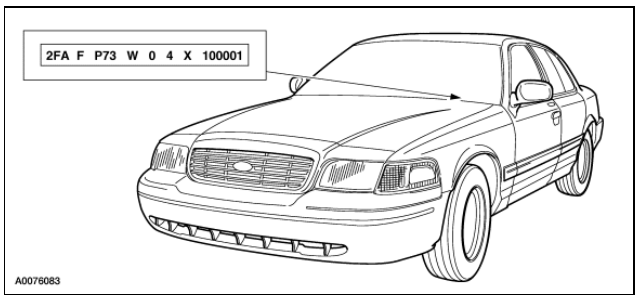
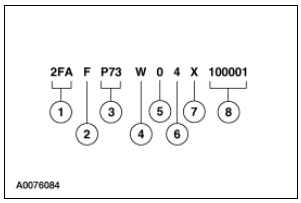
Identification Codes

Printable View (369 KB)

Vehicle Identification Number (VIN) Location



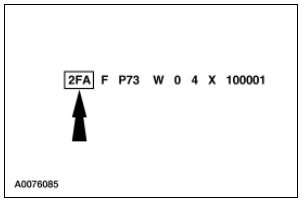
The vehicle identification number (VIN) is a seventeen-digit combination of letters and numbers. The VIN is stamped on a metal tab riveted to the instrument panel, top upper left of the dash. The VIN number is also found on the vehicle certification (VC) label.



Item	Description
1	World manufacturer identifier (WMI)
2	Restraint type code
3	Vehicle line and series code
4	Engine code
5	VIN check digit
6	Model year code
7	Assembly plant code
8	Production sequence number

Vehicle Identification Number (VIN)

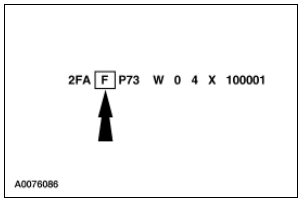
World Manufacturer Identifier (WMI)



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

- 2FA Ford, Canada, passenger car
- 2FD Ford, Canada, passenger car (incomplete vehicle)
- 2ME Mercury, Canada, passenger car
- 2MH Mercury, Canada, passenger car (incomplete vehicle)

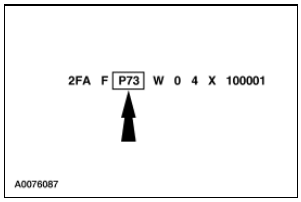
Restraint Type Code



The fourth VIN position is the vehicle restraint system type code.

- F Active safety belts all positions, driver and front passenger air bags
- H Active safety belts all positions, driver and front passenger air bags and driver and front passenger side impact air bags

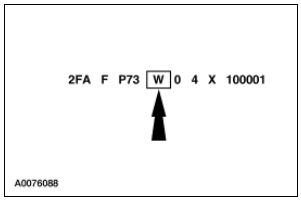
Vehicle Line and Series Code



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

- P70 Crown Victoria (Long wheel base)
- P71 Crown Victoria (Police Interceptor)
- P72 Crown Victoria (Base fleet vehicle)
- P73 Crown Victoria (Base four-door)
- P74 Crown Victoria (LX four-door)
- M70 Grand Marquis (Long wheel base)
- M74 Grand Marquis (GS four-door)
- M79 Mercury Marauder (four-door)

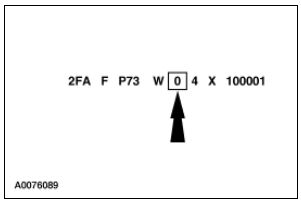
Engine Code



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

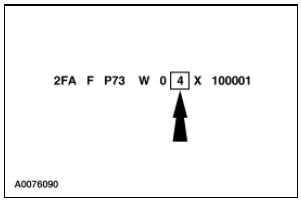
- 9 4.6L EFI (SOHC), eight cylinder, natural gas vehicle (NGV)
- V 4.6L EFI (DOHC), eight cylinder, gasoline, Mercury Marauder
- W 4.6L EFI (SOHC), eight cylinder, gasoline

Check Digit Code



The ninth VIN position is the check digit code (0-9).

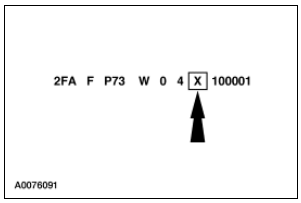
Model Year Code



The tenth VIN position is the model year code.

- 4 2004

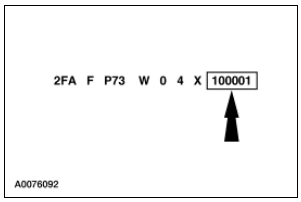
Assembly Plant Code



The eleventh VIN position is the assembly plant code.

- X St. Thomas, Talbotville, Ontario (Canada)

Production Sequence Code

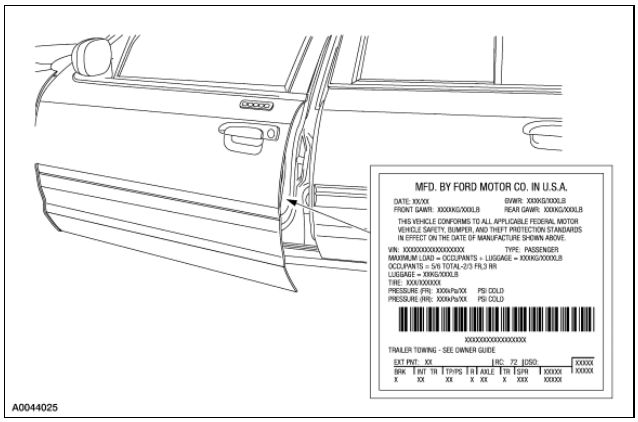


The last six VIN positions are the production sequence number. These six digits also are used as the vehicle serial and warranty number.

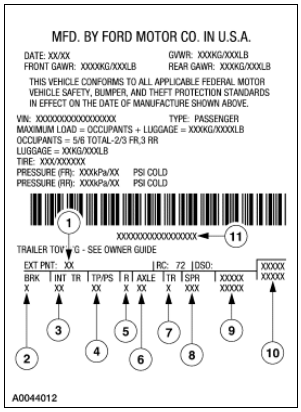
- Ford 100001-599999
- Lincoln/Mercury 600001-999999

Vehicle Certification (VC) Label

Vehicle Certification (VC) Label Location



The upper portion of 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) as well as tire size and pressure ratings. The VC label is located on the left-hand front door edge.



Item	Description
1	Exterior paint color code
2	Brake type code
3	Interior trim code
4	Tape/paint stripe code
5	Radio type code
6	Axle ratio code
7	Transmission code
8	Spring code
9	Engine calibration information
10	Powertrain calibration information
11	Vehicle identification number (VIN)

Vehicle Certification (VC) Label Reference

Paint Code

The first set of numbers/letters listed indicate the vehicle primary body color code. The second set of letters/numbers listed (if applicable), indicate a two-tone or accent body color code.

Primary Body Color

- AQ Arizona Beige (clear coat), Mercury/Ford
- BU Medium Brown Metallic, Mercury/Ford
- BY School Bus Yellow, Ford
- C2 Gold Ash Metallic (clear coat), Mercury/Ford
- DX Dark Blue Pearl (clear coat), Mercury/Ford
- FS Spruce Green (clear coat), Mercury/Ford
- JL Dark Toreador Red (clear coat), Mercury/Ford
- JP Silver Birch Metallic (clear coat), Mercury/Ford
- LK Dark Blue, Ford
- LM Royal Blue, Ford
- LN Light Blue Metallic, Ford
- LS Light Ice Blue Metallic (clear coat), Mercury/Ford
- MM Ultra Blue (clear coat), Ford
- TM Light Gray, Ford
- TN Silver Gray Metallic, Ford
- TV Midnight Gray, Mercury/Ford
- UA Ebony, Mercury/Ford
- WT Performance White (clear coat), Mercury/Ford
- YG Medium Titanium (clear coat), Ford

Accent Body Color

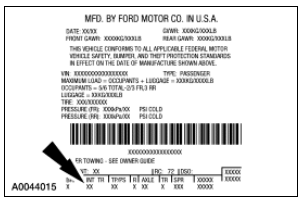
- AQ Arizona Beige, Ford
- BU Medium Brown Metallic, Ford
- BY School Bus Yellow, Ford
- C2 Gold Ash Metallic, Mercury/Ford
- DX Dark Blue Pearl, Mercury/Ford
- FS Spruce Green, Ford
- JL Dark Toreador Red, Mercury/Ford
- JP Silver Birch Metallic, Mercury/Ford
- LK Dark Blue, Ford
- LM Royal Blue, Ford
- LN Light Blue Metallic, Ford
- LS Light Ice Blue Metallic, Ford
- MM Ultra Blue, Ford
- TM Light Gray, Ford
- TN Silver Gray Metallic, Ford
- TS Silver Frost, Ford
- TV Midnight Gray, Mercury/Ford
- UA Ebony, Mercury/Ford
- WT Performance White, Mercury/Ford
- YG Medium Titanium, Ford

Brake Code

The brake type codes are:

- 3 Electronic traction control system (includes anti-lock brakes)
- H Police package
- C Police package with electronic traction control system (includes anti-lock brake system [ABS])

Interior Trim Code



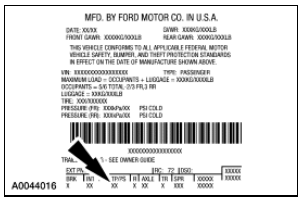
The interior trim codes are listed below. The first letter/number is for the interior fabric. The second letter is for the interior color.

- A Dalton cloth (split bench), Ford
- B Atmore cloth (split bench), Mercury
- C Vinyl 40/20/40 bench, Ford
- D Luxury Laura cloth (split bench), Mercury
- E G-Grain vinyl (split bench), Ford
- H Stockton cloth (front bucket seats), Ford
- I Stockton cloth (front bucket seats), Ford
- L G-Grain leather (split bench), Ford
- M Luxury Laura cloth (split bench), Mercury
- P Laura cloth (split bench), Ford
- R G-Grain Vinyl (split bench), Ford
- T Leather (front bucket seats), Ford
- 2 Leather (front bucket seats), Mercury
- 3 Leather twin comfort seats, Mercury
- 4 Super-Soft leather (split bench), Mercury
- 5 Leather two-tone (split bench), Mercury
- G Leather bucket, LS Sport
- 6 Leather with Imola leather inserts (split bench), Mercury Limited

The interior trim colors are:

- C Light Flint
- E Flint/Medium Flint
- H Medium Parchment
- K Parchment/Medium Parchment
- W Midnight Black

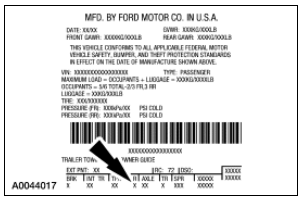
Tape and Paint Stripe Code



Tape and paint stripe codes do not apply to all vehicles. If applicable, the code(s) is as follows:

- B Black
- C Light Chestnut
- J Medium Red
- P Light Charcoal
- Q Dark Blue

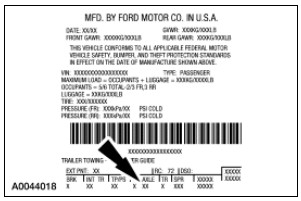
Radio Code



The radio type codes are:

- 5 Premium AM/FM electronic stereo with compact disc (CD)
- A Premium AM/FM electronic stereo with cassette (pre-equipment package 1)
- B Luxury electronic AM/FM stereo with cassette and clock (pre-equipment package 1)
- F Electronic AM/FM stereo
- H Electronic AM/FM stereo with cassette
- K Premium electronic AM/FM stereo with cassette, compact disc (CD) and clock
- Q Electronic AM/FM stereo with cassette (pre-equipment package 1)
- Y Radio delete
- Z Electronic AM/FM stereo with compact disc (CD) player (M100)

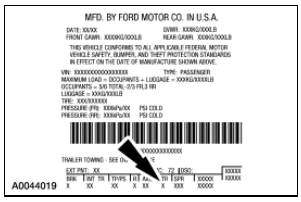
Axle Ratio Code



The axle ratios are:

- 1 2.73 conventional (non-limited slip)
- 4 2.73 conventional (non-limited slip)
- 5 3.55 conventional (limited slip)
- C 3.27 (limited slip)
- F 3.55 (locker)

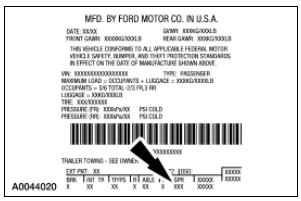
Transmission Code



The transmission codes are:

- H Four-speed automatic overdrive, (4R70W) Sharonville
- R Four-speed automatic overdrive, (4R75W) Livonia
- U Four-speed automatic overdrive, (4R70W) Livonia

Spring Code



The first number/letter listed identifies the front spring codes. The second number/letter listed identifies the rear spring codes.

Front Springs

- Base part number 5310

Rear Springs

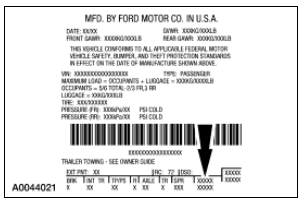
- Base part number 5560

Rear air suspension codes are:

Rear Air Suspension

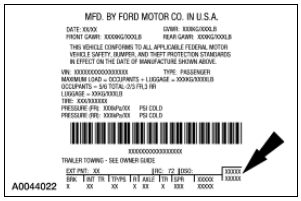
- Base part number 5A891

Engine Calibration Information



Engine calibration information is located on the VC label lower right corner between the spring code field and the powertrain calibration information. Engine calibration information is limited to a maximum of five characters per line (two lines maximum). Calibration information more than five characters long will wrap to the second line of this field.

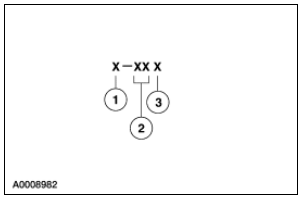
Powertrain Calibration Information



NOTE: Powertrain calibration information is limited to a maximum of five characters per line on the Vehicle Certification Label. Calibration identification consisting of more than five characters will wrap to the second line on the VC label.

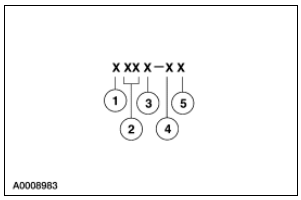
Powertrain calibration information is printed in the lower right corner of the Vehicle Certification Label. Only the base calibration information is printed. Revision levels will not appear, however, they can be found in On Line Automotive Service Information System (OASIS). For the current model year, 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 electronic calibration strategies introduced since the 2001 model year, protocol 3 will be used. Refer to Protocol 3 below.

Protocol 1



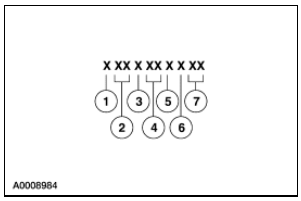
Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code
3	Engine revision level

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 for 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

Powertrain calibration protocol 3 strategy is explained in more detail in the following:

Model Year

Position 1 indicates the model year in which the calibration was first introduced.

- 1 2001
- 2 2002
- 3 2003
- 4 2004

Vehicle Code

Position 2 identifies the vehicle line in code.

- FB Crown Victoria/Grand Marquis/Marauder

Transmission Code

Position 3 identifies the transmission type in code.

- 1 Automatic transmission

Unique Calibration

Position 4 is explained in the following:

The Emissions/CAFE/CO2 Compliance Department is responsible for assigning these calibration codes. Unique calibration identifications are assigned to cover similar vehicles to differentiate between tires, drive configurations, final drive ratios and other calibration-significant factors.

These two characters are selected by the analyst to provide identifiable information unique to each calibration. For example, using the number 2 to denote a two-valve engine versus using the number 4 to denote a

four-valve engine, provides an easily identifiable difference.

Fleet Code

Position 5 Fleet calibration coding is as follows:

- 0 Certification (U.S. 4K, final sale in export markets)
- 1 HGDE/Dyno
- 2 Fast AMA, U.S.
- 3 ADP U.S.
- 4 Not assigned
- 5 Not assigned
- 6 Evaporative emissions
- 7 MACAA
- 8 On-board diagnostics
- 9 Not assigned

Certification Regions

Position 6 Certification region. Lists the lead region where multiple regions are included in one calibration.

- 5 U.S. fifty states
- A U.S. Federal (including altitude, may include Canada or Mexico)
- B U.S. California standard (includes U.S. green states)
- C Canada
- D China
- E European Community (Austria, Belgium, Denmark, Finland, Germany, Greece, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom)
- F Extended European Community (Croatia, Czech Republic, Estonia, Hungary, Norway, Poland, Romania, Russian Federation, Slovakia, Slovenia, Switzerland, Yugoslavia)
- G Gulf Cooperative Council
- H Hong Kong
- J Japan
- K Korea
- L Malaysia
- M Mexico
- N New Zealand
- P Australia
- Q South America (Brazil)
- S Singapore
- T Taiwan
- U South America (unleaded fuel)
- V Vietnam
- X ROW (rest of world)
- Y Military
- Z Israel

Revision Level

The revision level will advance as revisions occur. Not printed on label.

Jacking

Printable View (51 KB)

⚠ WARNING: On vehicles equipped with air suspension, the electrical power supply to the air suspension system must be shut off prior to jacking the vehicle. This can be accomplished by disconnecting the battery or turning off the air suspension service switch located in the luggage compartment on the LH side. 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: Never run the engine with one wheel off the ground, such as when changing a tire. The wheel still on the ground could cause the vehicle to move.

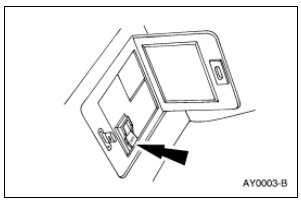
⚠ CAUTION: The jack provided with the vehicle is intended to be used in an emergency for changing a deflated tire. To avoid damage to the vehicle, never use the jack to hoist the vehicle for any other purpose. Refer to the Owner Guide when using the jack supplied with the vehicle.

⚠ CAUTION: Under no circumstances should the vehicle ever be lifted by the front control arms, crossmember, rear stabilizer or differential housing. Severe damage to the vehicle could result.

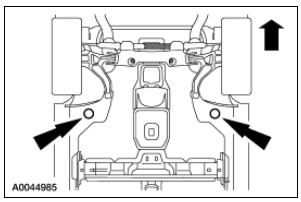
⚠ CAUTION: Do not attempt to use jack pressure on either the front bumper or the rear bumper of any vehicle. Damage to the bumper covers will occur.

Lift the vehicle using the Jacking Points procedure in this section.

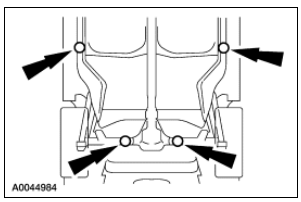
Jacking Points



Push the air suspension service switch to the OFF position.



To lift the front or either side of the front end, position the floor jack or the hoist under the front frame lift points.



To lift the rear or either side of the rear end, position the floor jack or the hoist under the rear lift points.

Lifting

Printable View (37 KB)

⚠ WARNING: On vehicles equipped with air suspension, the electrical power supply to the air suspension system must be shut off prior to lifting the vehicle. This can be accomplished by disconnecting the battery or turning off the air suspension service switch located in the luggage compartment on the LH side. 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 allow the hoist adapters to contact the steering linkage, suspension arms, stabilizer bar, rear subframe stabilizer brackets or to compress the lower suspension arm stabilizer bar insulator. Damage to the suspension, exhaust and steering linkage components may occur if care is not exercised when positioning the hoist adapters of two-post hoists prior to lifting the vehicle.

⚠ CAUTION: Never use the differential housing as a lift point. Damage to the differential housing and cover may occur.

Lift the vehicle using the Lifting Points procedure in this section.

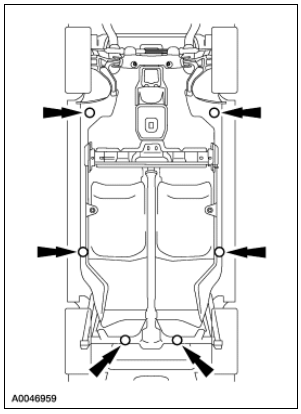
Lifting Points Drive-On Lift

⚠ CAUTION: To prevent possible damage to the underbody, do not drive the vehicle onto the drive-on hoist without first checking for possible interference.

Check for interference between the upright flanges of the hoist rails and the underbody.

If an interference exists, modify the hoist flanges or build up the approach ramps as necessary to provide clearance.

Lifting Points Two Post Lift

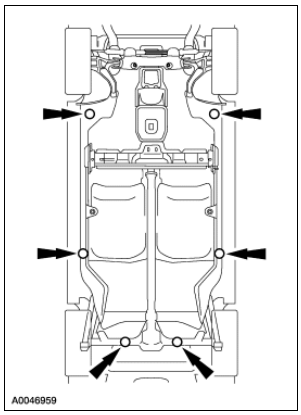


⚠ CAUTION: Under no circumstances should the vehicle be lifted by the front control arms, crossmember or rear control arms. Severe damage to the vehicle could result.

NOTE: Wheel adapters must be used under the tires when lifting the vehicle with a single-post hoist.

Lift the vehicle at the applicable lift points.

Lifting Points Single-Post Hoist



⚠ CAUTION: Under no circumstances should the vehicle be lifted by the front control arms or rear control arms. Severe damage to the vehicle could result.

NOTE: Wheel adapters must be used under the tires when lifting the vehicle with a single-post hoist.

Lift the vehicle at the applicable lift points.

Maintenance Schedule Vehicles with Gasoline Engines

Printable View (35 KB)

The maintenance schedule is designed to protect against major repairs resulting from neglect or inadequate maintenance and to prolong the life of the vehicle.

General Maintenance Information

NOTE: This is a generic maintenance schedule for all Ford, Lincoln and Mercury vehicles. There may be items listed that do not apply to all vehicles.

The Normal Schedule applies to operation of the vehicle under typical, everyday driving conditions. The maintenance frequency in this schedule typifies what the vast majority of vehicles will require. The listed services should be carried out at specified mileage intervals. There are, however, additional services required that only the noted vehicles require.

If the vehicle is operated in one or more of the following special operating conditions, those additional services will be required. The special operating conditions are:

- towing or carrying heavy loads.
- extensive idling and/or driving at low speeds for long distances.
- driving in dusty conditions.
- off-road operation.

There are also exceptions to the Normal Operating Schedule which will require more frequent maintenance for some components. Those exceptions are:

- natural gas and propane vehicles fuel tank intervals.
- normal vehicle axle maintenance and lubrication.
- police and taxi vehicles maintenance and lubrication.
- engine oil and Premium Gold coolant time and mileage-based interval.

Special Operating Condition Requirements

When towing a trailer or using a camper or car-top carrier:

- Change engine oil and install a new oil filter every 4,800 km (3,000 miles), 3 months or 200 hours of engine operation (whichever occurs first).
- Change transfer case fluid every 96,000 km (60,000 miles).
- Change automatic transmission fluid, lubricate 4x2 wheel bearings, install new grease seals and adjust bearings every 48,000 km (30,000 miles). If equipped, change the in-line service installed transmission fluid filter.
- Change manual transmission fluid as required.
- Inspect and lubricate U-joints and halfshafts as required.

During extensive idling and/or low speed driving for long distances, as in heavy commercial use such as delivery, taxi, patrol car or livery:

- Change engine oil and install a new oil filter every 4,800 km (3,000 miles), 3 months or 200 hours of engine operation (whichever occurs first).
- Lube front lower control arm and steering linkage ball joints with zerk fittings (if equipped) every 4,800 km (3,000 miles) or 3 months.
- Inspect brake system and check battery electrolyte level (Patrol cars) every 8,000 km (5,000 miles).
- Install a new fuel filter every 24,000 km (15,000 miles).
- Change automatic transmission fluid, lubricate 4x2 wheel bearings, install new grease seals and adjust bearings every 48,000 km (30,000 miles). If equipped, change the in-line service installed transmission fluid filter.
- Install new spark plugs and change transfer case fluid every 96,000 km (60,000 miles).
- Install a new cabin air filter as required.

When operating in dusty conditions such as unpaved or dusty roads:

- Change engine oil and install a new oil filter every 4,800 km (3,000 miles) or 3 months.
- Install a new fuel filter every 24,000 km (15,000 miles).
- Change automatic transmission fluid, check air filter minder and install a new filter as required (Focus PZEV engine only) every 48,000 km (30,000 miles). If equipped, change the in-line service installed transmission fluid filter.
- Change transfer case fluid every 96,000 km (60,000 miles).
- Install a new engine air filter as required.
- Install a new cabin air filter as required.

When operating in off-road conditions:

- Change automatic transmission fluid every 48,000 km (30,000 miles). If equipped, change the in-line service installed transmission fluid filter.
- Change transfer case fluid every 96,000 km (60,000 miles).
- Install a new cabin air filter as required.
- Inspect and lubricate U-joints and halfshafts.
- Inspect and lubricate steering linkage ball joints with zerk fittings.

Checks and Services

Certain basic maintenance checks and inspections should be carried out at specified intervals. Any recognized adverse condition should be corrected as soon as possible.

Multi-Point Inspection

The following inspections are recommended at every service interval:

- Check and top off brake, coolant, manual and automatic power steering and window washer fluids.
- Inspect tires for wear and correct air pressure, including the spare.
- Check exhaust system for leaks, damage, loose parts and foreign material.
- Check battery performance.
- Check operation of horn, exterior lamps, turn signals and hazard warning lights.
- Check radiator, coolers, heater and air conditioning hoses.
- Inspect windshield wiper spray and wiper operation.
- Check windshield for cracks, chips and pitting.
- Inspect for oil and fluid leaks.
- Inspect air cleaner filter.
- Inspect halfshaft dust boots.

- Check shocks, struts and other suspension components for leaks and damage.

In-Line, Service-Installed Transmission Fluid Filter

Some vehicles may be equipped with an in-line, service-installed transmission fluid filter. This filter is installed in the transmission fluid cooler return line. If equipped, install a new in-line filter during transmission fluid change intervals.

Maximum Oil Change Interval (Normal Schedule)

- 8,000 km (5,000 miles) or 6 months (whichever occurs first).

Maximum Oil Change Interval (Special Operating Conditions)

- 4,800 km (3,000 miles), 3 months or 200 hours of engine operation (whichever occurs first).

Monthly Checks

Check each of the following items every month:

- All interior and exterior lights.
- Tires for wear and correct air pressure.
- Engine oil fluid level.
- Windshield washer solvent fluid level.
- Spare tire air pressure.

Six Month Checks

Check each of the following items at least every six months:

- Lap/shoulder belts and seat latches for wear and function.
- Power steering fluid level.
- Parking brake for correct operation.
- Safety warning lamps (brake, ABS, air bag, safety belt) for correct operation.
- Coolant system fluid level and correct strength.
- Battery connections. Clean if necessary.
- Clutch fluid level, if equipped.
- Windshield washer spray, wiper operation, clean all wiper blades.
- Lubricate all hinges, latches and outside locks. Inspect for correct operation.
- Lubricate door rubber weatherstrips. Inspect for excessive wear.
- Clean body and door drain holes. Inspect for clogs and obstructions.
- Lubricate upper and lower sliding door tracks, if equipped.
- Clean sliding door contact switches, if equipped.

Special Checks (Mustang Only)

Carry out the following check every 8,000 km (5,000 miles):

- Adjust clutch by lifting pedal (manual transmission, as described in owner guide).

Normal Schedule

NOTE: Rotate tires and inspect for wear at 5,000 miles, 15,000 miles and every 15,000 miles thereafter. At

other 5,000-mile intervals, rotation is recommended for optimal life.

The following checks or procedures should be carried out for all cars, minivans, light trucks, sport utilities, vans, 4x4s, natural gas and propane vehicles.

8,000 Km (5,000 Miles)

- Change engine oil and install a new oil filter.
- Rotate tires and inspect for wear.
- Multi-point inspection recommended.

16,000 Km (10,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

24,000 Km (15,000 Miles)

- Change engine oil and install a new oil filter.
- If equipped, inspect automatic transmission fluid level with dipstick.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.
- If equipped, install a new cabin air filter.
- Multi-point inspection recommended.

ADDITIONAL INFORMATION: For light trucks, sport utilities and vans, inspect and lubricate the 4x2 ball joints. Inspect and lubricate the steering linkage if equipped with zerk fittings.

32,000 Km (20,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

40,000 Km (25,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Drain coalescent fuel filter bowl and install a new filter (NGV).
- Multi-point inspection recommended.

48,000 Km (30,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect exhaust system and heat shields.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.

- Install a new engine air filter (not required for PZEV Focus).
- Install a new fuel filter. (See ADDITIONAL INFORMATION below.)
- If equipped, install a new cabin air filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with 4F50N, 4R100 and 4F27E. Inspect automatic transmission fluid level using dipstick on all other vehicles, if equipped. Change the in-line service installed transmission fluid filter, if equipped.
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS, Freestar, Monterey, Expedition and Aviator).
- Multi-point inspection recommended.

ADDITIONAL INFORMATION: For light trucks, sport utilities and vans, inspect and lubricate the 4x2 ball joints. Inspect and lubricate the steering linkage if equipped with zerk fittings. If vehicle is registered in California, the California Air Resources Board (CARB) has determined that failure to install a new fuel filter at this interval will not nullify the emission warranty or limit recall liability prior to completion of the vehicle's useful life. It is, however, recommended that maintenance checks be carried out and recorded at the indicated intervals.

Natural gas and propane vehicles also require checking the fuel tanks and installing a new filter (propane vehicles).

56,000 Km (35,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

64,000 Km (40,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

72,000 Km (45,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect automatic transmission fluid level using dipstick, if equipped.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.
- If equipped, install a new cabin air filter.
- Multi-point inspection recommended.

ADDITIONAL INFORMATION: For light trucks, sport utilities and vans, inspect and lubricate the 4x2 ball joints. Inspect and lubricate the steering linkage if equipped with zerk fittings.

80,000 Km (50,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Drain coalescent fuel filter bowl and install a new filter (NGV).
- Clean injectors (natural gas vehicles).
- Multi-point inspection recommended.

88,000 Km (55,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

96,000 Km (60,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.
- Install a new engine air filter (not required for PZEV Focus).
- Install a new fuel filter. (See ADDITIONAL INFORMATION below.)
- If equipped, install a new cabin air filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with 4F50N, 4R100 and 4F27E. Inspect automatic transmission fluid level using dipstick on all other vehicles, if equipped. If equipped, change the in-line service installed transmission fluid filter.
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS, Freestar, Monterey, Expedition and Aviator).
- Multi-point inspection recommended.

ADDITIONAL INFORMATION: If vehicle is registered in California, the California Air Resources Board (CARB) has determined that failure to install a new fuel filter at this interval will not nullify the emission warranty or limit recall liability prior to completion of the vehicle's useful life. It is, however, recommended that maintenance checks be carried out and recorded at the indicated intervals.

Additional checks for natural gas and propane vehicles at this interval include inspecting fuel tanks, as well as draining coalescent fuel filter bowl and installing a new filter.

104,000 Km (65,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

112,000 Km (70,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

120,000 Km (75,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect automatic transmission fluid level using dipstick.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.
- Install a new cabin air filter.

- Drain coalescent fuel filter bowl and install a new filter (NGV).
- Multi-point inspection recommended.

ADDITIONAL INFORMATION: For light trucks, sport utilities and vans, inspect and lubricate the 4x2 ball joints. Inspect and lubricate the steering linkage if equipped with zerk fittings.

128,000 Km (80,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

136,000 Km (85,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

144,000 Km (90,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect exhaust system and heat shields.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.
- Install a new engine air filter.
- Install a new fuel filter.
- If equipped, install a new cabin air filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with 4F50N, 4R100 and 4F27E. Inspect automatic transmission fluid level using dipstick on all other vehicles, if equipped. If equipped, change the in-line service installed transmission fluid filter.
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS, Freestar, Monterey, Expedition and Aviator).
- Multi-point inspection recommended.

ADDITIONAL INFORMATION: For light trucks, sport utilities and vans, inspect and lubricate the 4x2 ball joints. Inspect and lubricate the steering linkage if equipped with zerk fittings.

Additional services for natural gas and propane vehicles include inspecting fuel tanks, as well as draining coalescent fuel filter bowl and installing a new filter.

152,000 Km (95,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

160,000 Km (100,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect accessory drive belt(s).
- Rotate tires and inspect for wear.

- Install new spark plugs.
- Change Premium Gold coolant or change at 5 years, whichever comes first.
- Install a new PCV external on all cars and light trucks under 6,000 pounds Gross Vehicle Weight (GVW), except 5.4L 3V engine.
- Drain coalescent fuel filter bowl and install a new filter (NGV).
- Clean injectors (NGV).
- Multi-point inspection recommended.

168,000 Km (105,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect automatic transmission fluid level if equipped with dipstick.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine coolant system and hoses.
- Lubricate 4x2 ball joints and steering linkage if equipped with zerk fittings.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.
- If equipped, install a new cabin air filter.
- Change coolant.
- Multi-point inspection recommended.

176,000 Km (110,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

184,000 Km (115,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

192,000 Km (120,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect exhaust system and heat shields.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.
- Install a new engine air filter (not required for PZEV Focus).
- Install a new fuel filter. (See ADDITIONAL INFORMATION below.)
- If equipped, install a new cabin air filter.
- Install a new external PCV valve on all cars and light trucks over 6,000 Gross Vehicle Weight, except 5.4L 3V engine.
- Change automatic transmission/transaxle fluid on all vehicles equipped with 4F50N, 4R100 and 4F27E. Inspect automatic transmission fluid level using dipstick on all other vehicles, if equipped. If equipped, change the in-line service installed transmission fluid filter.
- Install a new camshaft belt on all 2.0L, 4-cylinder engines (Focus and Escape).
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS, Freestar, Monterey, Expedition and Aviator).

- Multi-point inspection recommended.

ADDITIONAL INFORMATION: Additional services for natural gas and propane vehicles include inspecting fuel tanks, as well as draining coalescent fuel filter bowl and installing a new filter (propane only). Change manual transmission fluid. Install a new camshaft belt on 4 cylinder engine (2.0L Escape).

200,000 Km (125,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Drain coalescent fuel filter bowl and install a new filter (NGV).
- Multi-point inspection recommended.

208,000 Km (130,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

216,000 Km (135,000 Miles)

- Change engine oil and install a new oil filter.
- If equipped, inspect automatic transmission fluid level with dipstick.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.
- Install a new cabin air filter.
- Multi-point inspection recommended.

224,000 Km (140,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

232,000 Km (145,000 Miles)

- Change engine oil and install a new oil filter.
- Inspect tires for wear. Rotation recommended for optimal tire life.
- Multi-point inspection recommended.

240,000 Km (150,000 Miles)

- Install new 4x2 front wheel bearings and seals (if new bearings and seals have not been installed in the last 100,000 miles).
- Change engine oil and install a new oil filter.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect wheel ends for end play and noise.
- Inspect engine cooling system and hoses.
- Inspect exhaust system and heat shields.
- Inspect steering linkage, suspension and ball joints (if equipped), halfshafts, driveshaft and U-joints.
- Rotate tires and inspect for wear.

- Install a new engine air filter (not required on PZEV Focus).
- Install a new fuel filter. (See ADDITIONAL INFORMATION below.)
- Lubricate 4x2 ball joints and steering linkage if equipped with zerk fittings.
- If equipped, install a new cabin air filter.
- Change Premium Gold coolant (See Exceptions To Normal Schedule).
- Change automatic transmission/transaxle fluid and filter.
- Change rear axle lubricant on all rear wheel (RWD) vehicles.
- Install a new camshaft on 4 cylinder engine (2.0L Escape).
- Install a new accessory drive belt(s) (if a new belt has not been installed within the last 100,000 miles).
- If equipped, install new climate controlled seat filters (Navigator, Lincoln LS, Freestar, Monterey, Expedition and Aviator).
- Multi-point inspection recommended.

ADDITIONAL INFORMATION: If vehicle is registered in California, the California Air Resources Board (CARB) has determined that failure to install a new fuel filter at this interval will not nullify the emission warranty or limit recall liability prior to completion of the vehicle's useful life. It is, however recommended that maintenance checks be carried out and recorded at the indicated intervals.

Additional checks for natural gas and propane vehicles include inspecting fuel tanks, as well as draining and installing a new filter.

Exceptions To Normal Schedule

Premium Gold Coolant

- Change Premium Gold coolant at 5 years or 160,000 km (100,000 miles) of the vehicle's life, whichever comes first.
- After the initial change, change coolant every 3 years or 80,000 km (50,000 miles) thereafter.

Natural Gas and Propane Vehicles

- Inspect NGV fuel tanks from the date of tank manufacture every 3 years.
- Inspect propane fuel tanks from vehicle build date every 5 years.
- Install new NGV fuel tanks from the date of tank manufacture every 15 years.

Normal Vehicle Axle Maintenance

Rear axles and power take off (PTO) units containing synthetic lubricant and light duty trucks equipped with Ford-design axles are lubricated for life. These lubricants are not to be checked or changed unless service is required, or if a leak is suspected, or the axle assembly has been submerged in water.

The axle and PTO should be changed anytime they have been submerged in water. Non-synthetic rear axle lubricants should be replaced every 4,800 km (3,000 miles) or three months, whichever occurs first, during extended trailer tow operation above 21°C (70°F) ambient and wide open throttle for extended periods above 45 mph.

The 3,000 mile lube change interval may be waived if the axle was filled with 75W140 synthetic gear lubricant meeting Ford specification WSL-M2C192-A, part number F1TZ-19580-B or equivalent. Add four ounces of additive friction modifier C8AZ-19B546-A (EST-M2C118-A) or equivalent for complete refill of Traction-Lok rear axles.

The axle lubricant should be changed anytime an axle has been submerged in water.

Police and Taxi Vehicle Axle Maintenance

Replace rear axle lubricant every 160,000 km (100,000 miles). Rear axle lubricant change may be waived if the axle was filled with 75W140 synthetic gear lubricant meeting Ford specification WSL-M2C192-A, part number FITZ-19580-B or equivalent. Add four ounces of additive friction modifier C8AZ-19B546-A (EST-M2C118-A) or equivalent for complete refill of Traction-Lok rear axles.

The axle lubricant should be changed anytime an axle has been submerged in water.

Noise, Vibration and Harshness (NVH)

Printable View (146 KB)

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

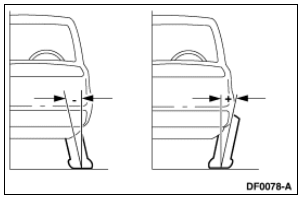
Strong noise fluctuations (less than 1000 Hz) caused by gusting winds. An example would be wind gusts against the side glass.

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.

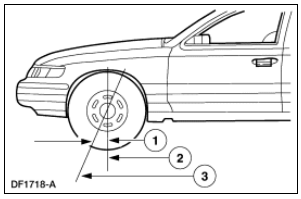
Camber

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

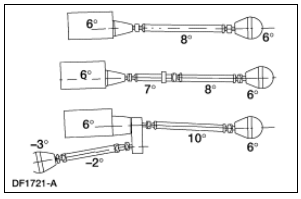
A unit of measurement, referring to sound pressure level, abbreviated dB.

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

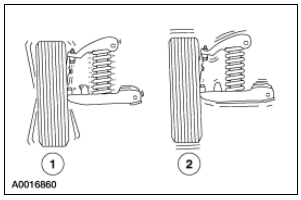
The physical quality of sound that relates to its frequency. Pitch increases as frequency increases and vice versa.

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.

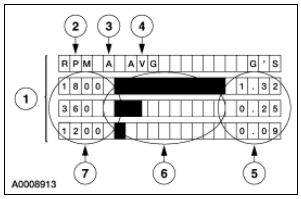
WOT

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.
   - Frequencies with a reading of 0.06 hz or less, are barely perceptible NVH levels. No corrective action is necessary.

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.

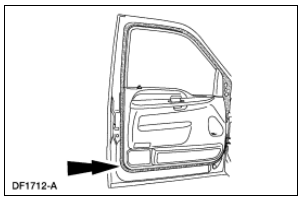
Squeak and Rattle Repair Kit

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:

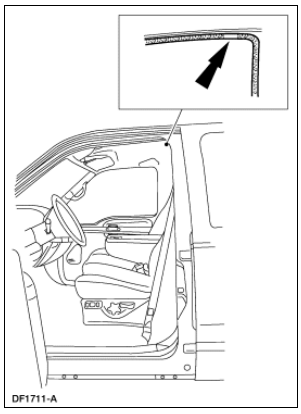
- PVC (soft foam) tape
- Urethane (hard foam) tape
- Flocked (black fuzzy) tape
- UHMW (frosted) tape
- Squeak and rattle oil tube
- Squeak and rattle grease tube

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:

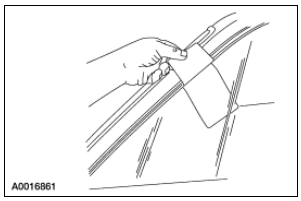


a. Clean the weatherstrip.
b. Spray the tracing powder on the mating surface only.
c. Close the door completely. Do not slam the door.
d. Open the door. An imprint is made where the weatherstrip contacted the mating surface seal. Gaps or a faint imprint will show where there is poor contact with the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



Index Card

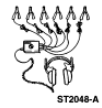
Place an index card or a piece of paper between the weatherstrip and the sealing surface, then close the door. Slowly withdraw the index card or paper after the door is closed and check the amount of pressure on the weatherstrip. There should be a medium amount of resistance as it is withdrawn. Continue 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)

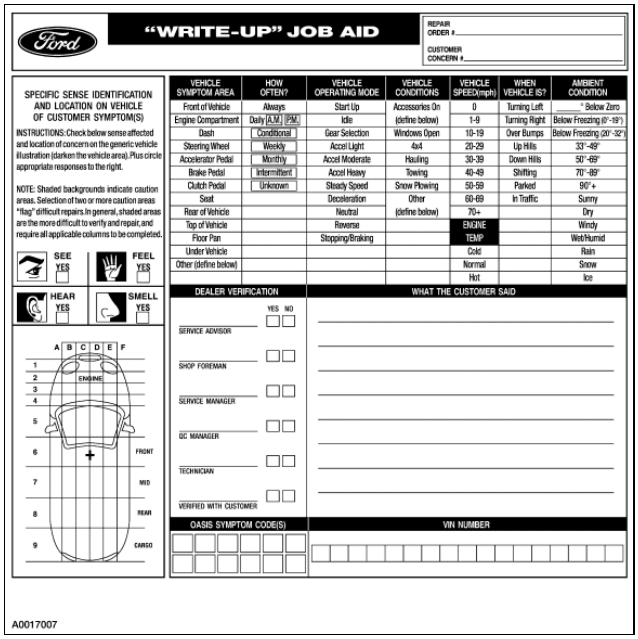
Printable View (746 KB)

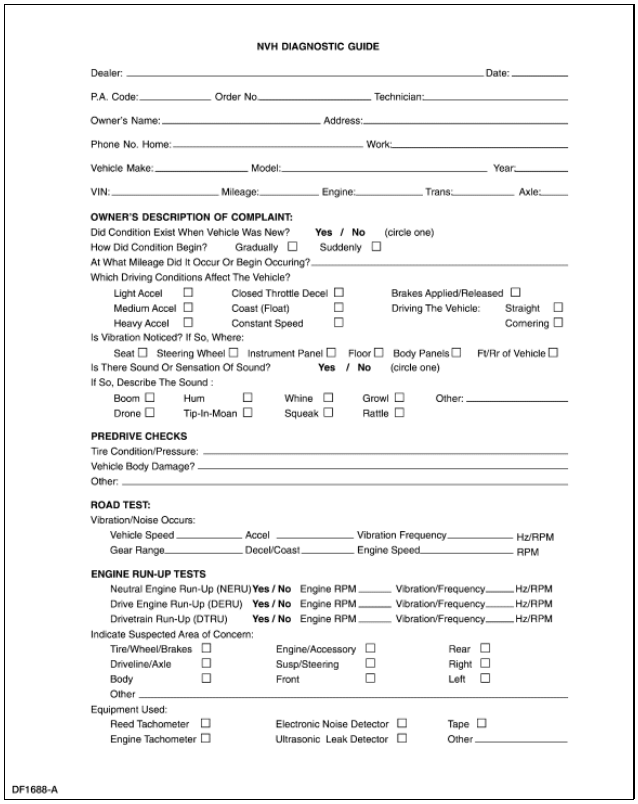
Special Tool(s)

 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.





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 _____

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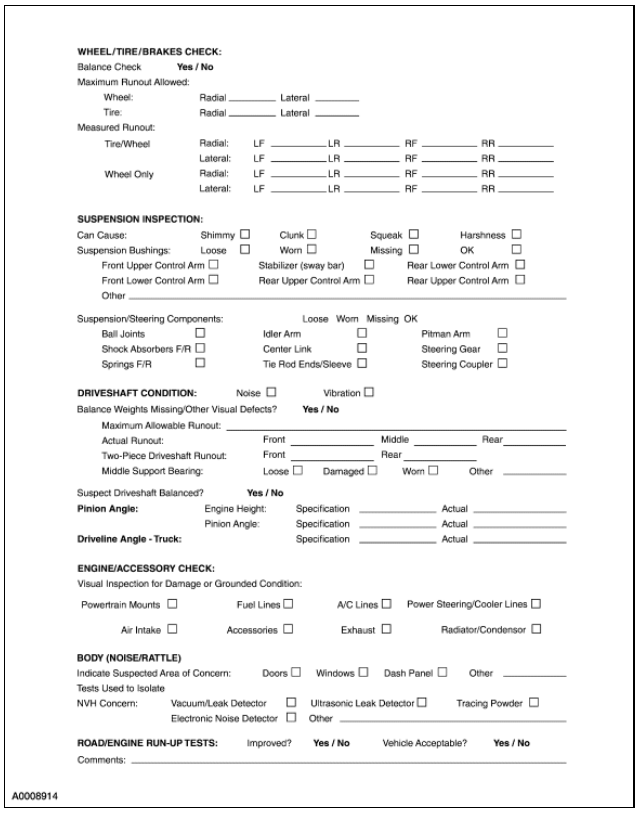

WHEEL/TIRE/BRAKES CHECK:

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: _____

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1: Customer Interview

The diagnostic process starts with the customer interview. The service advisor must obtain as much information as possible about the concern 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 the concern first noticed?
- Did the concern 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 or 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 or vibration. The cause can actually be some distance away, transferred from another part of the vehicle.
- Remember that the vibrating source component (originator) may only generate a small vibration. This small vibration can in turn cause a larger vibration or 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 or 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 or 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 or 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 4,000 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 2,000 rpm. Note the engine rpm and, if possible, determine the vibration frequency.
- Repeat the test in REVERSE.
- If the vibration or 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 or noise is duplicated when carrying out this test, the belts and accessories are not

sources.
- If the vibration or 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 or 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 or noise by carefully listening. Move around the vehicle while listening to find the general location of the vibration or 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 or 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 or 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 .

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. Shifting
   - Noise or vibration condition related to the transmission (automatic). GO to Symptom Chart Transmission (Automatic) Noise/Vibration .
6. 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 .
7. 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

Symptom Chart Brake Noise/Vibration

Symptom Chart Driveline Noise/Vibration

Symptom Chart Engine Noise/Vibration

Symptom Chart Idle Noise/Vibration

Symptom Chart Squeak and Rattle

Symptom Chart Steering Noise/Vibration

Symptom Chart Suspension Noise/Vibration

Symptom Chart Tire Noise/Vibration

Symptom Chart Transmission (Automatic) Noise/Vibration

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. For additional information, refer to the appropriate Workshop Manual section for removal and installation procedures. Reinstall all components after verifying system operation is normal.

PINPOINT TEST A: BRAKE VIBRATION/SHUDDER

Test Step	Result / Action to Take
A1 ROAD TEST THE VEHICLE LIGHT BRAKING	
• Check that the wheel and tires are correct for the vehicle. Inspect the tires for abnormal wear patterns. • Road test the vehicle. Warm the brakes by slowing the vehicle a few times from 80 32 km/h (50 to 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	
• 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 DIAGNOSIS	
• 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)	**Yes** GO to A5 . **No** The brake system is operating correctly.

indicates a concern with a brake or suspension component. • **Is the vibration/shudder vehicle speed sensitive?**	
A4 APPLICATION OF THE PARKING BRAKE	
• **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	
• 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	
• 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	
• ⚠ **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	
• 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	
• ⚠ **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

Test Step	Result / Action to Take
B1 CHECK FOR TICKING NOISE AT THE FUEL RAIL	
• 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	
• 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 or Section 303-04B . TEST the system for normal operation. **No** GO to B3 .
B3 CHECK THE BELT TENSIONER FOR TICKING NOISE	
• Inspect the accessory drive. Check for the belt tensioner bottoming at end of travel or not at end of stroke. • 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	
• 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	
• Inspect the cooling fan for obstructions. • 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	
• 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. REFER to Section 303-01A or Section 303-01B . TEST the system for normal operation. **No** GO to B7 .
B7 CHECK VALVE LIFTERS OR LASH ADJUSTERS FOR CORRECT OPERATION	
• 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

Test Step	Result / Action to Take
C1 CHECK THE ACCESSORY DRIVE IDLER AND TENSIONER PULLEY BEARINGS	
• Carry out the Vehicle Cold Soak Procedure in this section. • Key in START position. • Place an EngineEAR probe directly on the pulley center post or bolt to verify which bearing is making the noise. • Key in OFF position. • **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

Test Step	Result / Action to Take
D1 CHECK THE POWER STEERING SYSTEM	
	Yes GO to D2 .

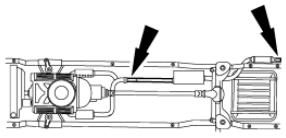
• Carry out the Vehicle Cold Soak Procedure in this section. • Key in START position. • Turn the steering wheel while the noise is occurring and listen for changes in sound pitch or loudness. • Key in OFF position. • **Does the sound pitch or loudness change while turning the steering wheel?**	**No** CONDUCT a diagnosis on other suspect accessory drive components.
D2 VERIFY THE SOURCE	
• Key in START position. • 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. • Key in OFF position. • **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. REFER to Section 211-02 . 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

Test Step	Result / Action to Take
E1 CHECK THE ENGINE DRIVEN COOLING FAN AFTER A COLD SOAK	
• Carry out the Vehicle Cold Soak Procedure in this section. • Key in START position. • Assess the airflow. • Raise the engine speed to 1500 rpm while listening for the moan to increase in proportion to the airflow. • Key in OFF position. • **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	
• Key in START position. • Run the engine to normal operating temperature while listening for the moan to stop. • Key in OFF position. • **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

Test Step	Result / Action to Take
F1 CHECK THE EXHAUST SYSTEM	

• Key in START position. • Increase the engine rpm until the noise is the loudest. Note the engine rpm. • Key in OFF position. • 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.  DF1768-A • Key in START position. • Increase the engine rpm and listen for the drumming noise. Note the engine rpm if the noise occurs. • Key in OFF position. • Using an 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	
• 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

Test Step	Result / Action to Take
G1 CHECK FOR NOISE AT THE VALVE COVERS AND THE FRONT COVERS (OHC ENGINES)	
• Carry out the Vehicle Cold Soak Procedure in this section. • Key in START position. • **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. • Key in OFF position. • **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	
• Key in START position.	**Yes** REPAIR or INSTALL new

• Using an EngineEAR, listen closely at the cylinder block by placing a probe on or near each freeze plug. • Key in OFF position. • **Is the noise source apparent?**	components as necessary. **No** GO to G3 .
G3 CHECK FOR NOISE WHILE DISCONNECTING EACH FUEL INJECTOR ELECTRICAL CONNECTOR, ONE AT A TIME	
• Key in START position. • Disconnect each fuel injector electrical connector, one at a time, to decrease piston force and listen for the noise. • Key in OFF position. • **Is the noise reduced or eliminated?**	**Yes** INSTALL a new fuel injector. TEST the system for normal operation. **No** INSPECT accessory drive system or the transmission as a possible source.

PINPOINT TEST H: FRONT SUSPENSION NOISE

Test Step	Result / Action to Take
H1 ROAD TEST THE VEHICLE	
• Test drive the vehicle. • **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	
• ⚠ **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. • Check the steering system for wear or damage. Carry out a steering linkage test. Refer Section 211-00 . • 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	
• Check the front shock absorbers/strut mounts for loose bolts or nuts. • 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	
• 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	
• Inspect the control arm bushings for wear or damage. • Inspect for twisted or bent control/radius arm. • **Are the control/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	
• Check the stabilizer bar/track bar bushings and links for damage or wear. • Check the stabilizer bar/track bar for damage. • 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.

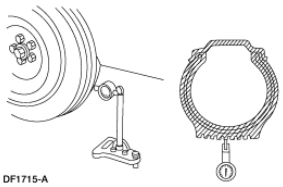
PINPOINT TEST I: REAR SUSPENSION NOISE

Test Step	Result / Action to Take
I1 ROAD TEST THE VEHICLE	
• Test drive the vehicle. • **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	
• ⚠ **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.	**Yes** TIGHTEN to specifications if loose. INSTALL new rear shock absorbers/struts if damaged. TEST the system for normal operation. **No** GO to I3 .

• Check the rear shock absorber/strut mounts for loose bolts or nuts. • Check the rear shock absorbers/struts for damage. Carry out a "bounce check". • **Are the rear shock absorbers/struts loose or damaged?**	
I3 CHECK THE REAR SPRINGS	
• 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	
• Inspect the control arm/trailing arm bushings for wear or damage. Check for loose control arm/trailing arm bolts. • 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	
• Check the stabilizer bar/track bar bushings and links for damage or wear. • Check the stabilizer bar/track bar for damage. • 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.

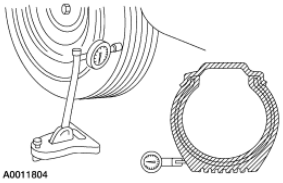
PINPOINT TEST J: WHEEL AND TIRE

Test Step	Result / Action to Take
J1 ROAD TEST THE VEHICLE	
• **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. • 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	

• 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	
• Check the tires for missing weights. • Check the wheels for damage. • 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	
• Spin the tires slowly and watch for signs of lateral runout.  DF1713-A • Spin the tires slowly and watch for signs of radial runout.  DF1714-A • **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	
• Measure the radial runout of the wheel and tire assembly. A typical specification for total radial runout is 0.045 inch.  DF1715-A • **Is the radial runout within specifications?**	**Yes** GO to J8 . **No** GO to J6 .
J6 RADIAL RUNOUT CHECK ON THE WHEEL	

• Measure the radial runout of the wheel. A typical specification for total radial runout is 0.045 inch. • **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	

• 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 204-01 for the front wheels or Section 204-02 for the rear wheels.

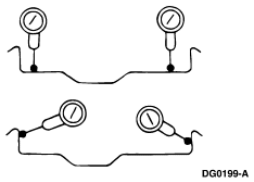
J8 LATERAL RUNOUT CHECK ON THE TIRE	
• Measure the lateral runout of the wheel and tire assembly. A typical specification for total lateral runout is 1.14 mm (0.045 inch).  A0011804 • **Is the lateral runout within specifications?**	**Yes** Wheel and tires OK. CONDUCT diagnosis on other suspect systems. **No** GO to J9 .
J9 LATERAL RUNOUT CHECK ON THE WHEEL	
• 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	

• 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 204-01 for the front wheels or

	Section 204-02 for the rear wheels.

PINPOINT TEST K: HIGH SPEED SHAKE OR SHIMMY DIAGNOSIS

Test Step	Result / Action to Take
K1 CHECK FOR FRONT WHEEL BEARING ROUGHNESS	
• Chock the rear wheels. • Raise and support the front end of the vehicle so that the front wheel and tire assemblies can spin. • 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	
• Check the end play of the front wheel bearings. Refer to Section 204-00 . • **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	
• Measure the lateral runout and the radial runout of the front wheels on the vehicle. Go 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	
• Measure the lateral runout of the front tires on the vehicle. Go 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	
• Measure the radial runout of the front tires on the vehicle. Go 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	
• 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	
• Dismount the tire and mount the wheel on a wheel balancer. Measure the runout on both wheel flanges. Refer to Section 204-04 .  DG0199-A • **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.** • 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**	**Yes** GO to K10 . **No**

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. • Chock the front wheels. • Raise and support the rear end of the vehicle so that the rear wheel and tire assemblies can spin. • Engage the drivetrain and carefully accelerate the drive wheels while checking for vibration. • **Is the vibration present?**	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.** • Remove the rear wheel and tire assemblies. Refer to Section 204-04 . • Secure the brake drums (if so equipped), by installing wheel hub bolt nuts, reversed. • 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.

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 degrees back from that position. Turn the steering wheel slowly in a 15 degree to 30 degree arc.

4. Turn the steering wheel another 90 degrees. Turn the steering wheel slowly in a 15 degree to 30 degree 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

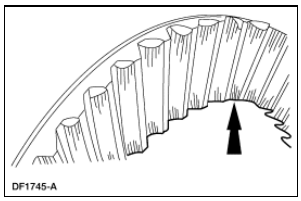
There are two basic types of conditions that will produce ring and pinion noise. The first type is a howl or chuckle produced by broken, cracked, chipped, scored or forcibly damaged gear teeth and is usually quite audible over the entire speed range. The second type of ring and pinion noise pertains 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.

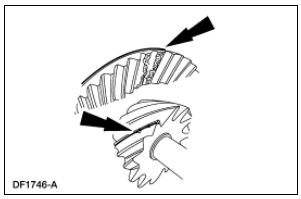
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Drain the axle lubricant. For additional information, refer to Section 205-02 .

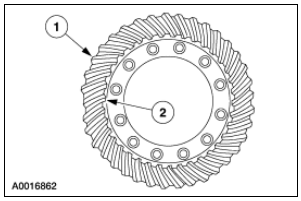
3. Remove the carrier assembly or the axle housing cover depending on the axle type. For additional information, refer to Section 205-02 .

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.

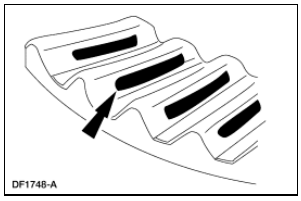


Item	Description
1	Heel
2	Toe

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.

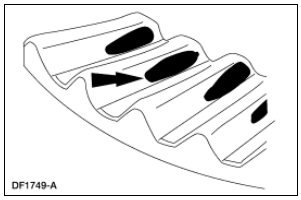
7. A good contact pattern should be centered on the tooth. It can also be slightly toward the toe. There should always be some clearance between the contact pattern and the top of the tooth.

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



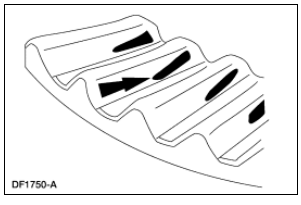
8. A high, thick contact pattern that is worn more toward the toe.

- 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.



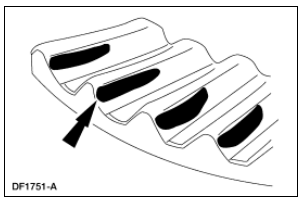
9. A high, thin contact pattern that is worn toward the toe.

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



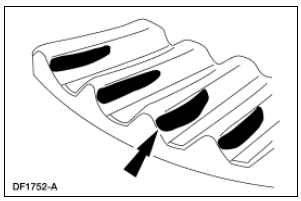
10. A contact pattern that is worn in the center of the differential ring gear tooth toward the heel.

- 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.



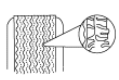
11. A contact pattern that is worn at the top of the differential ring gear tooth toward the heel.

- 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. For additional information, 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 the 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

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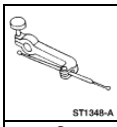
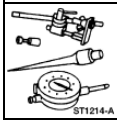
Special Tool(s)

 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1214-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

Printable View (9 KB)

⚠ 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.

Exhaust System Neutralizing

Printable View (10 KB)

⚠ 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

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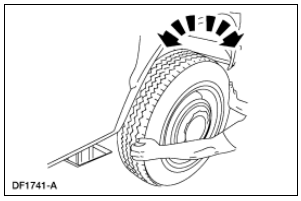
1. **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which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

   Raise the vehicle until the front tires are off the floor.

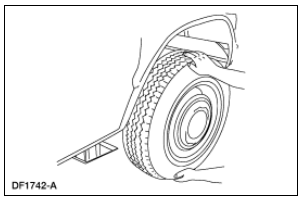
   - Make sure the wheels are in a straight forward position.

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.

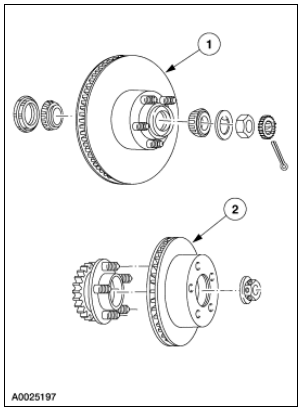
   Spin the tire by hand to check the wheel bearings for roughness.



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.



2004 Crown Victoria/Grand Marquis/Marauder Contents/Index

-- 1 --

1-2 Accumulator

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General Specifications

Item	Specification
Adhesives	
Weatherstrip Adhesive E8AZ-19552-A	ESB-M2G14-A
Lubricants	
Silicone Lubricant F7AZ-19G208-BA	ESR-M13P4-A
Sealers	
Liquid Butyl Sealer F8AZ-19554-CA	ESB-M4G162-A
3M Strip Caulk-Black 051135-08578	WSB-M4G32-C
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4

Body

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Body and Sheet Metal

The body:

- has roof and body side panels which are separate components with a trim insert at the joint.
- is a full framed body with an open cowl structure.
- is constructed off a monocoque, lightweight, all steel material.
- has removable doors, hood, luggage compartment lid, and front fenders constructed of a lightweight steel.

Insulation

Printable View (7 KB)

Insulation is comprised of urethane, PVC, and recycled felt. Insulation is installed:

- under the roof panel.
- above and below the instrument panel.
- on the cowl sides.
- over the front and rear floor areas.
- in the B-pillar and C-pillar sections.

Body Sealer Types And Applications

Printable View (9 KB)

Liquid Butyl Sealer

Liquid Butyl Sealer F8AZ-19554-CA or equivalent meeting Ford Specification ESB-M4G162-A:

- does not run.
- is fast drying.
- remains semi-elastic.
- can be used for seam sealing on the floor pan, wheelhouse, door openings, and drip rails.

Caulking Cord

3M Strip Caulk-Black 051135-08578 or equivalent meeting Ford specification WSB-M4G32-C:

- is a heavy-bodied, plastic base with a filler.
- is commonly known as perma-gum.
- is used on spot-welds holes and between surfaces not sealed with a gasket.

Weatherstrip Adhesive

Weatherstrip Adhesive E8AZ-19552-A or equivalent meeting Ford specification ESB-M2G14-A:

- is a quick drying, strong adhesive designed to hold weatherstripping onto all body panels and surrounding metal.

Silicone Lubricant

Silicone Lubricant F7AZ-19G208-BA meeting Ford specification ESR-M13P4-A:

- is used to keep the door and the window weatherstrip pliable and soft.
- should be applied to the weatherstrip at every lubrication period.
- makes the door easier to close.
- retards weatherstrip squeaks.
- retards weatherstrip wear.
- helps retain door window alignment by reducing friction between the glass frame and the rubber weatherstrip.
- should not be used prior to painting.

Body System

Printable View (13 KB)

Inspection and Verification

Leaks

NOTE: Trim will reveal the location of most leaks.

1. Remove any trim or carpet in the general area of the leak.
2. Road test or water test the vehicle.
3. Inspect for a dust pattern around the area in question. Inspect for water paths near and above the area in question.
4. Some leaks can be located by placing bright light under the vehicle, removing any necessary trim or carpet, and inspecting the interior of the body at joints and weld lines.

Noise

Wind noise, rattles and their sources are detected by driving the vehicle at highway speeds. The vehicle should be driven in four different directions with all of the windows closed, the radio off, the blower motor off, and all of the ventilation ducts open.

Most wind noise leaks will occur at the door and window seals or at the sheet metal joints in the door or the door opening.

Symptom Chart

Symptom Chart

Printable View (8 KB)

Torque Specifications

Description	Nm	lb-ft	lb-in
Air deflector screws	7		62
Air compressor bracket nuts	8		71
Fender bolts (rear)	28	21	
Fender brace bolts	12	9	
Fender to radiator support bolts	12	9	
Fender bolts (upper)	43	32	
Fender bolts	12	9	
Ground wire bolts	5		44
Hood hinge bolts	12	9	
Radiator grille opening panel bolts	6		53
Speed control actuator nuts	9		80
Battery tray bolt	12	9	

Fender Splash Shield LH

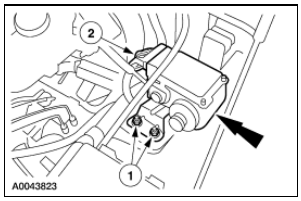
Printable View (287 KB)

Removal and Installation

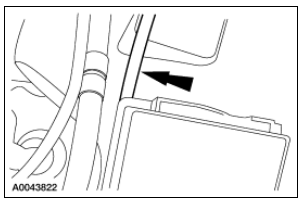
1. Disconnect the battery. For additional information, refer to Section 414-01 .

2. Remove the washer pump and reservoir. For additional information, refer to Section 501-16 .

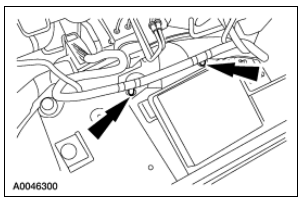
3. Position the speed control actuator aside.
    1. Remove the nuts.
    2. Disconnect the electrical connector.



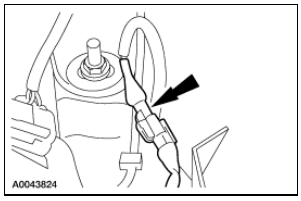
4. Disconnect the vacuum reservoir hose.



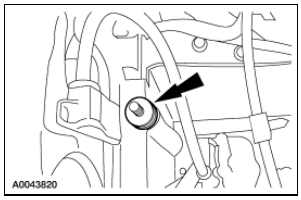
5. Release the wiring harness retainers from the splash shield.



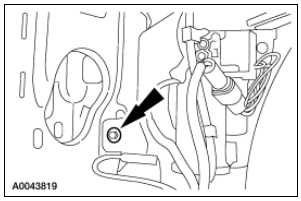
6. Disconnect the front ABS sensor wiring harness.



7. Remove the air cleaner mounting insulator.

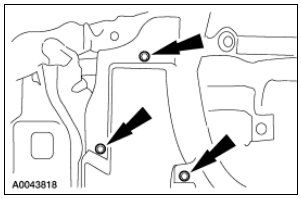


8. Remove the fender splash shield bolt.

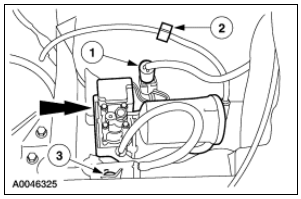


9. Remove the tire and wheel assembly. For additional information, refer to Section 204-04 .

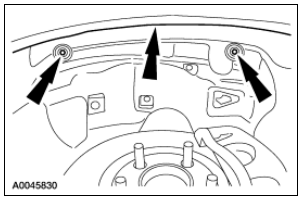
10. If equipped, remove the air compressor bracket nuts.



11. If equipped, position the air compressor aside.
    1. Disconnect the electrical connector.
    2. Release the air hose retainer.
    3. Remove the pin-type retainer.

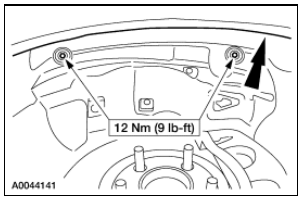


12. Remove the bolts and the fender splash shield.

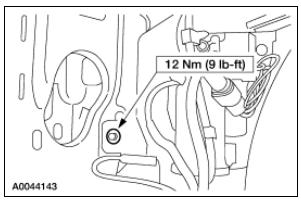


Installation

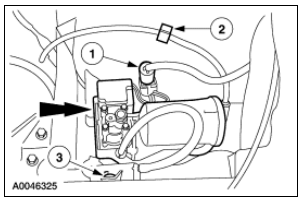
1. Position the fender splash shield and install the bolts.



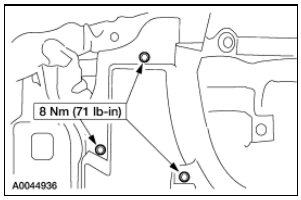
2. Install the fender splash shield bolt.



3. If equipped, install the air compressor.
    1. Connect the electrical connector.
    2. Connect the air hose retainer.
    3. Install the pin-type retainer.

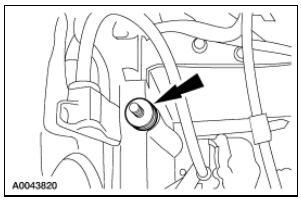


4. If equipped, install the air compressor bracket nuts.

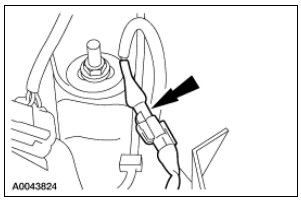


5. Install the tire and wheel assembly. For additional information, refer to Section 204-04 .

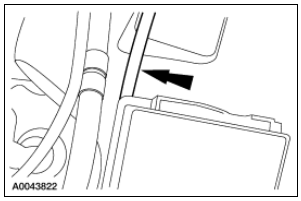
6. Install the air cleaner mounting insulator.



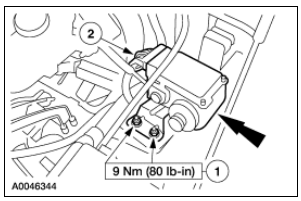
7. Connect the front ABS sensor wiring harness.



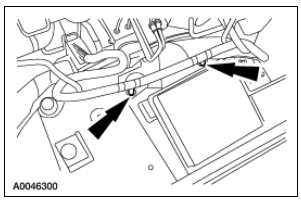
8. Connect the vacuum reservoir hose.



9. Position the speed control actuator.
    1. Install the nuts.
    2. Connect the electrical connector.



10. Connect the wiring harness retainers to the fender splash shield.



11. Install the washer pump and reservoir. For additional information, refer to Section 501-16 .

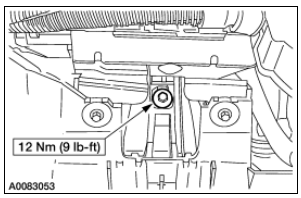
12. Connect the battery. For additional information, refer to Section 414-01 .

Fender Splash Shield RH

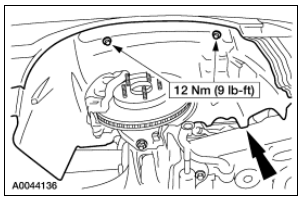
Printable View (57 KB)

Removal and Installation

1. Remove the battery. For additional information, refer to Section 414-01 .
2. Remove the tire and wheel assembly. For additional information, refer to Section 204-04 .
3. Remove the battery tray bolt.



4. Remove the bolts and the fender splash shield.



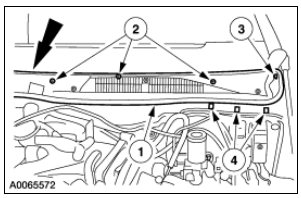
5. To install, reverse the removal procedure.

Cowl Panel Grille

Printable View (34 KB)

1. Remove the wiper pivot arms. For additional information, refer to Section 501-16 .

2. Position the cowl panel grille aside.
    1. Remove the weather seal.
    2. Remove the six screws.
    3. Remove the two pin-type retainers.
    4. Remove the five retainer clips.



3. Disconnect the washer hose union.

4. Remove the cowl panel grille.

5. To install, reverse the removal procedure.

Fender

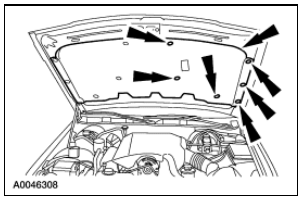
Printable View (531 KB)

Removal

NOTE: The LH fender is shown, the RH fender is similar.

1. **NOTE:** The pin-type retainers are a one-time use item, and new pin-type retainers must be installed after removal.

   If equipped with an engine compartment lamp, remove the pin-type retainers and position the hood insulation aside.



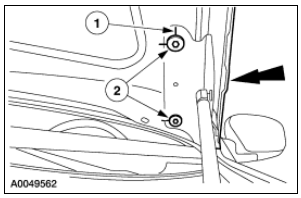
2. If equipped, release the wiring harness locators and disconnect the engine compartment lamp electrical connector.

3. **NOTE:** Two technicians needed to carry out this step.

   NOTE: Support the hood with a suitable hood support.

   Remove the hood.

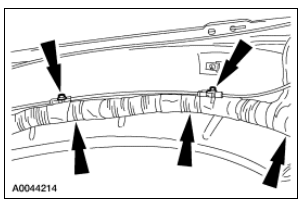
   - Mark the hinge locations and remove the hood hinge bolts.



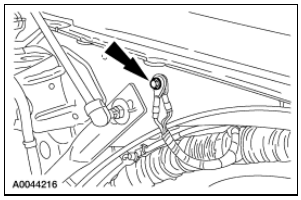
4. Remove the front bumper cover. For additional information, refer to Section 501-19 .

5. Remove the fender splash shield. For additional information, refer to Fender Splash Shield - LH or Fender Splash Shield - RH in this section.

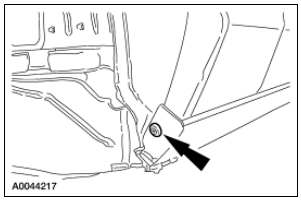
6. Release the wiring harness and the hood latch release cable locators.



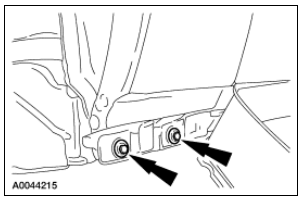
7. Remove the ground wire bolt.



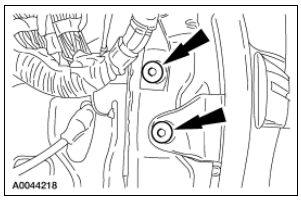
8. Remove the pin-type retainer and position the rocker panel moulding aside.



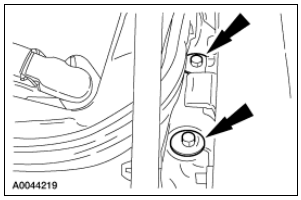
9. Remove the fender rear bolts.



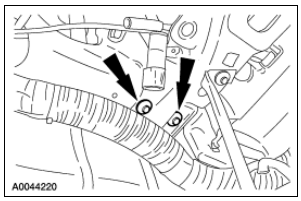
10. Remove the fender rear bolts.



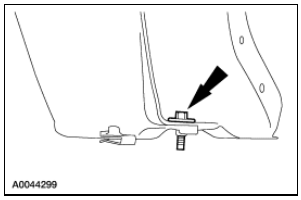
11. Remove the fender upper bolts.



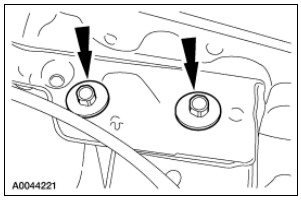
12. Remove the fender bolts.



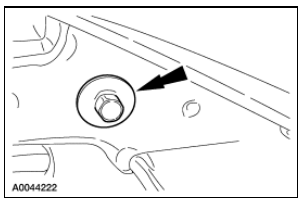
13. Remove the fender brace bolt.



14. Remove the fender to radiator support bolts.

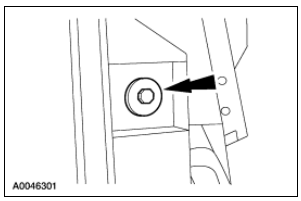


15. Remove the radiator grille opening panel bolt.



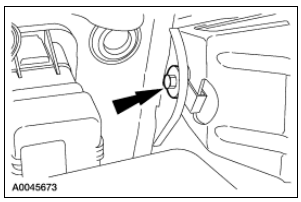
16. Remove the fender bolts.

17. Remove the radiator grille opening panel bolt.



18. **NOTE:** On the RH fender, an assistant is needed to support the fender when removing this bolt.

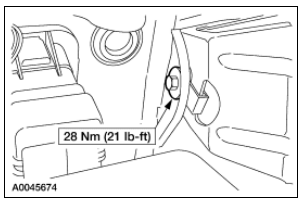
    Remove the fender rear bolt and the fender.



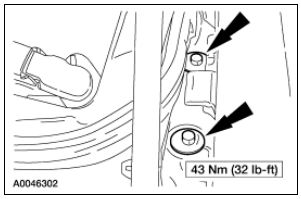
Installation

1. Position the fender.

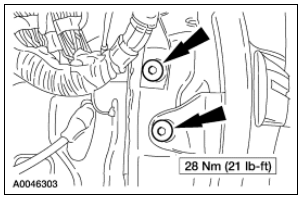
2. Install the fender rear bolts.



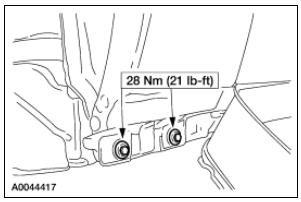
3. Install the fender upper bolts.



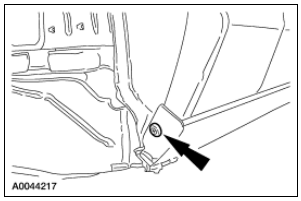
4. Install the fender rear bolts.



5. Install the fender rear bolts.



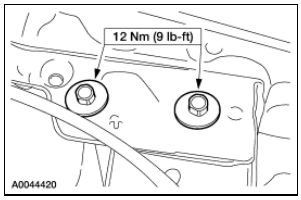
6. Position the rocker panel moulding and install the pin-type retainer.



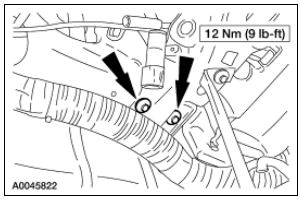
7. **⚠ CAUTION: The vehicle must be at the ride height when the front of the fender is attached. Failure to lower the vehicle will cause a misalignment between the radiator support and the fender.**

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

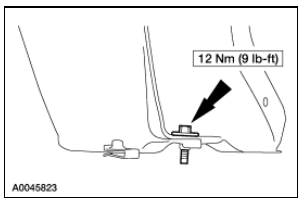
8. Install the fender to radiator support bolts.



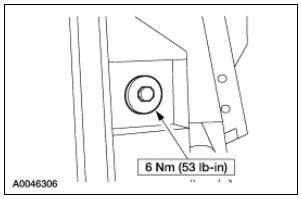
9. Install the fender bolts.



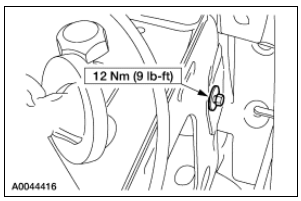
10. Install the fender brace bolt.



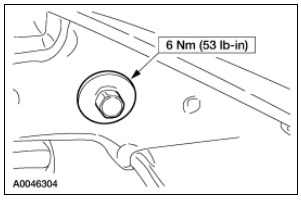
11. Install the radiator grille opening panel bolt.



12. Install the fender bolt.



13. Install the radiator grille opening panel bolt.



14. Connect the wiring harness and the hood latch release cable.