If fluid (water or oil) is present when disconnecting the air lines, purge the air line.	
	1 Disconnect the air line between the rear gate solenoid and the RR air shock absorber. 2 Connect Vacuum Tester to the air line and try

	to draw a vacuum. • **Can a vacuum be drawn and held?** → **Yes** REPAIR or INSTALL a new air line as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to D16 .
D16 CHECK FOR RESTRICTED AIR LINE (REAR)	
NOTE: If fluid (water or oil) is present when disconnecting the air lines, purge the air line.	
	1 Disconnect the air line between the rear gate solenoid and the rear fill solenoid. 2 Connect Vacuum Tester to the air line at the rear gate solenoid and try to draw a vacuum. • **Can a vacuum be drawn and held?** → **Yes** REPAIR or INSTALL a new air line as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new air compressor; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST E: DTC C1760, REAR HEIGHT SENSOR CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
E1 CARRY OUT ON-DEMAND SELF-TEST	
2  On-Demand Self-Test	1 Open any door. • **Is DTC C1760 retrieved?** → **Yes**

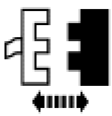
GO to E2 .

→ **No**
GO to E6 .

E2 CHECK HEIGHT SENSOR POWER

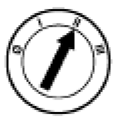
1

2

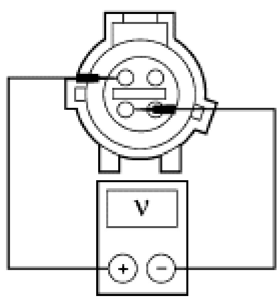


Height Sensor C433

3



4



GF1093-A

4 Measure the voltage between height sensor C433 Pin 3, Circuit 431 (PK/WH), harness side and height sensor C433 Pin 1, Circuit 570 (BK/WH) harness side.

- **Is the voltage approximately 5 volts?**

→ **Yes**
GO to E4 .

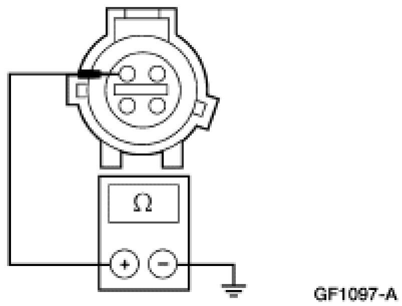
→ **No**
GO to E3 .

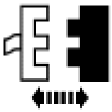
E3 CHECK HEIGHT SENSOR GROUND

1

1 **NOTE:** Do not use sheet metal or frame as a ground for this test step.

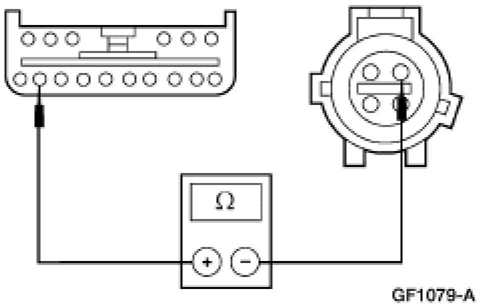
Measure the resistance between height sensor C433 Pin 1, Circuit 570 (BK/WH), harness side and ground.

	• **Is the resistance less than 5 ohms?** → **Yes** REPAIR Circuit 431 (PK/WH). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR Circuit 570 (BK/WH). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
E4 CHECK SUSPECT HEIGHT SENSOR OPERATION	
	1 Monitor the air suspension control module PID as appropriate. 2 Remove the height sensor from the lower ball stud. 3 While monitoring the RHGTSEN PID, slowly extend and compress the height sensor over the full range of travel. • **Does the voltage increase as the sensor is compressed, and decrease as the sensor is extended?** → **Yes** GO to E6 . → **No** GO to E5 .
E5 CHECK CIRCUIT 422 (PK/BK) OR CIRCUIT 428 (OG/BK) FOR OPEN	
1  2	



Air Suspension Control Module C2001

3



3 Measure the resistance between rear height sensor C433 Pin 2, Circuit 428 (OG/BK), harness side and air suspension control module C2001 Pin 9, Circuit 428 (OG/BK), harness side.

- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new height sensor; REFER to Height Sensor—Rear . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR Circuit 422 (PK/BK) and Circuit 428 (OG/BK) as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

E6 CHECK FOR INTERMITTENT OPEN

1 Monitor the air suspension control module PID RHGTSEN as appropriate.

2 Monitor the height sensor voltage while wiggling the harnesses between height sensor and air suspension control module.

- **Does the height sensor voltage indicate less than 0.2 volts?**

→ **Yes**
REPAIR Circuit 428 (OG/BK) and Circuit 431 (PK/WH) as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

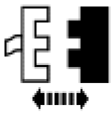
→ **No**
GO to E7 .

E7 CHECK FOR INTERMITTENT SHORT TO POWER	
	1 Monitor the air suspension control module PID RHGTSEN as appropriate. 2 Monitor the height sensor voltage while wiggling the harnesses between height sensor and air suspension control module. • **Does the height sensor voltage indicate more than 4.9 volts?** → **Yes** REPAIR Circuit 428 (OG/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new front height sensor; REFER to Height Sensor—Rear . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST F: DTC C1770, VENT SOLENOID CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
F1 CARRY OUT ON-DEMAND SELF-TEST	
2  On-Demand Self-Test	1 Open any door. • **Is DTC C1770 retrieved?** → **Yes** GO to F2 . → **No** GO to F10 .
F2 CHECK VENT SOLENOID CONNECTOR	
2	1 Turn the air suspension switch to the OFF position.

3



Air Compressor C430

4 Check the air compressor connector pins for damage, corrosion or pins that may be pushed out.

- **Are connector and pins OK?**

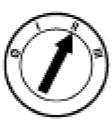
→ **Yes**
RECONNECT air compressor C430. GO to F3 .

→ **No**
REPAIR as necessary. CLEAR all DTCS. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F3 CARRY OUT AIR SUSPENSION CONTROL OUTPUT

1 Turn the air suspension switch to the ON position.

2



3 Select the air suspension control module active commands and activate the PID AS_VENT.

4 Use the air suspension control module active commands and activate the following commands in the given sequence:

- VENT to ON.
- REAR FILL to ON.
- VENT to OFF.
- REAR FILL to OFF.

- **Do the letters O, G, or B appear next to the ON/OFF text for the vent solenoid?**

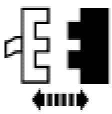
→ **Yes**
If O appeared, GO to F4 .
If G appeared, GO to F7 .
If B appeared, GO to F9 .

→ **No**
GO to F10 .

F4 CHECK VENT SOLENOID COIL FOR OPEN

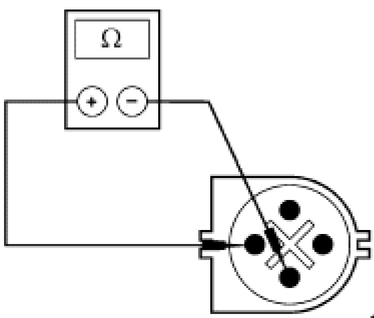
1

2



Air Compressor C430

3



GF1380-A

3 Measure the resistance between air compressor C430 Pin 4 (component side), and air compressor C430 Pin 2 (component side).

- **Is the vent solenoid relay coil resistance less than 25 ohms?**

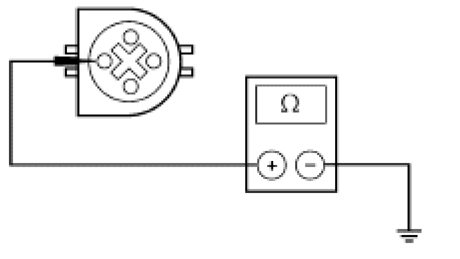
→ **Yes**
GO to F5 .

→ **No**
INSTALL a new air compressor assembly; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F5 CHECK CIRCUIT 430 (GY) FOR OPEN

1

1 Measure the resistance between air compressor C430 Pin 4, circuit 430 (GY), harness side and ground.



GF1082-A

- **Is the resistance less than 5 ohms?**

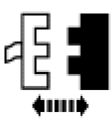
→ **Yes**
GO to F6 .

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F6 CHECK CIRCUIT 421 (PK) FOR OPEN

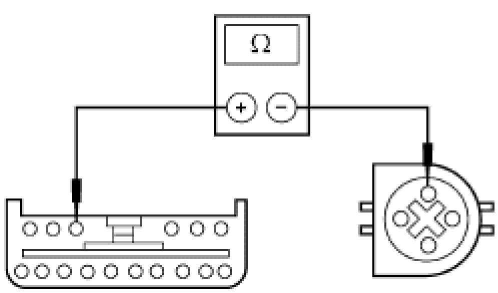
1 Turn the air suspension switch to the OFF position.

2



Air Suspension Control Module C2000

3



GF1588-A

3 Measure the resistance between air suspension control module C2000 Pin 30, Circuit 421 (PK), harness side and air compressor C430 Pin 4, Circuit 421 (PK), harness side.

- **Is the resistance less than 5 ohms?**

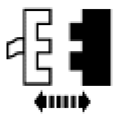
→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F7 CHECK VENT SOLENOID FOR SHORT

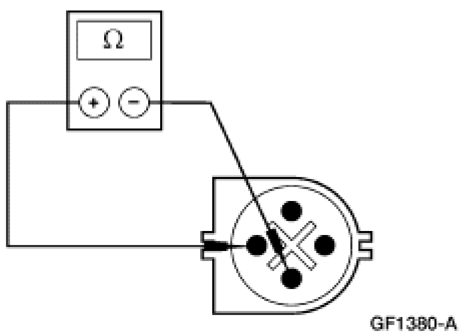
1

2



Air Compressor C430

3



3 Measure the resistance between air compressor Pin 4 component side, and air compressor Pin 2 component side.

- **Is the vent solenoid coil resistance greater than 25 ohms?**

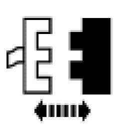
→ **Yes**
GO to F8 .

→ **No**
INSTALL a new air compressor assembly; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F8 CHECK CIRCUIT 421 (PK) FOR SHORT TO GROUND

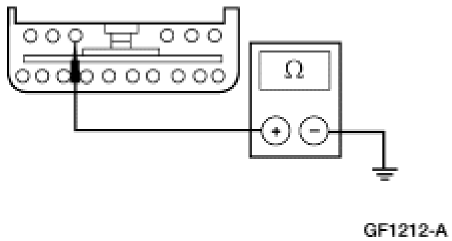
1 Turn the air suspension switch to the OFF position.

2



Air Suspension Control Module C2000

3



3 Measure the resistance between air suspension control module C2000 Pin 30, Circuit 421 (PK), harness side and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT the Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

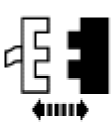
→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F9 CHECK CIRCUIT 421 (PK) FOR SHORT TO POWER

1

2 Turn the air suspension switch to the OFF position.

3



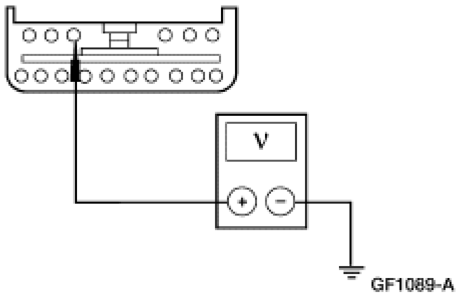
Air Suspension Control Module C2000

4 Turn the air suspension switch to the ON position.

5

6

6 Measure the voltage between air suspension control module module C2000 Pin 30, Circuit 421 (PK), harness side and ground.



- **Is voltage present?**

→ **Yes**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

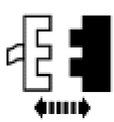
→ **No**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

F10 CHECK AIR COMPRESSOR ASSEMBLY CONNECTOR TERMINALS

1

2 Turn the air suspension switch to the OFF position.

3



Air Compressor C430

4 Inspect the pins of the air compressor connector for corrosion, bent or broken pins, moisture, or other damage.

- **Are the connectors and pins OK?**

→ **Yes**
GO to F11 .

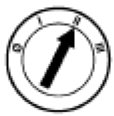
→ **No**
REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module

Diagnostics. TEST the system for normal operation.

F11 CHECK CIRCUIT 421 (PK) FOR INTERMITTENT SHORT TO GROUND

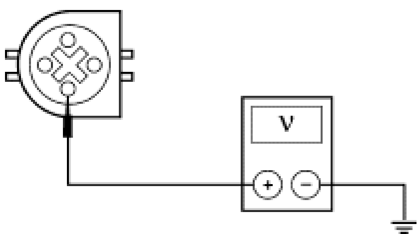
1 Turn the air suspension switch to the ON position.

2



3 Toggle the air suspension control module active command VENT ON.

4



GF1092-A

4 Use 88 Digital Multimeter, set to hold the lowest measurement, to measure the voltage between air compressor C430 Pin 4, Circuit 421 (PK), harness side and ground while wiggling the wiring harness between air suspension control C2000 and air compressor C430.

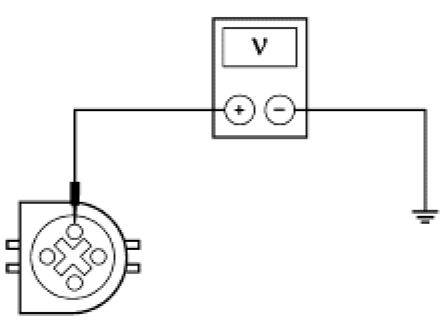
- **Is the voltage recorded less than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command VENT OFF. REPAIR Circuit 421 (PK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
Toggle the air suspension control module active command VENT OFF. GO to F12 .

F12 CHECK CIRCUIT 421 (PK) FOR INTERMITTENT SHORT TO POWER

1



GF1589-A

1 Use 88 Digital Multimeter, set to hold the highest measurement, to measure the voltage between air compressor C430 Pin 4, Circuit 421 (PK), harness side and ground while wiggling the wiring harness between air suspension control module C2000 and air compressor C430.

- **Is voltage present?**

→ **Yes**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
GO to F13 .

F13 CHECK INTERMITTENT MODULE FUNCTION

1

2 Turn the air suspension switch to the OFF position.

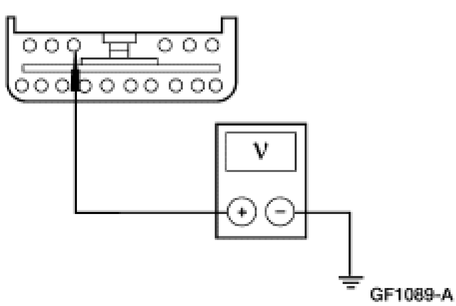
3 Remove Circuit 421 (PK) from air suspension control module C2000 Pin 30 (with connector connected to air suspension control module).

4 Turn the air suspension switch to the ON position.

5

6 Toggle the air suspension control module active command VENT ON.

7



7 Measure the voltage between air suspension control module terminal C2000 Pin 30 component side, Circuit 421 (PK), and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command VENT OFF. INSERT circuit 421 (PK) back into air suspension control module connector C2000 Pin 30 cavity. GO to F14 .

	→ **No** Toggle the air suspension control module active command VENT OFF. INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
F14 CARRY OUT THE ROAD TEST	
	1 Monitor the air suspension control module PID AS_VENT. 2 Take the vehicle for a ten-minute test drive with an additional 45 kg (100 lb) load in the rear of the vehicle. • **Do the letters O, G, or B appear next to the ON/OFF text for AS_VENT?** → **Yes** If O appeared, GO to F4 . If G appeared, GO to F7 . If B appeared, GO to F9 . → **No** CLEAR all DTCs and REPEAT the road test.

PINPOINT TEST G: DTC C1830, AIR COMPRESSOR RELAY CIRCUIT FAILURE

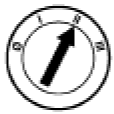
CONDITIONS	DETAILS/RESULTS/ACTIONS
G1 CARRY OUT ON-DEMAND SELF-TEST	
2  3  On-Demand Self-Test	1 Open any door. • **Is DTC C1830 retrieved?** → **Yes** GO to G2 .

→ **No**
GO to G9 .

G2 CARRY OUT AIR SUSPENSION CONTROL OUTPUT

1 Turn the air suspension switch to the ON position.

2



3 Select the air suspension control module active commands and activate the PID AS_COMP.

4 Use the air suspension control module active commands and toggle the COMPRESSR ON, and then OFF.

- **Do the letters O, G, or B appear next to the ON/OFF text for COMPRESSR?**

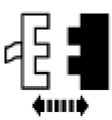
→ **Yes**
If O appeared, GO to G3 .
If G appeared, GO to G6 .
If B appeared, GO to G8 .

→ **No**
GO to G9 .

G3 CHECK AIR COMPRESSOR RELAY COIL FOR OPEN

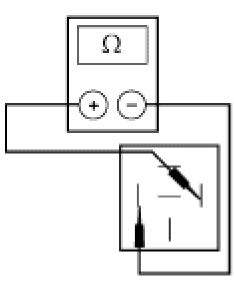
1

2



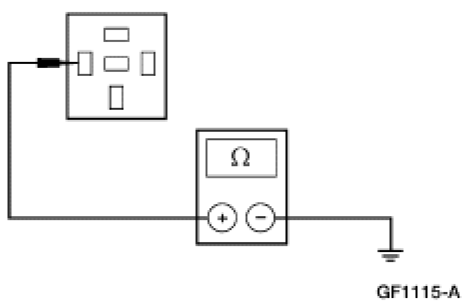
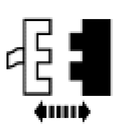
Air Compressor Relay

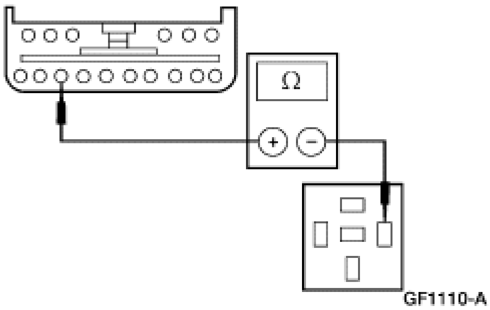
3



GF1100-A

3 Measure the resistance between air compressor relay Pin 85 component side, and air compressor relay Pin 86 component side.

	• **Is the resistance less than 90 ohms?** → **Yes** GO to G4 . → **No** INSTALL a new air compressor relay. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G4 CHECK CIRCUIT 57 (BK) FOR OPEN	
1  	1 Measure the resistance between air compressor relay connector Pin 85, Circuit 57 (BK), harness side and ground. • **Is the resistance less than 5 ohms?** → **Yes** GO to G5 . → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G5 CHECK CIRCUIT 420 (DB/YE) FOR OPEN	
2  Air Suspension Control Module C2000 3	1 Turn the air suspension switch to the OFF position. 3 Measure the resistance between air suspension control module C2000 Pin 18, Circuit 420 (DB/YE), harness side and air compressor relay connector Pin 86, Circuit 420 (DB/YE), harness side .



- **Is the resistance less than 5 ohms?**

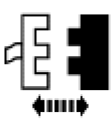
→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

G6 CHECK AIR COMPRESSOR RELAY COIL FOR SHORT

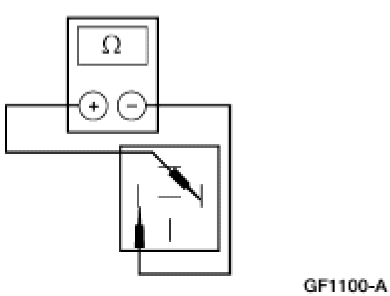
1

2



Air Compressor Relay

3



3 Measure the resistance between air compressor relay Pin 85 component side, and Pin 86 component side.

- **Is the resistance greater than 10 ohms?**

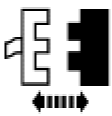
→ **Yes**
GO to G7 .

→ **No**
INSTALL a new air compressor relay. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

G7 CHECK CIRCUIT 420 (DB/YE) FOR SHORT TO GROUND

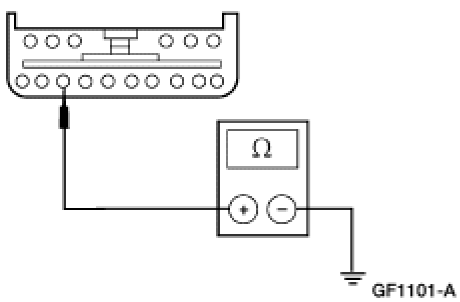
1 Turn the air suspension switch to the OFF position.

2



Air Suspension Control Module C2000

3



3 Measure the resistance between air suspension control module C2000 Pin 18, Circuit 420 (DB/YE), harness side and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

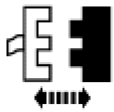
→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

G8 CHECK CIRCUIT 420 (DB/YE) FOR SHORT TO POWER

1

2 Turn the air suspension switch to the OFF position.

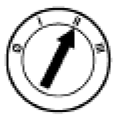
3



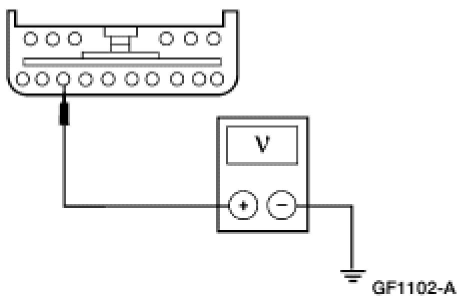
Air Suspension Control Module C2000

4 Turn the air suspension switch to the ON position.

5



6



6 Measure the voltage between air suspension control module C2000 Pin 18, Circuit 420 (DB/YE), harness side and ground.

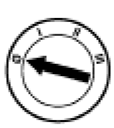
- **Is voltage present?**

→ **Yes**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

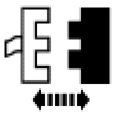
G9 CHECK AIR COMPRESSOR RELAY PINS

1



2 Turn the air suspension switch to the OFF position.

3



Air Compressor Relay

4 Inspect the pins of the air compressor relay connector for corrosion, bent or broken pins, moisture, or other damage.

- **Is relay OK?**

→ **Yes**
RECONNECT air compressor relay. GO to G10 .

→ **No**
REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

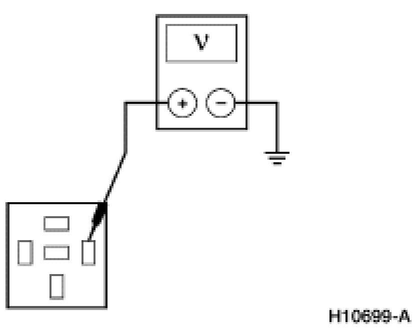
G10 CHECK CIRCUIT 420 (DB/YE) FOR INTERMITTENT SHORT TO GROUND

1 Turn the air suspension switch to the ON position.

2

3 Trigger the air suspension control module active command COMPRESSR ON.

4



4 Use 88 Digital Multimeter, set to hold the lowest measurement, to measure the voltage between air compressor relay C430 Pin 86, Circuit 420 (DB/YE), harness side and ground while wiggling the wiring harness between air suspension control module C2000, and air compressor C430.

- **Is the voltage recorded less than 10 volts?**

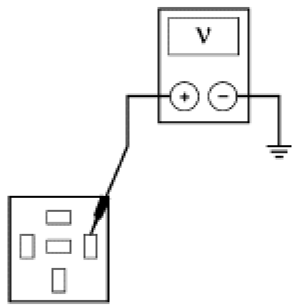
→ **Yes**
Toggle the air suspension control module active command COMPRESSR OFF. REPAIR circuit 420 (DB/Y). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal

operation.

→ **No**
Toggle the air suspension control module active command COMPRESSR OFF. GO to G11 .

G11 CHECK CIRCUIT 420 (DB/YE) FOR INTERMITTENT SHORT TO POWER

1



H10699-A

1 Use 88 Digital Multimeter, set to hold the highest measurement, to measure the voltage between air compressor relay connector Pin 86, Circuit 420 (DB/YE), harness side and ground while wiggling the wiring harness between air suspension control module C2000, and air compressor C430.

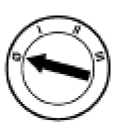
- **Is the voltage recorded greater than 0 volts?**

→ **Yes**
REPAIR Circuit 420 (DB/YE). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
GO to G12 .

G12 CHECK INTERMITTENT MODULE FUNCTION

1



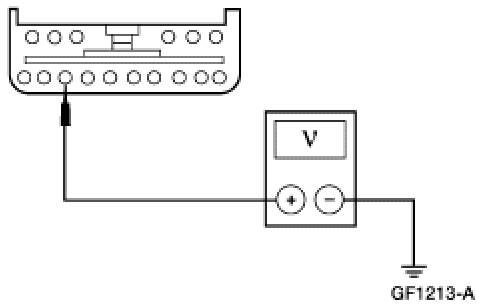
2 Turn the air suspension switch to the OFF position.

3 Remove Circuit 420 (DB/YE) from air suspension control module C2000 Pin 18 (with connector connected to air suspension control module).

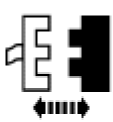
4 Turn the air suspension switch to the ON position.

5

6 Toggle the air suspension control module

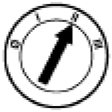
7 	active command COMPRESSR ON. 7 Measure the voltage between air suspension control module C2000 Pin 18, Circuit 420 (DB/YE), harness side and ground. • **Is the voltage greater than 10 volts?** → **Yes** Toggle the air suspension control module active command COMPRESSR OFF. RECONNECT Circuit 420 (DB/YE) back into air suspension control module connector C2000 Pin 18 cavity. GO to G13 . → **No** Toggle the air suspension control module active command COMPRESSR OFF. INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
G13 CARRY OUT ROAD TEST	
	1 Monitor the air suspension control module PID AS_COMP. 2 Take the vehicle for a ten-minute test drive with an additional 45 kg (100 lb) load in the rear of the vehicle. • **Do the letters O, G, or B appear next to the ON/OFF text for AS_COMP?** → **Yes** If O appeared, GO to G3 . If G appeared, GO to G6 . If B appeared, GO to G8 . → **No** CLEAR all DTCs and REPEAT the road test.

PINPOINT TEST H: DTC C1865, REAR FILL SOLENOID CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
H1 CARRY OUT ON-DEMAND SELF-TEST	
3  On-Demand Self-Test	1 Open any door. 2 The 4-wheel drive switch is in the 4WD LOW position and the 4WD LOW indicator is illuminated (4.0L). The ride control switch is in the OFF ROAD position (5.0L). • **Is DTC C1845 or C1865 retrieved?** → **Yes** GO to H2 . → **No** GO to H10 .
H2 CHECK FILL SOLENOID CONNECTOR	
1  3  Rear Fill Solenoid C428	2 Turn the air suspension switch to the OFF position. 4 Inspect the fill solenoid pins for damage, corrosion or pins that may be pushed out. • **Are the fill solenoid connector and pins OK?** → **Yes** RECONNECT the fill solenoid. GO to H3 . → **No** REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
H3 CARRY OUT AIR SUSPENSION CONTROL OUTPUT	

1 Turn the air suspension switch to the ON position.

2



3 Select the air suspension control module active commands, and monitor the suspect air suspension control module R_FILL.

4 Use the active commands and activate the following commands in the given sequence:

- GATEVALVE ON.
- REAR FILL ON.
- GATEVALVE OFF.
- REAR FILL OFF.

- **Do the letters O, G, or B appear next to the ON/OFF text for the vent solenoid?**

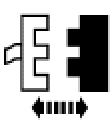
→ **Yes**
If O appeared, GO to H4 .
If G appeared, GO to H7 .
If B appeared, GO to H9 .

→ **No**
GO to H10 .

H4 CHECK FILL SOLENOID COIL OPEN CIRCUIT

1

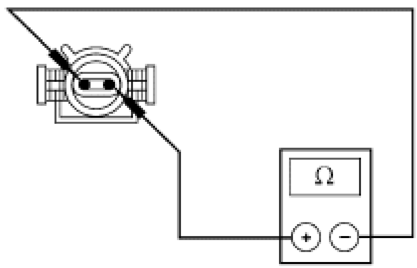
2



Rear Fill Solenoid C428

3

3 Measure the resistance between suspect fill solenoid pins component side.



GF1104-A

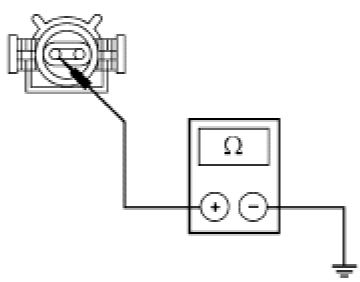
- **Is the resistance less than 20 ohms?**

→ **Yes**
GO to H5 .

→ **No**
INSTALL a new fill solenoid; REFER to Solenoid Valve—Rear Fill . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H5 CHECK CIRCUIT 57 (BK) FOR OPEN IN HARNESS

1



GF1105-A

1 Measure the resistance between the suspect fill solenoid C428 Pin 1, Circuit 57 (BK), harness side and ground.

- **Is the resistance less than 5 ohms?**

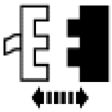
→ **Yes**
GO to H6 .

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H6 CHECK CIRCUIT 416 (LB/BK) FOR OPEN

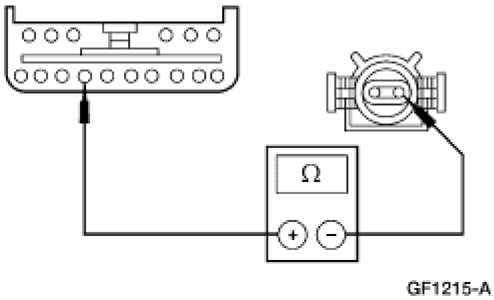
1 Turn the air suspension switch to the OFF position.

2



Air Suspension Control Module C2000

3



3 Measure the resistance between air suspension control module C2000 Pin 17, Circuit 416 (LB/BK), harness side and rear fill solenoid C428 Pin 2, Circuit 416 (LB/BK), harness side.

- **Is the resistance less than 5 ohms?**

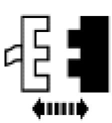
→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H7 CHECK FILL SOLENOID COIL FOR SHORT

1

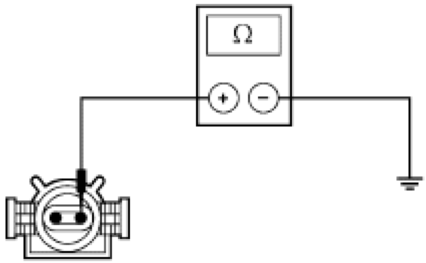
2



Rear Fill Solenoid C428

3

3 Measure the resistance between fill solenoid pin component side, and ground.



GF1587-A

- **Is the resistance greater than 10,000 ohms?**

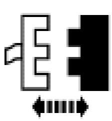
→ **Yes**
GO to H8 .

→ **No**
INSTALL a new fill solenoid; REFER to Solenoid Valve—Rear Fill . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H8 CHECK CIRCUIT 416 (LB/BK) FOR SHORT TO GROUND

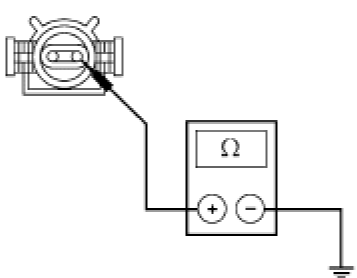
1 Turn the air suspension switch to the OFF position.

2



Air Suspension Control Module C2000

3 Measure the resistance between rear fill solenoid C428 Pin 2, Circuit 416 (LB/BK), harness side and ground.



GF1108-A

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures.

CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

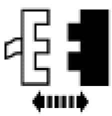
→ **No**
REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H9 CHECK CIRCUIT 416 (LB/BK) FOR SHORT TO POWER

1 Turn the air suspension switch to the OFF position.

2

3

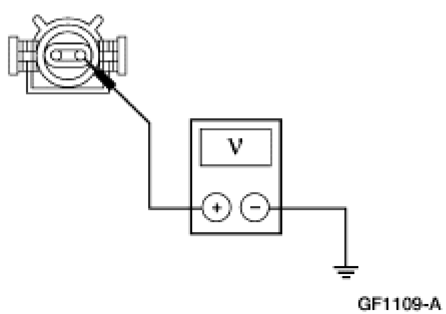


Air Suspension Control Module C2000

4 Turn the air suspension switch to the ON position.

5

6



6 Measure the voltage between rear fill solenoid C428 Pin 2, Circuit 416 (LB/BK), harness side and ground.

- **Is voltage present?**

→ **Yes**
REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
INSTALL a new air suspension control module;

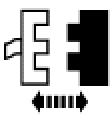
REFER to Module . CARRY OUT the Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H10 CHECK FILL SOLENOID CONNECTOR PINS

1

2 Turn the air suspension switch to the OFF position.

3



Rear Fill Solenoid C428

4 Inspect the pins of the fill solenoid connector for corrosion, bent or broken pins, moisture, or other damage.

- **Are the connectors and pins OK?**

→ **Yes**
RECONNECT the fill solenoid electrical connector. GO to H11 .

→ **No**
REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H11 CHECK CIRCUIT 416 (LB/BK) FOR INTERMITTENT CONDITION

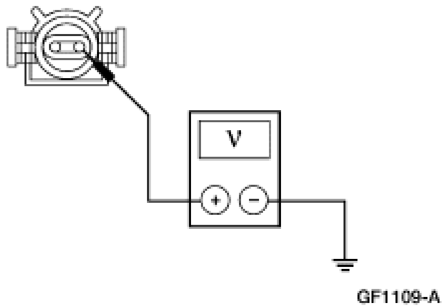
1 Turn the air suspension switch to the ON position.

2

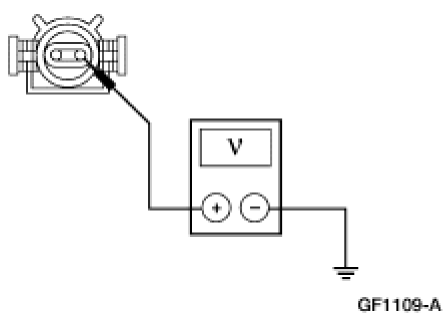
3 Toggle the air suspension control module active command REAR FILL ON.

4

4 Use 88 Digital Multimeter, set to hold the lowest measurement, to measure the voltage between fill solenoid C428 Pin 2, Circuit 416 (LB/BK), harness side and ground, while wiggling the wiring harness between air suspension control module C2000 and fill solenoid C428.

<table>
<tr><td>
</td><td>• **Is the voltage recorded less than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command OFF. REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
Toggle the air suspension control module active command OFF. GO to H12 .</td></tr>
<tr><td colspan="2">**H12** CHECK CIRCUIT 416 (LB/BK) FOR SHORT TO POWER</td></tr>
<tr><td>1

</td><td>1 Use 88 Digital Multimeter, set to hold the highest measurement, to measure the voltage between the fill solenoid C428 Pin 2, Circuit 416 (LB/BK), and ground while wiggling the wiring harness between air suspension control module C2000 and fill solenoid C428.

• **Is voltage present?**

→ **Yes**
REPAIR Circuit 416 (LB/BK). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

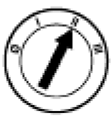
→ **No**
GO to H13 .</td></tr>
<tr><td colspan="2">**H13** CHECK INTERMITTENT MODULE FUNCTION</td></tr>
<tr><td>1</td><td></td></tr>
</table>

2 Turn the air suspension switch to the OFF position.

3 Remove Circuit 416 (LB/BK) from air suspension control module C2000 Pin 17 (with connector connected to air suspension control module).

4 Turn the air suspension switch to the ON position.

5



6 Toggle the air suspension control module active command REAR FILL ON as appropriate.

7 Measure the voltage between air suspension control module C2000 Pin 17 component side, and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command OFF. RECONNECT Circuit 416 (LB/BK) back into the air suspension control module C2000 cavity. GO to H14 .

→ **No**
Toggle the air suspension control module active command OFF. RECONNECT Circuit 416 (LB/BK) back into the air suspension control module C2000 cavity. INSTALL a new air suspension control module;. REFER to Module . CARRY OUT Ride Height Adjustments. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

H14 CARRY OUT THE ROAD TEST

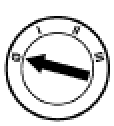
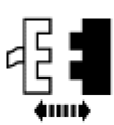
1 Monitor the suspect air suspension control module R_FILL.

2 Take the vehicle for a ten-minute test drive with an additional 45 kg (100 lb) load in the rear of the vehicle.

- **Do the letters O, G, or B appear next to the ON/OFF text for R_FILL?**

	→ **Yes** If O appeared, GO to H4 . If G appeared, GO to H7 . If B appeared, GO to H9 . → **No** CLEAR all DTCs and REPEAT the road test.

PINPOINT TEST I: DTC C1869, REAR GATE SOLENOID CIRCUIT FAILURE

CONDITIONS	DETAILS/RESULTS/ACTIONS
I1 CARRY OUT ON-DEMAND SELF-TEST	
	1 Open any door.
	2 The 4-wheel drive switch is in the 4WD LOW position and the 4WD LOW indicator is illuminated (4.0L). The ride control switch is in the OFF ROAD position (5.0L).
3  On-Demand Self-Test	
	• **Is the DTC C1869 retrieved?** → **Yes** GO to I2 . → **No** GO to I10 .
I2 CHECK REAR GATE SOLENOID CONNECTOR	
1 	
	2 Turn the air suspension switch to the OFF position.
3  Rear Gate Solenoid C429	
	4 Inspect the pins of the rear gate solenoid connector for corrosion, bent or broken pins, moisture, or other damage.

- **Is the rear gate solenoid C429 OK?**

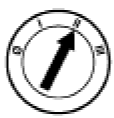
→ **Yes**
RECONNECT the rear gate solenoid C429. GO to I3 .

→ **No**
REPAIR the connector as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

I3 CARRY OUT AIR SUSPENSION CONTROL OUTPUT

1 Turn the air suspension switch to the ON position.

2



3 Select the air suspension control module active commands and monitor the air suspension control module PID AS_GATE.

4 Use the active commands and toggle the following commands in the given sequence:

  - GATEVALVE ON.
  - REAR FILL ON.
  - GATEVALVE OFF.
  - REAR FILL OFF.

- **Do the letters O, G, or B appear next to the ON/OFF text for the rear gate solenoid?**

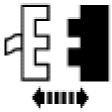
→ **Yes**
If O appeared, GO to I4 .
If G appeared, GO to I7 .
If B appeared, GO to I9 .

→ **No**
GO to I10 .

I4 CHECK REAR GATE SOLENOID COIL FOR OPEN

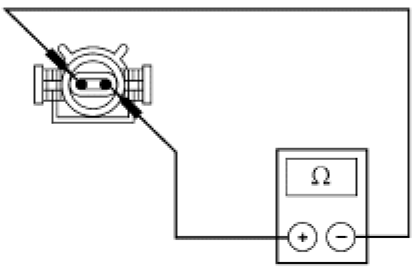
1

2



Rear Gate Solenoid C429

3



GF1104-A

3 Measure the resistance between rear gate solenoid pins (component side).

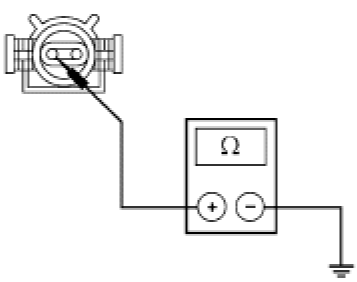
- **Is the resistance less than 20 ohms?**

→ **Yes**
GO to I5 .

→ **No**
INSTALL a new rear gate solenoid; REFER to Solenoid Valve—Rear Gate . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

I5 CHECK CIRCUIT 57 (BK) FOR AN OPEN

1



GF1105-A

1 Measure the resistance between rear gate solenoid C429 Pin 1, Circuit 57 (BK), harness side and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to I6 .

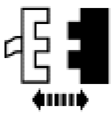
→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal

operation.

I6 CHECK CIRCUIT 414 (OG/RD) FOR OPEN

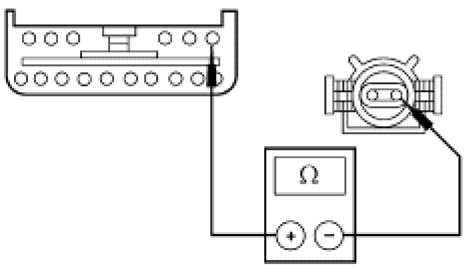
1 Turn the air suspension switch to the OFF position.

2



Air Suspension Control Module C2000

3



GF1112-A

3 Measure the resistance between air suspension control module C2000 Pin 27, Circuit 414 (OG/RD), harness side and rear gate solenoid C429 Pin 2, Circuit 414 (OG/RD), harness side.

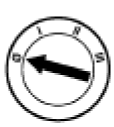
- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

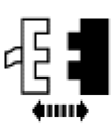
→ **No**
REPAIR Circuit 414 (OG/RD). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

I7 CHECK AIR SUSPENSION GATE SOLENOID COIL FOR SHORT

1



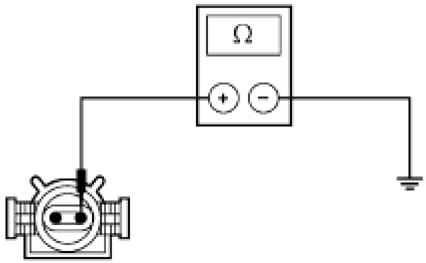
2



Rear Gate Solenoid C429

3

3 Measure the resistance between rear gate solenoid pin (component side) and ground.



- **Is the resistance greater than 10,000 ohms?**

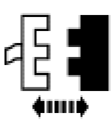
→ **Yes**
GO to I8 .

→ **No**
INSTALL a new rear gate solenoid; REFER to Solenoid Valve—Rear Gate . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

I8 CHECK CIRCUIT 414 (OG/RD) FOR SHORT TO GROUND

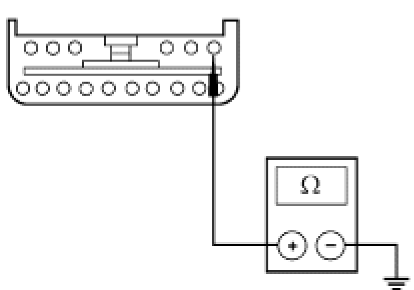
1 Turn the air suspension switch to the OFF position.

2



Air Suspension Control Module C2000

3



3 Measure the resistance between air suspension control module C2000 Pin 27, Circuit 414 (OG/RD), harness side and ground.

- **Is the resistance greater than 10,000 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures.

CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

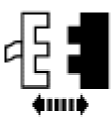
→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

I9 CHECK CIRCUIT 414 (OG/RD) FOR SHORT TO POWER AT THE AIR SUSPENSION CONTROL MODULE

1

2 Turn the air suspension switch to the OFF position.

3

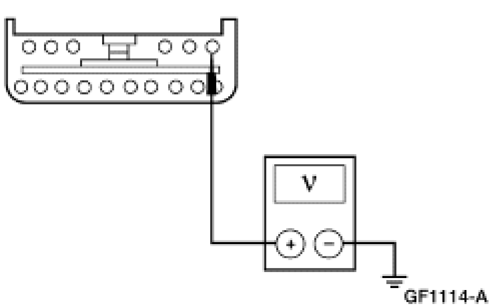


Air Suspension Control Module C2000

4 Turn the air suspension switch to the ON position.

5

6



6 Measure the voltage between air suspension control module C2000 Pin 27, Circuit 414 (OG/RD), harness side and ground.

- **Is voltage present?**

→ **Yes**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**

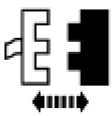
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

I10 CHECK REAR GATE SOLENOID CONNECTOR FOR DAMAGE

1

2 Turn the air suspension switch to the OFF position.

3



Rear Gate Solenoid C429

4 Inspect the pins of the rear gate solenoid connector for corrosion, bent or broken pins, moisture, or other damage.

- **Is the rear gate solenoid C429 OK?**

→ **Yes**
GO to I11 .

→ **No**
REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

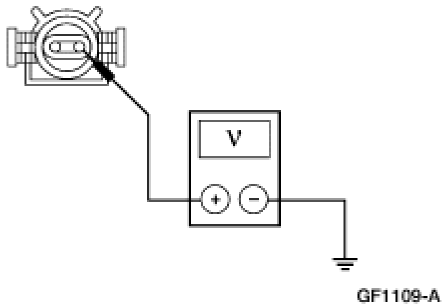
I11 CHECK REAR GATE SOLENOID FOR INTERMITTENT FAILURE

1 Turn the air suspension switch to the ON position.

2

3 Toggle the air suspension control module active command GATEVALVE ON.

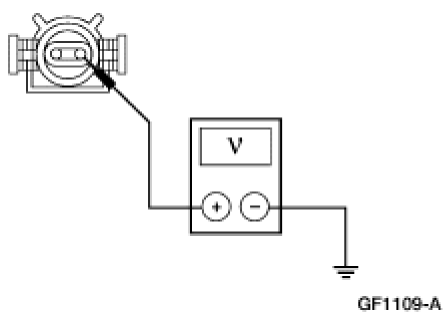
4 Use 88 Digital Multimeter, set to hold the lowest measurement, to measure the voltage between rear gate solenoid C429 Pin 2, Circuit 414 (OG/RD), harness side and ground while wiggling the wiring harness between air suspension control module C2000 and rear gate solenoid C429.

<table>
<tr><td>
</td><td>

- **Is the voltage recorded less than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command GATEVALVE OFF. REPAIR Circuit 414 (OG/RD). CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
Toggle the air suspension control module active command GATEVALVE OFF. GO to I12 .</td></tr>
<tr><td colspan="2">I12 CHECK CIRCUIT 414 (OG/RD) FOR SHORT TO POWER</td></tr>
<tr><td>1


</td><td>1 Use 88 Digital Multimeter, set to hold the highest measurement, to measure the voltage between rear gate solenoid C429 Pin 2, Circuit 414 (OG/RD), harness side and ground while wiggling the wiring harness between air suspension control module C2000 and rear gate solenoid C429.

- **Is voltage present?**

→ **Yes**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

→ **No**
GO to I13 .</td></tr>
<tr><td colspan="2">I13 CHECK INTERMITTENT MODULE FUNCTION</td></tr>
</table>

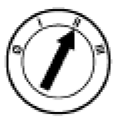
1

2 Turn the air suspension switch to the OFF position.

3 Remove circuit 414 (OG/RD) from air suspension control module C2000 Pin 27 (with connector connected to air suspension control module).

4 Turn the air suspension switch to the ON position.

5



6 Toggle the air suspension control module active command GATEVALVE ON.

7 Measure the voltage between air suspension control module C2000 Pin 27, (component side) and ground.

- **Is the voltage greater than 10 volts?**

→ **Yes**
Toggle the air suspension control module active command GATEVALVE OFF. RECONNECT Circuit 414 (OG/RD) back into air suspension control module connector C2000 cavity 27. GO to I14 .

→ **No**
Toggle the air suspension control module active command GATEVALVE OFF. RECONNECT Circuit 414 (OG/RD) back into air suspension control module connector C2000 cavity 27. INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

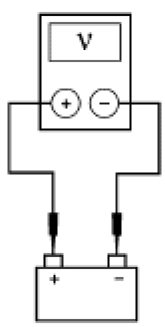
I14 CARRY OUT THE ROAD TEST

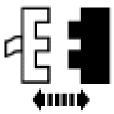
1 Monitor the air suspension control module PID AS_GATE.

2 Take the vehicle for a ten-minute test drive with an additional 45 kg (100 lb) load added to the rear of the vehicle.

	• **Do the letters O, G, or B appear next to the ON/OFF text for the AS_GATE?** → **Yes** If O appeared, GO to I4 . If G appeared, GO to I7 . If B appeared, GO to I9 . → **No** CLEAR all DTCs and REPEAT the road test. INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

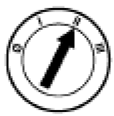
PINPOINT TEST J: DTC B1318, BATTERY VOLTAGE LOW

CONDITIONS	DETAILS/RESULTS/ACTIONS
J1 CHECK BATTERY VOLTAGE	
1  GL1223-A	1 Measure the battery voltage between the positive and negative battery posts with the key ON engine OFF (KOEO), and with the engine running. • **Is the battery voltage between 10 and 13 volts with KOEO, and between 11 and 17 volts with the engine running?** → **Yes** GO to J2 . → **No** REFER to Section 414-00 .
J2 CHECK POWER TO AIR SUSPENSION CONTROL MODULE	
1  2	

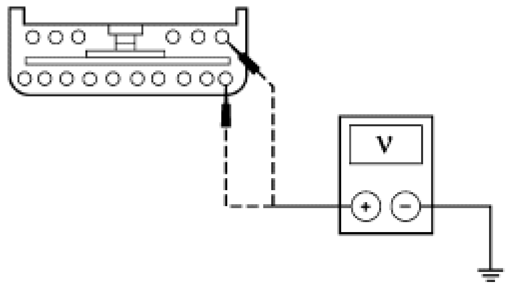


Air Suspension Control Module

3



4



GF1872-A

4 Measure the voltage between air suspension control module C2001 Pin 1, Circuit 418 (DG/YE), harness side and ground; and between air suspension control module C2001 Pin 21, Circuit 418 (DG/YE), harness side and ground.

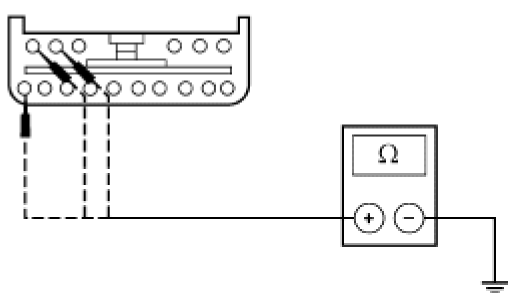
- **Are the voltages greater than 10 volts?**

→ **Yes**
GO to J3 .

→ **No**
REPAIR the Circuit 418 (DG/YE). CLEAR the DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

J3 CHECK CIRCUIT 570 (BK) FOR AN OPEN

1



GF1873-A

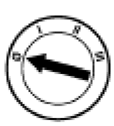
1 Measure the resistance between air suspension control module C2000 Pin 20, Circuit 570 (BK), harness side and ground; and between air suspension control module C2000 Pin 32, Circuit 570 (BK), harness side and ground.

- **Are the resistances less than 5 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT the Ride Height Adjustments. REFER to General Procedures. CLEAR the DTCs. REPEAT the

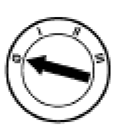
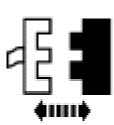
	Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** REPAIR Circuit 570 (BK). CLEAR the DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

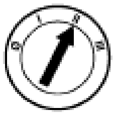
PINPOINT TEST K: DTC B1342, ECU INTERNAL FAULT

CONDITIONS	DETAILS/RESULTS/ACTIONS
K1 CARRY OUT ON-DEMAND SELF-TEST	
2  On-Demand Self-Test	1 Open any door. • **Is DTC B1342 retrieved?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** GO to K2 .
K2 CHECK FOR INTERMITTENT FAILURE	
1  4  5 	2 Turn the air suspension switch to the OFF position. 3 Turn the air suspension switch to the ON position.

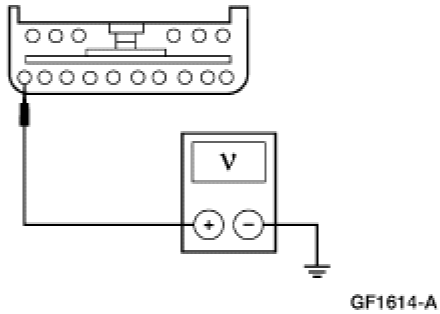
On-Demand Self-Test	• **Is DTC B1342 retrieved?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments. REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST L: DTC B1485, BRAKE LAMP SWITCH INPUT SHORT TO BATTERY

CONDITIONS	DETAILS/RESULTS/ACTIONS
L1 CARRY OUT ON-DEMAND SELF-TEST	
2  On-Demand Self-Test	1 Open any door. • **Is DTC B1485 retrieved?** → **Yes** GO to L2 . → **No** REPAIR any DTCs. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
L2 CHECK THE BRAKE PEDAL POSITION (BPP) SWITCH CIRCUITRY	
1  2  Air Suspension Control Module C2001 3	



4



4 Measure the voltage between air suspension control module C2001 Pin 10, Circuit 810 (RD/LG), harness side and ground.

- **Is voltage present?**

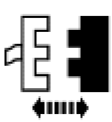
→ **Yes**
GO to L3 .

→ **No**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

L3 CHECK CIRCUIT 810 (RD/LG) FOR SHORT TO POWER

1

2

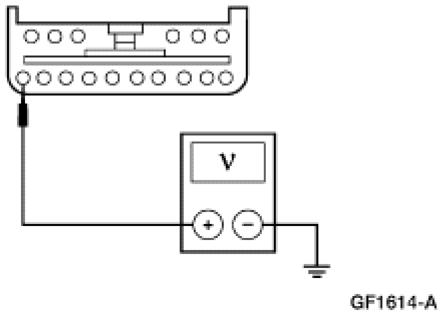


BPP Switch C224

3

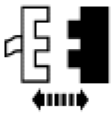
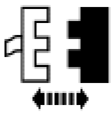
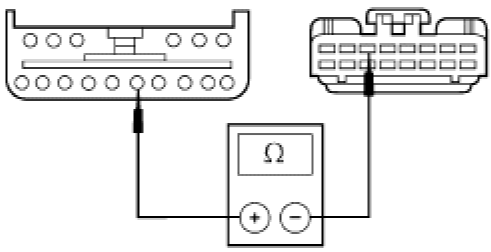
4

4 Measure the voltage between air suspension control module C2001 Pin 10, Circuit 810 (RD/LG), harness side and ground.

	• **Is voltage present?** → **Yes** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation. → **No** INSTALL a new BPP switch; REFER to Section 417-01 . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST M: DTC B1565, DOOR AJAR INPUT SHORT TO POWER

CONDITIONS	DETAILS/RESULTS/ACTIONS
M1 CARRY OUT ON-DEMAND SELF-TEST	
2  On-Demand Self-Test	1 Open any door. • **Is DTC B1565 retrieved?** → **Yes** GO to M2 . → **No** REPAIR any DTCs. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
M2 CHECK CIRCUIT 999 (LB/WH) FOR OPEN	
1	

	
2  Air Suspension Control Module C2001	
3  GEM C281	
4  GF1163-A	4 Measure the resistance between air suspension control module C2001 Pin 5, Circuit 999 (LB/WH), harness side and GEM C281 Pin 3, Circuit 999 (LB/WH), harness side.
	• **Is the resistance less than 5 ohms?** → **Yes** CHECK the operation of the door open warning indicator switch; REFER to Section 413-09 . → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

PINPOINT TEST N: THE AIR SUSPENSION SYSTEM IS INOPERATIVE

CONDITIONS	DETAILS/RESULTS/ACTIONS
N1 CHECK IGNITION SWITCH ON INPUT	
1  Scan Tool	
	2 Monitor the air suspension control module PID

IGN_RUN.

- **Does the IGN_RUN PID indicate ignition switch status as RUN?**

→ **Yes**
GO to N2 .

→ **No**
REPAIR Circuit 1003 (GY/YE). TEST the system for normal operation.

N2 CHECK IGNITION SWITCH OFF INPUT

1

2 Monitor the air suspension control module PID IGN_RUN.

- **Does the IGN_RUN PID indicate ignition switch status as OFF?**

→ **Yes**
GO to N3 .

→ **No**
REPAIR Circuit 1003 (GY/YE). TEST the system for normal operation.

N3 CHECK STEERING WHEEL ROTATION SENSORS A AND B

1

2 Monitor the air suspension control module PIDs STEER_A and STEER_B, while turning the steering wheel slowly 1/4 turn (90 degrees) in both directions.

- **Do the STEER_A and STEER_B PIDs toggle between HIGH and LOW?**

→ **Yes**
GO to N9 .

→ **No**
REPEAT the test, turning the steering wheel more slowly.

If STEER_A and STEER_B PIDs now toggle

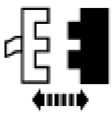
between HIGH and LOW after repeating the test, GO to N6 .

If slower turning of the steering wheel does not produce HIGH/LOW toggling, GO to N4 .

N4 CHECK CIRCUIT 1003 (GY/YE) FOR OPEN

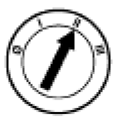
1

2

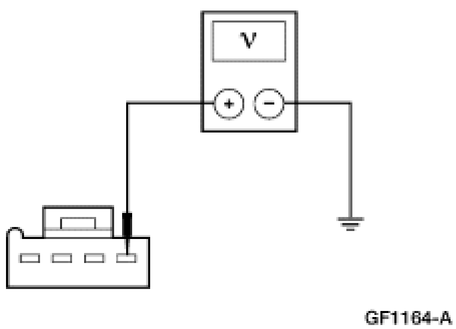


Steering Rotation Sensor C299

3



4



4 Measure the voltage between steering wheel rotation sensor C299 Pin 4, Circuit 1003 (GY/YE), harness side and ground.

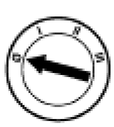
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to N5 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

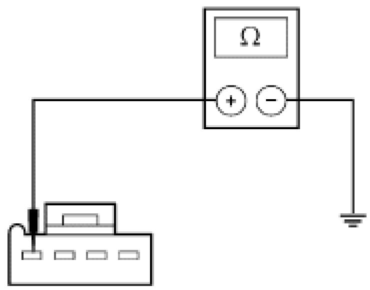
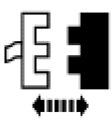
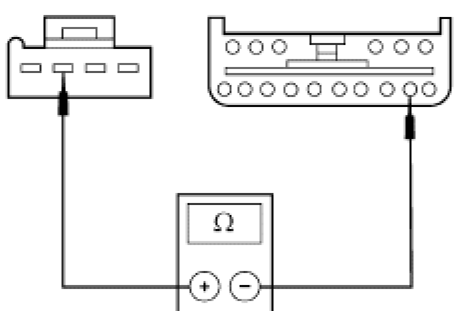
N5 CHECK CIRCUIT 57 (BK) FOR OPEN

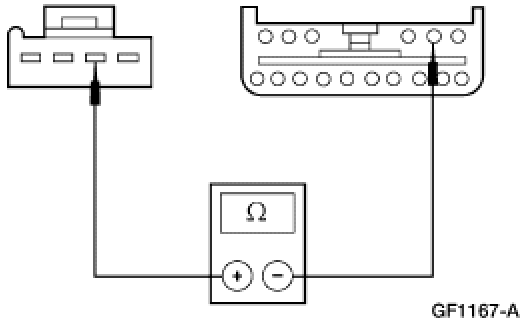
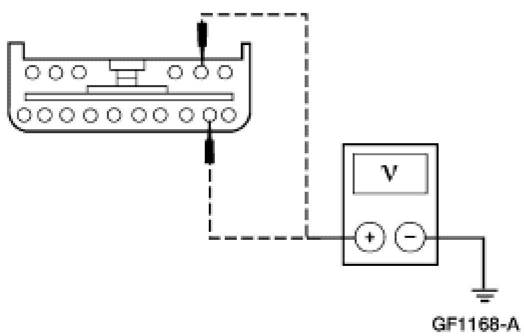
1



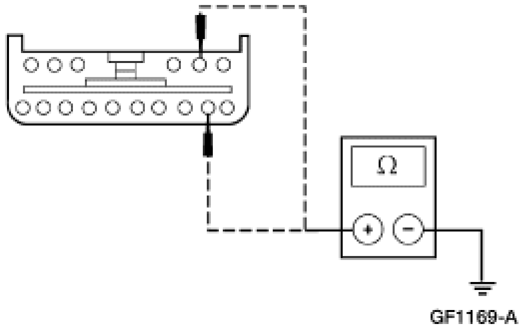
2

2 Measure the resistance between steering wheel rotation sensor C299 Pin 1, Circuit 57 (BK), harness side and ground.

 GF1165-A	• **Is the resistance less than 5 ohms?** → **Yes** GO to N6 . → **No** REPAIR the circuit. TEST the system for normal operation.
N6 CHECK CIRCUIT 634 (BN) AND CIRCUIT 633 (RD) FOR OPEN	
1 	
2  Air Suspension Control Module C2001	
3  GF1166-A	3 Measure the resistance between steering wheel rotation sensor C299 Pin 2, Circuit 634 (BN), harness side and air suspension control module C2001 Pin 2, Circuit 634 (BN), harness side.
4	4 Measure the resistance between steering wheel rate sensor C299 Pin 3, Circuit 633 (RD), harness side and air suspension control module C2001 Pin 22, Circuit 633 (RD), harness side.

	• **Are the resistances less than 5 ohms?** → **Yes** GO to N7 . → **No** REPAIR Circuit 634 (BN) and Circuit 633 (RD) as necessary. TEST the system for normal operation.
N7 CHECK CIRCUIT 634 (BN) AND CIRCUIT 633 (RD) FOR SHORT TO POWER	
1 	
2 	2 Measure the voltage between air suspension control module C2001 Pin 2, Circuit 634 (BN), harness side and ground; and between air suspension control module C2001Pin 22, Circuit 633 (RD), harness side and ground. • **Is voltage present?** → **Yes** REPAIR Circuit 634 (BN) and Circuit 633 (RD) as necessary. TEST the system for normal operation. → **No** GO to N8 .
N8 CHECK CIRCUIT 634 (BN) AND 633 (RD) FOR SHORT TO GROUND	
1	

2



2 Measure the resistance between air suspension control module C2001 Pin 2, Circuit 634 (BN), harness side and ground; and between air suspension control module C2001 Pin 22, Circuit 633 (RD), harness side and ground.

- **Are the resistances greater than 10,000 ohms?**

→ **Yes**
INSTALL a new steering wheel rotation sensor; REFER to Section 211-02 . TEST the system for normal operation.

→ **No**
REPAIR Circuit 634 (BN) and Circuit 633 (RD) as necessary. TEST the system for normal operation.

N9 CHECK BRAKE PEDAL POSITION (BPP) SWITCH INPUT

1 Monitor the air suspension control module PID BOO_ARC.

2 **NOTE:** The brake pedal must be pressed hard enough to turn on the brake lights.

Monitor the BOO_ARC PID while pressing and releasing the brake pedal.

- **Did the BOO_ARC status toggle from OFF, ON, and back to OFF?**

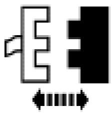
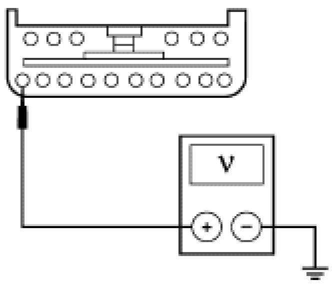
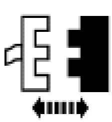
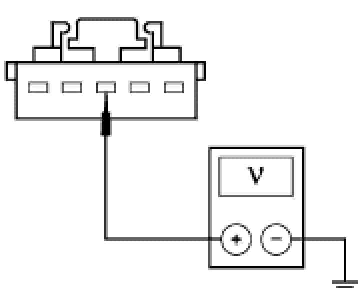
→ **Yes**
GO to N13 .

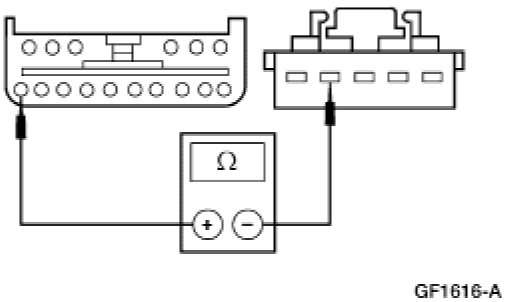
→ **No**
If the BOO_ARC PID did not change to ON, GO to N10 .

If the BOO_ARC PID status is ON and does not change to OFF, GO to Pinpoint Test L .

N10 CHECK THE BREAK PEDAL POSITION (BPP) SWITCH INPUT

1

 2  Air Suspension Control Module C2001 3  GF1614-A	3 Measure the voltage between air suspension control module C2001 Pin 10, Circuit 810 (RD/LG), harness side and ground, while depressing the brake pedal. • **Is the voltage greater than 10 volts?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation. → **No** GO to N11 .
N11 CHECK CIRCUIT 276 (BN) FOR AN OPEN	
1  BPP Switch C224 2  GF1615-A	2 Measure the voltage between BPP switch C224 Pin 3, Circuit 276 (BN), harness side and ground. • **Is the voltage greater than 10 volts?**

	→ **Yes** GO to N12 . → **No** REPAIR the circuit. TEST the system for normal operation.
N12 CHECK CIRCUIT 810 (RD/LG) FOR AN OPEN	
1 	1 Measure the resistance between air suspension control module C2001 Pin 10, Circuit 810 (RD/LG), harness side and BPP switch C224 Pin 2, Circuit 810 (RD/LG), harness side. • **Is the resistance less than 5 ohms?** → **Yes** INSTALL a new BPP switch; REFER to Section 417-01 . TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.
N13 CHECK DOOR OPEN WARNING INDICATOR INPUTS	
	1 Close all doors, liftgate and liftgate glass so the door ajar indicator in the instrument cluster is not illuminated. 2 Monitor the air suspension control module PID DR_OPEN. 3 Open any door. • **Does the DR_OPEN PID status indicate CLOSED and then AJAR?** → **Yes** GO to N17 . → **No** GO to N14 .
N14 CHECK DOOR AJAR INPUTS TO GEM	
	1 Monitor the following GEM PIDs:

- D_DR_SW.
- P_DR_SW.
- LGATE_SW.
- LRDR_SW.
- RRDR_SW.

2 Check the GEM door ajar inputs by opening and closing each door individually.

- **Do all five GEM inputs function correctly?**

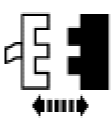
→ **Yes**
GO to N15 .

→ **No**
REFER to Section 417-02 .

N15 CHECK DOOR OPEN WARNING INDICATOR SIGNAL

1

2

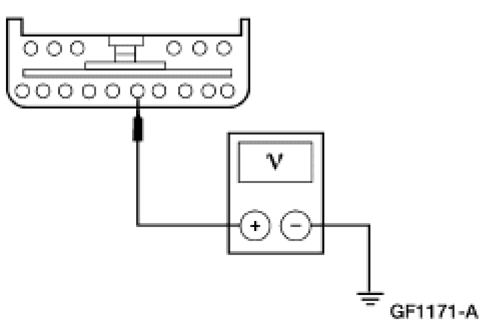


Air Suspension Control Module C2001

3

4 Close all the doors.

5



5 Measure the voltage between air suspension control module C2001 Pin 5, Circuit 999 (LB/WH), harness side and ground.

6 Open any door.

- **Is the voltage equal to zero volts with all the doors closed and greater than 5 volts with a door open?**

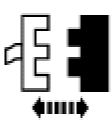
→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation.

→ **No**
GO to N16 .

N16 CHECK CIRCUIT 999 (LB/WH) FOR OPEN

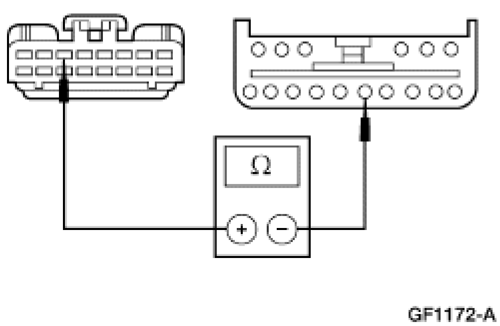
1

2



GEM C281

3



3 Measure the resistance between GEM C281 Pin 3, Circuit 999 (LB/WH), and air suspension control module C2001 Pin 5, Circuit 999 (LB/WH).

- **Is the resistance less than 5 ohms?**

→ **Yes**
REFER to Section 417-02 .

→ **No**
REPAIR the circuit. TEST the system for normal operation.

N17 CHECK PCM ACCELERATION INPUT

1 **NOTE:** Make sure the accelerator pedal is fully released.

Use scan tool to monitor the PCM PID PCM_ACC.

- **With the accelerator pedal fully released, does the PCM_ACC PID status indicate NO?**

→ **Yes**
GO to N20 .

→ **No**
GO to N18 .

N18 CHECK PCM ACCELERATION OUTPUT

1 Monitor the PCM PID TP V.

2 Press and release the accelerator pedal.

- **Does the PCM acceleration output voltage vary as the acceleration pedal is depressed?**

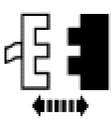
→ **Yes**
GO to N19 .

→ **No**
REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

N19 CHECK CIRCUIT 394 (OG/BK) FOR SHORT TO GROUND

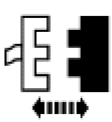
1

2



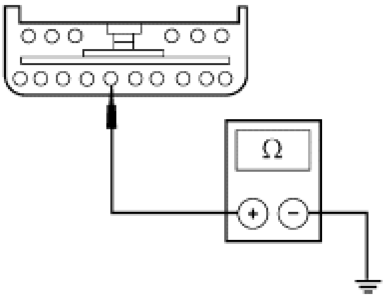
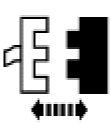
Air Suspension Control Module C2001

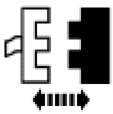
3



PCM C202

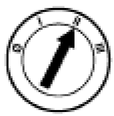
4 Measure the resistance between air suspension control module C2001 Pin 6, Circuit 394 (OG/BK), harness side and ground.

	• **Is the resistance greater than 10,000 ohms?** → **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation. → **No** REPAIR the circuit. TEST the system for normal operation.
N20 CHECK PCM ACCELERATION INPUT — WOT	
	1 **NOTE:** Make sure the accelerator pedal is in the wide-open throttle position. Use scan tool to monitor the PCM PID PCM_ACC. • **Does the PCM_ACC PID status indicate YES?** → **Yes** GO to N23 . → **No** GO to N21 .
N21 CHECK CIRCUIT 394 (OG/BK) FOR SHORT TO POWER	
1  2  Air Suspension Control Module C2001 3	

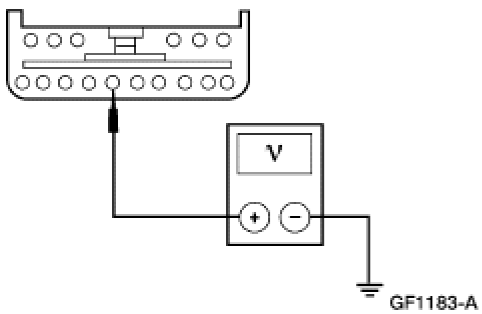


PCM C202

4



5



5 Measure the voltage between air suspension control module C2001 Pin 6, Circuit 394 (OG/BK), and ground.

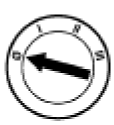
- **Is voltage present?**

→ **Yes**
REPAIR the circuit. TEST the system for normal operation.

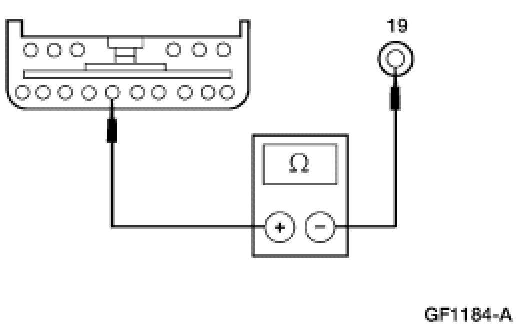
→ **No**
GO to N22 .

N22 CHECK CIRCUIT 364 (OG/BK) FOR OPEN

1



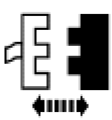
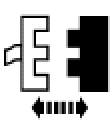
3

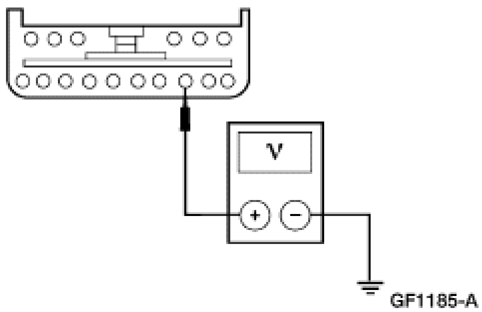


2 Connect EEC-V 104-Pin Breakout Box to PCM C202. Do not connect the PCM.

3 Measure the resistance between air suspension control module C2001 Pin 6, Circuit 394 (OG/BK), harness side and EEC-V 104-Pin Breakout Box Pin 19, Circuit 394 (OG/BK).

- **Is the resistance less than 5 ohms?**

	→ **Yes** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation. → **No** REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
N23 CHECK VEHICLE SPEED SIGNAL (VSS) INPUT	
	1 Monitor the VSS_ARC PID while driving the vehicle. • **Does the VSS_ARC indicate nearly the same speed as the speedometer?** → **Yes** All input signals and circuits are functional. RETURN to the Symptom Chart for further diagnostic procedures. → **No** GO to N24 .
N24 CHECK CIRCUIT 679 (GY/BK) FOR SHORT TO POWER	
1  2  Air Suspension Control Module C2001 3  Anti-Lock Brake Control Module C186 4  5	5 Measure the voltage between air suspension control module C2001 Pin 3, Circuit 679 (GY/BK), harness side and ground.



- **Is voltage present?**

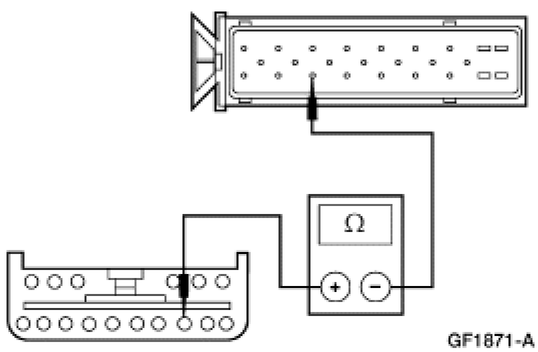
→ **Yes**
REPAIR the circuit. TEST the system for normal operation.

→ **No**
GO to N25 .

N25 CHECK CIRCUIT 679 (GY/BK) FOR OPEN

1

2



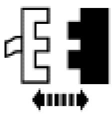
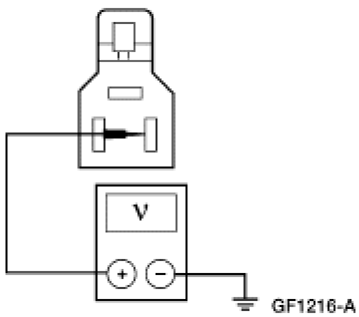
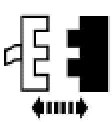
2 Measure the resistance between air suspension control module C2001 Pin 3, Circuit 679 (GY/BK), harness side and anti-lock brake control module C186 Pin 19, Circuit 679 (GY/BK), harness side.

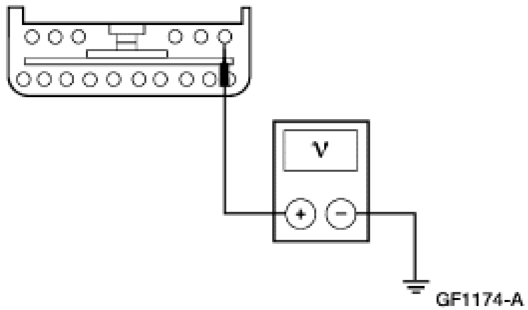
- **Is the resistance less than 5 ohms?**

→ **Yes**
INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation.

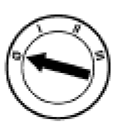
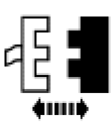
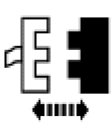
→ **No**
REPAIR the circuit. TEST the system for normal operation.

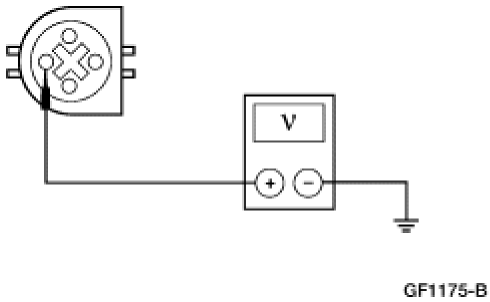
PINPOINT TEST O: THE AIR SUSPENSION SYSTEM OPERATES WITH THE AIR SUSPENSION IN THE OFF POSITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
O1 CHECK CIRCUIT 418 (DG/YE) FOR SHORT TO POWER	
1 	
2  Air Suspension Switch C412	
3 	3 Measure the voltage between air suspension switch C412 Pin 2, Circuit 418 (DG/YE), harness side and ground. • **Is voltage present?** → **Yes** GO to O2 . → **No** INSTALL a new air suspension switch; REFER to Switch—Air Suspension . TEST the system for normal operation.
O2 CHECK CIRCUIT 418 (DG/YE) FOR SHORT TO POWER WITH AIR SUSPENSION CONTROL MODULE DISCONNECTED	
1  Air Suspension Control Module C2001	
2 	
3	3 Measure the voltage between air suspension control module C2001 Pin 21, Circuit 418 (DG/YE), harness side and ground.

 	• **Is voltage present?** → **Yes** REPAIR Circuit 418 (DG/YE). TEST the system for normal operation. → **No** INSTALL a new air suspension control module; REFER to Module . CARRY OUT Ride Height Adjustments; REFER to General Procedures. TEST the system for normal operation.

PINPOINT TEST P: THE AIR COMPRESSOR CONTINUOUSLY CYCLES WITH THE IGNITION SWITCH IN THE OFF POSITION

CONDITIONS	DETAILS/RESULTS/ACTIONS
P1 CHECK CIRCUIT 417 (VT/OG) FOR SHORT TO POWER	
1  2  Air Compressor Connector C430 3  Air Compressor Relay 4	4 Measure the voltage between air compressor connector C430, Circuit 417 (VT/OG), harness side and ground.

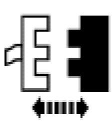
	• **Is voltage present?** → **Yes** REPAIR the circuit. TEST the system for normal operation. → **No** INSTALL a new air compressor relay. TEST the system for normal operation.

PINPOINT TEST Q: EXCESSIVE AIR COMPRESSOR NOISE

CONDITIONS	DETAILS/RESULTS/ACTIONS
Q1 CHECK COMPRESSOR WIRING FOR CONTACT WITH UNDERBODY	
	1 Check the wiring harness for any contact to the underbody. • **Is contact being made between the harness and the underbody at any point along the harness?** → **Yes** SECURE the air compressor wiring harness away from the vehicle underbody. TEST the system for normal operation. → **No** GO to Q2 .
Q2 CHECK FOR BENT AIR COMPRESSOR BRACKET	
	1 Inspect the air compressor bracket for any bends that may contact the underbody of the vehicle at any body height. • **Is contact being made or the possibility of contact being made at any point in spring compression?** → **Yes** REPAIR the bracket or INSTALL a new air compressor and bracket assembly. TEST the system for normal operation. → **No**

	GO to Q3 .
Q3 CHECK AIR COMPRESSOR MOUNTS FOR DAMAGE	
	1 Inspect the air compressor mounts for signs of cracks or insulating material that is breaking away. • **Are the air compressor mounts OK?** → **Yes** GO to Q4 . → **No** INSTALL a new air compressor and bracket assembly. TEST the system for normal operation.
Q4 CHECK AIR COMPRESSOR FOR NOISE	
	1 Remove the air compressor from the mounting position, but leave it connected to the wiring harness. 2 Run the air compressor while holding the compressor away from the body and undercarriage. • **Is the air compressor noisy?** → **Yes** INSTALL a new air compressor and bracket assembly. TEST the system for normal operation. → **No** RECHECK the mountings and bracket for damage. INSTALL a new air compressor and/or bracket assembly if any damage is found; REFER to Air Compressor . TEST the system for normal operation.

PINPOINT TEST R: AIR COMPRESSOR TEST

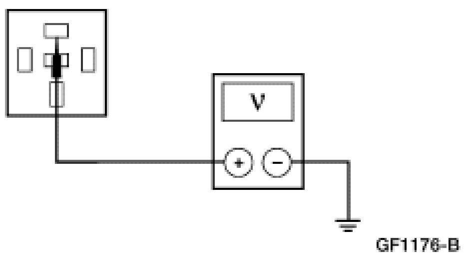
CONDITIONS	DETAILS/RESULTS/ACTIONS
R1 CHECK AIR COMPRESSOR RELAY	
1  Air Compressor Relay	2 Inspect the pins of the air compressor relay connector for corrosion, bent or broken pins, moisture, or other damage. • **Is the air compressor relay OK?** → **Yes**

GO to R2 .

→ **No**
REPAIR as necessary. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

R2 CHECK CIRCUIT 1053 (LB/PK) FOR AN OPEN

1



1 Measure the voltage between air compressor relay Pin 87, Circuit 1053 (LB/PK), harness side and ground.

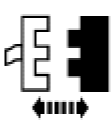
- **Is the voltage greater than 10 volts?**

→ **Yes**
GO to R3 .

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

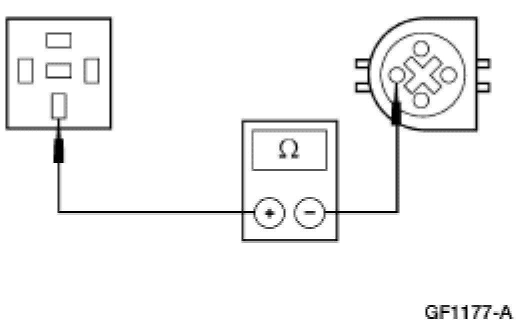
R3 CHECK CIRCUIT 417 (VT/OG) FOR AN OPEN

1



Air Compressor Assembly C430

2



2 Measure the resistance between air compressor relay Pin 30, Circuit 417 (VT/OG), harness side and air compressor assembly C430 Pin 4, Circuit 417 (VT/OG), harness side.

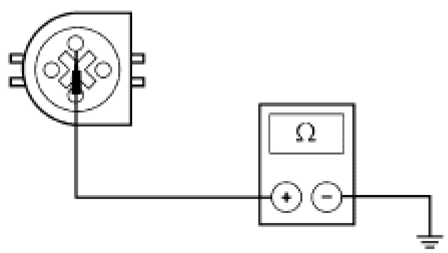
- **Is the resistance less than 5 ohms?**

→ **Yes**
GO to R4 .

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

R4 CHECK CIRCUIT 57 (BK) FOR AN OPEN

1



GF1178-A

1 Measure the resistance between air compressor assembly C430 Pin 1, Circuit 57 (BK), harness side and ground.

- **Is the resistance less than 5 ohms?**

→ **Yes**
RECONNECT the air compressor relay and air compressor assembly C430. GO to R5 .

→ **No**
REPAIR the circuit. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

R5 CHECK AIR COMPRESSOR AFTER COOL DOWN PERIOD

1 Allow the vehicle to sit for 60 minutes to give the air compressor assembly time to cool off.

2 Turn the air suspension switch to the ON position.

3

4 Toggle the air suspension control module active commands VENT ON and COMPRESSR ON.

- **Does the air compressor run?**

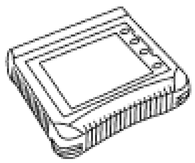
→ **Yes**
Toggle the air suspension control module

	active commands OFF. GO to R6 . → **No** Toggle the air suspension control module active commands OFF. INSTALL a new air compressor assembly. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.
R6 CHECK AIR COMPRESSOR THERMAL BREAKER	
	1 Toggle the air suspension control module active command COMPRESSR ON. 2 Run the air compressor for 60 seconds. • **Did the air compressor assembly run for 60 seconds?** → **Yes** The thermal breaker was overheated. CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics to VERIFY the system is OK. → **No** INSTALL a new air compressor assembly; REFER to Air Compressor . CLEAR all DTCs. REPEAT the Air Suspension Control Module Diagnostics. TEST the system for normal operation.

SECTION 204-05: Vehicle Dynamic Suspension *2000 Explorer/Mountaineer Workshop Manual*
GENERAL PROCEDURES

Ride Height Adjustments

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

1. Check torsion bar ride height and adjust if necessary. For additional information, refer to Section 204-01A .
2. Connect scan tool to the data link connector (DLC).
3. Select the RIDE CONTROL OUTPUT screen and turn on the following solenoids to vent the entire system of air and to lower the vehicle to its lowest attainable height:
   - REAR FILL (rear fill solenoid).
   - GATE VALVE (gate solenoid).
   - VENT (vent solenoid).
4. Close all doors including the liftgate and liftgate window.
5. Reopen any door (to ensure that the height will not change until the internal electronic calibration is complete).
6. Park the vehicle on a flat surface.
7. From the function menu, quickly select RIDE HEIGHT CALIBRATION.
8. Note the warning on the scan tool screen and follow the directions.

Air Line Repair

NOTE: A soapy water solution can be applied to the air lines to verify the location of air leaks.

1. If a leak is detected in an air line, it can be repaired by carefully making a good, clean, straight cut. Trim back the outer covering of the air line 16-20 mm (0.63-0.78 in) to reveal the white inner line. Install a repair fitting and wrap securely with electrical tape.
2. If multiple leaks are detected, replace the entire air line.

Air Leaks

1. To repair the system for air leaks, inspect the line for damage from the air compressor and air compressor drier assembly to the air springs. Repair or replace damaged portions of the line as necessary. For additional information, refer to Air Line Repair .

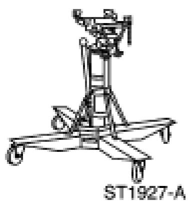
Air Line Fluid Purge

NOTE: Perform this procedure if fluid (water or oil) is found in the rear air lines. Purge fluid from air lines and replace affected components.

1. Disconnect air line at compressor air drier that is connected to front fill solenoid inlet.
2. Disconnect air line at inlet of front fill solenoid.
3. Connect stop air line to disconnected air line and blow out any water
4. Reconnect air line.
5. Disconnect air line at compressor air drier that is connected to the rear fill solenoid inlet.
6. Disconnect air line at RR shock absorber.
7. Connect scan tool to Data Link Connector (DLC).
8. Using the RIDE CONTROL OUTPUT command, turn on the following actuators:
   - REAR_FIL (rear fill solenoid) ON.
9. Connect shop air line to disconnected air line and blow out any water.
10. Reconnect air line at RR shock absorber.
11. Disconnect air line at LR shock absorber.
12. Using the RIDE CONTROL OUTPUT command, turn on the following actuators:
    - REAR_FIL (rear fill solenoid) ON.
    - GATEVALVE (front and rear gate solenoids) ON.
13. Connect shop air line to disconnected air line and blow out any water.
14. If oil was present in air lines, replace BOTH LR and RR shock absorbers. (Do not replace s hock absorbers if only water is in the lines.)
15. Replace compressor air drier.
16. Reconnect air line.

Air Shock Absorber —Rear

Special Tool(s)

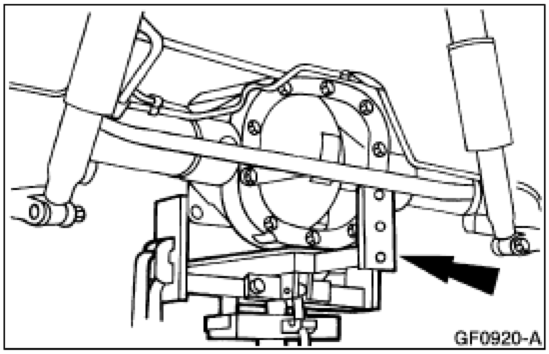
	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
	Highlift Transmission Jack or equivalent 164-R3508

Removal

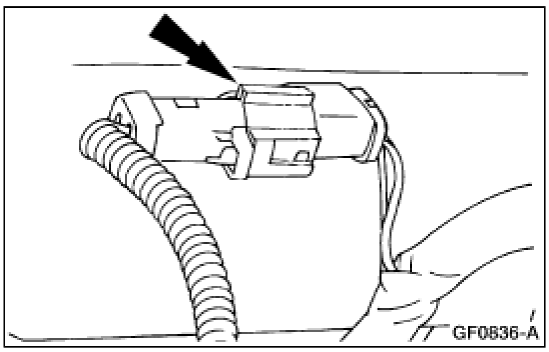
WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing of an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

WARNING: The low pressure gas shock absorbers are charged with nitrogen gas 930 kpa (135 psi). Do not attempt to open, puncture, or apply heat to the shock absorbers.

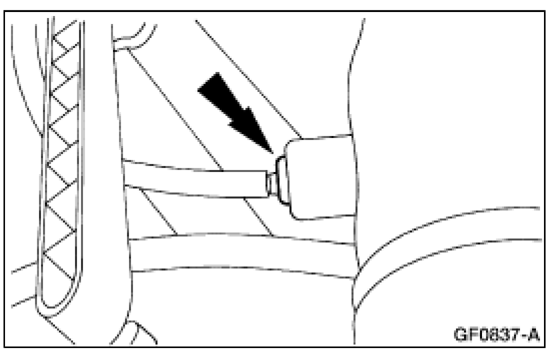
1. Connect scan tool to the data link connector (DLC).
2. Select the RIDE CONTROL OUTPUT screen and turn on the following solenoids to vent the entire system of air and to lower the vehicle to its lowest attainable height:
   - REAR FILL (rear fill solenoid).
   - GATEVALVE (gate solenoid[s]).
   - VENT (vent solenoid).
3. Raise and support the vehicle; refer to Section 100-02 .
4. Remove the spare tire.
5. Use Hi-Lift Transmission Jack to support the rear axle.



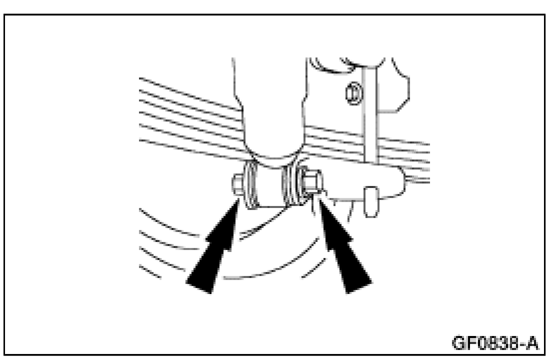
6. Remove the rear shock absorber electrical connector from the rear crossmember and disconnect the electrical connector.



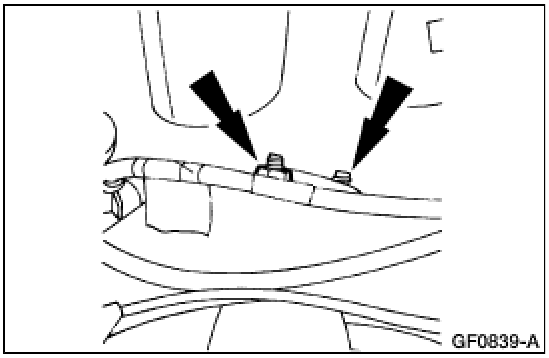
7. Disconnect the air line from the shock absorber.
    - Compress the quick connect locking ring and pull out the air line.



8. Remove the shock absorber lower retaining nut and bolt and swing the shock absorber out of the lower mounting bracket.



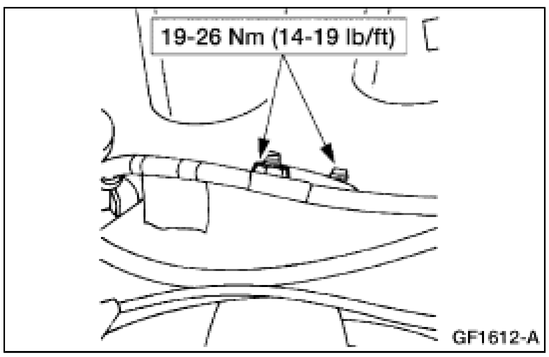
9. Remove the attaching nuts on top of the rear crossmember and remove the shock absorber.

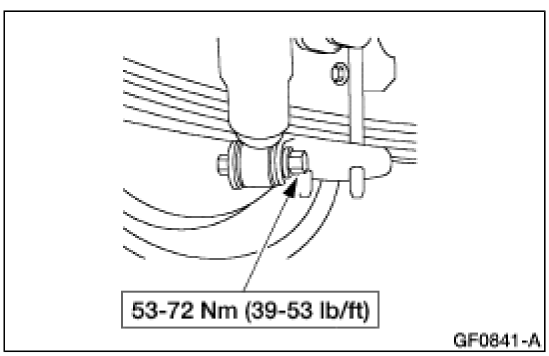


Installation

1. **NOTE:** When installing air lines make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.



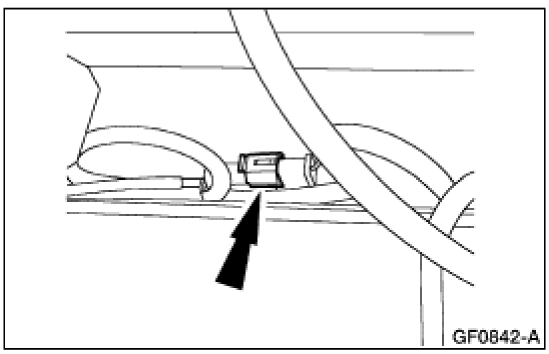


Height Sensor —Rear

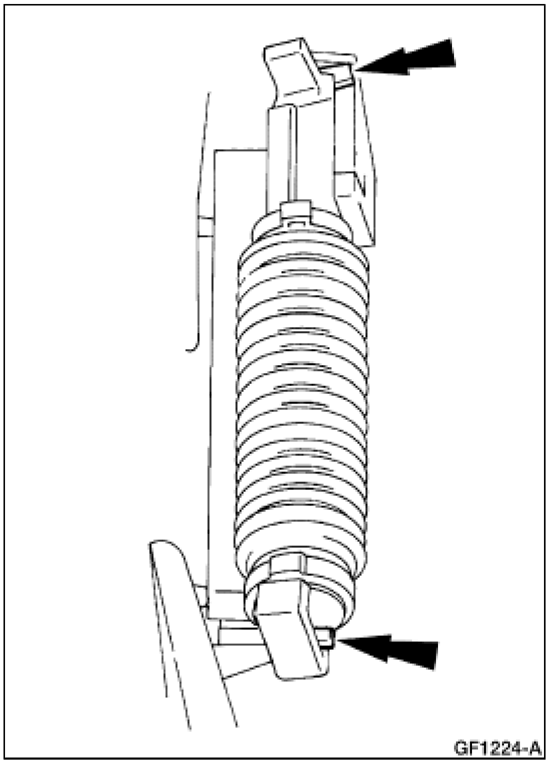
Removal

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing of an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

1. Raise and support the vehicle; refer to Section 100-02 .
2. Remove the spare tire.
3. Disconnect the height sensor electrical connector and remove the electrical connector harness from the frame and apron to separate the push-in fasteners.



4. Release the upper and lower spring clip and pull the sensor from the ball studs.



Installation

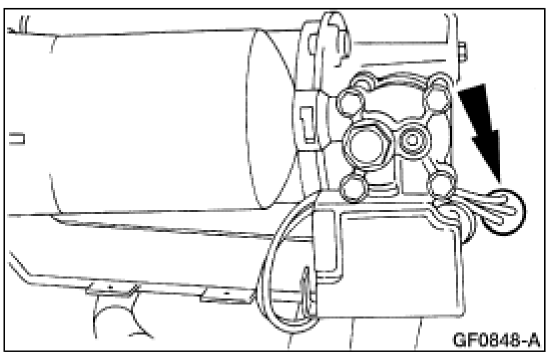
1. To install, reverse the removal procedure.

Air Compressor

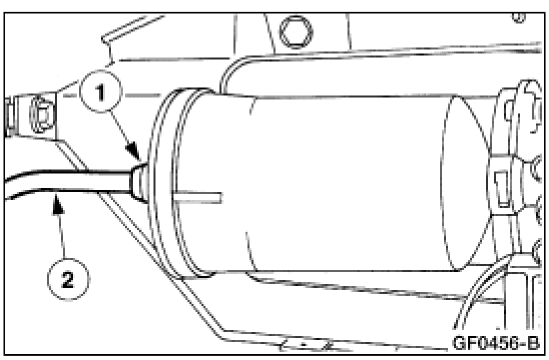
Removal

WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing of an air suspension vehicle. This can be accomplished by turning off the air suspension switch located in the rear jack storage area. Failure to do so may result in unexpected inflation or deflation of the air springs which may result in shifting of the vehicle during these operations.

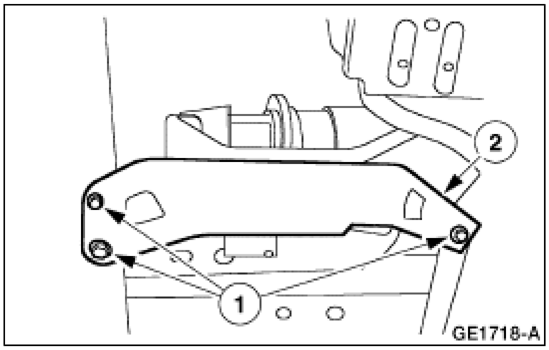
1. Raise and support the vehicle; refer to Section 100-02 .
2. Remove the spare tire.
3. Disconnect the air compressor electrical connector.



4. Disconnect the air line from the drier.
   1. Compress the quick connect locking ring and pull out the air line.
   2. Remove the air line from the drier.



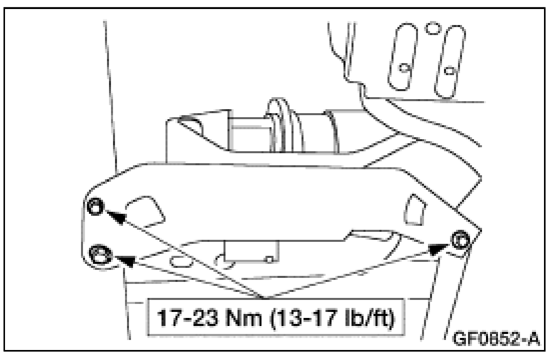
5. Remove the air compressor assembly from the vehicle.
   1. Remove the air compressor bolts.
   2. Remove the air compressor assembly.



Installation

1. **NOTE:** When installing the air lines make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.



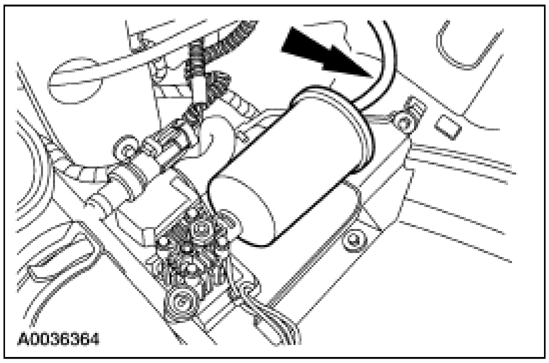
Drier

Material

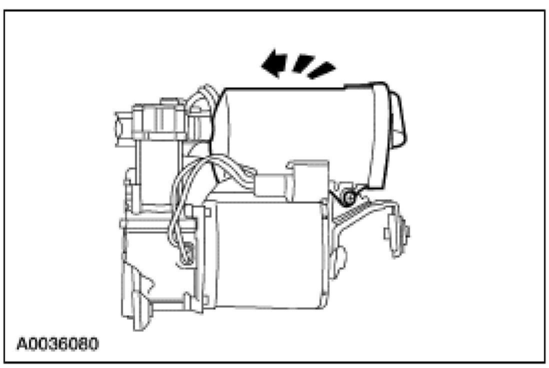
Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A or equivalent	ESE-M1C171-A

Removal and Installation

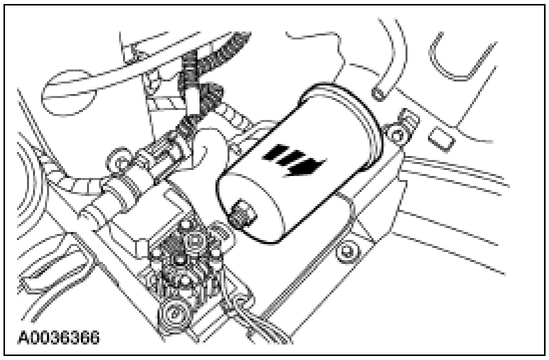
1. Disconnect the air line.



2. Remove the screw.



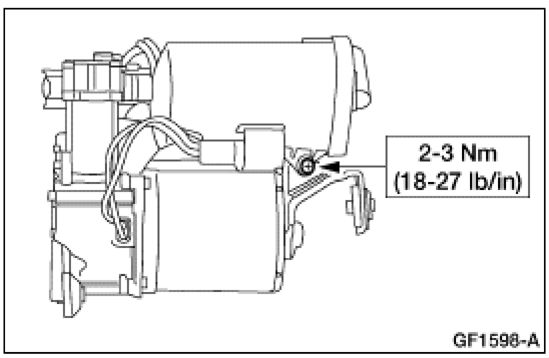
3. Rotate 90 degrees to unlock then remove the air compressor drier.



4. **NOTE:** Inspect the O-ring for damage and install a new O-ring as necessary. Lubricate the solenoid seal area with Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331A or equivalent meeting Ford specification ESE-M1C171-A.

   NOTE: When installing the air line, make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.

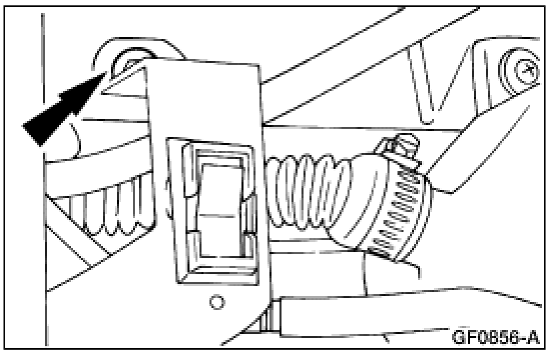


Switch —Air Suspension

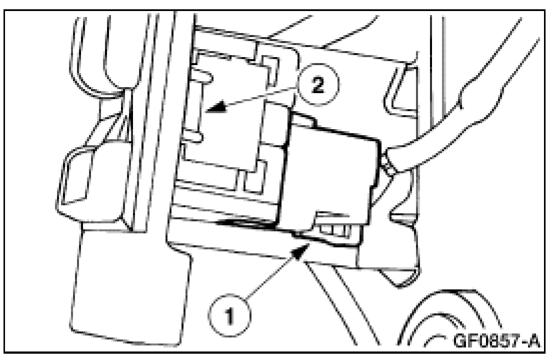
Removal

1. Remove the jack storage access cover.

2. Remove the retaining screw and air suspension switch bracket.

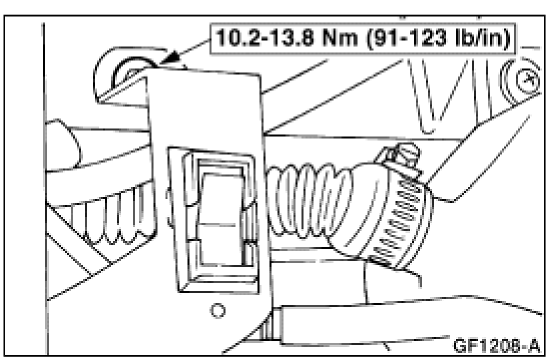


3. Remove the air suspension switch.
   1. Disconnect the electrical connector.
   2. Press the retaining clips and remove the air suspension switch from the bracket.



Installation

1. To install, reverse the removal procedure.



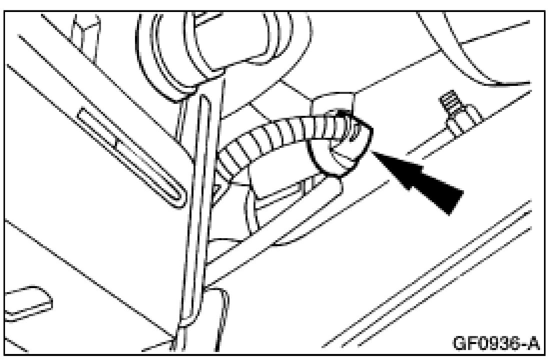
Solenoid Valve —Rear Fill

Special Tool(s)

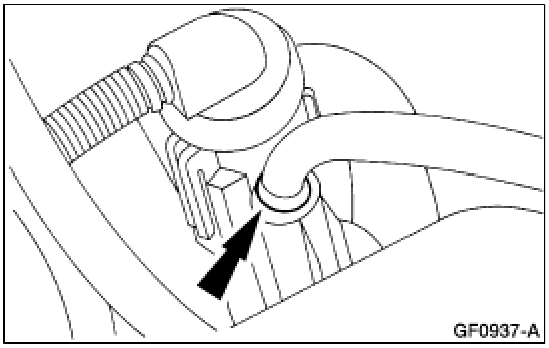
	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Removal

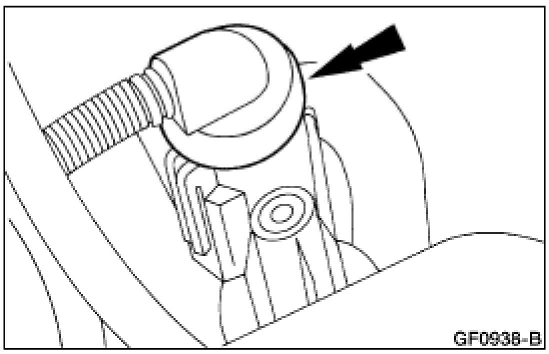
1. Connect New Generation STAR (NGS) Tester to the data link connector (DLC).
2. Select the RIDE CONTROL OUTPUT screen and turn on the following solenoids to vent the entire system of air and to lower the vehicle to its lowest attainable height:
   - REAR FILL (rear fill solenoid).
   - GATE VALVE (gate solenoid[s]).
   - VENT (vent solenoid).
3. Raise and support the vehicle; refer to Section 100-02 .
4. Remove the spare tire.
5. Remove the solenoid valve from the frame.



6. Compress the quick connect locking ring and pull out the air line.



7. Disconnect the solenoid valve electrical connector.



Installation

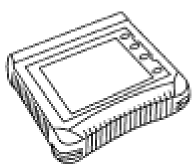
1. **NOTE:** When installing the air lines make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.

SECTION 204-05: Vehicle Dynamic Suspension *2000 Explorer/Mountaineer Workshop Manual*
REMOVAL AND INSTALLATION

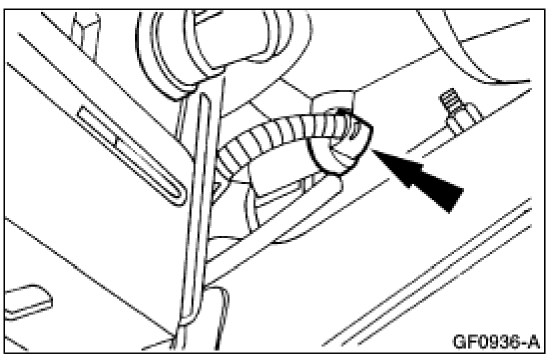
Solenoid Valve —Rear Gate

Special Tool(s)

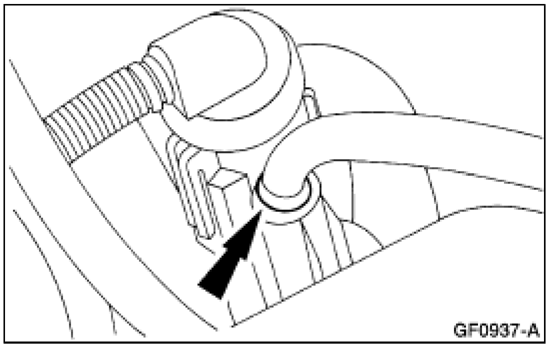
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Removal

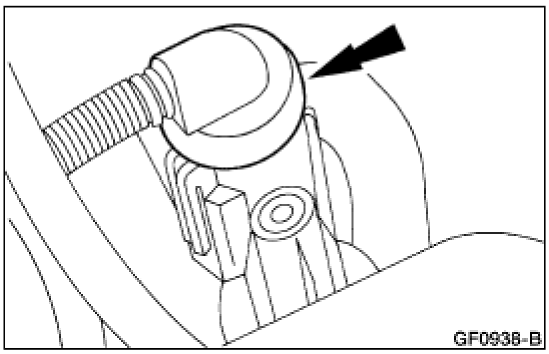
1. Connect scan tool to the data link connector (DLC).
2. Select the RIDE CONTROL OUTPUT screen and turn on the following solenoids to vent the entire system of air and to lower the vehicle to its lowest attainable height:
   - REAR FILL (rear fill solenoid).
   - GATE VALVE (gate solenoid[s]).
   - VENT (vent solenoid).
3. Raise and support the vehicle; refer to Section 100-02 .
4. Remove the spare tire.
5. Remove the evaporative canister, For more information, refer to Section 303-13 .
6. Remove the solenoid valve from the frame.



7. Compress the quick connect locking ring and pull out the air line.



8. Disconnect the solenoid valve electrical connector.



Installation

1. **NOTE:** When installing the air lines make sure the white air line is fully inserted into the fitting for correct installation.

   To install, reverse the removal procedure.