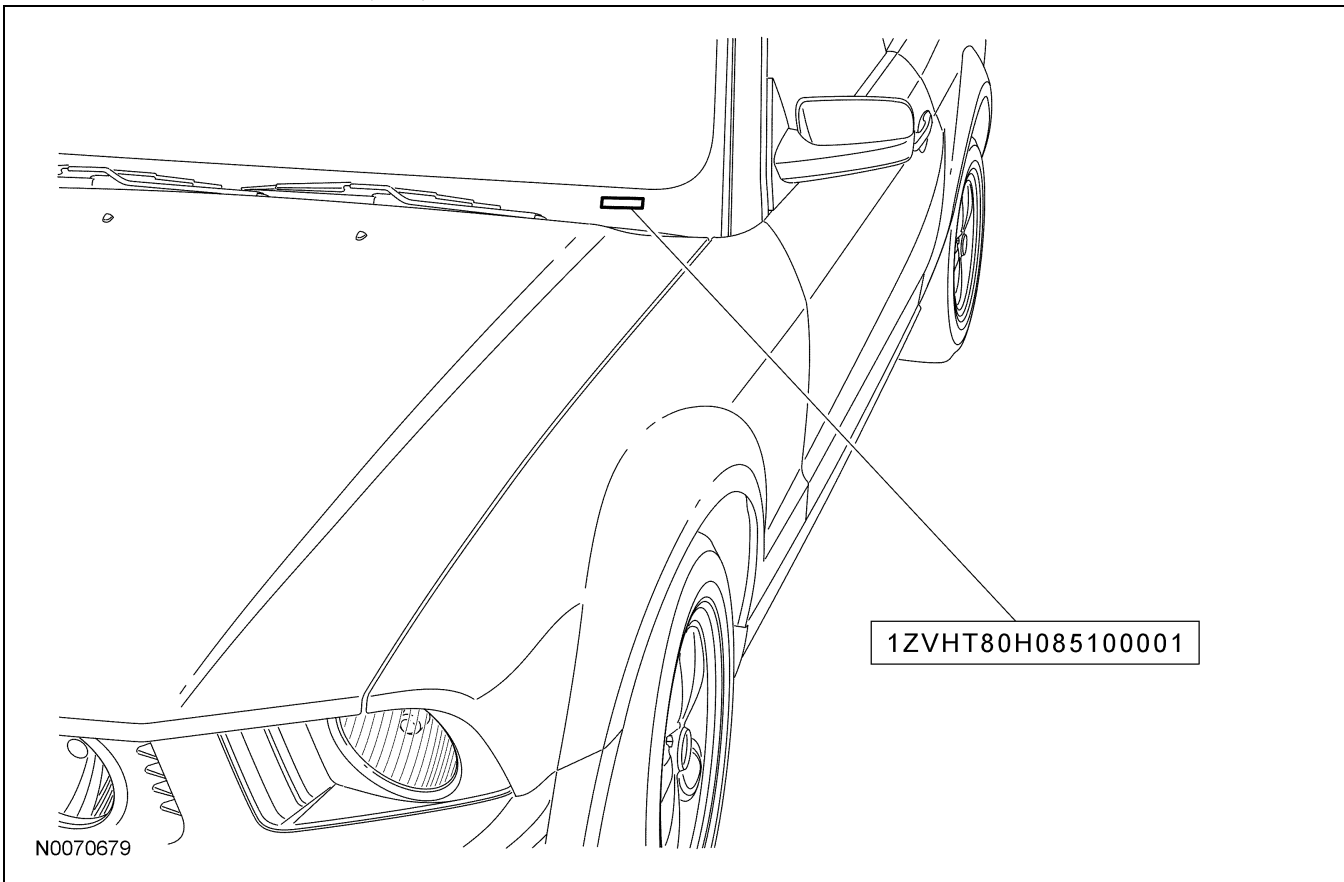


DESCRIPTION AND OPERATION

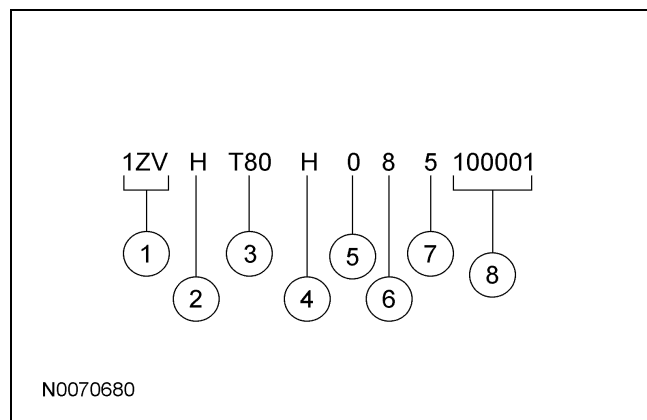
Identification Codes

Vehicle Identification Number (VIN) Locator



The vehicle identification number (VIN) is a 17-digit alphanumeric code. 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.

If the VIN plate requires replacement, authorized dealers must contact their respective regional office.



Item	Description
1	World manufacturer identifier (WMI)
2	Restraint-type code
3	Line, series, body type
4	Engine code
5	Computer-generated VIN check digit

DESCRIPTION AND OPERATION (Continued)

Item	Description
6	Model year code
7	Assembly plant code
8	Production sequence number

Vehicle Identification Number

World Manufacturer Identifier (WMI)

1ZV H T80 H 0 8 5 100001

↑

N0070681

The first 3 VIN positions are the world manufacturer identifier (WMI).

- 1ZV — Ford, USA, passenger car

Restraint-Type Code

1ZV H T80 H 0 8 5 100001

↑

N0070682

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 with side impact air bags

Line, Series and Body Type Code

1ZV H T80 H 0 8 5 100001

↑

N0070683

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

- T80 — 2-door coupe, base
- T82 — 2-door coupe, GT
- T84 — 2-door convertible, base
- T85 — 2-door convertible, GT
- T88 — 2-door coupe, GT500
- T89 — 2-door convertible, GT500

Engine Code

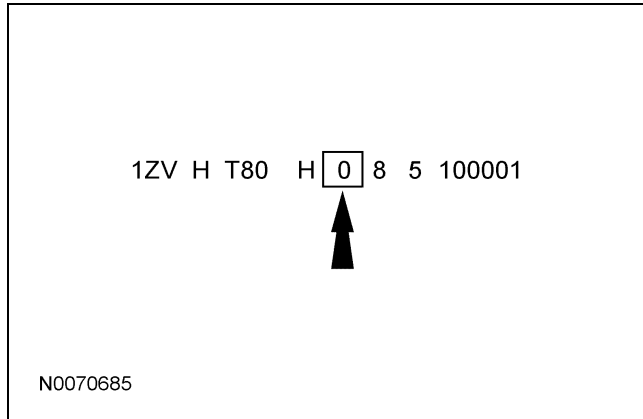
1ZV H T80 H 0 8 5 100001

↑

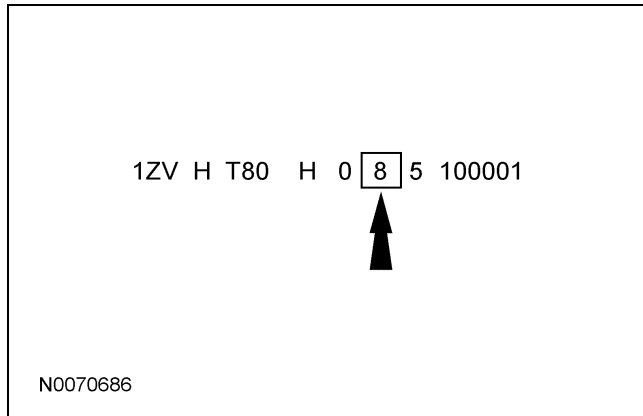
N0070684

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

- H — 4.6L, OHC, 3-valve, EFI, 8-cylinder
- N — 4.0L, SOHC, EFI, 6-cylinder
- S — 5.4L, DOHC, 4-valve, EFI, supercharged, 8-cylinder

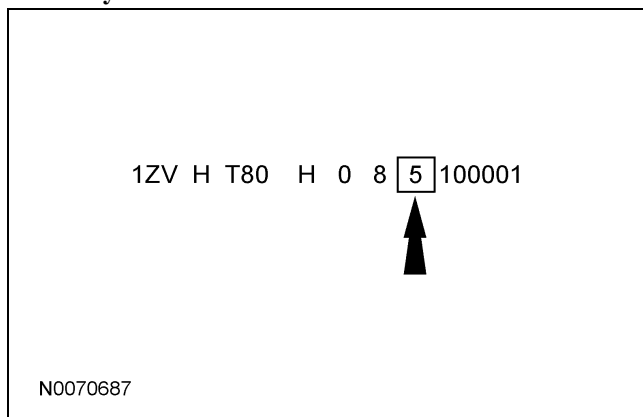
DESCRIPTION AND OPERATION (Continued)**Computer-Generated Check Digit**

The ninth VIN position is a government-assigned, computer-generated check digit code (0-9).

Model Year Code

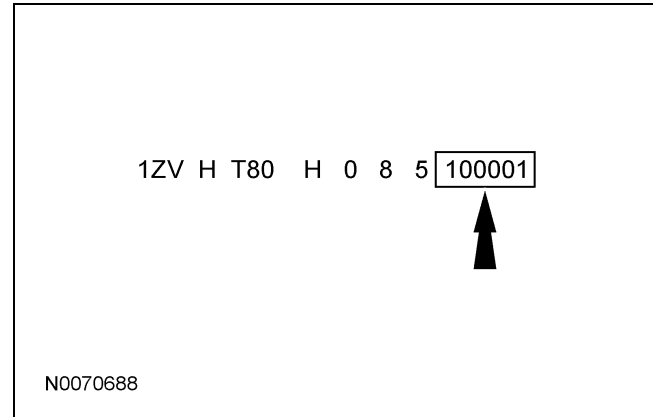
The tenth VIN position is the model year code.

- 8 — 2008

Assembly Plant Code

The eleventh VIN position is the assembly plant code.

- 5 — Auto Alliance International (AAI) — Flat Rock, Michigan (USA)

Production Sequence Number

The last 6 VIN positions are the production sequence number. This number is also used as the vehicle serial and warranty number.

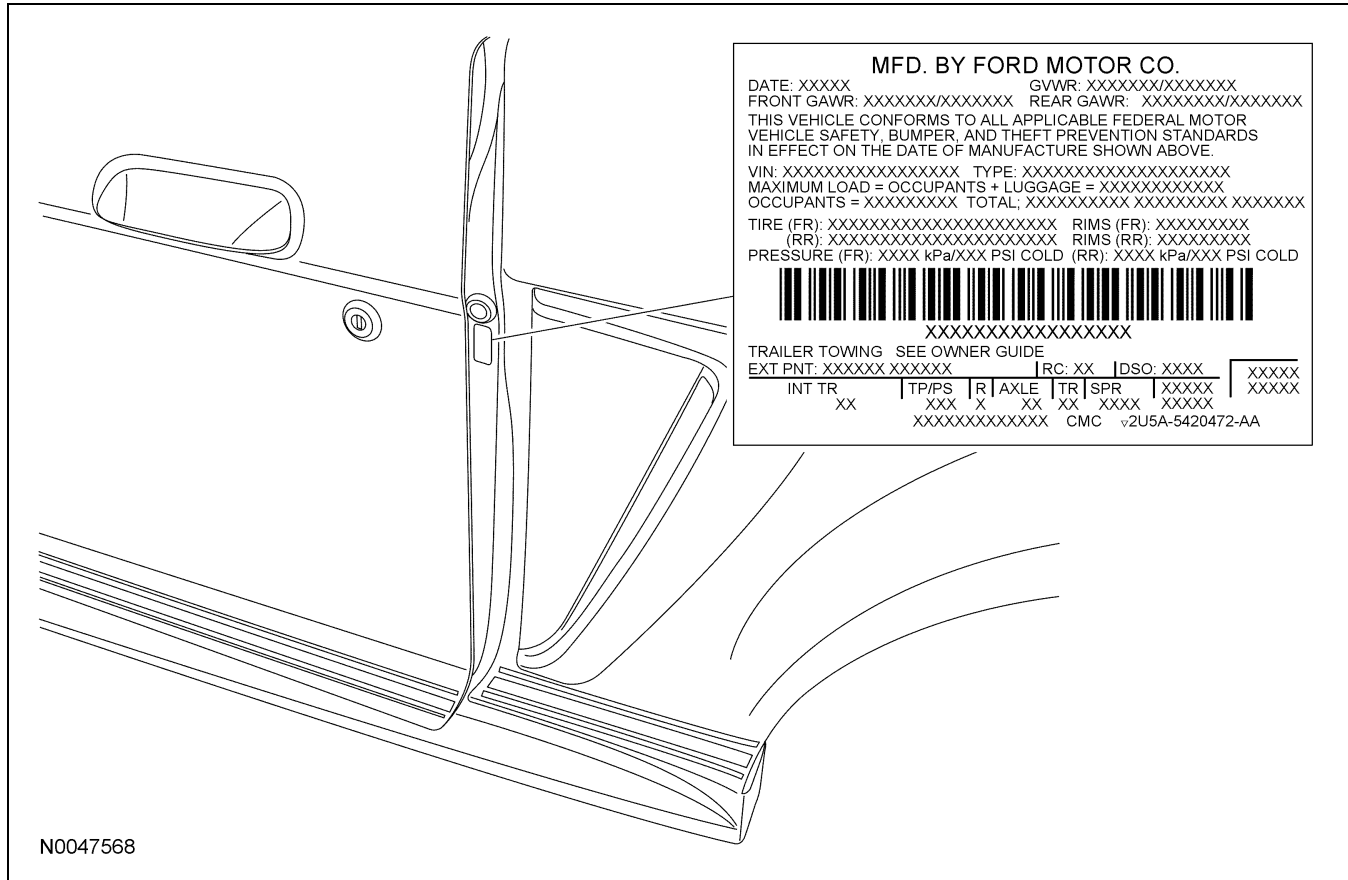
The serial number can also be found on the engine block and transmission.

- 100001-599999

DESCRIPTION AND OPERATION (Continued)

Vehicle Certification (VC) Label

Vehicle Certification (VC) Label Locator



The upper portion of the 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). The VC label is located on the LH door jamb.

If a vehicle requires replacement of the VC label and is 4 years old or less, an authorized dealer must submit the VIN to their respective regional office. The regional office will submit a web form to the assembly plant for the replacement label. Once the label has been printed, a representative from the regional office will deliver the label to the dealer and witness installation on the vehicle. If a vehicle is more than 4 years old and requires a replacement label, the dealer must submit a request to the Department of Motor Vehicles.

DESCRIPTION AND OPERATION (Continued)

MFD. BY FORD MOTOR CO.
 DATE: XXXX
 FRONT GAWR: XXXXXXXX/XXXXXXXXX GVWR: XXXXXXXX/XXXXXXXXX
 REAR GAWR: XXXXXXXX/XXXXXXXXX
 THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
 VIN: XXXXXX
 MAXIMUM LOAD = OCCUPANTS + LUGGAGE = XXXXXXXX
 OCCUPANTS = XXXXXXXX TOTAL: XXXXXXXX XXXXXXXX
 TIRE (FR): XXXXXXXX/XXXXXXXXX RIMS (FR): XXXXXXXX
 (RR): XXXXXXXX/XXXXXXXXX RIMS (RR): XXXXXXXX
 PRESSURE (FR): XXXX kPa/XXX PSI COLD (RR): XXXX kPa/XXX PSI COLD
 TRAILER TONGUE WEIGHT SEE OWNER GUIDE
 EXT PNT: XXXXXXX XXXXXXX
 INT TR XX | TP/PS XXX X | R AXLE XXX X | TR SPR XXXX | DSO: XXXX | XXXXX XXXXX
 XXXX
 MC 2U5A-420472-AA

Paint Codes

MFD. BY FORD MOTOR CO.
 DATE: XXXX
 FRONT GAWR: XXXXXXXX/XXXXXXXXX GVWR: XXXXXXXX/XXXXXXXXX
 REAR GAWR: XXXXXXXX/XXXXXXXXX
 THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
 VIN: XXXXXX
 MAXIMUM LOAD = OCCUPANTS + LUGGAGE = XXXXXXXX
 OCCUPANTS = XXXXXXXX TOTAL: XXXXXXXX XXXXXXXX
 TIRE (FR): XXXXXXXX/XXXXXXXXX RIMS (FR): XXXXXXXX
 (RR): XXXXXXXX/XXXXXXXXX RIMS (RR): XXXXXXXX
 PRESSURE (FR): XXXX kPa/XXX PSI COLD (RR): XXXX kPa/XXX PSI COLD
 TRAILER TONGUE WEIGHT SEE OWNER GUIDE
 EXT PNT: XXXXXXX XXXXXXX
 INT TR XX | TP/PS XXX X | R AXLE XXX X | TR SPR XXXX | DSO: XXXX | XXXXX XXXXX
 XXXX
 MC 2U5A-420472-AA

Paint codes may be listed as a 2-part code. The first set of paint code letters/numbers listed indicate the vehicle primary body color. The second set of paint code letters/numbers listed (if applicable) indicate a 2-tone or accent body color. All colors are base coat/clear coat.

- D3 — Colorado Red
- G5 — Alloy Gray
- G9 — Vista Blue
- HP — Performance White
- JV — Sangria Red
- PX — Dark Highland Green
- U3 — Valencia
- UA — Ebony
- YN — Silver Metallic
- ZY — Vapor Silver Pearl

Item	Description
1	Exterior paint color code
2	Region code
3	Special order code DSO — domestic special order FSO — foreign special order PTO — paint, tire option special order
4	Interior trim code
5	Tape/paint stripe code
6	Radio type code
7	Axle ratio code
8	Transmission code
9	Spring code
10	Powertrain calibration code

Interior Trim Codes

MFD. BY FORD MOTOR CO.
 DATE: XXXX
 FRONT GAWR: XXXXXXXX/XXXXXXXXX GVWR: XXXXXXXX/XXXXXXXXX
 REAR GAWR: XXXXXXXX/XXXXXXXXX
 THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
 VIN: XXXXXX
 MAXIMUM LOAD = OCCUPANTS + LUGGAGE = XXXXXXXX
 OCCUPANTS = XXXXXXXX TOTAL: XXXXXXXX XXXXXXXX
 TIRE (FR): XXXXXXXX/XXXXXXXXX RIMS (FR): XXXXXXXX
 (RR): XXXXXXXX/XXXXXXXXX RIMS (RR): XXXXXXXX
 PRESSURE (FR): XXXX kPa/XXX PSI COLD (RR): XXXX kPa/XXX PSI COLD
 TRAILER TONGUE WEIGHT SEE OWNER GUIDE
 EXT PNT: XXXXXXX XXXXXXX
 INT TR XX | TP/PS XXX X | R AXLE XXX X | TR SPR XXXX | DSO: XXXX | XXXXX XXXXX
 XXXX
 MC 2U5A-420472-AA

DESCRIPTION AND OPERATION (Continued)

The interior trim codes are listed as a 2-part code. The first character listed is the interior fabric. The second character listed is the interior color.


- 5 — Cloth seats with logo — GT
- G — No grain mini perforation — GT500
- J — Verona leather seats — Base
- K — Nudo/Aberdeen leather seats — GT
- M — Nudo/Aberdeen leather with contrasting insert — California Special Edition
- N — Mustang Sally leather with stitching
- P — Cloth seats — Base

The interior trim colors are:

- 2 — Medium Dove Gray
- 4 — Charcoal Black/Chamois
- C — Charcoal Black/Camel
- D — Charcoal Black/Medium Dove Gray
- H — Camel Tan
- R — Midnight Black/Crimson Red
- W — Charcoal Black

Tape/Paint Stripe Codes

MFD. BY FORD MOTOR CO.
 DATE: XXXXX GVWR: XXXXXXX/XXXXXXXX
 FRONT GAWR: XXXXXXX/XXXXXXXX REAR GAWR: XXXXXXX/XXXXXXXX
 THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
 VIN: XXXXXXXXXXXXXXXXXXXX TYPE: XXXXXXXXXXXXXXXXXXXX
 MAXIMUM LOAD = OCCUPANTS + LUGGAGE = XXXXXXXXXXXX
 OCCUPANTS = XXXXXXXX TOTAL: XXXXXXXXXXX XXXXXXXX XXXXXXXX
 TIRE (FR): XXXXXXXXXXXXXXXXXXXX RIMS (FR): XXXXXXXX
 (RR): XXXXXXXXXXXXXXXXXXXX RIMS (RR): XXXXXXXX
 PRESSURE (FR): XXXX kPa/XXX PSI COLD (RR): XXXX kPa/XXX PSI COLD



XXXXXXXXXXXXXXXXXXXX

TRAILER TOWING SEE OWNER GUIDE
 EXT PNT: XXXXXX XXXX IRC: XX DSO: XXXX XXXXX XXXXX
 INT TR XX TP/PS X R AXLE TR SPR XXXX XXXXX
 XXXXXXXXXXXXXXXX CMC v2U5A-5420472-AA

N0039639


The tape and paint stripe codes are:

- 1 — Black
- 2 — Oxford White
- 3 — Light Pearl Gold
- 4 — Performance White
- 7 — Satin Silver
- 8 — Vista Blue
- A — Alloy Gray

- E — Ebony
- P — Pink
- X — Satin Black

Radio Codes

MFD. BY FORD MOTOR CO.
 DATE: XXXXX GVWR: XXXXXXX/XXXXXXXX
 FRONT GAWR: XXXXXXX/XXXXXXXX REAR GAWR: XXXXXXX/XXXXXXXX
 THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
 VIN: XXXXXXXXXXXXXXXXXXXX TYPE: XXXXXXXXXXXXXXXXXXXX
 MAXIMUM LOAD = OCCUPANTS + LUGGAGE = XXXXXXXXXXXX
 OCCUPANTS = XXXXXXXX TOTAL: XXXXXXXXXXX XXXXXXXX XXXXXXXX
 TIRE (FR): XXXXXXXXXXXXXXXXXXXX RIMS (FR): XXXXXXXX
 (RR): XXXXXXXXXXXXXXXXXXXX RIMS (RR): XXXXXXXX
 PRESSURE (FR): XXXX kPa/XXX PSI COLD (RR): XXXX kPa/XXX PSI COLD



XXXXXXXXXXXXXXXXXXXX

TRAILER TOWING SEE OWNER GUIDE
 EXT PNT: XXXXXX XXXXXX IRC: XX DSO: XXXX XXXXX XXXXX
 INT TR XX TP/PS X R AXLE TR SPR XXXX XXXXX
 XXXXXXXXXXXXXXXX CMC v2U5A-5420472-AA


N0039640

The radio type codes are:

- 5 — Premium electronic AM/FM stereo with CD player and clock
- 9 — CDX6+, AM/FM stereo with 6-disc CD changer, MP3 and speed-sensing volume control
- X — AM/FM stereo with 6-disc CD changer and navigation system

Axle Ratio Codes

MFD. BY FORD MOTOR CO.
 DATE: XXXXX GVWR: XXXXXXX/XXXXXXXX
 FRONT GAWR: XXXXXXX/XXXXXXXX REAR GAWR: XXXXXXX/XXXXXXXX
 THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
 VIN: XXXXXXXXXXXXXXXXXXXX TYPE: XXXXXXXXXXXXXXXXXXXX
 MAXIMUM LOAD = OCCUPANTS + LUGGAGE = XXXXXXXXXXXX
 OCCUPANTS = XXXXXXXX TOTAL: XXXXXXXXXXX XXXXXXXX XXXXXXXX
 TIRE (FR): XXXXXXXXXXXXXXXXXXXX RIMS (FR): XXXXXXXX
 (RR): XXXXXXXXXXXXXXXXXXXX RIMS (RR): XXXXXXXX
 PRESSURE (FR): XXXX kPa/XXX PSI COLD (RR): XXXX kPa/XXX PSI COLD



XXXXXXXXXXXXXXXXXXXX

TRAILER TOWING SEE OWNER GUIDE
 EXT PNT: XXXXXX XXXXXX IRC: XX DSO: XXXX XXXXX XXXXX
 INT TR XX TP/PS X R AXLE TR SPR XXXX XXXXX
 XXXXXXXXXXXXXXXX CMC v2U5A-5420472-AA

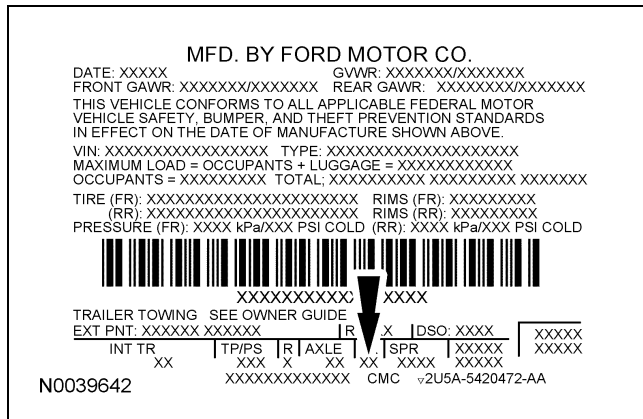
N0039641

The axle ratios are:

- BG — 3.31 — non-limited slip, base vehicle with manual or automatic transmission
- CD — 3.55 — limited slip, GT with manual transmission
- CG — 3.31 — limited slip, GT with automatic transmission

DESCRIPTION AND OPERATION (Continued)

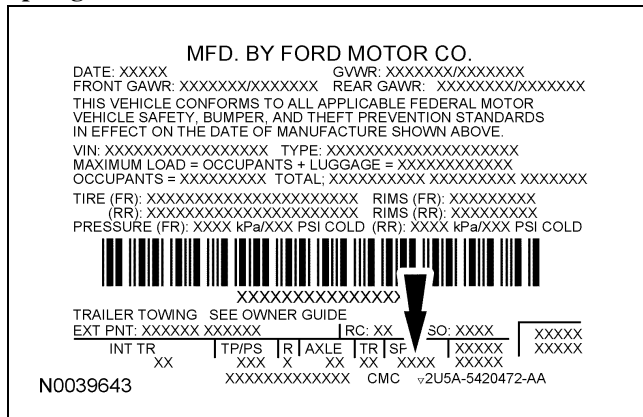
Transmission Codes



The transmission codes are:

- E — 6-speed manual (T56) — GT500
- F — 5-speed manual (T5OD/TR3150) — Base
- K — 5-speed manual (TR3650) — GT
- L — 5-speed automatic (5R55S) — Base/GT

Spring Codes



The spring code portion of the VC label identifies both the front and rear springs. The first set of characters listed indicate the front spring code. The second set of characters indicate the rear spring code.

Front Springs

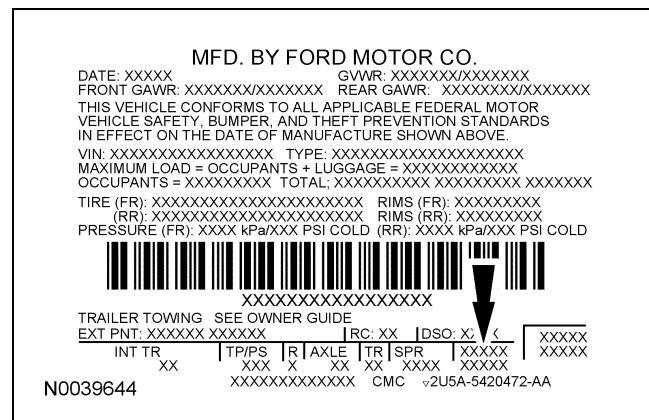
- AA — 4R33-5310-AA
- BB — 4R33-5310-BA

- CC — 4R33-5310-CA
- DD — 4R33-5310-DA
- FF — 4R33-5310-FA
- GG — 4R33-5310-GA

Rear Springs

- AA — 5R33-5560-AA
- BB — 5R33-5560-BA
- CC — 5R33-5560-CA
- DD — 5R33-5560-DA
- EE — 5R33-5560-EB
- FF — 5R33-5560-FA
- GG — 5R33-5560-GA
- HH — 5R33-5560-HA
- JJ — 7R3V-5560-JA
- KK — 7R3V-5560-KA
- LL — 7R3V-5560-LA
- MM — 7R3V-5560-MA

Powertrain Calibration Information

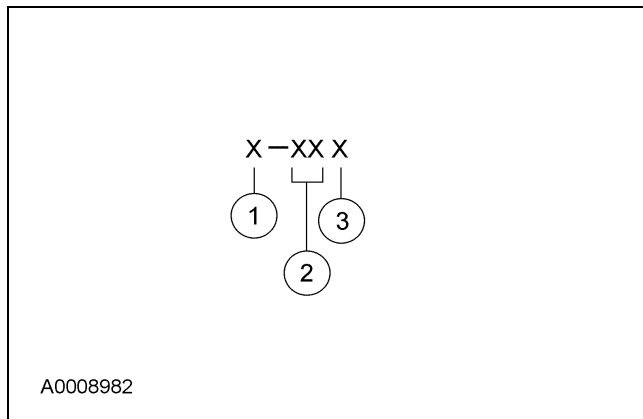


DESCRIPTION AND OPERATION (Continued)

NOTE: Powertrain calibration information is limited to a maximum of 5 characters per line on the VC label. Because of this, calibration identification consisting of more than 5 characters will wrap to the second line on the VC label.

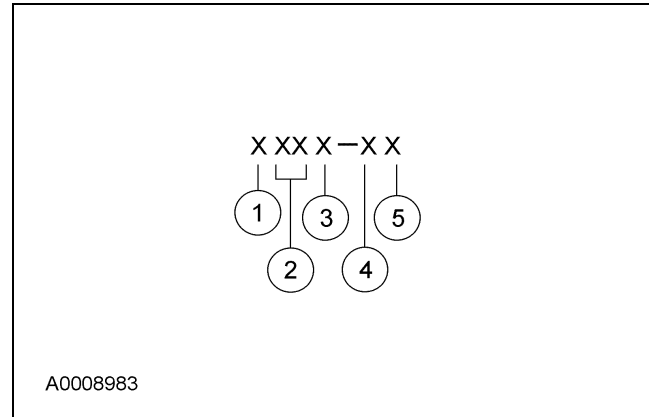
Powertrain calibration information is printed in the lower right corner of the VC label. Only the base calibration information is printed. Revision levels will not appear, however, this information can be found in OASIS. For the current model year, Ford Motor Company is using 3 different protocols which describe powertrain base calibration. These protocols are designed to provide worldwide standardization for vehicle calibration. If the electronic calibration strategy has been used since 1998 and carried into the current model year, Protocol 1 will be used. Refer to Protocol 1 below. If the electronic calibration strategy has been used since 1999 and is carried into the current model year, Protocol 2 will be used. Refer to Protocol 2 below. For new electronic calibration strategies introduced since the 2000 model year, use Protocol 3. Refer to Protocol 3 below.

Protocol 1



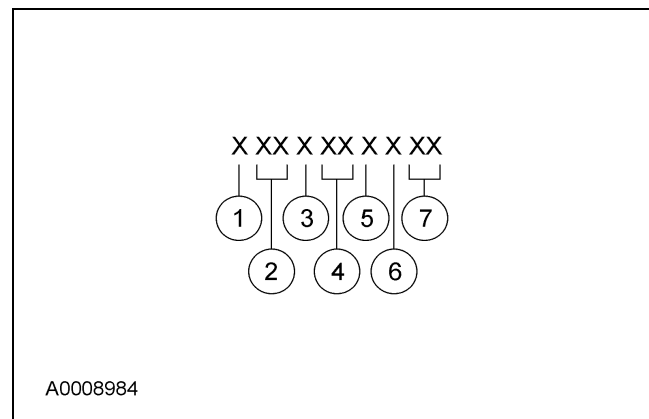
Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Engine code
3	Engine revision level

Protocol 2



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

Protocol 3



Item	Description
1	Model year (model year in which calibration strategy was first introduced)
2	Vehicle code
3	Transmission code
4	Unique calibration (designates different hardware to similar vehicles). Example: tires, drive ratios, etc.

DESCRIPTION AND OPERATION (Continued)

Item	Description
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

Protocol 3

The following offers a more detailed explanation of the coding strategy used for Protocol 3.

Model Year

- Y — 2000
- 1 — 2001
- 2 — 2002
- 3 — 2003
- 4 — 2004
- 5 — 2005
- 6 — 2006
- 7 — 2007
- 8 — 2008

Vehicle Line

- ZF — Mustang

Transmission

- 1 — Automatic transmission
- 2 — Manual transmission

Unique Calibration

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

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

Fleet Code

- 1 — HDGE/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 (OBD)
- 9 — Not assigned

Certification Region

- 5 — U.S. 50 states
- A — U.S. federal, including altitude, may include Canada and/or Mexico
- B — U.S. California standard, includes U.S. green states
- C — Canada
- D — China
- E — European Community (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom)
- F — Extended European Community (E plus Croatia, Czech Republic, Estonia, Hungary, Norway, Poland, Romania, Russian Federation, Slovakia, Slovenia, Switzerland and Yugoslavia)
- G — Gulf Cooperative Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE)
- 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 regions)
- V — Vietnam
- X — Rest of world (ROW)
- Y — Military
- Z — Israel

Revision Level (not printed on label)

- 91-99 — Hardware certification levels
- 01-04 — Preliminary levels

DESCRIPTION AND OPERATION (Continued)

- 00 — Job 1 production (initial certification)
 - 05-09 — Pre-job 1 revisions to calibrations
 - 10-89 — Post-job 1 revisions to calibrations
 - 0B — Durability test level
 - BD — On-board diagnostics (OBD) intermediate level (pre-05)
-

DESCRIPTION AND OPERATION

Jacking and Lifting

⚠ WARNING: When jacking or lifting the vehicle, block all wheels remaining on the ground. Set the parking brake if the rear wheels will remain on the ground. These actions help prevent unintended vehicle movement. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Never get underneath a vehicle that is supported only by a jack. The jack could unintentionally lower. Always support vehicle with floor stands. Failure to follow these instructions may result in serious personal injury.

⚠ WARNING: Only raise the vehicle when positioned on a hard, level surface. Attempting to raise the vehicle on an uneven or soft surface may result in vehicle slipping or falling from the jack or jackstand. Failure to follow this instruction may result in serious personal injury.

⚠ 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.

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

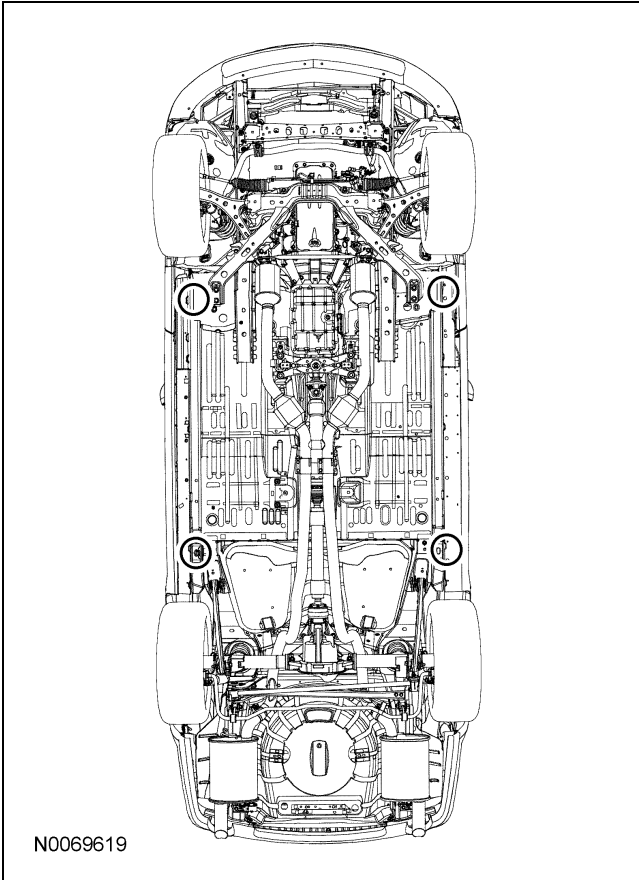
⚠ CAUTION: To prevent possible damage to the underbody, do not drive the vehicle onto the drive-on lift without first checking for possible interference.

⚠ CAUTION: When raising a vehicle on a twin-post hoist, use care when positioning the vehicle so that the hoisting forks do not interfere with the suspension components, mounting brackets or stabilizer mounting brackets, if equipped. In addition, use care in hoist positioning to avoid possible damage to the axle carrier or rear cover.

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

DESCRIPTION AND OPERATION (Continued)

Jacking and Lifting Locations — Front and Rear



DESCRIPTION AND OPERATION

Maintenance Schedules — Gasoline Engines

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, time or hours of operation, whichever occurs first. 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 a trailer or using a camper or car-top carrier
- Extensive idling and/or low-speed driving for long distances as in heavy commercial use such as delivery, taxi, patrol car or livery
- Driving in dusty conditions such as unpaved or dusty roads
- Off-road operation
- Use of E85 fuel 50% of the time or greater (flex fuel vehicles only)

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

- Vehicle axle — maintenance and lubrication
- Police and taxi vehicles — maintenance and lubrication
- Engine oil and Motorcraft Premium Gold Coolant — time-based and mileage-based intervals
- Change brake fluid every 2 years (Class A Motorhome)

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 8,000 km (5,000 mi) or 6 months.
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise every 8,000 km (5,000 mi). Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.
- Change automatic transmission/transaxle fluid (not required on 6R60/6R75/TorqShift® transmissions) every 48,000 km (30,000 mi).
- Replace wheel bearing grease and install new grease seals on rear wheel drive (RWD) front wheel bearings (if non-sealed bearings) every 48,000 km (30,000 mi).
- Change transfer case fluid every 96,000 km (60,000 mi).
- 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 8,000 km (5,000 mi) or 6 months or 200 hours of engine operation.
- Lube front lower control arm and steering linkage ball joints with zerk fittings (if equipped) every 8,000 km (5,000 mi).
- Inspect brake system every 8,000 km (5,000 mi).
- Inspect and lubricate U-joints (if equipped) every 8,000 km (5,000 mi).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise every 8,000 km (5,000 mi). Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

DESCRIPTION AND OPERATION (Continued)

- Lubricate control arm and steering ball joints (if equipped).
- Install a new fuel filter every 24,000 km (15,000 mi) (not required for Fusion, Milan, MKZ, Edge, MKX, Taurus X, Taurus and Sable).
- Replace wheel bearing grease and install new grease seals on RWD front wheel bearings (if non-sealed bearings) every 48,000 km (30,000 mi).
- Change automatic transmission fluid (not required on 6R60/6R75/TorqShift® transmissions) every 48,000 km (30,000 mi).
- Install new spark plugs every 96,000 km (60,000 mi).
- Change transfer case fluid every 96,000 km (60,000 mi).
- Install a new cabin air filter as required (if equipped).

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

- Change engine oil and install a new oil filter every 8,000 km (5,000 mi) or 6 months.
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise every 8,000 km (5,000 mi). Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.
- Inspect and lubricate U-joints (if equipped) every 8,000 km (5,000 mi).
- Install a new fuel filter every 24,000 km (15,000 mi) (not required for Fusion, Milan, MKZ, Edge, MKX, Taurus X, Taurus and Sable).
- Change automatic transmission fluid (not required on 6R60/6R75/TorqShift® transmissions) every 48,000 km (30,000 mi).
- Replace wheel bearing grease and install new grease seals on RWD front wheel bearings (if non-sealed bearings) every 48,000 km (30,000 mi).
- Change rear axle lubricant every 80,000 km (50,000 mi) (E-450 and F-450/550 only).
- Change transfer case fluid every 96,000 km (60,000 mi).

- Install a new engine air filter as required.
- Install a new cabin air filter as required (if equipped).

When operating in off-road conditions:

- Change engine oil and install a new oil filter every 8,000 km (5,000 mi) or 6 months.
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise every 8,000 km (5,000 mi). Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.
- Replace wheel bearing grease and install new grease seals on RWD front wheel bearings (if non-sealed bearings) every 48,000 km (30,000 mi).
- Change automatic transmission fluid (not required on 6R60/6R75/TorqShift® transmissions) every 48,000 km (30,000 mi).
- Change rear axle lubricant every 80,000 km (50,000 mi) (E-450 and F-450/550 only).
- Change transfer case fluid every 96,000 km (60,000 mi).
- Install a new cabin air filter as required (if equipped).
- Inspect and lubricate U-joints and halfshafts as required.
- Inspect and lubricate steering linkage ball joints with zerk fittings as required.

Use of E85 fuel 50% of the time or greater (flex fuel vehicles only):

- Fill fuel tank with a full tank of regular unleaded fuel every 4,800 km (3,000 mi).
- Change engine oil and install a new oil filter every 8,000 km (5,000 mi), 6 months or 200 hours of engine operation.
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise every 8,000 km (5,000 mi). Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

DESCRIPTION AND OPERATION (Continued)

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 transmission (if equipped with a underhood fluid level indicator), power steering and window washer fluids.
- Inspect tires for wear and correct air pressure, including spare tire.
- 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 engine air filter.
- Inspect halfshaft dust boots (if equipped).
- Check shocks, struts and other suspension components for leaks and damage.
- Inspect steering and linkage.
- Inspect accessory drive belt(s).
- Inspect clutch operation (if equipped).

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)

- 12,000 km (7,500 mi) or 6 months.

Maximum Oil Change Interval (Special Operating Conditions)

- 8,000 km (5,000 mi), 6 months or 200 hours of engine operation.

Engine Coolant Change Interval

- 6 years or 169,000 km (105,000 mi).
- After initial change: 3 years or 73,000 km (45,000 mi).

Monthly Checks

Check each of the following items every month:

- All interior and exterior lights for correct operation
- Tires for wear and correct air pressure, including spare tire
- Engine oil fluid level
- Windshield washer solvent fluid level

Six Month Checks

Check each of the following items at least every 6 months:

- Lap/shoulder belts and seat latches for wear and function
- External mounted spare tire is stowed correctly (tight to body)
- Power steering fluid level
- Washer spray, wiper operation and clean all wiper blades (install new wiper blades as necessary)
- Parking brake for correct operation
- Lubricate all hinges, latches, door check straps and outside locks
- Lubricate upper and lower sliding door tracks (if equipped)
- Clean sliding door contact switches (if equipped)
- Lubricate door rubber weatherstrips
- Clean body and door drain holes
- 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

DESCRIPTION AND OPERATION (Continued)**Normal Schedule**

The following check procedures should be carried out for all cars, minivans, light trucks, sport utilities, vans and four wheel drive (4WD) vehicles.

- Retighten the wheel nuts to the specified torque at 800 km (500 mi) after any wheel disturbance (tire rotation, changing a flat tire or wheel removal).
- On vehicles equipped with dual rear wheels, retighten the wheel nuts to the specified torque at 160 km (100 mi) and again at 800 km (500 mi) of new vehicle operation or after any wheel disturbance (tire rotation, changing a flat tire or wheel removal).

12,000 Km (7,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

24,000 Km (15,000 Mi)

- Change engine oil and install a new oil filter.
- Install a new cabin air filter (if equipped).
- Inspect steering linkage, suspension and if equipped, driveshaft and U-joints.
- Inspect engine cooling system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect engine air filter.
- Inspect automatic transmission fluid level (if equipped with an underhood fluid level indicator).
- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).
- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).

- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

36,000 Km (22,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

48,000 Km (30,000 Mi)

- Change engine oil and install a new oil filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with the TorqShift® transmission and externally mounted remote filter.
- Install a new remote filter if equipped with a TorqShift® transmission.
- Inspect automatic transmission/transaxle fluid level using the fluid level on all other vehicles (if equipped with an underhood fluid level indicator).
- Install a new cabin air filter (if equipped).
- Install new climate controlled seat cushion filters (if equipped).
- Install a new engine air filter (except Focus with partial zero emission vehicle [PZEV] engine).
- Install a new fuel filter (not required for Fusion, Milan, MKZ, Edge, MKX, Taurus X, Taurus and Sable).
- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine cooling system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect and lubricate ball joints (if equipped with zerk fittings).

DESCRIPTION AND OPERATION (Continued)

- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

60,000 Km (37,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

72,000 Km (45,000 Mi)

- Change engine oil and install a new oil filter.
- Install a new cabin air filter (if equipped).
- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine cooling system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect engine air filter.
- Inspect automatic transmission fluid level (if equipped with an underhood fluid level indicator).
- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).
- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

84,000 Km (52,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

96,000 Km (60,000 Mi)

- Change engine oil and install a new oil filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with the TorqShift® and 4F27E transmissions.
- Install a new externally mounted remote filter element for all TorqShift® transmissions (if equipped).
- Install a new internal TorqShift® transmission fluid filter located inside the transmission bottom pan (vehicles without externally mounted remote filter only).
- Inspect automatic transmission/transaxle fluid level on all other vehicles (if equipped with an underhood fluid level indicator).
- Install a new cabin air filter (if equipped).
- Install new climate controlled seat cushion filters (if equipped).
- Install a new engine air filter.
- Install a new fuel filter (not required for Fusion, Milan, MKZ, Edge, MKX, Taurus X, Taurus and Sable).
- Replace wheel bearing grease and install new grease seals on RWD front wheel bearings (if non-sealed bearings).
- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine cooling system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).

DESCRIPTION AND OPERATION (Continued)

- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

108,000 Km (67,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

120,000 Km (75,000 Mi)

- Change engine oil and install a new oil filter.
- Install a new cabin air filter (if equipped).
- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine cooling system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect engine air filter.
- Inspect automatic transmission fluid level (if equipped with an underhood fluid level indicator).
- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).
- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

132,000 Km (82,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

144,000 Km (90,000 Mi)

- Change engine oil and install a new oil filter.
- Change automatic transmission/transaxle fluid on all vehicles equipped with the TorqShift® transmission and externally mounted remote filter.
- Install a new remote filter if equipped with a TorqShift® transmission.
- Inspect automatic transmission/transaxle fluid level using the fluid level on all other vehicles (if equipped with an underhood fluid level indicator).
- Install a new cabin air filter (if equipped).
- Install new climate controlled seat cushion filters (if equipped).
- Install a new engine air filter (except Focus with PZEV engine).
- Install a new fuel filter (not required for Fusion, Milan, MKZ, Edge, MKX, Taurus X, Taurus and Sable).
- Install new spark plugs.
- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine cooling system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect drive belts.
- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).
- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).

DESCRIPTION AND OPERATION (Continued)

- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

156,000 Km (97,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

168,000 Km (105,000 Mi)

- Change engine oil and install a new oil filter.
- Install a new cabin air filter (if equipped).
- Install a PCV valve on all cars and light trucks under 6,000 lb GVW (except 3V engines).
- Change rear axle fluid on vehicles equipped with DANA axles which use synthetic lubricants.
- Change premium gold engine coolant.
- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine coolant system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect engine air filter.
- Inspect automatic transmission fluid level (if equipped with an underhood fluid level indicator).
- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).
- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).

- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

180,000 Km (112,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

192,000 Km (120,000 Mi)

- Change engine oil and install a new oil filter.
- Install a new cabin air filter (if equipped).
- Install new climate controlled seat cushion filters (if equipped).
- Install a new engine air filter (except Focus with PZEV engine).
- Install a new fuel filter (not required for Fusion, Milan, MKZ, Edge, MKX, Taurus X, Taurus and Sable).
- Install a new PCV valve on all cars and light trucks over 6,000 lb GVW (except 3V engines).
- Change automatic transmission/transaxle fluid on all vehicles equipped with the TorqShift® and 4F27E transmissions.
- Install a new externally mounted remote filter element for all TorqShift® transmissions (if equipped).
- Install a new internal TorqShift® transmission fluid filter located inside the transmission bottom pan (vehicles without externally mounted remote filter only).
- Inspect automatic transmission/transaxle fluid level on all other vehicles (if equipped with an underhood fluid level indicator).
- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine cooling system and hoses.

DESCRIPTION AND OPERATION (Continued)

- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect drive belts.
- Replace wheel bearing grease and install new grease seals on RWD front wheel bearings (if non-sealed bearings).
- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).
- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

204,000 Km (127,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

216,000 Km (135,000 Mi)

- Change engine oil and install a new oil filter.
- Install a new cabin air filter (if equipped).
- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine cooling system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect engine air filter.
- Inspect automatic transmission fluid level (if equipped with an underhood fluid level indicator).

- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).
- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

228,000 Km (142,500 Mi)

- Change engine oil and install a new oil filter.
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

240,000 Km (150,000 Mi)

- Change engine oil and install a new oil filter.
- Change premium gold engine coolant.
- Install a new cabin air filter (if equipped).
- Install new climate controlled seat cushion filters (if equipped).
- Install a new engine air filter (except Focus with PZEV engine).
- Install a new fuel filter (not required for Fusion, Milan, MKZ, Edge, MKX, Taurus X, Taurus and Sable).
- Change automatic transmission/transaxle fluid and filter on all vehicles except 4F27E, TorqShift® without external filter (filter not required on CD4E, 6F50, AWF-21 and FNR5).
- Install a new remote filter if equipped with a TorqShift® transmission.
- Change transfer case fluid (if equipped).
- Install new front wheel bearings (if not sealed units).
- Install a new drive belt(s) (if a new belt has not been installed within the last 160,000 km [100,000 mi]).

DESCRIPTION AND OPERATION (Continued)

- Inspect steering linkage, suspension and, if equipped, driveshaft, ball joints and U-joints.
- Inspect engine cooling system and hoses.
- Inspect brake pads, shoes, rotors, drums, brake lines, hoses and parking brake system.
- Inspect halfshaft boots (if equipped).
- Inspect exhaust system and heat shields.
- Inspect PVC for flow (3V engines).
- Inspect and lubricate ball joints and U-joints (if equipped with zerk fittings).
- Inspect and lubricate 4WD front axle shaft U-joints (if equipped).
- Carry out multi-point inspection (recommended).
- Rotate tires, inspect tires for wear, measure tread depth and inspect wheel ends for end play and noise. Vehicles with dual rear wheels should only be rotated if unusual wear is noted. For vehicles with different front-to-rear tire pressures, the tire pressure must be adjusted and the tire pressure sensor training must be done.

Exceptions To Normal Schedule

Maximum Oil Change Interval

- Normal schedule: 12,000 km (7,500 mi) or 6 months, whichever occurs first.
- Special operating conditions: 8,000 km (5,000 mi), 6 months or 200 hours of operation, whichever occurs first.

Motorcraft Premium Gold Coolant

- Change premium gold engine coolant at 6 years or 168,000 km (105,000 mi) of the vehicle's life, whichever occurs first.
- After the initial change, change coolant every 3 years or 72,000 km (45,000 mi) thereafter.

Normal Vehicle Axle Maintenance

Rear axles and transfer case/power transfer unit (PTU) 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 transfer case/PTU fluid should be changed anytime they have been submerged in water. Non-synthetic rear axle lubricants should be installed new every 4,800 km (3,000 mi) or 3 months, whichever occurs first, during extended trailer tow operation above 21°C (70°F) ambient and wide open throttle (WOT) for extended periods above 72 km/h (45 mph).

The 3,000 mile lube change interval may be waived if the axle was filled with 75W-140 synthetic gear lubricant. Add 4 ounces of additive friction modifier 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

Install new rear axle lubricant every 160,000 km (100,000 mi). Rear axle lubricant change may be waived if the axle was filled with 75W-140 synthetic gear lubricant. Add 4 ounces of additive friction modifier for complete refill of Traction-Lok® rear axles.

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

Class A Motorhome

- Every 2 years — change brake fluid.

DESCRIPTION AND OPERATION

Noise, Vibration and Harshness (NVH)

Noise is any undesirable sound, usually unpleasant in nature. Vibration is any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down. Harshness is a ride quality issue where the vehicle's response to the road transmits sharply to the customer. Harshness normally describes a firmer than usual response from the suspension system. 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 symptoms.

Acceptable NVH

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. As a technician, it is very important to be familiar with vehicle features and know how they relate to NVH symptoms 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.

Glossary of Terms

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. See Intensity.

Boom

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

Buffet/Buffering

Strong noise fluctuations caused by gusting winds. An example would be wind gusts against the side glass.

Buzz

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

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.

Conductor

The components that carry (transmit) a vibration frequency from the originator to the reactor.

Cycles Per Second

Cycles per second. Same as hertz (Hz).

Cracks

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

Creak

A metallic squeak.

Cycle

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

Decibel (dB)

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

DESCRIPTION AND OPERATION (Continued)**Drone**

A low-frequency, steady sound, like a freezer compressor. Also described as a moan.

Drumming

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

Flutter

Mid to high 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.

G-force

The additional load or weight produced in an object during acceleration. When measuring the level or amplitude of a vibration without sound, the unit G is added to associate the force of the vibration to gravity. This is similar to measuring the weight of an object, which is also a function of gravity.

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.

Hertz (Hz)

A frequency measured in cycle per second.

Hiss

Steady, high-frequency noise. Vacuum leak sound.

Hoot

A steady, low-frequency tone, sounds like blowing over a long neck bottle.

Howl

A mid-range frequency noise between drumming and whine. Also described as a hum.

Hum

Mid-frequency steady sound, like a small fan motor. Also described as a howl.

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. See Amplitude.

Knock

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

Moan

A constant, low-frequency tone. Also described as a hum.

Ping

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

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.

Rattle

A random and momentary or short-duration noise.

Reactor

The component, or part, that receives a vibration from an originator and conductor and reacts to the vibration by moving.

Roughness

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

Rustling

Intermittent sound of varying frequency, sounds similar to shuffling through leaves.

Shake

A low-frequency vibration, 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.

DESCRIPTION AND OPERATION (Continued)**Squeak**

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

Squeal

A long-duration, high-pitched noise.

Tap

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

Thump

A dull beat caused by 2 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).

Transient

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

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 with a very narrow frequency band. Examples of whistle noises are a turbocharger or air flow around an antenna.


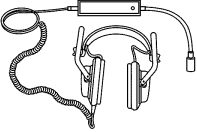
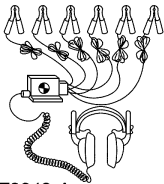
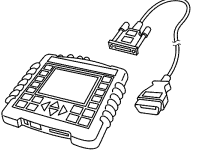

Wind Noise

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

DIAGNOSIS AND TESTING

Noise, Vibration and Harshness (NVH)

Special Tool(s)

 <p>ST2311-A</p>	<p>Electronic Vibration Analyzer (EVA) 100-F027 (014-00344) or equivalent</p>
 <p>ST2312-A</p>	<p>EngineEAR 107-R2100 or equivalent</p>
 <p>ST2048-A</p>	<p>EngineEAR/ChassisEAR 107-R2102 or equivalent</p>
 <p>ST3025-A</p>	<p>Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) 257-00018 or equivalent</p>
 <p>ST2314-A</p>	<p>Ultrasonic Leak Detector 134-R0135 or equivalent</p>

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 NVH symptoms requires:

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

Diagnostic Procedure Overview

Qualifying the symptom by the particular sensation present can help narrow down the cause. 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” using the diagnostic tools described in this section.
- After determining the possible “system(s)”, refer to the appropriate section in this manual to identify the worn or damaged “components”.
- After identifying the “components”, identify the “cause” of the failure.

Tools and Techniques

The diagnostic tools allow for a systematic collection of information that is necessary to accurately diagnose and repair NVH problems. Remember that the vibrating source component (originator) may only generate a small vibration. This small vibration can in turn cause a larger vibration/noise to emanate from another receiving component (reactor), due to contact with other components (transfer path). For the best results, carry out the test as follows:

- a. Test drive the vehicle with the vibration sensor inside the vehicle.

DIAGNOSIS AND TESTING (Continued)

- 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.
- If a vibration symptom is vehicle speed related, the tire and wheel rpm/frequency and driveshaft frequency should be calculated.
 - If a vibration symptom is engine speed related, the engine, engine accessory and engine firing frequencies should be calculated.
 - Frequencies with an amplitude reading of 0.06 Gs 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 symptom is caused by the engine, torque converter or engine accessory. Use the diagnostic tools in the rpm mode and check if symptom is rpm related.

The following diagnostic tools and techniques can be used separately or in conjunction with each other to aid in the diagnosis of NVH symptoms. They are listed in order of preference for ease in their use for locating these symptoms.

NVH Analyzer (Vetronix)

The Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) and the MTS 4100 NVH analyzers are tools to aid in the identification and isolation of a noise, vibration or harshness symptom in a vehicle. They measure noise and vibration data and compare it with data obtained from the vehicle's PCM as well as vehicle variants that were entered by the user such as pulley size, axle ratio and tire size in order to provide possible sources. The Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) and the MTS 4100 have the following characteristics:

- Interface with the vehicle's computer system
- Support and store vibration data input from 1 or 2 accelerometers
- Support and store noise data input from 2 microphones
- Provide a photo-tachometer for operation of the driveshaft balancing function
- Provide a strobe output capable of driving a standard timing light
- Contain a real-time clock circuit that provides time and date information which is used for tagging test data
- Have the capability to print to an external printer and interface with a PC
- Can be powered from a variety of power sources: cigarette lighter, AC power or the internal battery pack

The Mastertech® Series MTS 4000 Driveline Balance and NVH Analyzer (Vetronix) and the MTS 4100 NVH analyzers have 4 main operating modes. The first is for vibration diagnosis. This mode measures data from 1 or 2 accelerometers simultaneously while obtaining data from the vehicle. Then it carries out a frequency analysis on the accelerometer information and compares the vibration frequencies with the frequencies associated with various rotating components within the vehicle. The data can be presented in 4 different display modes: principle component, bar chart, frequency spectrum or waterfall. All display mode formats contain the same common elements, such as amplitude.

DIAGNOSIS AND TESTING (Continued)

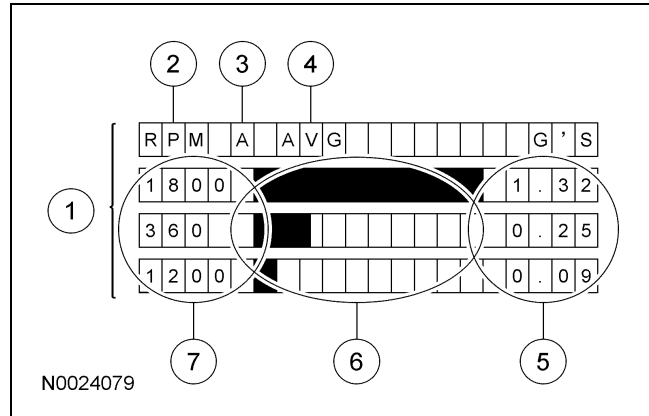
The second is for noise diagnosis. This mode measures noise from 1 or 2 microphones simultaneously. All noise measurements are in decibels (dBs). All frequency bands used for noise measurements are the same as for the vibration measurements, up to 1,000 Hz.

The third is driveshaft balancing. Driveshaft balancing is done using 1 or 2 accelerometers and a photo-tachometer. The accelerometers measure the vibration at both ends of the driveshaft, while the photo-tachometer measures the rotation speed and position reference. Refer to Section 205-00.

The fourth is the strobe. A strobe or standard timing light can be connected to an analyzer, to provide a means for measuring rotation speed. The strobe function is used for isolating the source of a vibration.

Electronic Vibration Analyzer (EVA)

The EVA is a hand-held electronic scan 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 3 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	Electronic Vibration Analyzer (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

Record the readings taken with the diagnostic tool.

- Frequencies should be read in the “average” mode.
- Frequencies have a range of plus or minus 2 Hz. A reading of 10 Hz can be displayed as an 8 Hz through 12 Hz.

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 symptom:

- Enter the vehicle information. Vibrate will do all the calculations and display a graph showing tire, driveshaft and engine vibrations.

DIAGNOSIS AND TESTING (Continued)

- 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 symptom.
 - A frequency measurement tool capable of measuring vibration frequency and engine rpm will be needed.
- Provides graphics of diagnostic procedures to aid in testing components.

Reed Tachometer

The Reed tachometer is a hand-held vibration sensor which will assist in locating the source of unacceptable vibrations. The vibration sensor can be placed anywhere in the vehicle for testing purposes. The Reed tachometer contains several reeds that are tuned to vibrate or resonate at different frequencies ranging from 10 to 80 Hz or 600 to 4,800 rpm. Though the Reed tachometer is able to measure multiple frequencies, it does not measure amplitude.

Sirometer

The Sirometer measures frequency in hertz and rpm. To use the Sirometer, place it on any vibrating component and slowly scroll the wire out by turning the knob. As the length of wire changes, so does its natural frequency. Find the length of wire that vibrates with the highest amplitude. This frequency will match that of the vibrating component. Read the frequency for that length of wire.

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, coolant 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.

Mechanic's Stethoscope

A mechanic's stethoscope is an inexpensive tool for locating noises in engines and other moving parts. It can be used to help diagnose piston slap, worn gears, faulty valves, coolant pump failure, damaged gaskets, defective bearings and body squeaks.






Ultrasonic Leak Detector

The Ultrasonic Leak Detector is used to detect wind noises caused by leaks and gaps in areas where there is weatherstripping 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.

DIAGNOSIS AND TESTING (Continued)

Write-Up Job Aid

To assist the service advisor and the technician, a Write-Up Job Aid used during the interview process is included with this material. The Write-Up Job Aid serves as a place to record all important symptom information.

	"WRITE-UP" JOB AID	REPAIR ORDER # _____ CUSTOMER CONCERN # _____																																																																																																																																																																				
<p style="text-align: center; font-weight: bold;">SPECIFIC SENSE IDENTIFICATION AND LOCATION ON VEHICLE OF CUSTOMER SYMPTOM(S)</p> <p>INSTRUCTIONS: Check below sense affected and location of concern on the generic vehicle illustration (darken the vehicle area). Plus circle appropriate responses to the right.</p> <p>NOTE: Shaded backgrounds indicate caution areas. Selection of two or more caution areas "flag" difficult repairs. In general, shaded areas are the more difficult to verify and repair, and require all applicable columns to be completed.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>SEE YES <input type="checkbox"/> NO <input type="checkbox"/></p> </div> <div style="text-align: center;">  <p>FEEL YES <input type="checkbox"/> NO <input type="checkbox"/></p> </div> </div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>HEAR YES <input type="checkbox"/> NO <input type="checkbox"/></p> </div> <div style="text-align: center;">  <p>SMELL YES <input type="checkbox"/> NO <input type="checkbox"/></p> </div> </div> <div style="text-align: center; margin-top: 10px;"> <table border="1" style="border-collapse: collapse; width: 100px; height: 100px;"> <tr><td style="font-size: 0.8em;">A</td><td style="font-size: 0.8em;">B</td><td style="font-size: 0.8em;">C</td><td style="font-size: 0.8em;">D</td><td style="font-size: 0.8em;">E</td><td style="font-size: 0.8em;">F</td></tr> <tr><td style="text-align: center;">1</td><td colspan="4" style="text-align: center;">ENGINE</td><td></td></tr> <tr><td style="text-align: center;">2</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">3</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">4</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">5</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">6</td><td style="text-align: center;">+</td><td></td><td></td><td></td><td style="text-align: right;">FRONT</td></tr> <tr><td style="text-align: center;">7</td><td></td><td></td><td></td><td></td><td style="text-align: right;">MID</td></tr> <tr><td style="text-align: center;">8</td><td></td><td></td><td></td><td></td><td style="text-align: right;">REAR</td></tr> <tr><td style="text-align: center;">9</td><td></td><td></td><td></td><td></td><td style="text-align: right;">CARGO</td></tr> </table> </div>	A	B	C	D	E	F	1	ENGINE					2						3						4						5						6	+				FRONT	7					MID	8					REAR	9					CARGO	<table border="1" style="width:100%; border-collapse: collapse; font-size: 0.8em;"> <thead> <tr style="background-color: black; color: white;"> <th style="width: 15%;">VEHICLE SYMPTOM AREA</th> <th style="width: 15%;">HOW OFTEN?</th> <th style="width: 15%;">VEHICLE OPERATING MODE</th> <th style="width: 15%;">VEHICLE CONDITIONS</th> <th style="width: 10%;">VEHICLE SPEED(mph)</th> <th style="width: 10%;">WHEN VEHICLE IS?</th> <th style="width: 10%;">AMBIENT CONDITION</th> </tr> </thead> <tbody> <tr> <td>Front of Vehicle</td> <td>Always</td> <td>Start Up</td> <td>Accessories On</td> <td>0</td> <td>Turning Left</td> <td>Below Zero</td> </tr> <tr> <td>Engine Compartment</td> <td>Daily [A.M.] [P.M.]</td> <td>Idle</td> <td>(define below)</td> <td>1-9</td> <td>Turning Right</td> <td>Below Freezing (0 -19)</td> </tr> <tr> <td>Dash</td> <td style="border: 1px solid black;">Conditional</td> <td>Gear Selection</td> <td>Windows Open</td> <td>10-19</td> <td>Over Bumps</td> <td>Below Freezing (20 -32)</td> </tr> <tr> <td>Steering Wheel</td> <td style="border: 1px solid black;">Weekly</td> <td>Accel Light</td> <td>4x4</td> <td>20-29</td> <td>Up Hills</td> <td>33 -49</td> </tr> <tr> <td>Accelerator Pedal</td> <td style="border: 1px solid black;">Monthly</td> <td>Accel Moderate</td> <td>Hauling</td> <td>30-39</td> <td>Down Hills</td> <td>50 -69</td> </tr> <tr> <td>Brake Pedal</td> <td style="border: 1px solid black;">Intermittent</td> <td>Accel Heavy</td> <td>Towing</td> <td>40-49</td> <td>Shifting</td> <td>70 -89</td> </tr> <tr> <td>Clutch Pedal</td> <td style="border: 1px solid black;">Unknown</td> <td>Steady Speed</td> <td>Snow Plowing</td> <td>50-59</td> <td>Parked</td> <td>90 +</td> </tr> <tr> <td>Seat</td> <td></td> <td>Deceleration</td> <td>Other</td> <td>60-69</td> <td>In Traffic</td> <td>Sunny</td> </tr> <tr> <td>Rear of Vehicle</td> <td></td> <td>Neutral</td> <td>(define below)</td> <td>70+</td> <td></td> <td>Dry</td> </tr> <tr> <td>Top of Vehicle</td> <td></td> <td>Reverse</td> <td></td> <td style="background-color: black; color: white;">ENGINE</td> <td></td> <td>Windy</td> </tr> <tr> <td>Floor Pan</td> <td></td> <td>Stopping/Braking</td> <td></td> <td style="background-color: black; color: white;">TEMP</td> <td></td> <td>Wet/Humid</td> </tr> <tr> <td>Under Vehicle</td> <td></td> <td></td> <td></td> <td>Cold</td> <td></td> <td>Rain</td> </tr> <tr> <td>Other (define below)</td> <td></td> <td></td> <td></td> <td>Normal</td> <td></td> <td>Snow</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Hot</td> <td></td> <td>Ice</td> </tr> </tbody> </table>	VEHICLE SYMPTOM AREA	HOW OFTEN?	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DIAGNOSIS AND TESTING (Continued)

1: Customer Interview

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

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

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

2: Pre-Drive Check

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

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

3: Preparing for the Road Test

Observe the following when preparing for the road test:

- Review the information recorded on the write-up job aid. It is important to know the specific symptom the customer has with the vehicle.
- Do not be misled by the reported location of the noise/vibration. The cause can actually be some distance away.

- Conduct the road test on a quiet street where it is safe to duplicate the vibration/noise. The ideal testing route is an open, low-traffic area where it is possible to operate the vehicle at the speed in which the condition occurs.
- While observing that they are not related to the symptom, eliminate the following:
 - If possible, lower the radio antenna in order to minimize turbulence.
 - Identify anything that could potentially make noise or be a source of wind noise.
 - Inspect the vehicle for add-on items that create vibration/noise.
 - Turn off the radio and the heating and cooling system blower.
- The engine speed is an important factor in arriving at a final conclusion. Therefore, connect a diagnostic tool, Vetronix, or an accurate tachometer to the engine, even if the vehicle has a tachometer. This will make sure of 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 symptom. 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.

DIAGNOSIS AND TESTING (Continued)

5: Road Test

NOTE: It may be necessary to have the customer ride along or drive the vehicle to point out the symptom. 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 symptom, especially when a road test with the customer is not possible.
- The Heavy Acceleration Test helps to determine if the symptom is torque-related.
- The Neutral Coast Down Speed Test helps to determine if the symptom is vehicle speed-related.
- The Downshift Speed Test helps to determine if the symptom 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 symptom.
- 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 Engine Run-Up (NERU) Test and the Drive Engine Run-Up (DERU) Load Test. These tests help to determine if the symptom is engine speed-related.
- The Neutral Engine Run-Up (NERU) Test is used as a follow-up test to the Downshift Speed Test when the symptom occurs at idle.
- The Drive Engine Run-Up (DERU) Load Test helps to identify vibration/noise sensitive to engine load or torque. It also helps to reproduce engine speed-related symptoms that cannot be duplicated when carrying out the Neutral Engine Run-Up (NERU) Test or the Neutral Coast Down Test.
- The Engine Accessory Test helps to locate faulty belts and accessories that cause engine speed-related symptoms.
- The Vehicle Cold Soak Procedure helps to identify symptoms 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 symptom 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 symptom is coming.
- Attempt to identify the source of the symptom.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

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 symptom is torque-related if duplicated while carrying out this test.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Neutral Coast Down Speed Test

To carry out this test, proceed as follows:

- Drive at a higher rate of speed than where the symptom occurred when carrying out the Slow Acceleration Test.

DIAGNOSIS AND TESTING (Continued)

- Place the transmission in NEUTRAL and coast down past the speed where the symptom occurs.
- The symptom is vehicle speed-related if duplicated while carrying out this test. This eliminates the engine and the torque converter as sources.
- If the symptom was not duplicated while carrying out this test, carry out the Downshift Speed Test to verify if the symptom is engine speed related.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

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 symptom occurs.
- The symptom 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.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Steering Input Test

To carry out this test, proceed as follows:

- Drive at the speed where the symptom occurs, while making sweeping turns in both directions.
- If the symptom goes away or gets worse, the wheel bearings, hubs, U-joints (contained in the axles of Four-Wheel Drive (4WD) applications), and tire tread wear are all possible sources.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Brake Test

To carry out this test, proceed as follows:

- With the brake released, accelerate the vehicle. While coasting (brake pedal released) to a stop in NEUTRAL, note any abnormal rate of deceleration. Abnormal deceleration could indicate a parking brake or service brake that is not fully releasing.
- Warm the brakes by slowing the vehicle a few times from 80-32 km/h (50-20 mph) using light braking applications.
- Accelerate to 89-97 km/h (55-60 mph). Moderately apply the brakes and slow the vehicle to a stop.
- A brake vibration can be felt in the steering wheel, seat or brake pedal. A brake noise can be heard upon brake application and should diminish when the brake is released. For vehicles with separate park brake shoes, noise or vibration from the parking brake system will not be affected by applying the hydraulic brakes. On these systems, the parking brake system requires inspection if a parking brake concern is suspected.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate brake section(s) for further diagnosis and repair. If the source has not been identified, continue with the road test.

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.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

DIAGNOSIS AND TESTING (Continued)

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 (FWD) 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 symptom is coming from.
- Attempt to identify the source of the symptom.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Drive Engine Run-Up (DERU) Load Test

To carry out this test, proceed as follows:

⚠ WARNING: Block all wheels, set the parking brake and firmly apply the service brake to reduce the risk of vehicle movement during this procedure. Failure to follow these instructions may result in serious personal injury.

NOTICE: Do not carry out the Engine Load Test for more than 5 seconds or damage to the transmission or transaxle may 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/noise is duplicated when carrying out this test, inspect the engine and transmission or transaxle mounts.
- If the symptom is definitely engine speed-related, carry out the Engine Accessory Test to narrow down the source.

- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Engine Accessory Test

To carry out this test, proceed as follows:

⚠ WARNING: Block all wheels, set the parking brake and firmly apply the service brake to reduce the risk of vehicle movement during this procedure. Failure to follow these instructions may result in serious personal injury.

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

NOTE: Use a frequency measurement tool to pinpoint accessory vibrations. A listening device, such as an EngineEAR, will also help to identify noises from specific accessories.

- Remove the accessory drive belt(s).
- Increase the engine rpm to where the symptom occurs.
- If the vibration/noise is duplicated when carrying out this test, the belt(s) and accessories are not sources.
- If the vibration/noise was not duplicated when carrying out this test, install the accessory belt(s), one at a time, to locate the source.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Vehicle Cold Soak Procedure

To carry out this procedure, proceed as follows:

- Test preparations include matching customer conditions (if known). If not known, document the test conditions: gear selection and engine rpm. Monitor the vibration/noise duration with a watch for up to 3 minutes.
- Park the vehicle where testing will occur. The vehicle must remain at or below the symptom temperature (if known) for 6-8 hours.
- Before starting the engine, conduct a visual inspection under the hood.

DIAGNOSIS AND TESTING (Continued)

- Turn the key on, but do not start the engine. Listen for the fuel pump, ABS and air suspension system noises.
- Start the engine.
- Isolate the vibration/noise by carefully listening. Move around the vehicle while listening to find the general location of the vibration/noise. Then, search for a more precise location by using a stethoscope or EngineEAR.
- If the source of the symptom has been identified as a result of this test, proceed to the appropriate section for further diagnosis and repair. If the source has not been identified, continue with the road test.

Classify NVH Symptom

For NVH concerns, it is necessary to classify the customer's concern into one of the 3 categories: noise, vibration or harshness. The reason for this is that a customer concern may consist of a combination of symptoms involving noise and vibration, or vibration and harshness. In cases where there are combination symptoms, determine which diagnostic path to follow: noise, vibration or harshness. For example, if a customer has a concern involving a noise and a vibration, and it is determined that it is vehicle speed-related, follow the vibration diagnostic path.

Noise Symptoms

Once a symptom is classified as a noise, the particular conditions under which the noise occurs need to be identified. These conditions are identified and verified during the road test. For example, a noise may only occur while turning. The next step is to determine which systems on the vehicle are related to that condition. In this case, the steering system and wheel/tire system may be suspect. After identifying possible systems, a preliminary inspection of these systems should be done. If the source of noise is still unidentified, use a listening device (such as the ChassisEAR) to pinpoint the source. Once the source has been identified, determine if this source is related to the suspected system previously identified. If it is related, then complete the repair to resolve the customer concern. If it is unrelated, then it is possible that the source of the noise is a reactor to a noise being transmitted through a transfer path. If this is the case, repairing the reactor will not resolve the customer concern. The transfer path must be identified and a determination made if the noise is normal, but accentuated by the transfer path (conductor), or if the originator is the fault causing excessive noise to transfer to another component through a conductor. There is a relationship between systems identified as related to conditions and the noise transfer path. In some cases, the condition under which the noise occurs has nothing to do with the identified source. This relationship is important in the diagnosis of noise concerns. It is the first clue that the identified source of noise might be a reactor and that further investigation is needed to diagnose a possible noise transfer path concern. Based on the results from the road test, make a determination of which action in the symptom chart to take first.

Vibration Symptoms

Most vibrations consist of movements back and forth or up and down that repeat. Every time the vibrating component goes through its complete range of motion and returns to the starting point is called a cycle. The rate at which these cycles occur within a given time is called the frequency. Frequency is measured in cycles per second or Hertz (Hz). One cycle per second equals one Hz. Once the frequency of a vibration is known, calculations can be done to determine the system that is the source of the concern.

DIAGNOSIS AND TESTING (Continued)

Order of Vibration

The order of a vibration refers to how often the vibration is present in one revolution of the component. For example, a vibration that is present once each revolution of a component would be a first order vibration. A vibration present twice each revolution of the component would be a second order vibration. Vibration orders do not have to be whole numbers, they can have decimal values such as 1.5 order vibration or 3.08 order vibration.

The concept of order of vibration is important to remember when the measured frequency of a vibration does not seem to match the frequency calculations of any of the likely systems or components. As the order increases, the frequency of the vibration will also increase by a multiple of that number.

For example, vibration may be present where the frequency is measured at 14 Hz. After doing the necessary calculations it is determined the first order tire and wheel frequency is 7 Hz and the first order driveshaft frequency is 22 Hz. Based on this information it can be determined the vibration is most likely a second order tire and wheel vibration: 7 Hz (first order tire and wheel frequency) multiplied by 2 (second order) equals 14 Hz (second order tire and wheel frequency).

Relationship of Vibration Frequency to Order of Vibration

After carrying out the road test as described in this section, the vibration was determined to be either vehicle-speed related or engine-speed related. That determination will identify the vibration frequency calculations that should be done.

Vibration Type	Calculate
Vehicle-speed related	Tire-speed vibration frequency Driveshaft-speed vibration frequency

Vibration Type	Calculate
Engine-speed related	Engine vibration frequency Engine accessory vibration frequency Engine firing vibration frequency

In calculating and using frequency readings, it is important to remember the direct relationship between Hz and rpm. One Hz is equal to 60 rpm. This is easy to remember; think of Hz as cycles per second. There are 60 seconds in a minute, therefore multiply Hz reading by 60 to get rpm. Conversely, divide rpm by 60 to get Hz.

Use the Frequency and RPM Calculations Worksheet to calculate system/component frequencies. The worksheet provides the necessary steps to determine each system/component group frequency.

Frequency Calculations

Calculating Tire and Wheel Frequency

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.

DIAGNOSIS AND TESTING (Continued)

- If the vehicle speed is not listed, calculate the tire and wheel frequency as follows:
 - Divide the vehicle speed at which the vibration occurs by 16 km/h (10 mph). Multiply that number by the 16 km/h (10 mph) tire rpm listed for that tire diameter in the chart. Then divide that number by 60.
 - For example, if calculating the frequency based on vehicle speed in km/h for a 64 km/h vibration with 835 mm tires, divide 64 km/h by 16 km/h = 4. Multiply 4 by 105 rpm = 420. Divide 420 by 60 seconds = 7 Hz at 64 km/h.
 - If calculating the frequency based on vehicle speed in mph for a 40 mph vibration with 33 inch tires, divide 40 mph by 10 mph = 4. Multiply 4 by 105 rpm = 420. Divide 420 by 60 seconds = 7 Hz at 40 mph.
 - The calculated frequency of 7 Hz is the first order tire and wheel vibration; the second order tire and wheel vibration would be twice this number at 14 Hz; the third order tire and wheel vibration would be 21 Hz; and so on.

Tire Speed and Frequency Chart

Tire Diameter	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz
mm (in)	@ 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

DIAGNOSIS AND TESTING (Continued)

Calculating Driveshaft Frequency

Knowing the tire and wheel frequency allows for easy calculation of driveshaft frequency. The driveshaft drives the tires through the rear axle. Therefore, to determine driveshaft frequency, multiply tire and wheel frequency by the ratio of the rear axle. Calculate driveshaft frequency by performing the following steps:

- Obtain the axle ratio of the vehicle. Suppose the vehicle has a vibration problem at 64 km/h (40 mph) and a rear axle ratio of 2.93:1.
- Multiply the tire and wheel frequency of 7 Hz (calculated previously) with the rear axle ratio of 2.93:1. This results in a driveshaft frequency of 21 Hz at a vehicle speed of 64 km/h (40 mph).

The calculated frequency of 21 Hz is the first order driveshaft frequency; the second order frequency of the driveshaft is twice this number, or 42 Hz; and so on.

Calculating Engine Frequency

Use the engine rpm where the vibration symptom occurs to determine engine frequency. Calculate engine frequency by dividing the engine rpm by 60 (the number of seconds in a minute). For example, if the corresponding engine rpm of a vibration concern on a vehicle is 2,400 rpm, the resulting engine frequency is 40 Hz. Therefore, a 40 Hz vibration is a first order engine vibration. For purposes of vibration diagnosis, the engine also includes the torque converter and exhaust system.

Calculating Engine Accessory Frequency

Belt-driven engine accessories often produce vibrations at different frequencies than the engine itself. This is because the drive ratio created by the different size pulleys causes them to rotate at different speeds. Determining engine accessory frequency is comparable to calculating driveshaft frequency.

Calculate engine accessory frequency by performing the following steps:

- Determine the size ratio factor between the accessory pulley and the crankshaft pulley. For example, if the diameter of the crankshaft pulley is 6 inches and the accessory pulley diameter is 2 inches, the accessory pulley rotates 3 times for every crankshaft rotation (6 divided by 2).

- Multiply the engine rpm where the vibration condition occurs by the number of times the accessory pulley is rotating per crankshaft revolution. For example, if the engine rpm is 2,400 rpm, the accessory is rotating at 7,200 rpm (2,400 rpm multiplied by 3).
- Divide the accessory rpm by 60 (the number of seconds in a minute). In this example, the engine accessory frequency is 120 Hz (7,200 divided by 60).

Calculating Engine Firing Frequency

Engine firing frequency is a term used to describe the pulses an engine creates from the firing of the cylinders. Engine firing frequency depends on how many cylinders an engine has. The number of times an engine fires a cylinder with each crankshaft revolution is equal to one-half the number of cylinders. A 4-cylinder engine fires 2 cylinders with each crankshaft revolution. Two revolutions of the crankshaft fire all 4 cylinders. A 6-cylinder engine fires 3 cylinders with each crankshaft revolution. An 8-cylinder engine fires 4 cylinders for each crankshaft revolution.

Calculate engine firing frequency by performing the following steps:

- Multiply the engine rpm where the vibration symptom occurs by the number of cylinders fired with each crankshaft revolution. For example, a vehicle with a 6-cylinder engine experiences a vibration concern at 2,400 rpm. The engine is firing the cylinders at 7,200 times per minute (3 multiplied by 2,400).
- Divide this number by 60 (the number of seconds in a minute) to obtain the engine firing frequency. In this example, the engine firing frequency is 120 Hz (7,200 divided by 60) at 2,400 rpm.

DIAGNOSIS AND TESTING (Continued)**Frequency and RPM Calculations Worksheet****FREQUENCY AND RPM CALCULATIONS****TIRE AND WHEEL**

Vibration occurs at _____ mph (km/h)

Tire diameter _____

Tire speed RPM and frequency from chart _____ RPM _____ Hz

DRIVESHAFT

Tire/wheel frequency _____ x axle ratio = _____ Hz

Tire/wheel RPM _____ x axle ratio = _____ RPM

ENGINE FREQUENCIES AND ASSOCIATED RPMS

Engine RPM divided by 60 equals 1st order frequency _____ Hz

1st order RPM x 2 = 2nd order RPM (normal for 4 cylinder engines)

Cylinders fired per engine revolutions _____ RPM

1st order Hz x 2 = 2nd order Hz (normal for 4 cylinder engines) _____ Hz

1st order RPM x 3 = 3rd order RPM (normal for 6 cylinder engines)

1st order Hz x 3 = 3rd order Hz (normal for 6 cylinder engines)

x 4 = 4th order vibrations (normal for 8 cylinder engines)

x 5 = 5th order, x 6 = 6th order, etc.

Order of vibration x engine RPM equals cylinders fired per minute _____ RPM

Order of vibration (2nd, 3rd, 4th etc.) x 1st order Hz equals _____ Hz

ENGINE ACCESSORY FREQUENCIES AND RPMS

Crankshaft pulley diameter _____ divided by accessory pulley diameter _____ = _____ pulley size ratio

Engine speed _____ RPM x pulley ratio = accessory _____ RPM

Accessory pulley _____ RPM divided by 60 = _____ Hz

DIAGNOSIS AND TESTING (Continued)

Harshness Symptoms

Harshness is customer perception which gives the impression of no isolation from the tire/wheel and suspension system. Harshness may be caused by road conditions, temperature changes, component damage and/or incorrect customer modifications on original components/specifications. Customers usually experience harshness when the vehicle is driving over bumps or potholes and in cold weather conditions. Harshness can also be experienced with excessive tire pressure, sporty tires, heavy-duty springs and shocks, or other vehicle modifications. Some aftermarket tires, even with the correct size, may change vehicle behavior and produce customer concerns. The first step in diagnosing a harshness concern is to determine if the concern was experienced only in certain specific operating conditions, such as large potholes or extremely cold weather. In these cases, harshness should be considered normal. A known good vehicle can be driven under the same conditions and the rides can be compared to determine whether the concern is normal or vehicle specific. The second step is to check tire pressure and make sure it was set within vehicle specifications. The third step is to inspect for aftermarket or modified components and determine if they are the cause of the harshness complaint. If the harshness concern persists after the above steps, it is possible that some components are damaged. Based on the results from the road test, make a determination of which action in the symptom chart to take first.

NVH Symptom Chart Categories

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

- Identify the operating condition that the vehicle is exhibiting.

- Match the operating condition to the symptom.
- Verify the symptom.
- Calculate the frequency and order of the symptom
- Identify which category or system(s) could cause the symptom.
- Refer to the section indicated to identify and diagnose the symptom or confirm that the system is not the source of the condition.

Use the diagnostic instructions in this section along with the necessary listed tools to identify the vibration order and to isolate the symptom and the possible systems associated with that symptom. Then based on the results from the road test, make a determination of which action in the symptom chart to take first. Since it is possible any one of multiple systems may be the cause of the symptom, it may be necessary to use a process of elimination type diagnostic approach to pinpoint the concern. Refer to the section(s) indicated to identify and isolate the cause or rule that system out as being the causal system for the symptom.

Vehicle-Speed Related Vibrations

NOTE: Any assembly that is out of balance will only cause a first order vibration, it will not cause a higher order vibration.

When a vehicle-speed related vibration is present, both tire-speed related vibration and driveshaft-speed related vibration calculations should be carried out.

DIAGNOSIS AND TESTING (Continued)**Symptom Chart — Tire-Speed Related Vibrations****Symptom Chart — Tire-Speed Related Vibrations**

Condition	Possible Sources	Action
<ul style="list-style-type: none"> • First order tire vibration 	<ul style="list-style-type: none"> • Tire or wheel • Wheel bearings • Drive axle • Halfshaft • Brake rotor or drum 	<ul style="list-style-type: none"> • REFER to Section 204-04. • REFER to Section 204-00. • REFER to Section 205-00. • REFER to Section 205-00. • REFER to Section 206-00.
<ul style="list-style-type: none"> • Second order tire vibration 	<ul style="list-style-type: none"> • Tire or wheel 	<ul style="list-style-type: none"> • REFER to Section 204-04.
<ul style="list-style-type: none"> • Third order tire vibration 	<ul style="list-style-type: none"> • Tire or wheel • Drive axle • Driveshaft • Halfshaft 	<ul style="list-style-type: none"> • REFER to Section 204-04. • REFER to Section 205-00. • REFER to Section 205-00. • REFER to Section 205-00.

Symptom Chart — Driveshaft-Speed Related Vibrations**Symptom Chart — Driveshaft-Speed Related Vibrations**

NOTE: Any assembly that is out of balance will only cause a first order vibration, it will not cause a higher order vibration.

Condition	Possible Sources	Action
<ul style="list-style-type: none"> • First order driveshaft vibration 	<ul style="list-style-type: none"> • Driveshaft • Rear drive axle/differential 	<ul style="list-style-type: none"> • REFER to Section 205-00. • REFER to Section 205-00.
<ul style="list-style-type: none"> • Second order driveshaft vibration 	<ul style="list-style-type: none"> • U-joint • Output shaft bushing in transmission/transaxle 	<ul style="list-style-type: none"> • REFER to Section 205-00. • Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section.
<ul style="list-style-type: none"> • Third order driveshaft vibration 	<ul style="list-style-type: none"> • Rear drive axle/differential 	<ul style="list-style-type: none"> • REFER to Section 205-00.

DIAGNOSIS AND TESTING (Continued)**Symptom Chart — Engine-Speed Related Vibrations****Symptom Chart — Engine-Speed Related Vibrations**

NOTE: When an engine-speed related vibration is present, engine, engine accessory and engine firing calculations should be carried out.

NOTE: Any assembly that is out of balance will only cause a first order vibration, it will not cause a higher order vibration.

NOTE: Some engine-speed related vibrations are normal though they should not be felt in the passenger compartment.

Condition	Possible Sources	Action
<ul style="list-style-type: none"> • 0.5 order engine vibration 	<ul style="list-style-type: none"> • Engine 	<ul style="list-style-type: none"> • REFER to Section 303-00.
<ul style="list-style-type: none"> • First through sixth order engine vibration 	<ul style="list-style-type: none"> • Engine • Transmission/transaxle • Engine mounts • Transmission/transaxle mounts • Exhaust system 	<ul style="list-style-type: none"> • REFER to Section 303-00. • Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section. • REFER to Section 303-00. • Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section. • REFER to Section 309-00.
<ul style="list-style-type: none"> • Belt driven accessory speed vibration 	<ul style="list-style-type: none"> • Engine pulley • Coolant pump • Generator • A/C compressor • Power steering pump • Vacuum pump • Accessory drive belt 	<ul style="list-style-type: none"> • REFER to Section 303-00. • REFER to Section 303-00. • REFER to Section 414-00. • REFER to Section 412-00. • REFER to Section 211-00. • REFER to Section 303-00. • REFER to Section 303-00.

DIAGNOSIS AND TESTING (Continued)**Symptom Chart — Noise, Air Leaks or Water Leaks****Symptom Chart — Noise, Air Leaks or Water Leaks**

Condition	Possible Sources	Action
<ul style="list-style-type: none"> • Wind noise, air or water leaks 	<ul style="list-style-type: none"> • Body • Roof opening panel 	<ul style="list-style-type: none"> • REFER to the Symptom Chart in Section 501-00. • REFER to the Symptom Chart in Section 501-00.
<ul style="list-style-type: none"> • Belt driven accessory noise/squeal or chirping 	<ul style="list-style-type: none"> • Accessory drive belts • Pulleys 	<ul style="list-style-type: none"> • REFER to Section 303-05.
<ul style="list-style-type: none"> • Front end noise while driving vehicle 	<ul style="list-style-type: none"> • Front suspension • Drive axle or differential • Brake system • Steering linkage or gear • Transmission/transaxle • Engine • Exhaust system • Body 	<ul style="list-style-type: none"> • REFER to Section 204-00. • REFER to Section 205-00. • REFER to Section 206-00. • REFER to Section 211-00. • Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section. • REFER to Section 303-00. • REFER to Section 309-00. • REFER to the Symptom Chart in Section 501-00.
<ul style="list-style-type: none"> • Rear end noise while driving vehicle 	<ul style="list-style-type: none"> • Rear suspension • Drive axle or differential • Brake system • Transmission/transaxle • Exhaust system • Body 	<ul style="list-style-type: none"> • REFER to Section 204-00. • REFER to Section 205-00. • REFER to Section 206-00. • Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section. • REFER to Section 309-00. • REFER to the Symptom Chart in Section 501-00.
<ul style="list-style-type: none"> • Noise with vehicle stopped 	<ul style="list-style-type: none"> • Engine • Transmission/transaxle • Exhaust system • Power steering pump • Generator • A/C compressor • Body 	<ul style="list-style-type: none"> • REFER to Section 303-00. • Refer to the appropriate section in Group 307 for the procedure. Refer to the appropriate section in Group 308 for the procedure. GO to the Symptom Chart in the appropriate section. • REFER to Section 309-00. • REFER to Section 211-00. • REFER to Section 414-00. • REFER to Section 412-00. • REFER to the Symptom Chart in Section 501-00.

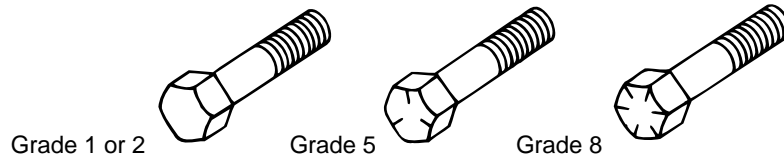
DIAGNOSIS AND TESTING (Continued)**Symptom Chart — Harshness****Symptom Chart — Harshness**

Condition	Possible Sources	Action
<ul style="list-style-type: none">• Harsh vehicle ride	<ul style="list-style-type: none">• Front suspension• Rear suspension	<ul style="list-style-type: none">• REFER to Section 204-00.• REFER to Section 204-00.

METRICS

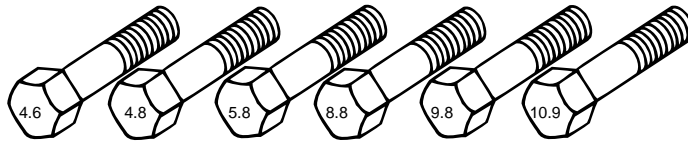
BOLT STRENGTH IDENTIFICATION

ENGLISH SYSTEM



English bolts: Identification marks on the bolt head represent Rockwell hardness. Generally, the bolt's grade is equal to the number of marks plus two. The higher the grade, the stronger the bolt.

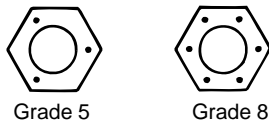
METRIC SYSTEM



Metric bolts: Identification class numbers on bolt heads represent tensile strength. Higher numbers indicate stronger bolts. Common metric fastener bolt strength properties are 9.8 and 10.9.

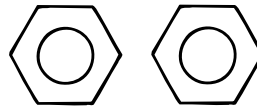
HEX NUT STRENGTH IDENTIFICATION

ENGLISH SYSTEM



Identification dots represent Rockwell hardness. The nut's grade is equal to the number of dots plus two. The higher the grade, the stronger the nut.

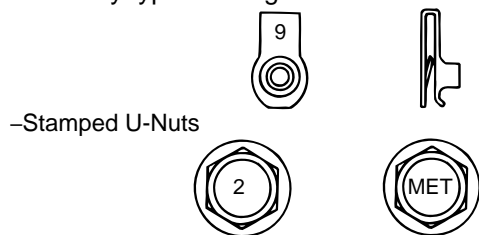
METRIC SYSTEM



Identification class numbers on nuts represent tensile strength. Higher numbers indicate stronger nuts. Nuts may also have blue finish or paint daub on hex flat.

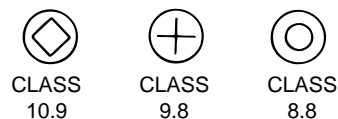
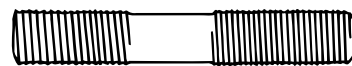
OTHER TYPES OF PARTS

Metric identification schemes vary by type of part, most often a variation of that used for bolts and nuts. Note that many types of English and Metric fasteners carry no special identification if they are otherwise unique.



-Stamped U-Nuts

-Tapping, thread forming and certain other case hardened screws.



-Studs, Large studs may carry the property class number. Smaller studs use a geometric code on the end.

METRICS

ENGLISH/METRIC CONVERSION

DESCRIPTION	MULTIPLY	BY	FOR METRIC EQUIVALENT
Acceleration	ft/s ²	0.3048	m/s ²
	in/s ²	0.0254	m/s ²
Torque	lb-in	0.11298	N·m
	lb-ft	1.3558	N·m
Power	horsepower	0.746	kW
Pressure or Stress	inches of water	0.2491	kPa
	psi	6.895	kPa
	psi	0.069	bar
Energy or Work	BTU	1055.0	Joules(J)
	lb-ft	1.3558	Joules(J)
	kiloWatt-hour	3,600,000 or 3.6 x 10 ⁶	Joules(J)
Light	foot candle	10.764	lumens/square meter (lm/m ²)
Fuel Performance	miles/gal	0.4251	kilometers/liter (km/L)
	gal/mile	2.3527	liters/kilometer (L/km)
Velocity	mph	1.6093	kilometers/hour (km/h)
Length	inch	25.4	mm
	foot	0.3048	m
	yard	0.9144	m
	mile	1.609	km
Area	square inch (in ²)	645.2	mm ²
		6.45	cm ²
	square ft (ft ²)	0.0929	m ²
	square yard	0.8361	m ²
Volume	cubic inch (in ³)	16387.0	mm ³
		16.387	cm ³
		0.0164	liters (L)
	quart	0.9464	liters (L)
	gallon	3.7854	liters(L)
	cubic yard	0.7646	m ³
	Mass	pound	0.4536
ton		907.18	kg
ton		0.9078	tonne (t)
Force	kilogram	9.807	N
	ounce	0.2780	N
	pound	4.448	N
Temperature	degree Farenheit (°F)	(°F-32) 0.556	degree Celsius (°C)