Section 3 PINPOINT DIAGNOSIS



Lesson Objectives

1. Demonstrate the ability to select a pinpoint diagnostic procedure that is appropriate for the conditions identified during the NVH diagnostic procedures.

- 2. Demonstrate the ability to perform a thorough visual inspection.
- 3. Demonstrate the ability to use the pinpoint diagnostic charts to assist in selecting the appropriate procedures.
- 4. Demonstrate the ability to select and perform the proper repair that will ensure long term customer satisfaction.
- 5. Determine when it is appropriate to call for technical assistance.
- 6. Be able to list the information necessary for a quick resolution to the concern, prior to contacting technical assistance.
- 7. Demonstrate the ability to verify the concern has been resolved.

Introduction	The pinpoint diagnosis section focuses on the procedures required to identify the specific condition causing the concern. It will also, in many cases, identify the solution to resolve the condition. Situations that require additional procedures to repair the condition are covered
	in Section 4.
	At this point in the diagnosis, the technician knows the symptom that is associated with the concern and the source of the concern.
	This part of the diagnostic section will deal with isolating the component or condition relating to the concern. It is organized by source group (same as the NVH Analyzer), dealing with the most common condition associated with each classification in that source group.
Visual Inspection	Throughout this course we have been discussing NVH in relationship to the senses. It only follows that the senses are one of the technicians greatest assets in resolving NVH conditions.
	Throughout all aspects of diagnosis the technician should:
	• Look
	• Listen
	• Feel
	A thorough visual inspection can provide the technician with clues or even reveal the condition causing the concern. Observations can uncover:
	Vehicle damage
	Previous service
	Broken, loose, missing or worn components
	Aftermarket installations
	Tire wear or damage
	Examples include:
	• An aftermarket exhaust system that is not built to the same specifications as an OEM systems. These types of parts can produce drones or body contact which will show up on the NVH Analyzer as an engine related vibration.
	• A trailer hitch installation that produces a transmission path to the interior of the vehicle.
	• Mass or dynamic dampers that have been removed for a service procedure and not put back on the vehicle.

- A reinforcing bracket between the engine and the bell housing left off during a previous service.
- A bell housing which has not been properly torqued.

Visual Inspection	During a visual inspection, a stethoscope or a screw driver can be
Continued	used to amplify a vibration from a suspect component and relate it to
	the concern vibration.

Examples include:

- Lightly holding a screw driver on the metal support of a vibrating headrest. The resulting tapping noise can be associated with a frequency range. Knowing the frequency would help the technician identify the source of the vibration.
- Lightly holding a screw driver on components such as an exhaust system or suspension will amplify a vibration which can be associated with the customer concern.
- Care must be taken in the above procedures to avoid contact with moving or rotating components.
- Extreme caution must be taken while diagnosing an operating vehicle in the air to insure that the vehicle does not move.

Sophisticated automotive stethoscopes are available to assist in isolating a concern. Some are based on the screwdriver technique and others are **electronic** with multiple clip-on microphones. The clips can be placed in different areas of the vehicle and monitored with earphones to determine the location of a condition.



Visual Inspection Continued A close look at the wheels and tires while a vehicle is on a lift can reveal many possible causes of concerns. Examples include:

- Wheel covers for fit, looseness and condition.
- Lug nuts and studs for proper size, torque, fit or condition. For example, a large locking lug nut can contribute to an imbalance condition that would not be corrected on an off car balancer.
- OEM wheels are important for proper fit and suspension geometry.
- Incorrect tire match (brand, size or inflation).
- Rotate the tire to look for obvious conditions such as damage, runout or lack of uniformity.
- Check the tread for wear that could indicate conditions that require correction. For example, alignment, balance, or worn suspension components.
- Listen for noises while rotating a wheel and tire. This will help identify loose components, foreign matter inside a tire or worn bearings.
- Look for evidence of tire filler or plugs that could contribute to an imbalance.
- Lodged ice, mud or other foreign material in the rim or suspension components.

The key to a successful visual inspection is to be **familiar with the vehicle** you are diagnosing and to **pay particular attention to detail**. Take the time to look closely at non concern vehicles while performing other services. This will provide the experience that will be useful to quickly identify conditions that don't normally exist on a vehicle.



This part of the pinpoint section is designed to be a reference that Pinpoint discusses diagnostic procedures relative to the common NVH Diagnosis by conditions outlined in Section 1. Source and Symptom Charts Conditions are grouped into three charts. They are the vibrating sources that are identified by the NVH Analyzer: • Engine Symptoms Diagnostic Chart Driveline Symptoms Diagnostic Chart Wheel and Tire Symptoms Diagnostic Chart **Some conditions will appear in more than one chart**. The use of the classification flow chart, road test and a knowledge of the theory relating to these conditions will insure that the proper pinpoint diagnostic procedures are being used. Refer to the end of this section for the charts. NOTE Summary The pinpoint diagnosis determines the **specific cause** of the concern and analyzes the possible solutions. If a specific condition and solution is not identified at this point then the diagnostic steps need to be **reviewed** for areas that may require further investigation. If the condition has **not** been resolved after carefully reviewing your diagnostic procedures and conclusions, then technical assistance should be consulted. Be sure to have the details of the diagnosis ready when calling for help (Discussed in detail later). Case study: Part IV From the classification, road test and NVH Analyzer, it is established that the two symptoms are steering shimmy and body booming. They are caused by the driveline and wheels. The NVH Analyzer indicates that the greatest amplitude is in the area of driveline. This would make a good starting point for pinpoint diagnosis. *Pinpoint diagnosis of the driveline would include checking the following:* • Balance • Runout

- Hunout
- Angle
- U-joint inspection

This order was selected because the symptoms indicate balance as the most likely because the driveline spike was a first order vibration. (Section 1)

During the diagnosis for balance, it was found that the propeller shaft was out of balance.

Case study: Part IV Balancing the shaft according to the procedures in Section 4, corrected one of the symptoms of the customer concern.

A pinpoint diagnosis of the wheel and tire vibration includes checking the following:

- Balance
- Runout
- Condition

The symptom is a steering shimmy vibration and a distinct second and third order vibration was noticed. Therefore, wheel balance should be your first step. (See Section 1)

Section 4 should be consulted for the proper balancing procedures.

 Choose and Perform the Appropriate
 Choose and Perform the Appropriate
 Depending on the condition or problem found, there are many resources

Depending on the condition or problem found, there are many resources available such as, the repair manual, TSBs, NCFs and EWDs. In addition, assistance is available from the AFTS or the 800 hot line.

Unfortunately, in some cases, the industry has experienced a level of repair or a short cut procedure that is below standard and not in line with long term customer satisfaction. This usually occurs as a result of **frustration** due to a poor diagnostic procedure. Hopefully, the diagnostic procedures outlined in this course and the NVH Analyzer will **minimize** those frustrations.

Section 4 of this course deals with the common repair techniques used in NVH repair. Many of the other NVH repairs are standard service procedures detailed in the **repair manuals**.

Technical Assistance Current vehicles are very complex and the amount of information required to **successfully repair a vehicle the first time** is enormous. Lexus recognizes this fact and has established systems to provide the technician with assistance. The areas for assistance are:

- TAS 800 hot line
- Area Field Technical Specialist (AFTS)

During NVH diagnosis the possible conditions vary greatly and may or may not be easily serviceable by the technician. By using TAS, technicians can tap into resources which provide a data base of **similar situations and successful solutions**. Outside help can also provide some **objective clarity** to our diagnostic process and point out additional areas to examine.

Technical Assistance

It is important to look at assistance as an **additional tool** and **not** a last resort or a sign of failure.

Continued

In order for assistance to be successful, however, there are key factors that **must** be in place **prior** to making your call:

- Good communication skills
- Organized diagnosis procedure
- Reliable data

Most assistance is done over the **phone**. The listener cannot verify the concern or follow the diagnostic procedure on the vehicle and therefore must **rely on what they are told**. The use of **standardized terms** is critical. The symptoms and description must be **clearly understood** by both parties.

When both the technician and the engineer use the same diagnostic procedure, then the engineer can follow along in the same **organized manner** as the technician. The engineer can **predict the steps** and not get confused in trying to sort out a random diagnosis. At specific points in the discussion, the engineer will be looking for **data** that will support the decision process.

The engineer can now **point out conditions** to consider, in the diagnosis or the data, which will redirect the technician toward a successful solution.

He may **confirm your conclusions** and recommend **further assistance** to deal with a condition that is **not** serviceable by the technician.

Nobody likes to get "buried" in a job and customers do not like the service experience associated with the inability to satisfactorily resolve a concern. As the service experience becomes unpleasant to the customer, they often become more difficult to satisfy.

The **quicker** the technician resolves the concern, or identifies the need for outside help, the better the service experience for all involved.

It is important to note that jumping to assistance without making a **concerted effort** to follow the above procedures is also a **waste of time**. Without specific information, technical assistance cannot help, and **will** direct you to perform the procedures.

Summary Technical assistance is an option for a technician when help is needed in diagnosing a serviceable concern or in identifying when outside technical support is necessary.

The key is to have solid diagnostic data available and to use technical assistance as soon as it is necessary.

The object is to get the concern resolved to ensure customer satisfaction and not wait until it is a last resort or too late. **Case study: Part V** The concerns on the LS400 are easily diagnosed and resolved by the technician. Technical assistance should not be necessary in this case.

If the conditions found did not exist, yet there was still a verifiable concern, then assistance should be consulted using the above criterion and the support documentation from the diagnosis.

Verify that the concern has been satisfactorily resolved

The data collected while verifying and measuring the concern will be useful as a basis for comparison of the effectiveness of the repair.

In many cases the vibration or sound will never completely go away. The objective may be to lower the amplitude to an acceptable level. The acceptable level may change for a customer as they become tuned into the concern, especially if they are experiencing some frustration with the service experience. Simply showing the customer graphic printouts of the improvement may satisfy them.

The advantage of hard data is to objectively provide a comparison to show improvement or the acceptable levels of other similar vehicles.

Summary When the concern is successfully resolved and verified, then the vehicle is ready to be returned to the customer. You will have the confidence of knowing the diagnosis and repair was done right the first time and you will have the documentation to prove it.

If you cannot objectively verify that the concern has been resolved, then the opportunity exists to go back through the process to find the condition, without the customer's involvement.

Case study: A test drive with the NVH Analyzer verified that the concern was resolved **Conclusion** when a comparison is made with the data collected during the road test.



The next section of the course will deal with the common NVH repair techniques in greater depth.



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Engine Symptoms Pinpoint Diagnosis

Symptom

Accelerator Pedal Vibration

Description



Accelerator Pedal Vibrations Fig. 3-4

Accelerator Pedal Vibrations occur at frequencies associated with engine speed.

They are usually of low amplitude and not in the direction of the pedal stroke.

They can usually be duplicated when the engine reaches a specific RPM regardless of vehicle speed.

If the vehicle is moving, the vibrations will go away when coasting in neutral.

Pinpoint diagnosis includes inspection of the engine running condition at: Pinpoint Diagnosis

- the RPM recorded during the verification and classification sections
 - idle quality both normal and under load (A/C, P/S, electrical load)
 - fast idle quality both normal and under load
 - cruise RPM

Pinpoint inspection also includes checking:

- the engine, transmission and accessories for contact with the body
- throttle lever and accelerator cables
 - check brackets, bushing and grommet
 - disconnect cable clamp and A/T throttle cable and see if the vibration changes. If the vibration disappears when the A/T throttle cable is disconnected then inspection of the transmission may be required
- accelerator pedal
 - play or looseness
 - return spring and free play
 - mass damper (if equipped)

A complete TCCS diagnosis may be required to deal with engine Remarks driveability conditions that may contribute to engine related vibrations.

Symptom Shift Lever Vibrations

Description



Shift Lever Vibrations Fig. 3-5

Pinpoint Diagnosis

Inspection and repair of shift lever vibrations include the same engine condition inspections outlined in the accelerator cable vibration section, with the addition of the following:

sound.



Mounts Fig. 3-6

- check the engine and transmission mounting for:
 - overall alignment
 - contact or looseness at mounting points

Shift lever vibrations are generated by engine torque fluctuations or imbalance of revolving or

They occur at particular, high engine RPM and may be amplified by imbalance in the propeller shaft or shaft joint angle on a FR vehicle.

They may also be associated with a "buzz"

reciprocating engine components.

- mount slit clearance
- deterioration of rubber quality due to a leak

Pinpoint Diagnosis Continued



Stiffener Bracket Fig. 3-7



Shift Lever Fig. 3-8



Linkage Fig. 3-9

• engine and transmission tightness including stiffener plates or brackets must be checked

- shift lever
 - check for installation
 - wear of housing and retainer
 - action of the restriction pin

- shift control linkage and cable
 - check for bent linkage and excessive play
 - cables need to be checked for proper flex, contact with other components and excessive play



Transmission Condition Fig. 3-10

- transmission condition
 - check for play in the shift fork and shaft
 - inspect each gear and thrust clearance
 - shift fork to hub sleeve clearance

Remarks



Two Piece Oil Pan Fig. 3-11

The two piece oil pans on later model vehicles have been designed to improve NVH characteristics. Stiffener plates are not used on these vehicles. Symptom Engine Noise

Description



Engine Noise Fig. 3-12

Pinpoint Diagnosis

Engine noise is most commonly diagnosed by searching for the source visually or with a stethoscope.

Other techniques such as, removing a plug wire and grounding it or disconnecting an injector, can help identify the location of an internal engine noise. By changing the firing load in a cylinder, noises from a piston, piston pin or rod bearing condition may change, identifying a cylinder causing the concern.

Vehicles with multiple belts can be diagnosed by removing the belts one at a time until the condition changes. Accessories associated with the belt and the condition of the belt should be checked. Components include:

• fan

• fan shroud

alternator

water pump



Engine Accessories Fig. 3-13



Perform diagnosis quickly when belts are removed so that concerns such as overheating will not occur.

- A/C compressor
- idler pulley
- P/S pump

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Engine noise is engine speed related and may require a change in load.

Pinpoint Diagnosis Continued

The air intake system can also be a source of both noise and vibrations. This system is designed to deliver filtered, fresh air to the engine with minimal noise. Many systems incorporate resonators to accomplish noise reduction.



Intake System Fig. 3-14

A technician can inspect the air intake system:

- for the proper components properly connected
- to see if the concern can be modified by pushing on or disconnecting components or hoses
- for proper mounting and mount condition
- for foreign material that can make noise or cause an obstruction
- **Remarks** The exhaust system is discussed in many areas of this course as a possible transmitter of engine vibration and noise through body contact. You should also consider the possibility of exhaust restriction as a potential noise source. Vehicles with this condition would also exhibit power loss under load. A vacuum gauge is very helpful in pinpointing a restricted exhaust condition.

Symptom

Clutch Judder

Description



Clutch Judder Fig. 3-15

Pinpoint Diagnosis

Engine running condition needs to be considered as well as the condition of the motor mounts when troubleshooting engine noise.

ment.



Bushing Contacts and Slits Fig. 3-16 Suspension bushings need to be inspected by prying them apart and checking the slits provided to minimize vibration and noise. The suspension system can be a transmission path for normal vibration during clutch engagement.

Clutch judder can be reproduced during partial clutch engagement when the vehicle encounters

rolling resistance, for example, climbing a grade. This condition can be simulated by lightly applying the brake during clutch engage-

Pinpoint Diagnosis

Continued



Rubber Insulator Fig. 3-17



The pedal height, free play and movement need to be checked while operating the pedal. Repair manual procedures contain the specifications should an adjustment be required.

Clutch Pedal Free Play Fig. 3-18



Driveshaft Fig. 3-19 A driveshaft can cause a clutch judder condition. It should be checked for smooth operation without excessive free play.

Pinpoint Diagnosis

Continued



Clutch Assembly Fig. 3-20



Clutch Disc Fig. 3-21

When external inspections do not produce the condition then inspection of the clutch assembly is necessary. This includes the following:

- Lexus clutch components are specifically designed to meet the torsional characteristics required for torque fluctuation of the engine. These components are recommended to ensure the best operation of the clutch.
- the clutch release lever needs to be checked for mounting, alignment and wear.
- the release bearing should be checked for proper alignment and smooth movement. Retaining clips should also be checked.
- the pressure plate assembly and diaphragm spring must be inspected for:
 - wear
 - spring tension and alignment
 - evidence of heat that would effect the temper and tension of the spring
 - evidence of discoloration or hard spots on the pressure plate and flywheel
 - scores, grooves or runout in the pressure plate or flywheel
 - warpage of the pressure plate mounting assembly due to uneven torque or loose mounting bolts
 - clutch disc surface condition, rivets, torsion springs, and spline must be looked at closely
- close inspection of the transmission input shaft spline and pilot bearing also reveal the cause of the concern

Symptom Take-Off Vibration

Description



Take-Off Vibration Fig. 3-22

Take-off vibration occurs when the vehicle transitions from a stop to initial acceleration. It can be noticed in the dash, steering wheel (vertical movement) and floor on FR vehicles.

This type of vibration occurs at low frequency (15 to 30 Hz) for short periods of time and may be extended by idling slowly up a hill.

Pinpoint Torque fluctuations are transmitted to the body through the following areas:



Exhaust System Inspection Fig. 3-23

- The exhaust system needs to be checked:
 - when it is both cold and hot because it will expand and contract with temperature
 - for overall exhaust system tension by looking at the load on each rubber mount. Loosening the entire system to relax the tension and retightening it is effective in resolving many concerns
 - for damage
 - for alignment
 - for OEM components
 - for the condition of rubber mounts for hardening, cracks and elasticity
 - for rubber stoppers, clamps and the body for evidence of contact

Pinpoint Diagnosis

Continued



Engine Mounting Fig. 3-24



Propeller Shaft Inspection Fig. 3-24

• Engine mounts can be inspected as in other engine related NVH diagnosis. Engine torque type concerns relating to mounts or contact can be duplicated by rocking the power train. This is done by increasing the RPM with the vehicle in gear, wheels blocked and the brakes applied. Both drive and reverse should be used.

- The drive shafts must rotate smoothly without excessive play. Both conditions are sensitive to torque fluctuations.
- Take-off vibrations that are felt in the floor may be produced by the propeller shaft and transmitted through the center carrier. An inspection of the propeller shaft includes checks for:
 - play at the extension housing and yoke
 - missing weight (look for a trace of a spot weld)
 - joint phase
 - smoothness and runout (rotate shaft manually)
 - center bearing alignment both vertically and horizontally

Remarks

CAUTION

Do not perform the engine torque test at high RPM or for extended periods due to overheating of the engine, torque converter or transmission.

See Section 4 for details on propeller shaft inspection and repair.



example, when in gear or with the A/C on. Vehicles with transverse-mount engines are more sensitive to idle vibrations that are transmitted through the exhaust system.

If it is found that an engine performance condition is the cause of the symptoms then a thorough TCCS diagnosis is recommended.

Symptom Body Booming Noise

- **Description** Body booming noise is a symptom that can be caused by engine, driveline and tire/wheel conditions.
 - **NOTE** Be sure to check the details in all three source areas when diagnosing a body booming symptom.

Pinpoint Diagnosis Establishing whether a symptom is engine speed related or vehicle speed related is the first step in determining which area to focus the pinpoint tests. Engine related symptoms can be heard while increasing the engine RPM, therefore, the engine can be eliminated as the cause if the noise is heard while coasting in neutral.

> The exterior of the body should be checked for conditions that may resonate with normal vibrations. A thorough visual inspection is important to find conditions such as fit, looseness or damage of body components. An overall look at the vehicle ride height will help you identify conditions such as uneven tire inflation.

Inspection for engine noise should be performed through all operating engine speeds including the RPM that produces the most noise. All engine driven accessories should be operated to see if they contribute to the condition.

A technician should look at the belts, component fit, rattle or contact and any foreign material lodged between components. Engine mounts should be checked during this inspection as mentioned before.

While duplicating the noise, see if it changes while modifying the intake air duct system, such as disconnecting or pushing on it.

The exhaust system is also an area that will cause a body booming noise which is engine related. The system should be checked for damage, mounting, contact with the body and clamp condition. As stated before, the system should be checked to determine that it is properly designed for the vehicle.

An exhaust system changes shape with temperature and should be checked in all temperature ranges. Modifying the system by removing hangers or placing a jack under it to keep it stationary will also help to isolate the exhaust system as the cause.

Symptom Body Beating Noise

Description



Beating Fig. 3-26

Body beating noise requires two vibrations as discussed in Section 1.

It is being addressed in the engine area because the vibrations generated by the engine can be one of the two vibrations involved.

Engine vibrations contributing to body beating include imbalance and torque fluctuation. Imbalance is a first order vibration, while torque fluctuation is a second order vibration on four cylinder engines and third order on six cylinder engines.

A vibration from the engine area combined with one from the driveline or wheel will create the body beating symptom. Resolving this type of concern can be done by eliminating either one of the vibrations or reducing both of them to a minimal level.

Duplicating a beating noise requires a slow change in engine RPM while waiting for the symptom to occur. A beating noise is most noticeable at a frequency between 2 and 6 Hz therefore the technician needs to hold a constant speed long enough for the symptom to appear.

Body beating is a cyclical sound which will occur at a particular RPM. This RPM should be identified during verification of the concern.

Both engine speed and vehicle speed are required to create this symptom, therefore the vehicle speed should also be identified during verification for diagnosis of the second vibration.

Pinpoint Diagnosis

The specific pinpoint tests for the engine vibration are the same as those for body booming noise. In addition, the engine and transmission tightening and the stiffener bracket should also be inspected.

Driveline Pinpoint Diagnosis

Symptom

Transmission Gear Whine and Differential Gear Whine

Description



Transmission gear whine and Differential gear whine are very similar sounds that are not likely to be noticed on the NVH Analyzer. The frequency range is between 400 and 3k Hz for transmission gear whine and 400 to 1500 Hz for differential gear whine which are above the 500 Hz range of the NVH Analyzer.

Gear Whine Fig. 3-27

Pinpoint Diagnosis

To pinpoint the source of gear whine, first determine which symptom exists. The road test will be the most useful technique for this step.

- Operate the vehicle at the speed the whine is most noticeable.
- Then change the speed of the vehicle to see if the noise is speed related.
- Next change gears to determine if the noise changes with different gear selections.
- Note the level of the noise when the gear ratio is 1:1. At this ratio the power flow is direct through the transmission and the load on the gears is the minimal.

Differential gear whine is vehicle speed related and will not change with different gear selections.

The transmission path is an important area of pinpoint diagnosis for both transmission and differential gear whine. Inspection of components that could transmit noise to the passenger compartment will often resolve the concern.

Inspection of body sound insulators is also important in gear noise diagnosis. The technician should look for the following:

- gaps in body panels
- · damage to grommets, body molding, boots and seals
- condition of sound absorbing materials such as asphalt sheets, silencer pads and floor carpets.

Pinpoint Diagnosis

Continued

Remarks



Gears Fig. 3-28 If it is determined that the noise is coming from the transmission or differential, careful inspection of the gears as well as the bearings is important.

Gear whine and bearing noise are very similar, depending on the condition of the bearings, and difficult to isolate in a test drive. Bearing condition could also have an effect on gear mesh and condition.

A thorough understanding of the transmission power flow, will help anticipate the gears and bearings causing the concern during the test drive.

The repair manual is an important resource to consult when diagnosing and repairing internal transmission and differential noises. Procedures and specifications are available to insure the component is repaired properly the first time. Symptom

Body Booming Noise

Description



U-Joint Phase Fig. 3-29

Pinpoint Diagnosis

t A visual inspection includes checking for proper U-joint phase. Fig.
3-29 shows the proper position of the U-joints on the different shafts.



Center Carrier Fig. 3-30

On a 3-joint propeller shaft the center bearing position must be checked for vertical and horizontal alignment.

> The shafts should be rotated, checking for free movement, smoothness, unusual noises or looseness. Visual inspection for alignment, damage or contact with other components such as cables or the exhaust may pinpoint the cause of the concern.

Body booming noise is discussed in the engine pinpoint diagnosis chart specific to causes that are engine related. In this area, pinpoint diagnosis of body booming noise conditions

related to driveline are discussed.

Specific details on the following are covered in Section 4 of this course:

- driveline balancing
- runout measurement and correction
- angle adjustment and repair

Pinpoint Diagnosis Continued The NVH portion of the Diagnostic Tester is very helpful in isolating Remarks the source of the vibration including differentiating between balance, runout and angle conditions. • First order (primary component) driveline vibration is associated with balance or runout conditions. • Second order (secondary component) driveline vibration is associated with U-joint condition such as angle, tightness or looseness. Symptom Body Beating Noise As discussed in the engine body beating noise section, it requires two Description vibrations to cause a concern. The driveline is one of the possibilities to consider, especially if the NVH Analyzer indicates a strong vibration in the driveline area. Pinpoint diagnosis of a body beating noise is the same as the pinpoint Pinpoint diagnosis of the driveline for body booming noise. Diagnosis

Wheel Pinpoint Diagnosis

Symptom Body Shake, Steering Flutter, and Steering Shimmy

Description Body Shake, Steering Flutter and Steering Shimmy concerns all involve pinpoint diagnosis of the same components. The condition of the component is what determines which of the symptoms occur.

The wheels and tires are a good place to start especially if the NVH Analyzer identifies this area as the generating force of the vibration.

Pinpoint Tire and wheel inspection includes:

Diagnosis

- Checking all four tires for the same manufacture, size, and specifications. Proper tire pressure is also an important item to confirm.
- Looking for damage, deformation and wear. The technician should also rotate the tire and wheel assembly, looking at both the side wall and tread, to reveal obvious conditions caused by internal tire damage, flat spots or runout.
- Feeling the tread for unusual wear patterns that may be abnormal. This will direct the technician to conditions that need to be corrected.



• The tire and wheel needs to be checked for proper bead seating all the way around, on both sides.

Bead Seating Fig. 3-31



Hub to Wheel Centering Fig. 3-32

• Hub to wheel centering is important to insure that the clearance is even and within the target value of 0.1 mm (0.004 in.) max. If the clearance is out of spec. then the wheel can be rotated to minimize the difference. If the clearance is still out of spec. then check the hub for runout to determine if the condition is in the wheel or hub. **nt** There are two types of runout to check on the tires, wheels and hubs:

Pinpoint Diagnosis

Continued

Vertical run-out

Wheel and Tire Runout Fig. 3-33

• radial

• lateral



Rim and Tire Runout Fig. 3-34

Radial runout is the **change in the radius** as it rotates. It is measured with a dial indicator that is mounted in a stationary position, parallel with the rotating plane. Check radial runout through one complete 360° rotation of the tire and wheel assembly.

Lateral runout is the **side to side** movement.

A dial indicator is used to measure the runout as the tire and wheel assembly is rotated 360°.

The balance of rotating components must be checked including the tire, wheel, hub, drum or rotor.

- Tires and wheels are commonly balanced off the car which takes into consideration irregularities of the tires and wheels
- Dynamic balancing (wheel and tire in motion) is recommended for accuracy as compared to static or bubble balancing
- On car balancing or finish balancing not only includes tires and wheels but also checks everything that rotates (ie: hub, rotor/drum and bearings).

Pinpoint Diagnosis Continued While performing an inspection, the technician should keep in mind components in other areas that will resonate at wheel speed. This includes many components in the steering and suspension systems.

Steering system component checks include:

- ball joint play
- leakage
- steering linkage play or damage
- steering damper condition
- condition of the rubber bushings

Suspension system components checks include:

- condition of suspension arms and bushings
- condition of the springs
- wheel bearing adjustment
- shock absorber inspection for leaks, bushing condition and proper operation
- **Remarks** Tire wear may cause a vibration but may be the result of another condition such as incorrect wheel alignment or worn components. The technician needs to do a thorough inspection to be sure the original cause of the condition is repaired.

Details on measuring and correcting runout are discussed in Section 4.

Details on balancing are also included in Section 4.

Symptom Riding Comfort, Harshness, Road Noise, Tire Pattern Noise

Description



Harshness Fig. 3-35

Pinpoint Diagnosis



Low Profile Tire Fig. 3-36

Riding Comfort, Harshness, Road Noise and Tire Pattern Noise are all different symptoms with different characteristics as discussed in Section 1. The generating forces in these conditions are caused by contact with the road which we have **no control or cannot change**. What we have control over is the **transmission path** of the impact through the vehicle.

The transmission path and the components to inspect are the **same for all four of the above conditions**, therefore the pinpoint diagnosis will cover the **same systems and components**.

The components in these areas to check are also similar to the inspections discussed in previous pinpoint diagnosis of tire and wheel vibrations:

- tire and wheel
- suspension
- body sound insulators

In all pinpoint diagnosis it is important to look for changes from the manufacturer's original condition.

For example:

Low aspect ratio/profile tires are popular for appearance to some customers. These tires do not have the same ride characteristics as the original profile tire. The customer will feel a greater impact from road irregularities.

Symptom

Brake Vibration

Description

Brake vibration occurs only when the brakes are applied. As a result the technician can go directly to pinpoint diagnosis.



Rotor Runout and Thickness Fig. 3-37

Pinpoint diagnosis of this condition includes inspection of the:

- pedal for lateral play
- rotor for surface condition such as rust, grooves, glazing, hard spots, evidence of overheating and evidence of poor surface condition
- rotor runout and parallelism (target value 0.1 mm (0.004 in.) or less)
- Wheel bearing adjustment and condition needs to be checked
- Pads must be checked for glazing, cracks, uneven wear and proper installation. OEM is recommended to insure the proper function and friction characteristics.
- Disc brake hardware should be checked for looseness, wear, dirt, leaks and operation.
- The surface of the wheel that mounts to the hub should be flat with no cracks. target value 0.1 mm (0.004 in.) or less. It is important to check hub and axle runout before making corrections for rotor runout or wheel and tire runout. A bent axle will cause all of the components to indicate a runout condition if checked while on the vehicle.

Symptom Brake Squeak

Description Brake squeak is associated with the contact of the pads to the rotors.



Pad and Shoe Condition Fig. 3-40

Cylinder slide pin Backing plate Disc rotor Axle hub Disc caliper Disc brake cylinder mounting

Component Condition Fig. 3-41

Inspection and repair involves inspection of:

- The surface of the pads for wear, hardness, and shine.
- Pad contact, by placing them against the rotor surface and noting even contact.

• Brake component tightness including the backing plate, hub and rotor, caliper mounting and slide pins.

Pinpoint Diagnosis

Continued



Brake Pad Anti-squeal Shims Fig. 3-42

• Anti-squeal shims and pad support plates for assembly accuracy and damage.

Symptom Body Booming Noise, Body Beating Noise

Description Body booming noise and Body beating noise are symptoms that can originate from wheels and tires. Body booming noise from tire uniformity and a tire/wheel vibration can also be one of the two vibrations required for body beating noises.

PinpointTo pinpoint the cause of these conditions use the same procedures as**Diagnosis**with other wheel and tire vibration diagnosis.

Remarks More than one tire out of balance at different pressures can be the cause of beating due to the slightly different diameters of the tires.