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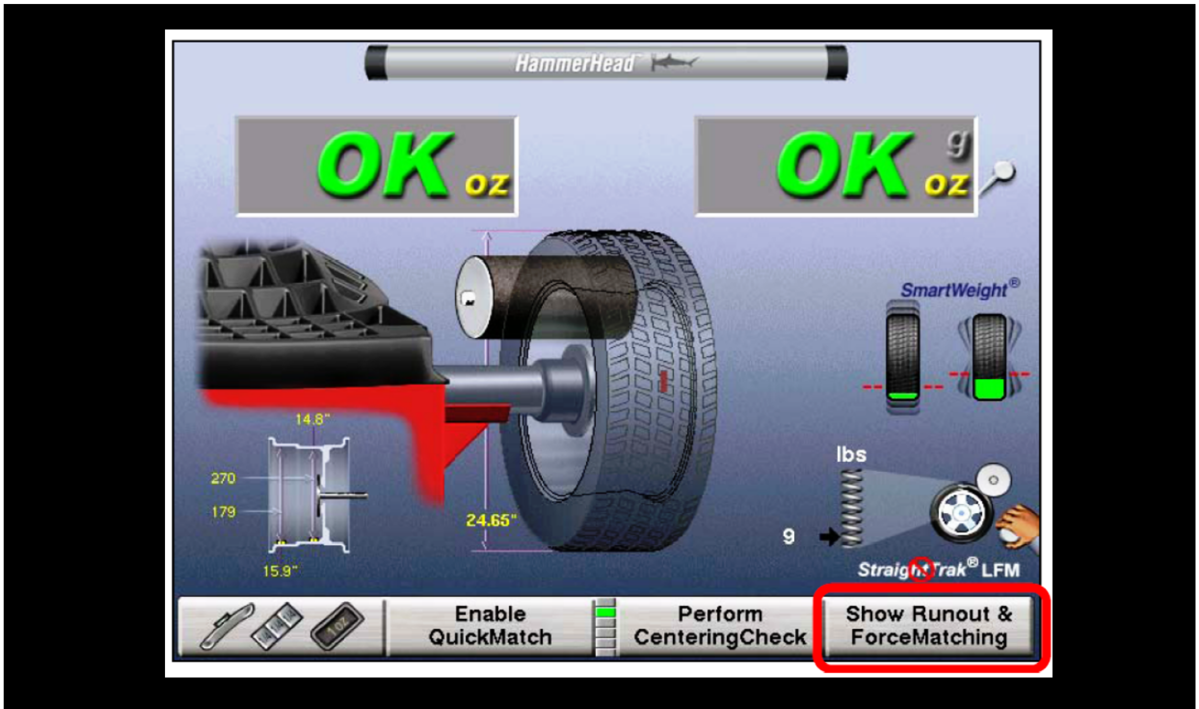
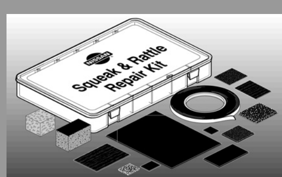
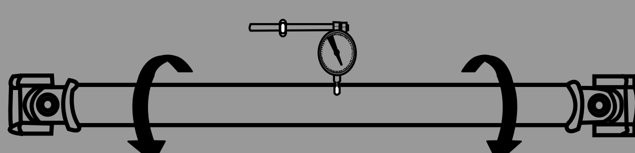


Service Technician Workbook



Noise, Vibration, & Harshness Diagnosis and Repair



NISSAN

INFINITI

REVISED SEPTEMBER, 2011

This book is designed for instructional use only for authorized Nissan North America, Inc. and Nissan dealer personnel. For additional information contact:

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Revised Printing: September, 2011

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NATIONAL AUTOMOTIVE SERVICE TASK FORCE

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NOISE, VIBRATION AND HARSHNESS
TABLE OF CONTENTS

Section 1: Text

Section 2: Modules

NOISE, VIBRATION AND HARSHNESS OBJECTIVES

- Given a classroom discussion and Power Point presentation, you will identify the fundamentals of Noise, Vibration and Harshness including the:
  - Definition, nature and causes of Vibration
  - Definition of Cycle, Amplitude and Frequency
  - Definition of Resonance
  - Explanation of 1st, 2nd or 3rd Order Vibrations
  - Explanation of how to calculate vibration Frequency
  - Identification of tools used to measure vibration
- Given an ASIST workstation, you will locate resource information available in TSBs and the ESM which identify cause and correction procedures for NVH customer concerns.
- Given Vehicle #1 with a NVH problem, you will test drive the vehicle and verify the nature of the noise, vibration or harshness. You will use a Sirometer to measure the vibration frequency, calculate the 'Order' of the vibration and identify the cause of the problem.
- Given Vehicle #2 with a NVH problem, you will test drive the vehicle and verify a vibration felt in seat and steering wheel. You will use an Electronic Vibration Analyzer to measure both the Frequency and G forces of the vibration, and identify the cause of the problem.
- Given Vehicle #3 with a NVH problem, you will test drive the vehicle and verify a vibration at cruising speed. You will use a Sirometer or EVA to isolate the frequency of the vibration problem, then calculate and identify the component group causing the problem.
- Given Vehicle #4 with a NVH problem, you will test drive the vehicle and verify either a shimmy or shake in the steering wheel. You will measure driveline components and identify any out of specification conditions that are causing the problem.
- Given a vehicle with a 1 or 2 piece driveshaft, you will measure the Driveshaft Working Angles. You will identify any problems and recommend corrections for any working angles that exceed recommended specifications.
- Given a vehicle with a NVH complaint, you will use a Steelman Chassis Ear to identify the cause of chassis or driveline noises.
- Given a vehicle with a concern of wind noise, you will use a Steelman Engine Ear to identify the location of the air leak, and the components or repairs necessary to repair the problem.
- Given a vehicle with a NVH concern, you will check ASIST and the ESM for information regarding the symptom. You will then verify the problem and indicate the required repairs.
- Given a wheel and tire assembly with Road Force Variation exceeding the recommended limits, you will use the Hunter GSP9700 to identify the tires RFV 'high spot'. You will then force match the wheel and tire assembly to minimize RFV.

Course Procedures

Class begins promptly at 9:00 a.m. Please be in your seat and ready to begin at 9:00 a.m. Please silence your cell phones.

Class ends when all the modules on the sign-off page of your guidebook are initialed by the instructor. Nissan designs training so that most technicians should be able to complete all activities in the time allotted for the course. If you are unable to complete the requirements of the course in the time provided, your instructor will discuss options with you to receive course credit. You are responsible for learning the techniques and procedures featured in this course. It is important you take as much time as you need to learn the skills presented in the course material. If you cannot complete the requirements of the course in the time provided, your instructor will work with you and your dealership and help you complete the course.

Text:

The text contains information relating to the procedures, features and technology contained in the material of this course. The instructor may assign reading from the text as homework, and some of the text may help you answer questions included in the activities of this course. Read the text section for detailed information regarding the technology featured in this training. It is recommended that you save the text and use it in the future as a resource.

Course Map:

The course map indicates the order in which the modules should be completed. In the case of some training courses, certain modules must be completed before you begin other modules.

Modules:

1. Begin the module by reading the Objective, Relevance, Resources, and Skill Check on the first page. This information will present the basis for the skills included in the module.
2. Read each step carefully to determine the appropriate actions or procedures the modules are designed to impart.
3. Pay attention to the Notes, Cautions, and Service Tips included in the module. In many instances, they will help you derive the answer to questions included in the module and will help you develop the skill sets intended by the design.
4. You will probably be working with one or more technicians during this course. Follow these basic guidelines to work effectively as a team:
   - Take responsibility to understand and perform each step yourself.
   - When using diagnostic tools (CONSULT-III, multi-meters, etc.), be sure to check the on-screen results yourself and hand the tool to the other members of your group so they can confirm the results as well.
   - If you are expected to test or remove and inspect a component, perform these procedures yourself and give the same opportunity to other members of your team.

- Be patient. Everyone works at different speeds. You are responsible to be able to perform each module objective - and you are responsible to ensure that others working with you can complete the skill check.
- Complete all questions on the worksheet. In some cases, the worksheet may give you the opportunity to skip some steps, for example - you may not need to follow the instructions for booting CONSULT-III if you are already confident using the tool. If your co-workers wish to complete these instructions, be patient as they perform these steps.
- Treat the training center vehicles as if they were a customer's car. However if you damage a vehicle in the course of completing a module, notify the instructor immediately. Some components such as trim pieces or wire connectors may be damaged during testing. We expect these occasional problems and need to know about them as soon as they occur.
- Return the vehicle to the condition it needs to be in for the next group of technicians to complete the workstation. For example, reset the bugs if applicable, return tools to the workbench or tool box and straighten up the work area.
- Contact the instructor when you have completed the module and are confident you can perform the "Skill Check" stated on the first page. Expect the instructor to review your worksheet and confirm that you have completed the objective. Tell the instructor if you feel you need more practice. If possible, the instructor will provide you with additional information or give you the opportunity to work on the vehicle later that day.

Resources:

Resources may include ASIST, CONSULT-III, service manuals, digital multi-meters, hand tools, special service tools, and vehicle parts. If the ASIST terminal is not working properly or has not been updated, please notify your instructor.

Monitor the battery power for CONSULT-III and connect it to the charger as needed. For some courses we expect you to be comfortable using CONSULT-III for testing the CAN system and accessing Self Diagnosis, Data Monitor, Active Test and Work Support. Contact your instructor if you are not familiar using these applications. Contact the instructor if you have any questions about using the listed resources or, there is a problem with any of the resources you will need to complete the module.

PowerPoint Notes:

The PowerPoint slides are reprinted in your guidebook. Refer to the Notes section of the book to follow the classroom presentation. The classroom discussion highlights information you will practice during completion of the modules. Make notes and ask questions during the discussion and you will learn information that will help you complete the worksheet objectives.

Technician Creed and Code of Repair

This vehicle is the personal property of the customer.

The customer's desire is: I correctly service / repair their vehicle today.

My desire is: He / She returns to my place of business for additional service and repairs unrelated to today's visit.

It is my choice regarding the quality of repair I make today.

I will do all I can to gain the customer's trust while servicing and repairing their vehicle.

ATTITUDE IS EVERYTHING!

TEXT

NOISE, VIBRATION & HARSHNESS

NVH concerns make up some of the most frequent customer complaints. JD Powers ranked Wind Noise and Noisy Brakes 1st and 2nd respectively in their Initial Quality and 3 Year Old vehicle surveys.

Noise, vibration and harshness are terms associated with a variety of conditions which are particularly annoying to customers. They fall into the following broad categories:

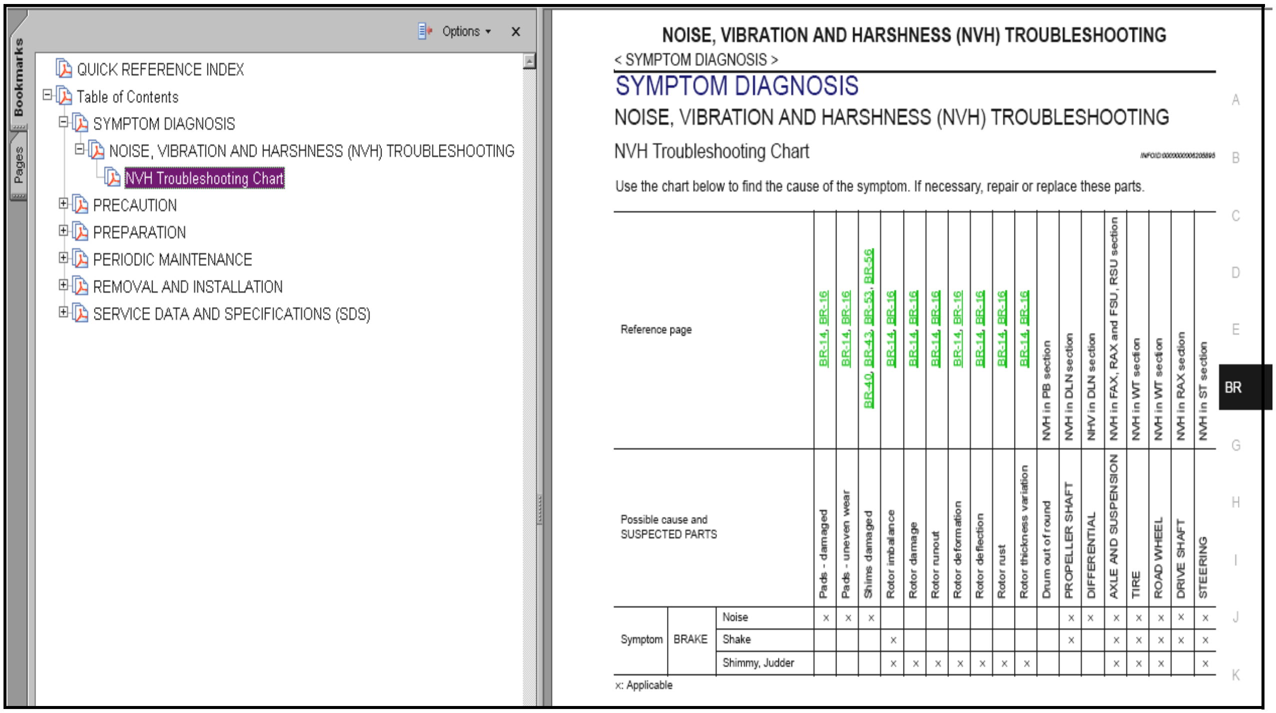
- Engine-induced vibrations
- Driveline-induced vibrations
- Wheel/tire-induced vibrations
- Brake noises and vibrations
- Windnoises
- Squeaks and rattles

Vehicle noises and vibrations occur for many reasons. Some occur during the normal operation of the vehicle. These include the engine, transmission, driveline, and tire and wheel assemblies. Other conditions such as tire radial force variation (RFV), excessive propeller shaft angle, tire pattern noise or brakes may also cause vibrations. Squeaks and rattles sometimes require the use of special tools to effectively identify and repair the problem. Wind noise and air leaks can also be isolated using some the procedures described in this book.

This text will describe the causes of common noise, vibration or harshness issues, and review the tools and diagnostic procedures available to technicians to effectively resolve these problems.

SQUEAK & RATTLE RESOURCES

Nissan and Infiniti ESMs have information to support NVH related concerns. Many chapters in the ESMs now have specific NVH Troubleshooting charts. The example below is found in the ‘Brakes’ chapter.



Bookmarks
Pages
Options

- QUICK REFERENCE INDEX
- Table of Contents
  - SYMPTOM DIAGNOSIS
    - NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING
      - NVH Troubleshooting Chart
  - PRECAUTION
  - PREPARATION
  - PERIODIC MAINTENANCE
  - REMOVAL AND INSTALLATION
  - SERVICE DATA AND SPECIFICATIONS (SDS)

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING
< SYMPTOM DIAGNOSIS >

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting Chart

Use the chart below to find the cause of the symptom. If necessary, repair or replace these parts.

Reference page			BR-14, BR-16	BR-14, BR-16	BR-40, BR-43, BR-53, BR-56	BR-14, BR-16	BR-14, BR-16	BR-14, BR-16	BR-14, BR-16	BR-14, BR-16	BR-14, BR-16	BR-14, BR-16	NVH in PB section	NVH in DLN section	NHV in DLN section	NVH in FAX, RAX and FSU, RSU section	NVH in WT section	NVH in WT section	NVH in RAX section	NVH in ST section
Possible cause and SUSPECTED PARTS			Pads - damaged	Pads - uneven wear	Shims damaged	Rotor imbalance	Rotor damage	Rotor runout	Rotor deformation	Rotor deflection	Rotor rust	Rotor thickness variation	Drum out of round	PROPELLER SHAFT	DIFFERENTIAL	AXLE AND SUSPENSION	TIRE	ROAD WHEEL	DRIVE SHAFT	STEERING
Symptom	BRAKE	Noise	×	×	×									×	×	×	×	×	×	×
		Shake				×								×		×	×	×	×	×
		Shimmy, Judder				×	×	×	×	×	×	×				×	×	×		×

×: Applicable

Following the links in the NVH chart, the ESM directs to ‘Pad Inspection’ if the vehicle has a symptom of brake noise.

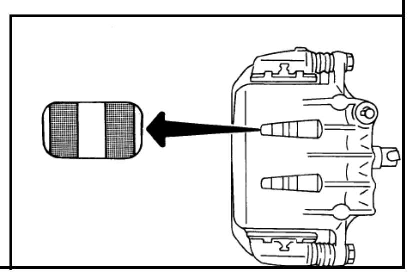
BRAKE PAD : Inspection and Adjustment

INSPECTION

2 Piston Type
Check brake pad wear thickness from an inspection hole on cylinder body. Check using a scale if necessary.

Limit

Wear thickness **: Refer to BR-66, "Front Disc Brake".**



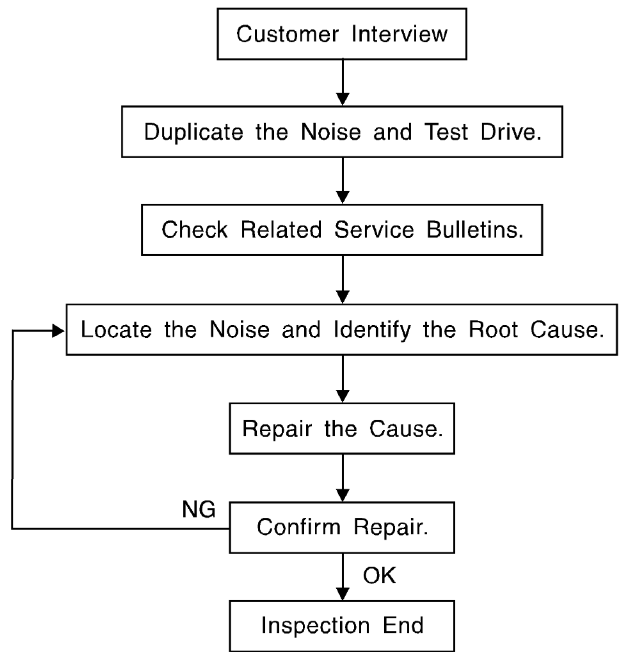
The addition in the ESM of NVH Troubleshooting charts and Squeak and Rattle Diagnosis sections targets some of the most common customer concerns.

Refer to these sections as well as TSBs, SIR Videos and eLearning programs on Virtual Academy to identify the most likely causes of noises or vibrations.

The Work Flow chart below identifies a process designed to fix the problem right the first time.

SQUEAK AND RATTLE TROUBLE DIAGNOSES

Work Flow



This chart summarizes the Four Step Repair Process:

- **Verify the Symptom**
- **Isolate the Probably Cause**
- **Repair**
- **Recheck the Repair**

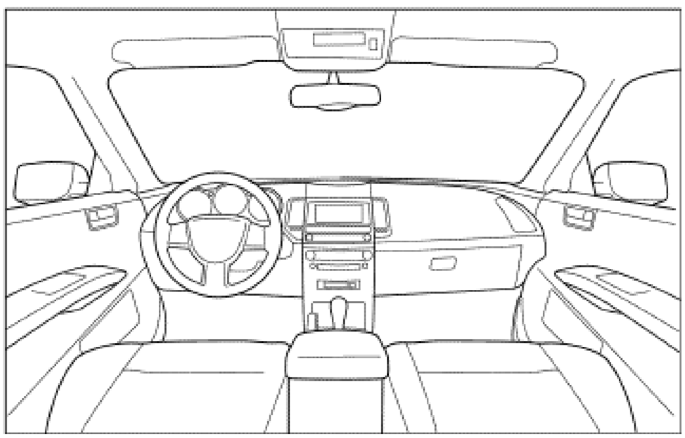
The Customer Interview and Diagnosis Worksheet are used to help Verify the Symptom. The first page of the Squeak and Rattle worksheet suggests a test drive with the customer may be necessary. Nissan and Infiniti strongly recommend test driving with the customer before beginning any squeak, rattle or wind noise diagnosis.

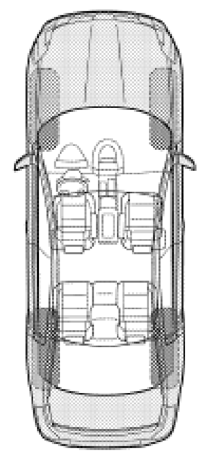
Verify the Symptom

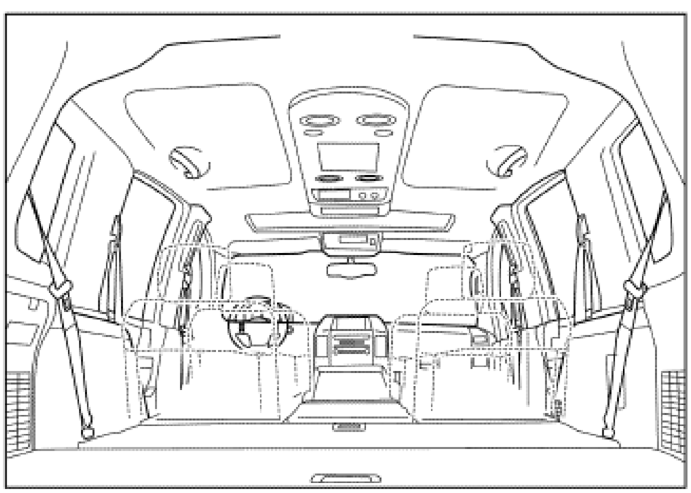
Dear Customer:
We are concerned about your satisfaction with your vehicle. Repairing a squeak or rattle sometimes can be very difficult. To help us fix your vehicle right the first time, please take a moment to note the area of the vehicle where the squeak or rattle occurs and under what conditions. You may be asked to take a test drive with a service advisor or technician to ensure we confirm the noise you are hearing.

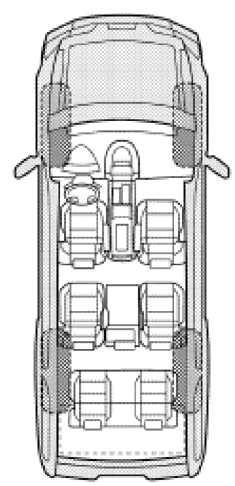
SQUEAK & RATTLE DIAGNOSTIC WORKSHEET

I. WHERE DOES THE NOISE COME FROM? (circle the area of the vehicle)
The illustrations are for reference only, and may not reflect the actual configuration of your vehicle.









The two page Diagnosis Worksheet should be kept with the work order for the purpose of supporting warranty claims submitted based on the necessary repairs.

SQUEAK & RATTLE DIAGNOSTIC WORKSHEET - page 2

Briefly describe the location where the noise occurs:

____

____

II. WHEN DOES IT OCCUR? (please check the boxes that apply)

- ☐ Anytime
- ☐ 1st time in the morning
- ☐ Only when it is cold outside
- ☐ Only when it is hot outside
- ☐ After sitting out in the rain
- ☐ When it is raining or wet
- ☐ Dry or dusty conditions
- ☐ Other:

III. WHEN DRIVING:

- ☐ Through driveways
- ☐ Over rough roads
- ☐ Over speed bumps
- ☐ Only about ____ mph
- ☐ On acceleration
- ☐ Coming to a stop
- ☐ On turns: left, right or either (circle)
- ☐ With passengers or cargo
- ☐ Other: ____________________
- ☐ After driving _____ miles or _____ minutes

IV. WHAT TYPE OF NOISE

- ☐ Squeak (like tennis shoes on a clean floor)
- ☐ Creak (like walking on an old wooden floor)
- ☐ Rattle (like shaking a baby rattle)
- ☐ Knock (like a knock at the door)
- ☐ Tick (like a clock second hand)
- ☐ Thump (heavy muffled knock noise)
- ☐ Buzz (like a bumble bee)

TO BE COMPLETED BY DEALERSHIP PERSONNEL

Test Drive Notes:

____

____

____

	YES	NO	Initials of person performing
Vehicle test driven with customer	☐	☐	____________
- Noise verified on test drive	☐	☐	____________
- Noise source located and repaired	☐	☐	____________
- Follow up test drive performed to confirm repair	☐	☐	____________

VIN: ________________________ Customer Name ________________________

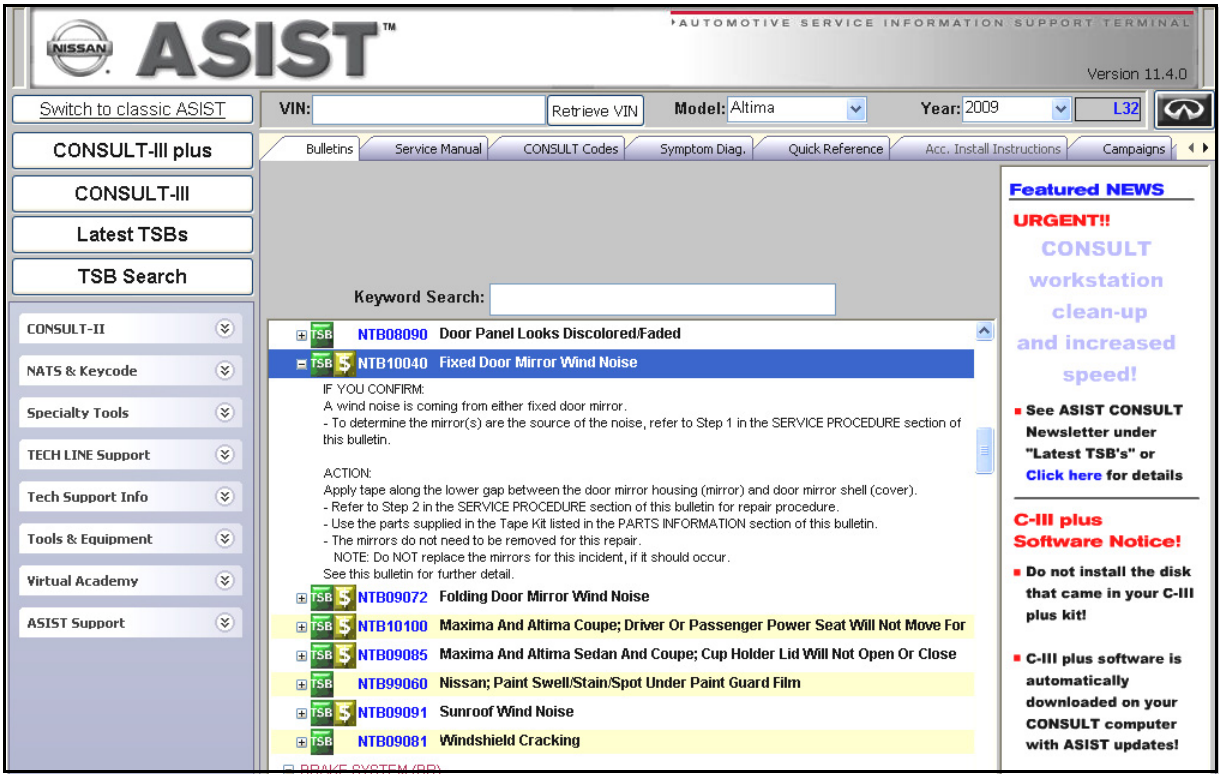
W.O.# ________________________ Date: ________________

This form must be attached to Work Order

Page 2 of this worksheet provides documentation for the type of noise and is the first step in isolating the cause.

Isolate the Probable Cause

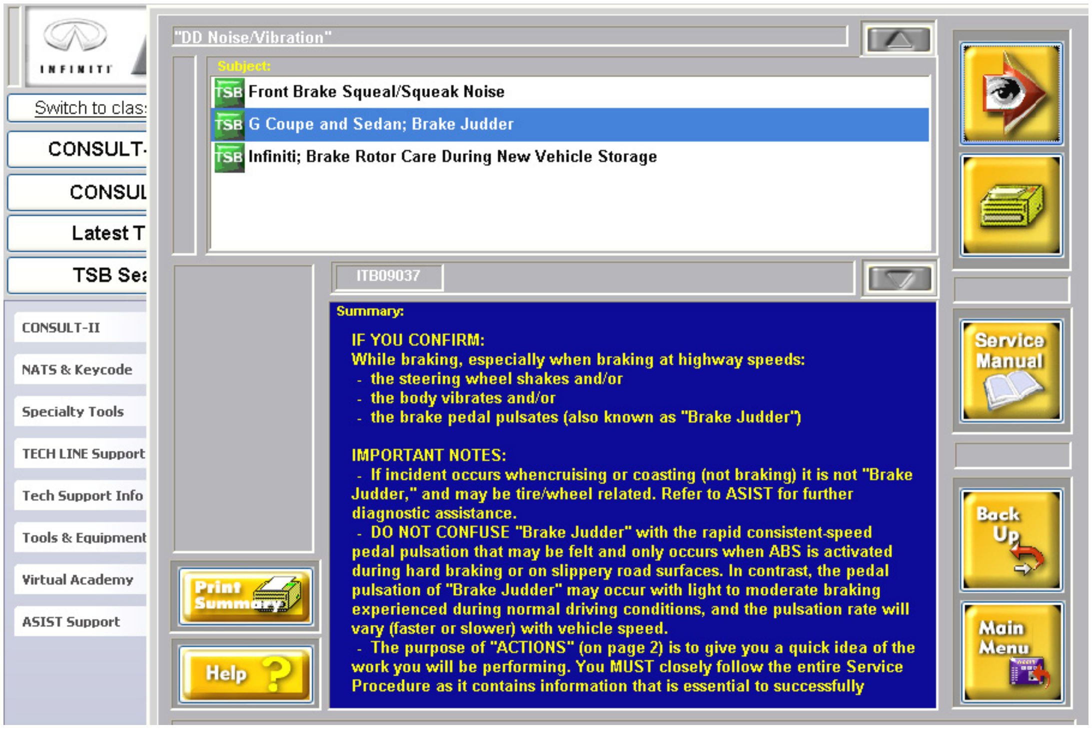
ASIST should be checked to determine if there are any known causes for the customer complaint.



In the example shown, a 'Wind Noise' issue was identified among the Service Bulletins listed for a 2009 Altima. The TSB identifies a simple repair by taping a seam on the mirror.

The TSB (NTB10-040) describes how to first confirm that the mirror is the cause of the noise and then details repair procedures to eliminate the problem.

You may also search for problems by Symptom. The Symptom Diag. tab is shown next to the CONSULT Codes tab.



In the example screen above, the Symptom tab was used to search for Brake Noise for a G35. Two bulletins for Brake Squeal and Brake Judder are listed.

In the case of these examples, the problems can repaired by following the procedures listed in the bulletins.

In some cases, technicians will need to use the diagnostic techniques and special tools used during this NVH training course to isolate the cause of NVH complaints.

Virtual Academy

The Technician Virtual Academy provides access to information about resolving NVH concerns.

Review available resources such as the eLearning program Intro to Noise, Vibration and Harshness in addition to the following SIR videos:

- SIR 130 - Driveline Vibration Analysis
- SIR 147 - Wind Noise
- SIR 164 - Diagnosing Sunroof Issues

Tech Talk occasionally features articles covering topics such as:

- Diagnosing and Eliminating Wind Noise
- Sunroof and Moonroof Inspections and Repairs
- Vehicle Shimmy and Tire Vibration

VIBRATION FUNDAMENTALS

Vibration is the repetitive motion exhibited by a moving object. Vibration is a quivering or trembling sensation. It can be caused by a normal condition or a heightened (abnormal) condition. This can be up and down like a jack hammer, or back and forth like a pendulum. This section covers the characteristics of vibrations detected through touch, sound and sight.

Vibrations develop as a result of the engine combustion process or the centrifugal force of rotating components. When engine combustion occurs, vibrations develop as a result of that process. Engine components, such as the flywheel and crankshaft, are designed to minimize the effects or “feel” of these vibrations so they are not as harsh. Engine mounts and mass dampers reduce the feel of these vibration pulses even more.

Vibrations resulting from rotating parts are normal in many cases. However, when conditions such as excessive runout, imbalance or misalignment are “out of tolerance,” they result in customer dissatisfaction.

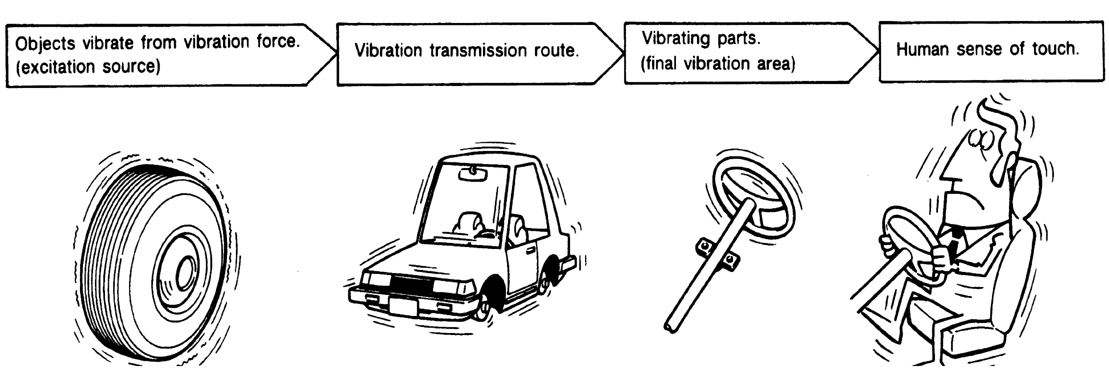
Vibration Sources	Reduced by
Normal combustion	Mass dampers, engine mounts, exhaust mounts, etc.
Rotating parts	Crankshaft counterweights, flywheel, harmonic balancer,etc.

Vibration Elements

Vibrations caused by excessive runout, imbalance, or misalignment produce the kind of harshness that is offensive to the customer. In order for these vibrations to be noticeable, three elements are necessary. There must be a:

- **Source** - The component that causes the vibration.
- **Transmission route** - The path the vibration takes through the vehicle. The path can include body or suspension parts, and in the case of some noises, the air.
- **Oscillator** - The component through which the customer feels the vibration, such as the steering wheel, the floorboard or seat.

Source Transmission Route Oscillator

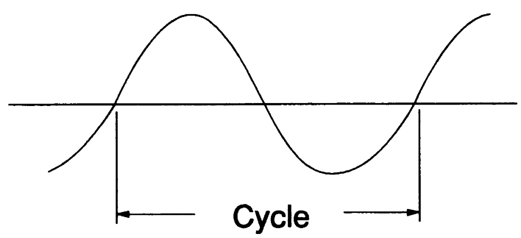


Service Tip: If rough road surfaces or engine torque are contributing to the vibration feel, vehicle service will not eliminate those factors. In such cases, changing the **transmission route** or reducing the vibration at the oscillator is the best alternative solution.

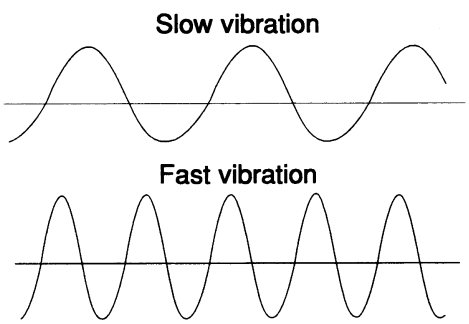
Vibration Characteristics

There are three characteristics of vibrations. They are:

- **Cycle** - The repeated pattern of the vibration. A cycle begins and ends at the same frequency and then repeats over and over.



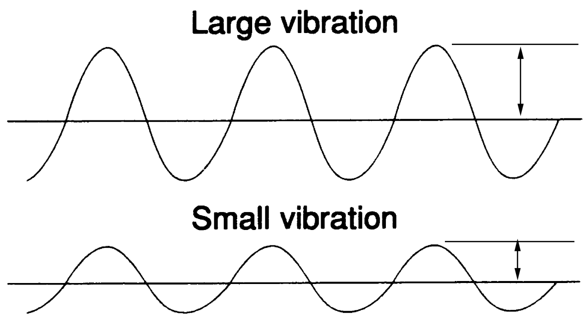
- **Frequency** - The speed of the vibration in a given period of time. Frequency is measured in cycles per second. The term used to describe cycles per second is Hertz, abbreviated Hz. The more cycles per second, the higher the frequency (the faster the vibration occurs).



3 Cycles per second or 3 Hz.

5 Cycles per second or 5 Hz.

- **Amplitude** - The magnitude or strength of the vibration. The greater the amplitude, the stronger the vibration is felt. Relatively weak vibrations have a very low amplitude.



Strong signal or High Amplitude

Noise/Vibration Relationship

Unlike vibrations that we detect through touch, sound is a vibration we detect through hearing. Sound is the product of vibrations caused by air pressure changes and has three principal characteristics. They are:

- **Loudness** - which is determined by the sound pressure felt by the ear. The higher the pressure, the louder the sound. The larger the amplitude, the louder the sound.
- **Pitch** - which is determined by frequency. The higher the frequency, the higher the pitch.
- **Tone** - which is determined by wave form. Due to their differing wave forms, the note produced by a piano, for example, will sound different than the same note played by a violin.

For the purposes of this course, we need to make the distinction between "sound" and "noise." While both refer to the vibrations caused by air pressure changes, when we speak of noise, it is used to describe unpleasant sounds. For example, the sound of a vehicle exhaust may not be unpleasant. However, vibrations emitted from the exhaust of a vehicle nearby can cause a booming noise to be heard in another vehicle.

All vibrations result in some noise. As vibrations become more severe, the noise associated with them also becomes more severe. This chart indicates common passenger compartment noises and their associated vibration frequency ranges:

Typical Noises & Associated Vibration Frequencies	
Passenger Compartment Noises	Vibration Frequency Ranges
Engine Related Noises	
Air Intake Noise	63 - 630Hz.
Engine Noise	
Exhaust Noises	80 - 5000Hz.
Exhaust Resonance (1st Order)	31.5 - 40Hz.
Exhaust Noise, Muffler	60 - 3150Hz.
Transmission/Transaxle Noises	
Transmission Control Lever Chatter	125 - 200Hz.
Final Gear Noise	400 - 800Hz.
Transmission Rattle	400 - 630Hz.
Transmission Gear Noise	500 - 1600Hz.
Transfer Gear Noise (4WS)	630 - 1000Hz.
Interior Related Noises	
Instrument Panel/Steering Shake	25 - 40Hz.
Indoor Cavity Resonance	63 - 80Hz.
Indoor Cavity Droning	155 - 160Hz.
Air Leakage Noise	315 - 3150Hz.
Wind Noise	400 - 8000Hz.
Tire/Road Noise	
Road Noise	40 - 200Hz.
Tire Resonance	80 - 160Hz.
Tire Resonance (Radial Bias)	125 - 160Hz.

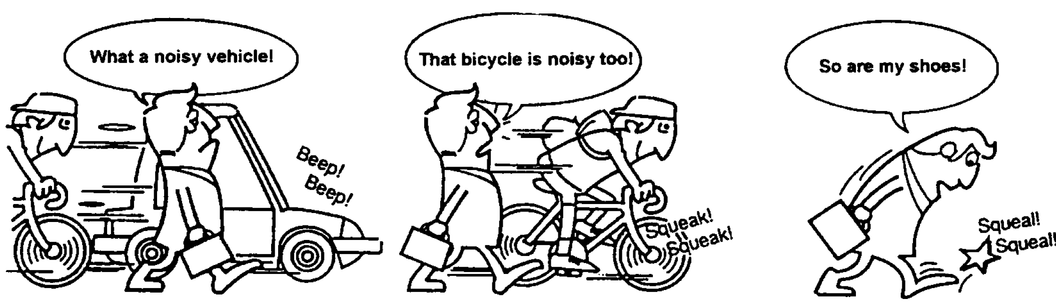
Resonance

All objects have different frequencies at which they vibrate. This is their natural frequency. The engine, propeller shaft, and suspension all have natural frequencies, which explains why vibrations are only felt at certain engine RPM or road speeds. For example, the natural frequency of a vehicle's suspension system is about 15 Hz. As the speed of an unbalanced tire increases with vehicle speed, the vibration frequency of the tire also increases. When the vibration frequency of the tire matches the natural frequency of the suspension, the two frequencies produce a sudden, large vibration. The point at which this occurs is called **resonance**.

Vibrations are present at frequencies above and below the resonance point, but at the point of resonance, they are most noticeable. The amplitude of a vibration is always greatest at the point of resonance. This simply means that vehicle occupants will feel them and will likely be annoyed by them when the vibration's point of resonance is reached.

Masking

Multiple audible sounds often occur simultaneously. When this happens one sound is hidden by the others. This is referred to as "masking" and can present a problem during noise diagnosis repairs. After the audible noise has been repaired, a noise that was masked initially now becomes apparent.

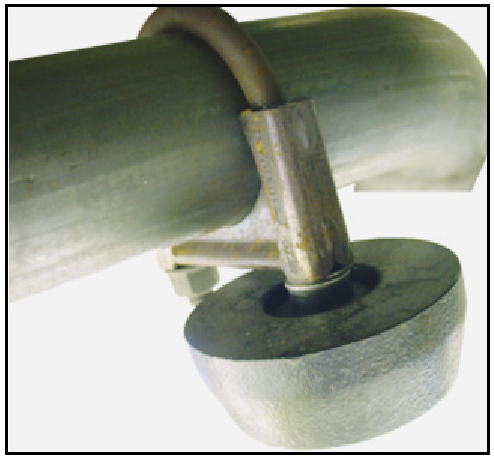


Service Tip: An important initial step in the isolation of noises and vibrations is to determine whether the disturbance is caused by the engine or by some other vehicle component or system. Begin with a road test to verify the symptom. During a road test, note the engine speed (RPM) at which the noise or vibration is noticeable.

Dampers

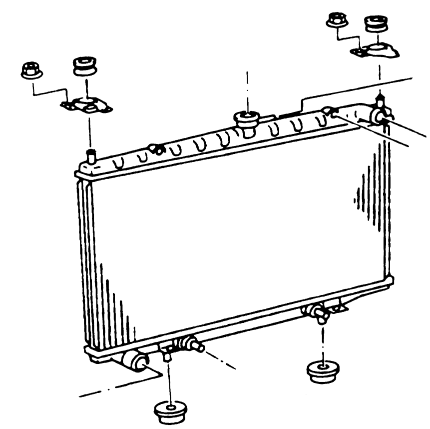
Because resonance presents such a great problem, vehicles are manufactured with a number of dampers that absorb resonant frequencies. These include cushions and shock absorbing devices that either absorb the vibrations or shift the resonance frequency. The two principal types of dampers are **mass dampers** and **dynamic dampers**.

Mass dampers are additional weights that are added to the vehicle to shift the resonance frequency. Mass dampers are of specific weight and are bolted to the body at specific points to minimize the effect of the vibration at the original resonance point.



Typical mass damper

Dynamic dampers consist of an additional weight and a spring action. Dynamic dampers have the effect of creating two resonance points, one on each side of the original one. On some vehicles, components such as a rubber mounted radiator or a spare tire bolted to the trunk floor act as dynamic dampers to control noises and body vibrations at engine idle.



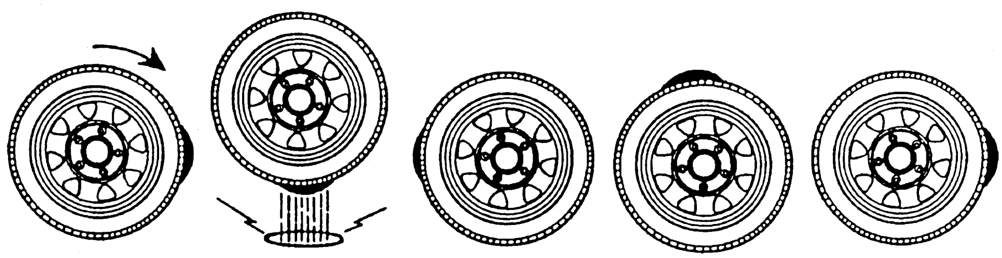
Typical dynamic dampers (Radiator mounts)

UNDERSTANDING THE ORIGINS OF VIBRATIONS

Vibration Order

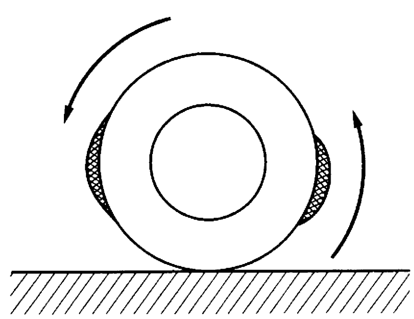
When a rotating component is not balanced, the imbalance causes additional centrifugal force to develop. The heavy spot on a tire, for example, will create additional centrifugal force as the tire rotates, resulting in an abnormal vibration.

Example: As vehicle speed increases, the heavy spot causes the tire to be lifted up and then forced downward again at increasing frequency. At the same time, the amplitude or severity of the vibration will increase. This continues with every revolution of the tire. A vibration of this type is called a **1st order vibration** because it occurs one time for every revolution of the part. If this tire rotates 12 turns a second, a vibration of 12 Hz is generated.



Other examples of 1st order vibrations are a crankshaft or propeller shaft with a single heavy spot. This heavy spot causes an imbalance similar to a knot or heavy spot in the tire.

Example: Suppose that a tire has two heavy spots opposite each other. For every rotation of the tire there will be two instances in which the centrifugal force lifts the tire and forces it downward. Consequently, a vibration will occur twice per tire revolution. If this tire rotates 12 turns per second, a vibration of 24 Hz is generated.This is a **2nd order vibration** of the tire.



Two different components with 1st order vibrations may increase or decrease the amplitude of the problem, but that is all. These two 1st order vibrations could be caused by a tire, crankshaft, or a propeller shaft which is out of balance. However, two 1st order vibrations are not the same as a 2nd order vibration.

Vibration Resulting from Engine Operation

One source of engine vibration is crankshaft torque variation caused by combustion. Another source of engine vibration is imbalance. For example, a crankshaft counterweight will cause the crankshaft to lift and be forced downward, just as an imbalanced tire. This will create a **1st order engine vibration,** designed to offset vibration caused by piston movement.

Vibration Caused by Normal Combustion

To have a clearer understanding of the way engines produce vibrations as a part of the combustion process, study the following charts. Keep in mind that normal 1st order vibrations are produced by the spinning mass of the crankshaft. Each time combustion occurs, vibration increases. Combustion induced vibration occurs at a different frequency than vibration caused by rotating engine components.

In the following example, each dot represents a firing pulse. When 2 firing pulses occur during the same rotation of the crankshaft, a **2nd order vibration** develops. This occurs during normal engine operation.

Normal Engine Operation -4 Cylinder						
Crankshaft Revolutions	1	2	1	2	1	2
Combustion Pulses	✍ ✍	✍ ✍	✍ ✍	✍ ✍	✍ ✍	✍ ✍
	4 stroke cycle		4 stroke cycle		4 stroke cycle	

In the next example the number of pulses increases from 4 to 6 with each four-stroke cycle. This sets up a normal **3rd order vibration** because 3 pulses occur with each revolution of the crankshaft.

Normal Engine Operation -6 Cylinder						
Crankshaft Revolutions	1	2	1	2	1	2
Combustion Pulses	✍ ✍ ✍	✍ ✍ ✍	✍ ✍ ✍	✍ ✍ ✍	✍ ✍ ✍	✍ ✍ ✍
	4 stroke cycle		4 stroke cycle		4 stroke cycle	

In this example the number of pulses increased from 6 to 8 for each four-stroke cycle. This sets up a normal **4th order vibration**, because 4 pulses occur during each rotation of the crank-shaft.

Normal Engine Operation -8 Cylinder						
Crankshaft Revolutions	1	2	1	2	1	2
Combustion Pulses	✍ ✍ ✍ ✍	✍ ✍ ✍ ✍	✍ ✍ ✍ ✍	✍ ✍ ✍ ✍	✍ ✍ ✍ ✍	✍ ✍ ✍ ✍
	4 stroke cycle		4 stroke cycle		4 stroke cycle	

Vibrations Caused by Misfire

When misfire occurs as in the following example for a 4 cylinder engine, the combustion pulses change. This results in a disruption or change of the normal second order vibration. While we don't know the exact frequency that will be produced by this misfire condition, we do know that it is not a normal second order vibration. In this example, the **X** represents a misfire of the cylinder in second place in the fire order.

Misfire Occurring -4 Cylinder						
Crankshaft Revolutions	1	2	1	2	1	2
Combustion Pulses	✍ **X**	✍ ✍	✍ **X**	✍ ✍	✍ **X**	✍ ✍
	4 stroke cycle		4 stroke cycle		4 stroke cycle	

If one cylinder misfires, "torque depression" occurs once during every two turns of the crank-shaft, regardless of the number of cylinders. This generates a **half order vibration**. Usually, this will not be very noticeable until higher engine torque or RPM is generated. In other words, misfire at idle is not as apparent as misfire under heavy load or at high RPM.

FREQUENCY CONVERSION FORMULAS

Frequency Calculations for Normal Engine Vibration

The frequency of a normal engine vibration can be calculated using the engine RPM associated with the normal vibration. For this example we will use 1,200 RPM.

- To calculate a **1st order** engine vibration frequency, use the following formula:

  Engine RPM ÷ 60 = Engine Hz.

  Example: 1,200 RPM ÷ 60 = 20 Hz. (1^{st} Order Frequency)

- To compute a **2nd order** engine vibration frequency, use the following formula:

  (Engine RPM ÷ 60) x 2 = Hz. or (First order vibration) x 2 = Hz.

  Example: 20 x 2 = 40 Hz. (2nd Order Frequency)

- To compute a **3rd order** engine vibration frequency, use the following formula:

  (Engine RPM ÷ 60) x 3 = Hz. or (First order vibration) x 3 = Hz.

  Example: 20 x 3 = 60 Hz. (3rd Order Frequency)

- To compute a **4th order** engine vibration frequency, use the following formula:

  (Engine RPM ÷ 60) x 4 = Hz. or (First order vibration) x 4 = Hz.

  Example: 20 x 4 = 80 Hz. (4^{th} Order Frequency)

Service Tip: If the frequency of an incident vibration matches the calculated normal engine vibration frequency, suspect an engine-induced vibration. This could be caused by faulty engine mounts or problems relating to the exhaust system.

Driveline Vibration Frequency Calculations

A 1^{st} order driveline vibration frequency can be calculated by dividing the 1^{st} order engine frequency by the gear ratio of the gear the vibration occurs in. For this example, we will use an engine frequency of 60 Hz and a 2^{nd} gear ratio of 1.545 (gear ratios can be found in the service manual).

To determine **1^{st} order** driveline vibration frequency, use this formula:

1^{st} Order Engine Hz ÷ Gear Ratio = Driveline Hz.

Example: 60 Hz ÷ 1.545 (gear ratio) = 39 Hz

Service Tip: If the frequency of an incident vibration matches the calculated driveline frequency, suspect a driveline problem. It could be caused by imbalance, runout, or excessive working angle.

Wheel / Tire Vibration Frequency Calculations

Wheel / Tire vibration frequency can be calculated by using the driveline frequency divided by the differential gear ratio. For this example we will use a driveline frequency of 39 Hz. and a differential gear ratio of 3.619 (differential gear ratios can be found in the service manual).

Compute **1st order** wheel/tire vibration frequency with this formula:

Driveline Hz. ÷ Differential Gear Ratio = Wheel/Tire Hz.

Example: 39 Hz. ÷ 3.619 Ratio = 11 Hz.

Service Tip: If the frequency of an incident vibration matches the calculated wheel/tire frequency suspect a wheel/tire problem. It could be caused by an out of balance condition, excessive runout or physical damage such as a bent wheel.

Summary of Vibration Frequencies

As a general rule, 1st order vibrations resulting from rotating components will generate much lower frequencies than combustion-induced vibrations. Use the following chart as a reference in dealing with typical vibration concerns.

Rule of Thumb for Isolating Vibrations
1st order Wheel & Tire Vibrations:10- 20Hz.
1st order Driveline Vibrations: 30 - 80Hz.
1st order Engine Vibrations: 30 - 60Hz.
Combustion-Induced Vibrations: 60Hz. & up (2nd, 3rd, 4th order)

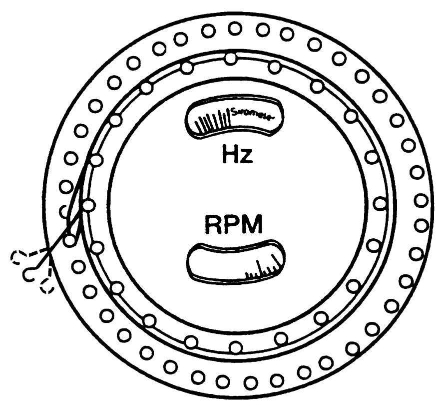
In summary, 1st order wheel and tire vibrations generate much lower frequencies than 1st order engine vibrations. This is because they are rotating at a much lower speed than the crankshaft.

NVH DIAGNOSTIC TOOLS

Regardless of the source of the vibration, when components operate at a **constant speed**, the frequency of the vibration can be accurately measured. These measurements can be made with specialized test equipment such as a Sirometer or an Electronic Vibration Analyzer (EVA). If the frequency of a vibration is known, the source of the vibration can be determined by using some simple analytical skills.

There are numerous tools available for detecting vibrations. They range in price from around $20 for a Sirometer to as much as $1400 for an EVA. Any of these tools may be adequate to help diagnose vibrations, but the availability of the tool in your workplace will determine which tool you will use. During this training you will see or use a variety of tools. It will be up to you and your service manager to determine which tools best meet your needs. Keep in mind the cost and complexity of the tool and the nature of the diagnosis you are performing with the tool. The following tools are available for diagnosing vibration concerns.

Sirometer



The Sirometer is an inexpensive tool used to measure both frequency (Hz) and RPM. A wire, coiled inside the case, scrolls in and out, exposing more or less length. The Sirometer operates on the principle of resonant frequency. As the length of the scrolled wire changes, so does its natural frequency. When the natural frequencies of the vibrating component and the scrolled wire match each other they are said to have resonance. When this resonant frequency is matched, the scrolled wire vibrates at its highest amplitude.

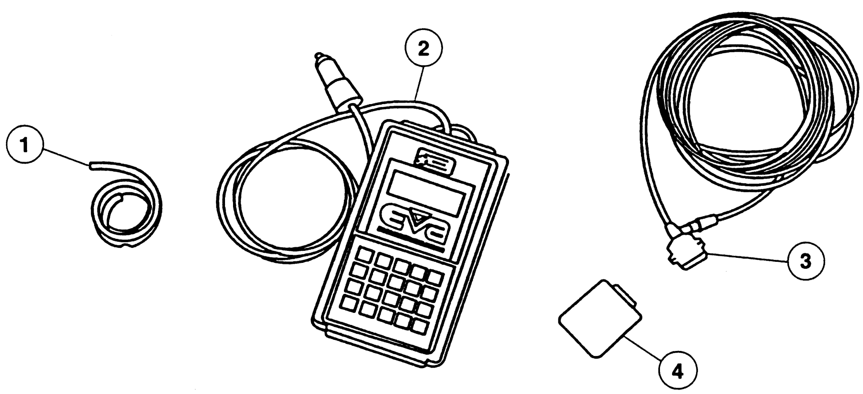
Electronic Vibration Analyzer (EVA)

Introduction

The basic function of the EVA is to provide frequency and amplitude readings of vibrations. The EVA includes the following components:

- EVA unit with a five-foot power cord and protective cover
- Software cartridge - Contains operating program

- Vibration sensor with a 20-foot cord
- Magnet (Not shown)
- Velcro holding strap
- Putty - To stick the sensor to something non-magnetic (Not shown)
- Instructions (Not shown)
- Carrying case (Not shown)



Item	Description
1	Velcro Holding Strap
2	Electronic Vibration Analyzer
3	Vibration Sensor
4	Software Cartridge

Electronic Vibration Analyzer (EVA) Features

Display Screen

The display screen on the EVA unit is a liquid crystal display that provides output messages to the operator. It also provides information about vibration frequency and amplitude for the three strongest vibrations. Instruction messages for unit operation can also be displayed.

Keypad

The keypad allows the user to program the EVA for several different operating modes. Several of the keys have dual functions, depending on the operating mode of the unit.

Cartridge Port

The software cartridge plugs into a port at the bottom of the unit. USE ONLY THE EVA CARTRIDGE CURRENTLY INSTALLED IN THIS UNIT.

Input Jacks

At the top of the EVA unit is a pair of sensor input jacks (labeled 'A' and 'B'). Input 'A' is the most commonly used port.

Sensor

The sensor is an accelerometer which detects vehicle vibrations and transmits data to the EVA. It is attached to the input cable and is functional in either of the EVA input jacks.

Power Cord

A 12-volt feed from the vehicle's cigarette lighter supplies power to the EVA. Once the power cord is attached, the unit display is on-no switches are necessary.

Strobe

The strobe function requires the use of a normal ignition timing light with an inductive probe. It is used to detect imbalance in rotating components. A trigger wire for the inductive pickup transmits a signal which causes the strobe light to flash at the same frequency as the vibration frequency. The trigger wire is looped across the top of the EVA.

Active Mode

The EVA operates in Active Mode until another function is selected. Active Mode can be set as average (AVG) or non-average in either RPM display or Hz. display.

Keypad Operation

YES	NO	⬆	⬇	STROBE
0 RPM/HZ	1	2	3	4 RECORD
4	5	6	7	PLAY BACK
8 AVG	9	ENTER	EXIT	FREEZE

Electronic Vibration Analyzer (EVA) Keypad

0 to 9 Keys

Keys numbered 0-9 are used to select the snapshot tag number when storing or playing back information.

A/B Key

Use this key to switch between the A and B sensor inputs.

AVG Key

This key is used to toggle back and forth from average mode to non-average mode.

Arrow Keys

Press the up and down arrow keys to scroll forward and backward when in the playback mode.

ENTER Key

Press this key to start the record function.

EXIT Key

Press this key to return the screen to the ACTIVE, STROBE, RECORD, PLAYBACK, or FREEZE modes.

FREEZE Key

Press this key to “freeze” the current readings in either ACTIVE or PLAYBACK mode. Press either the **FREEZE** or **EXIT** button to deactivate the “freeze” function.

RECORD Key

Press this key to change to the RECORD mode. Press EXIT to return to the ACTIVE mode.

PLAYBACK Key

Press this key to display stored snapshot information. Press EXIT to return to the ACTIVEmode.

RPM/HZ Key

Press this key to toggle between RPM and Hertz (Hz).

STROBE Key

Press this key to convert to the STROBE function to balance rotating components such as drive shafts. Press the key again to return to the ACTIVE mode.

YES/NO Keys

These keys provide responses to questions posed by the EVA when programming the strobe for balancing operations.

Preparing the Electronic Vibration Analyzer (EVA) for Use

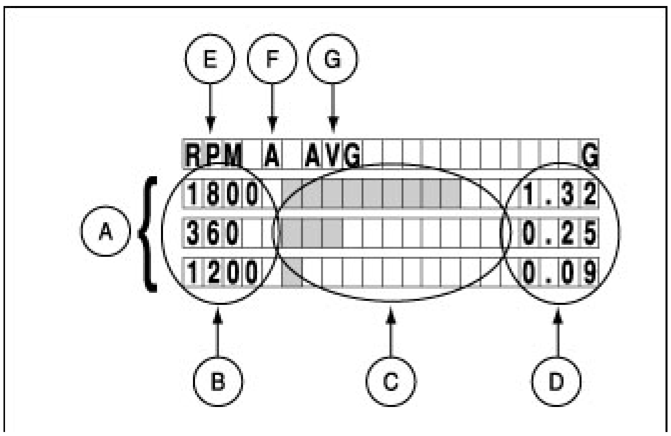
- Connect the cord from the vibration sensor into Input A on the top of the EVA.
- Plug the power cord into the vehicle’s 12-volt accessory outlet (cigarette lighter). This instantly provides power since there is no ON/OFF switch.

The EVA always defaults to ACTIVE RPM mode.

Sensor Placement

- Proper operation of the EVA requires careful positioning of the sensor. Placing the sensor near the location of the suspected vibration should produce the highest amplitude reading.
- The sensor is directionally sensitive and must be placed so that the ‘UP’ mark literally points up.
- Never place the sensor on a component that is rotating (driveshaft, etc.) or extremely hot (exhaust pipes, etc.). This could damage the sensor or leads.
- The magnet provided with the kit allows the user to attach the sensor to metal (ferrous) components. Use the putty or Velcro strap to mount the sensor when it is not possible to use the magnet.

Data Information Averaging



Item	Description
A	The three (3) most prominent vibration frequencies
B	The frequency in RPM/Hz of each vibration
C	A bar graph showing the strength of each vibration
D	A numerical display of the strength of each vibration
E	Shows whether frequency displayed is in RPM or Hz
F	Active sensor input
G	Current active mode

- The EVA normally displays data in the averaging mode as indicated by the letters “AVG” on the top line of the display. When in this mode, the EVA averages multiple vibration samples to make it easier to read.

- To access the non-averaging mode, press the **AVG** button (8/AVG key) on the keypad.
- Pressing the **AVG** button again returns the unit to the averaging mode, which is the best mode for most testing situations.

Freeze

- To freeze the data on the EVA display, press the **FREEZE** button on the keypad. The letters "FRZ" appear at the top of the screen and the display is frozen until this mode is changed.
- Press either the **FREEZE** or **EXIT** button to deactivate the freeze function.

Record

The record function allows the operator to record and store vibration information for playback at another time. The EVA retains stored data for about 70 hours with no power. The EVA records data in 10-frame "snapshots" of vibration information. A total of 10 "snapshots" (100 total frames of data) can be stored.

Recording a Snapshot

The process for recording a snapshot is simple:

1. To begin, press the **RECORD** button. The screen displays "R?" to request a tag number of the snapshot to be taken.
2. Select a number from 0-9 using the keypad. After selecting a number, the screen displays the letter "W" followed by the number chosen.
3. Press the **ENTER** key to begin the recording process. The EVA displays "R" and the selected tag number followed by the letter "F" and a series of numbers from 0-9. This indicates which frame of the snapshot is being displayed and recorded. At the completion of the 10-frame recording sequence, the EVA automatically reverts to ACTIVE mode.

Playback

- To review the recorded data, press the **PLAYBACK** button on the keypad. The screen displays "P?" to request the tag number of the snapshot to be played back.
- Enter the number.
- EVA displays "P" and the selected tag number followed by the letter "F" and a series of numbers from 0-9 indicating which frame is displayed.
- When finished viewing the snapshot, press the **EXIT** button to return the EVA to the ACTIVE mode.

EVA Strobe Balancing

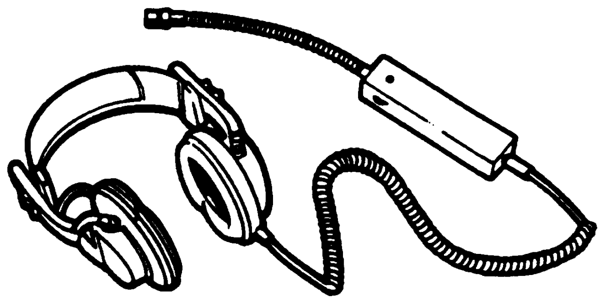
The EVA has a strobe balancing function for diagnosing imbalance of a propeller shaft. To perform this function use an inductive timing light. By clamping the inductive probe of the timing light around the trigger loop on the top of the EVA, a pulsing strobe signal will cause the timing light to flash in time with the imbalance.

Follow these steps to perform a strobe balance:

1. Connect the vibration sensor to input A.
2. Place the sensor where the vibration is noticeable facing “Up”.
3. Clamp the inductive probe of the timing light around the trigger wire loop at the top of the EVA.
4. Attach the power cable to the cigarette lighter socket.
5. Change the display from RPM to Hz. by pressing the RPM/Hz. button.
6. Press the **STROBE** key on the keypad and follow the prompts to set the filter range.
7. Set the filter range so that it includes the frequency shown on the top line of the EVA display.
8. Select the range that is closest to that frequency for greatest accuracy.
9. The three ranges are:
    - Full Range
    - 35 Hz.- 45 Hz.
    - 45 Hz.- 55 Hz.
10. Position the vehicle on a lift.
11. Raise and support the vehicle on jack stands both front and rear.
12. Make sure the propeller shaft is at the same angle as if the vehicle were being driven.
13. Start the engine.
14. Place the transmission in gear and accelerate to the speed at which the vibration is strongest.
15. Hold the speed constant while performing the Strobe Balance.
16. Look at the display screen on the EVA.
17. Make sure it is in ACTIVE mode. It won’t work in FRZ or RECORD modes.
18. The display shows the strobe amplitude (Strobe Amp), frequency (Strobe Frq), and range of the strongest vibration frequency. If the frequency is not on the top line of the display, the test will be inaccurate.
19. Have someone under the vehicle aim the timing light at the propeller shaft.
20. The timing light should flash each time a pulsed signal is generated by the EVA.
21. Pay attention to which mark on the propeller shaft illuminates when the light flashes.
22. This marks the light spot of the imbalance.
23. After completing this test, balance the propeller shaft, then retest to verify the repair.

STEELMAN® Engine EAR®

The STEELMAN® EngineEAR® is an advanced electronic listening tool which can be used to detect wind noises, water leaks, bad bearings and bushings, exhaust leaks, and faulty plug wires. It consists of a set of headphones, a control unit that has an on/off switch and volume control, and a cable to attach the headphones to the control unit.



EngineEAR

Features:

- Quickly locates problems under the hood
- Identifies worn bearings and bushings
- Amplifies sound and shuts out surrounding
- Identifies broken or worn gear teeth noise
- Identifies noisy valves and lifters
- Listens to fuel injectors and solenoids
- Identifies exhaust and other leaks
- Comes with battery and ABS plastic case

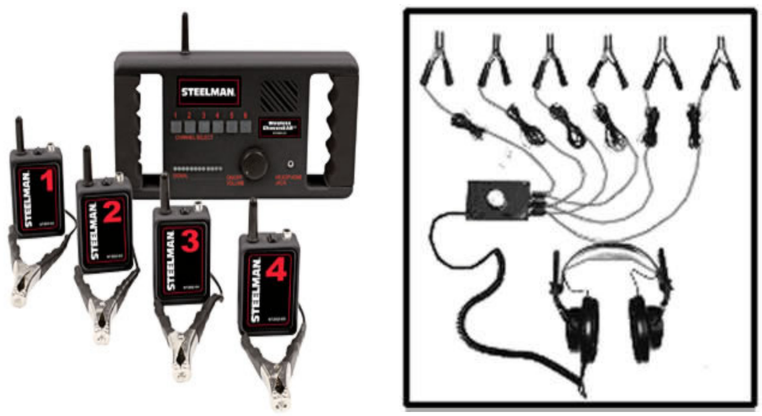
How to Use the EngineEAR® Tool:

1. Make sure the control switch is off.
2. Put the headphones over your ears.
3. Attach the headphone plug to the EngineEAR®, turn the control switch on, then adjust the volume control to a comfortable level.
4. Move the flexible wand back and forth close to the area where the noise originates so the microphone pickup can “sense” the noise.
5. Listen carefully for a change in the noise level being amplified by the sensing device.
6. If necessary, road test the vehicle and have another person listen for the noise while driving.

7. When the general area of the noise is identified, pinpoint it by slowly moving back and forth over that general area.
8. Once you have isolated the noise location, perform necessary repairs and retest the area to verify the repair.

STEELMAN® ChassisEAR®

The STEELMAN® ChassisEAR® is a versatile electronic listening device which can be used to detect and amplify noises. It consists of a control box with 6 switchable channels, a set of 6 leads with microphone clamps, and a set of headphones. To accurately diagnose a variety of noises, it is typically used while road testing a vehicle which has a rattle or other hard-to-diagnose symptoms. Noises may change relative to vehicle load and speed and therefore are not as easy to diagnose while the car is on a hoist.



J 39570 Electronic Listening Tool ChassisEAR(tm)

Features:

- Quickly locates problems under chassis, usually in one road test
- Includes 6 clamp-on microphones for use under chassis
- 6-way switch to listen to each microphone separately
- Also listens to fuel injectors and solenoids
- Can be used under hood or inside vehicle
- Comes with battery and ABS plastic case

Use it to diagnose noises originating from these and other components:

1. Bearings (wheel, compressor, etc.)
2. Brake components (calipers, loose pads, brake shoes)
3. Constant velocity joints
4. Coil or leaf springs (popping, creaking, or rattling)
5. Differential (noisy gears or bearings)
6. Transmission (gears, bearings, clearance problems)
7. Body squeaks and rattles
8. Engine noises
9. Pump noises

How to Use the ChassisEAR® Tool:

1. With vehicle elevated attach the clamps to the suspect areas.
2. Run the wire leads to the passenger front seat and connect the jack from each wire lead into the control box. Match the color to the number, i.e., the red Jack is plugged into input Jack #1, green is plugged into #2, and so forth.
3. Using the Location identifier Note Pad, make notes of the location and corresponding color for each microphone/clamp.
4. Using the nylon and Velcro® ties that are provided, secure the leads under the car so that they do not drag on the pavement. Avoid placing the leads against the exhaust pipe or any other location which would cause damage.
5. Lower the vehicle and conduct a road test. During the test, turn on the control switch.
6. Listen to each channel to pinpoint problem areas. Inclinometer

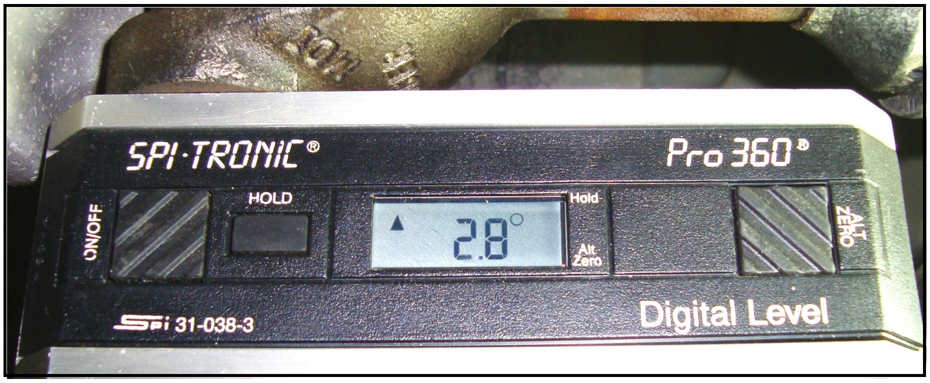
CAUTION:

When using the ChassisEAR, it is highly recommended the technician wearing the headphones sits on the passenger side while a second person drives the car. It is against many state motor vehicle laws to operate a vehicle while wearing headphones.

Service Tip: Important! Make notes while driving as to what is heard (rattles, squeaks, grinds, whines, etc.) at each channel. When you return to the shop, zero in on the exact location of the problem. Begin by identifying which channel is loudest. Then move other clips close to that same vicinity to pinpoint a specific location.

Inclinometer

An inclinometer can be used to measure driveline angles. By placing one of the flat surfaces on the component to be measured (transmission, driveshaft, differential, etc.) you can determine the angle of that component. Though the service manual does not usually contain angle specifications, you should look for minimal or equal angles when making measurements.

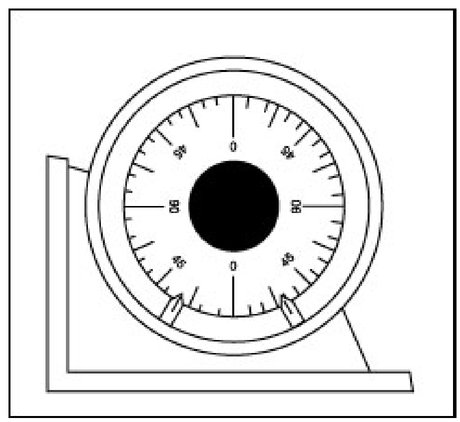


Digital protractor/inclinometer

The manual inclinometer / protractor shown on the right can be used to for driveline angle measurements.

It will not reproduce the precise readings available with the digital inclinometer.

The magnetic base enables you to quickly check driveline angles.



Vibrating Reed Tachometer

A vibrating Reed Tachometer is a hand-held device which can be placed on a surface in the area of a vibration. This device houses two rows of accurately calibrated reeds which will vibrate (similar to a tuning fork vibrating) when it is placed in contact with a part of the car which transmits the vibration. While these can be used to sense frequency or RPM, they are fairly expensive.

ASIST®

Nissan's Automotive Service Information Support Terminal (ASIST®) provides technicians with the latest diagnosis and repair information. The ASIST® interface now lists TSBs that pertain to each vehicle model. The interface also has a 'Keyword Search' function that will enable technicians to search bulletins based on a symptom such as: noise, vibration, squeal or judder.

Information available on ASIST® includes:

- **Technical Service Bulletins (TSBs) and Technical Tips -** Select a model or model year to search TSBs or Technical Tips.
- **Diagnostic Procedures -** To use this feature select a model or model year, and then choose symptoms.
- **Wiring and Other Diagrams -** Located with every diagnostic procedure.
- **Service Date Specifications (SDS) -** Located when selecting the model, model year, Quick Reference, and job type button.
- **Service Manual Amendments, Product Information, and Campaign Bulletin Information -** Located under the Information Tool Box button.
- **CONSULT Utilities -** Enables the capturing of data from the CONSULT unit, and the captured data can be viewed in ASIST®, and then sent to TECH LINE.

Electronic Service Manual (ESM)

Electronic Service Manuals (ESM) are taking the place of paper versions of service manuals. By producing an electronic version of this widely used service publication, continuous updating of service procedures and specifications is possible. Quick research capabilities with print-on-demand options make rapid retrieval of pertinent information easy. All current Classifications, Contents, Quick Reference Index, Trouble Diagnosis, Wiring Diagrams, Assembly and Disassembly procedures are contained in this electronic form. ESM is incorporated within the ASIST® workstation to enable you to find relevant service information quickly.

Virtual Academy

The Virtual Academy contains technician training records and is used for course enrollments. VA also has access to SIR Videos and eLearning programs that may be prerequisites for training enrollments. Check the VA home page regularly for Tech Line Tips, Tech Talk articles and other technical and general information about Nissan and Infiniti products.

ISOLATING ENGINE AND DRIVELINE NOISES AND VIBRATIONS

Part 1: Engine Related Noises

If you have confirmed an engine speed related noise, use the following steps to further isolate the cause.

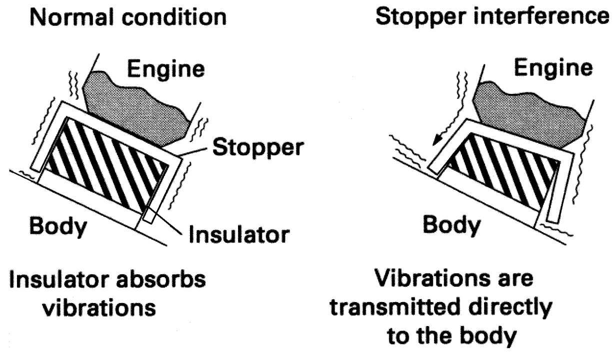
- Use a stethoscope or other listening device to isolate engine noises.
  - Valve train noise (ticking)
  - Drive belt or timing chain tensioner noise (rattling or flapping)
  - Timing chain or gear noise (rattle, whine)
  - Combustion noise or knocking
- If you suspect an accessory noise, isolate it by removing the appropriate drive belt. Listen for changes in noises such as:
  - Humming
  - Whirring
  - Popping
  - Whining
- Listen for air intake noises or vacuum leaks.
  - Pinch hoses and listen for change in noises.
  - Remove intake components and hoses and listen for change in noises.

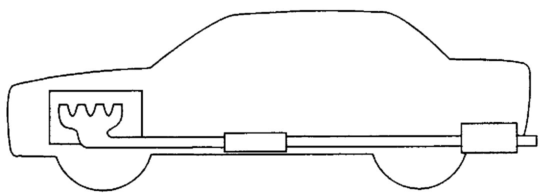
Part 2: Isolating Engine Vibrations

If you have verified an engine speed related vibration, use the following steps to further isolate the cause. Visually inspect for:

- Engine mount alignment and wear. Inspect the rubber engine mounts. If the mounts are not aligned correctly or are collapsed, engine vibrations can be transmitted to the passenger compartment via the body and frame.

- Exhaust mounting. Check for contact between the exhaust system and the body or frame. Such contact can allow engine vibrations to be transmitted to the passenger compartment.





On vehicles equipped with automatic transmissions, apply the parking brake and place the selector lever in D range. Release the parking brake and apply the service brakes. Applying either the front brakes or rear brakes can change the transmission path of the vibration and can help you isolate the source of the vibration.

If the noise or vibration is not present with the vehicle stationary, the condition is caused by the movement of the vehicle on the road. These disturbances can be classified into one of two groups:

- Those caused by rotating driveline components.
- Those caused by travel (motion).

Recheck

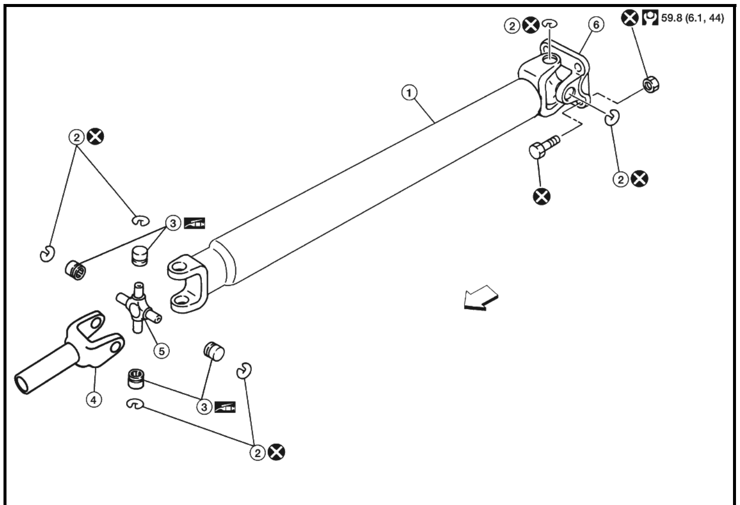
The repair should be rechecked under the same conditions used to verify the concern. Make sure that the original noise has been repaired and no new noises have appeared.

Driveshaft Noise and Vibration

Nissan and Infiniti use several driveshaft designs.

Each design features U-joints or CV joints to enable the drive shaft to move independently of the rear axle or front wheels. If these joints are damaged or out of phase, the drivetrain may be the cause of a variety of different noises or vibrations.

Rear Drive Shaft - 1 Piece



1. Propeller shaft tube
2. Snap ring
3. Journal bearing
4. Sleeve yoke
5. Journal
6. Flange yoke

⇐: Front

The propeller shaft is connected to the Sleeve yoke from the output shaft and Flange Yoke of the differential.

Replaceable U-joints and needle bearings enable the shafts to move independently.

TSBs NTB10-052 and ITB10-025 explain repair procedures if U-joints are responsible for drive shaft noise or vibration.

Axial play in U-joints is limited to 0.02mm (0.0008”).

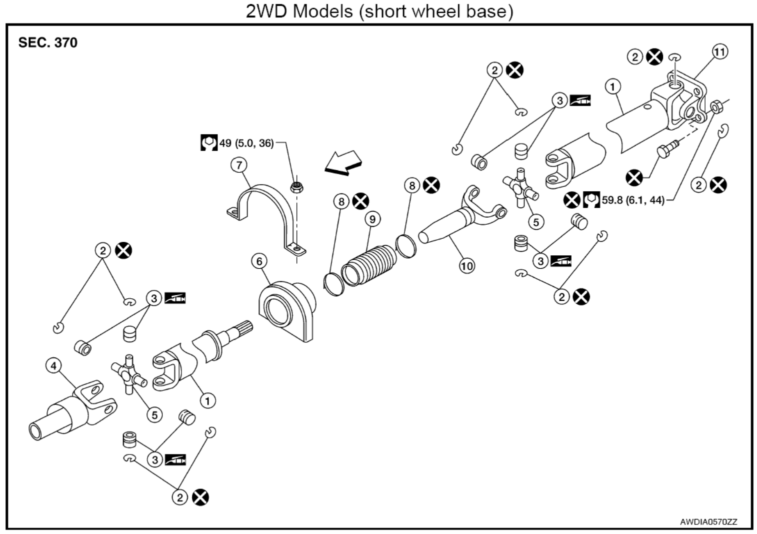
Rear Drive Shaft - 2 Piece

The 2 piece drive shaft includes a center bearing.

U-joints (journals and bearings) are replaceable.

Notice that all retaining clips, bolts and nuts are marked with an X to indicate they should always be replaced if they are removed from the drivetrain components.

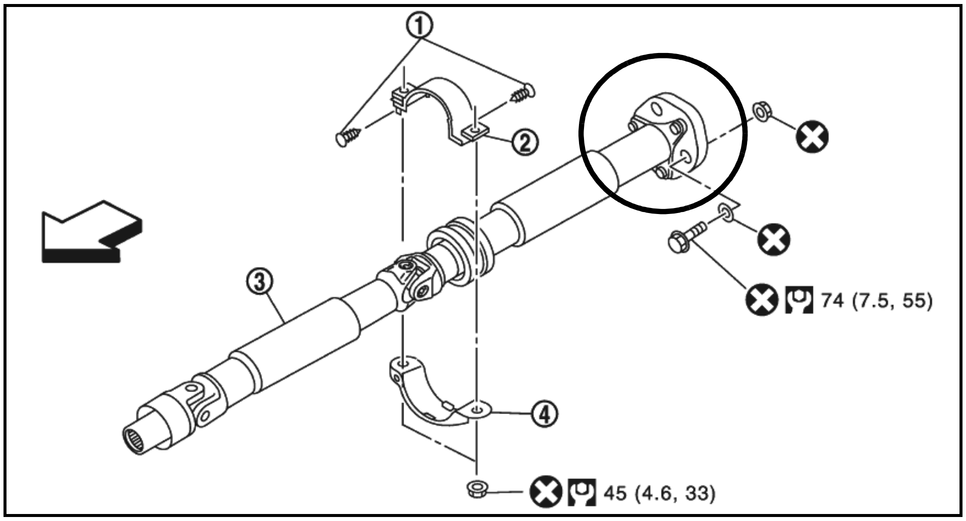
2WD Models (short wheel base)



1. Propeller shaft tube
2. Snap ring
3. Journal bearing
4. Sleeve yoke
5. Journal
6. Center support bearing
7. Center support bearing bracket
8. Clamp
9. Boot
10. Slip yoke
11. Flange yoke

⇨ : Front

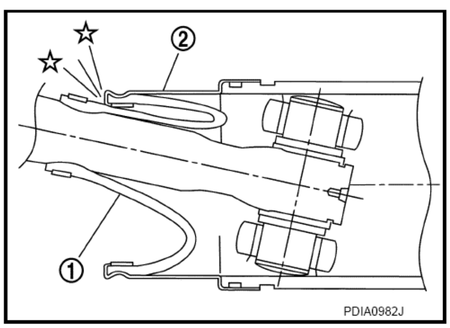
Rear Drive Shaft with Rubber Coupling

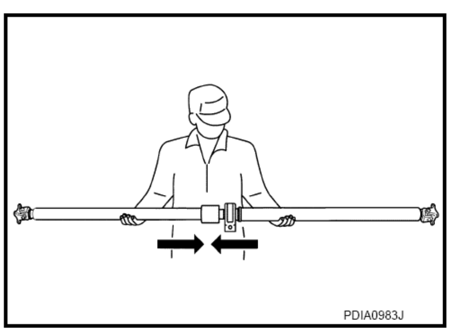


The circled rubber coupling, sometimes called a 'Rebro' joint, connects the propeller shaft to the final drive flange. This driveshaft is equipped on the G37, and Nissan uses a 'Rebro' joint on the GTR. These drive shaft assemblies have a specification of 0.0 for U-joint axial play and are not serviceable.

TSB ITB11-019 describes servicing the Rebro joint to eliminate a vibration in the vehicle floor or a booming noise hear at highway speed.

CV Joint Rear Drive Shaft





This example shows the rear drive shaft on AWD Juke and Rogue models.

The CV joint shown minimizes vibration for the 2 piece drive shaft.

In the top image, the ESM warns to be careful not to tip the shafts so that the CV joint boot is not damaged.

In the bottom image, the ESM indicates that the two shafts should be held together if the drive shaft assembly is removed. There is no clip to hold the two shafts together.

These drive shaft assemblies are not serviceable.

Propeller Shaft Imbalance

The most common cause of driveline vibrations on rear drive vehicles is the propeller shaft. The propeller shaft transmits power from the transmission to the differential. It is an exposed drive component, and therefore, can be damaged during vehicle operation. Additionally, because the propeller shaft is serviceable, removal and installation procedures are also critical for smooth, vibration free operation. There are three major sources of vibration related to propeller shafts. They are:

- Assembly (tight u-joint or alignment)
- Balance
- Angle

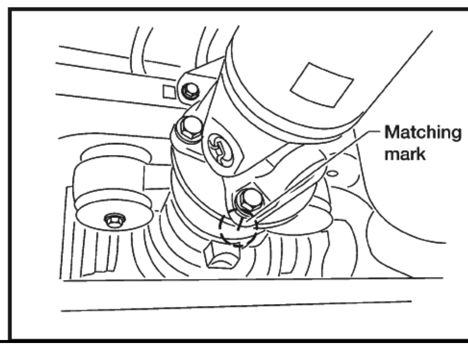
Assembly

At the factory, all propeller shafts are balanced prior to installation on the vehicle and aligned during assembly. Propeller shaft alignment can be upset, however, when the vehicle is serviced, causing a new vibration to develop. For example, if the propeller shaft has been incorrectly installed following transmission repairs and creates a vibration, the technician can be misled into thinking the vibration is coming from the transmission.

NOTE: To avoid this situation, whenever the propeller shaft is removed, always mark it so it can be reinstalled in exactly the same position as before removal.

Vehicles that have a two-piece propeller shaft have a center support bearing that is in some cases is serviceable. During center bearing replacement, always mark the propeller shaft prior to disassembly. Incorrect reassembly of the two sections of the propeller shaft can produce an imbalance that will create vibrations.

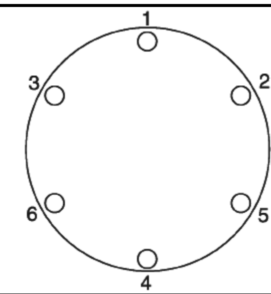
Put matching marks on the rear propeller shaft flange yoke and the rear final drive companion flange as shown.
CAUTION:
For matching marks, use paint. Never damage the rear propeller shaft flange yoke or the companion flange.



Propeller Shaft Runout

The ESM provides a specification for Propeller Shaft runout that varies from 0.60 mm for some models to as much as 1.02mm (0.040”). If the runout exceeds specification, the ESM may recommend the flange at the final drive be disconnected and the shaft reattached at 90 degree increments. Runout should be inspected after each adjustment. If the runout exceeds the spec in each measurement, the propeller shaft should be replaced.

- After assembly, perform a driving test to check propeller shaft vibration. If vibration occurred, separate propeller shaft from final drive. Reinstall companion flange after rotating it by 60, 120, 180, 240, 300 degrees. Then perform driving test and check propeller shaft vibration again at each point.



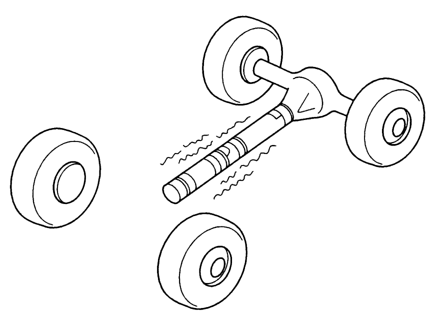
The example above is taken from a G37 ESM. This vehicle features a 6 bolt ‘Rebro’ joint. If vibration is felt while driving after propeller shaft replacement, the ESM recommends this re-installation service procedure.

This procedure has the potential to minimize vibration that could be caused by either drive shaft imbalance or runout.

Balance

An imbalanced propeller shaft will produce a 1st order vibration. During factory assembly, a balance weight is welded to the outside of the propeller shaft. If a vibration is isolated to the propeller shaft, look for physical damage.

If a vibration appears to be related to imbalance, check for overspray of undercoating. Always check for universal joint binding before attempting to balance the propeller shaft.



Propeller Shaft Balancing

The following information is intended to fine-tune propeller shaft balancing with the propeller shaft mounted in the vehicle.

As an FYI, the propeller shaft and differential pinion flange runout should be within specification regarding runout before attempting to balance the propeller shaft and related parts.

CAUTION:

All-wheel drive and/or four-wheel drive vehicles locked in four-wheel drive must have both front and rear wheels lifted off the ground. When performing this procedure, use caution in preventing the engine from overheating.

Imbalance can be directly related to runout which makes the logical starting place the low point of the propeller shaft.

When propeller shafts are balanced during the manufacturing process, balance weights in graduated increments are used: 1/16-ounce, 1/8-ounce, etc. If the weight added to the propeller shaft at the plant is slightly heavy or too light, placing the hose clamp directly in line with or opposite the factory balance weight may be a good starting place.

1. Road test the vehicle and verify the speed where the vibration severity is most noticeable.
2. Eliminate tire imbalance by balancing the rear wheel/tire assemblies.
3. Road test a second time if necessary.
4. Place the vehicle on a suitable axle contact hoist or jackstands so the rear axle is fully supported.
5. Remove the rear wheels and brake drums (if drum brake equipped). Never apply the brakes when the brake drums are removed.
6. Reinstall the lug nuts on the brake rotor (if disk brake equipped).
7. Run the vehicle at a speed where the vibration is most noticeable.

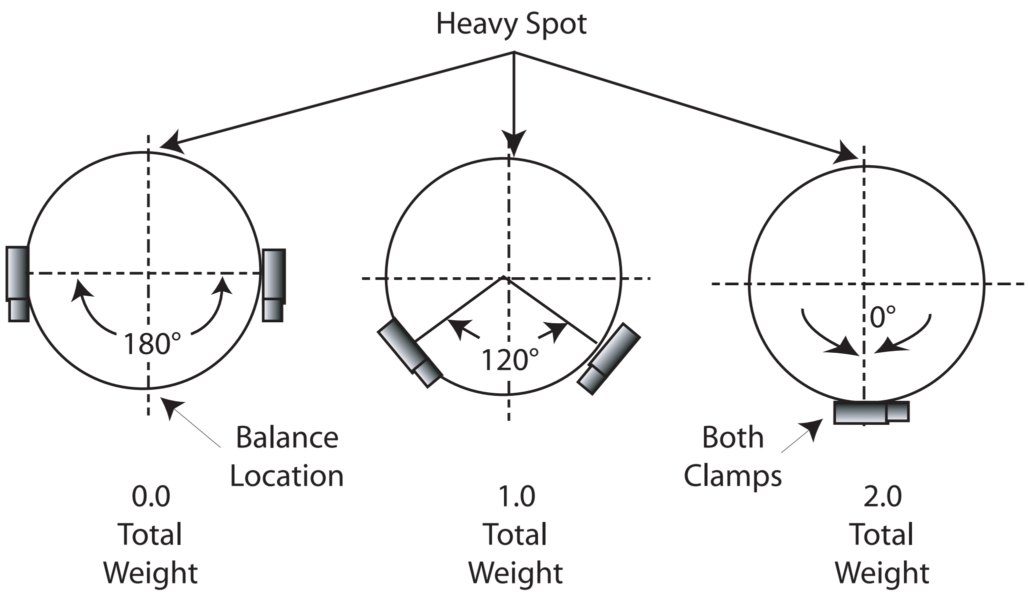
CAUTION:

Keep all loose fitting clothing and/or long hair away from the rotating propeller shaft when performing the following procedure.

8. From beneath the vehicle gently hold a piece of chalk or tire crayon up to the rear portion of the rotating propeller shaft. Do not allow the chalk/crayon to make a mark all the way around the shaft.
9. Allow the chalk or crayon to make very light contact with the rotation propeller shaft. This identifies the high side of the shaft.
10. Observe the chalk/crayon mark.

If done correctly, the mark identifies the heavy spot on the shaft as it deflected downward while the chalk/crayon was held up to the shaft. If the mark circles the entire shaft, clean off the shaft and repeat the procedure while applying only light pressure.

- Place one hose clamp 180° opposite the chalk/crayon mark.
- Run the vehicle at the same speed as noted earlier with the vibration.
- If the vibration worsens, the amount of weight may be too little, too much or not correctly positioned.
- If necessary, rotate the hose clamp in 1/8 to 1/4 turn increments.
- Run the vehicle at the same speed to identify when the vibration improves.
- If the vibration is not affected at all, or only gets worse, then one clamp is not sufficient.



- Repeat the above process with two clamps.
- Rotate the clamps opposite one another in 45° increments. (see above illustration)
- Continue this process by rotating the hose clamps in different amounts until the vibration improves or is eliminated.
- If the vibration can be reduced significantly with the vehicle on the hoist, but cannot be eliminated completely, road test the vehicle and evaluate accordingly. A slight vibration felt on the hoist may not be noticeable while driving.

Angle

The U-joints enable the drive shaft and suspension to move independently. However, once the angle between the any two shafts varies from 0 degrees, the U-joint will move in a slight elliptical pattern. This causes the driven shaft to speed up and slow down twice per revolution. This acceleration and deceleration creates a vibration.

Second-Order Driveline Vibrations

As explained earlier, first order driveline vibrations are mostly the result of excessive runout or imbalance of a driveline component. Second-order driveline disturbances are independent from these factors. Due to the operational characteristics of U-joints, a vibration that occurs twice per revolution of the propeller shaft may occur.

As the propeller shaft rotates, the U-joints normally speed up and slow down twice for every revolution of the propeller shaft. As mentioned earlier, a vibration which occurs twice per revolution is termed second-order.

As the propeller shaft rotates, the acceleration and deceleration of the U-joints cannot always be seen, but in the case of vibration complaints, it may be felt or even heard.

Compare the U-joint in a vehicle to a universal-type socket found in every technician's toolbox. Imagine using the universal socket to tighten a bolt. As the angle for the socket increases to 90°, the universal begins to 'bind and release' as you turn the socket. This 'bind and release' occurs twice for each revolution of the socket.

This exact condition occurs in a vehicle's U-joints as they operate through an angle. The greater the angle placed on the shafts, the more pronounced the effect. Because the transmission output speed remains constant, the binding and releasing of the U-joints could be described as accelerating and decelerating that occurs two times per propeller shaft revolution. When running the propeller shaft at a low rate of speed, you should be able to view the accelerating and decelerating effect. This speeding up and slowing down can create a vibration due to the fluctuations in force that are generated at high speeds.

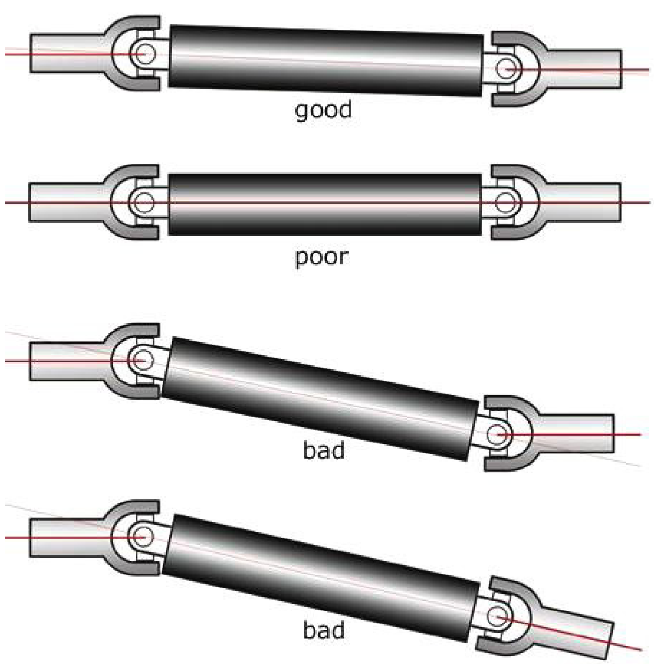
Drivelines are designed in a manner that allows for acceleration/deceleration to be cancelled out so a smooth and constant power flow is produced.

- The transmission drives the front yoke of the driveshaft at a smooth and constant speed.
- As the power travels through the first U-joint, it fluctuates twice per revolution of the shaft.
- The second U-joint is oriented or positioned in a manner that allows the power flow to fluctuate opposite that of the first joint.
- As the first joint is slowing down or binding, the second joint is speeding up or releasing the binding which occurred a moment ago.

This binding and releasing creates the effect of one U-joint canceling out the other, which results in a smooth, constant power flow from the output yoke of the propeller shaft. Second order driveline vibration occurs when the cancellation becomes unequal between the front and rear joints.

When universal joints operate at their designed angle variation, they are almost bullet-proof. Problems occur when the vehicle is fitted with a suspension lift that places the universal joints at an extreme angle.

Propeller shaft angle is a critical factor in vibration isolation. When verifying and isolating suspected propeller shaft angle problems, be sure to road test the vehicle under the exact conditions specified by the customer for accurate diagnosis. The driveline working angle does not refer to the angle of any one shaft, but to the angle that is formed by the intersection of two shafts. The procedure for measuring and correcting driveline working angles depends on whether the vehicle is equipped with a one or two-piece propeller shaft.



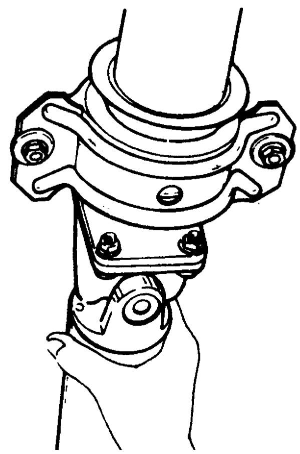
The top image shows a slight angle between the output yoke and the driveshaft, and a similar angle between the driveshaft and final drive flange.

If there are no angles, the U-joints won't move at all, possibly damaging the journal bearings.

If the driveshaft angles are too extreme, vibration may be felt as a shudder, especially during acceleration from a standing start.

In this last example, the driveshaft and final drive flange angles do not cancel each other, and a second order vibration is likely to occur.

Propeller shaft angle is particularly critical on vehicles with two-piece propeller shafts. However, more than just the angle of the propeller shaft is critical for quiet, vibration-free operation. Prior to making any measurements, inspect the installation and condition of the engine and transmission mounts. Broken or sagging mounts can change the angle of all components in the driveline, and be the cause of a driveline vibration. On a vehicle with a two-piece propeller shaft, check the condition of the center bearing.



Inspecting a Center Support Bearing

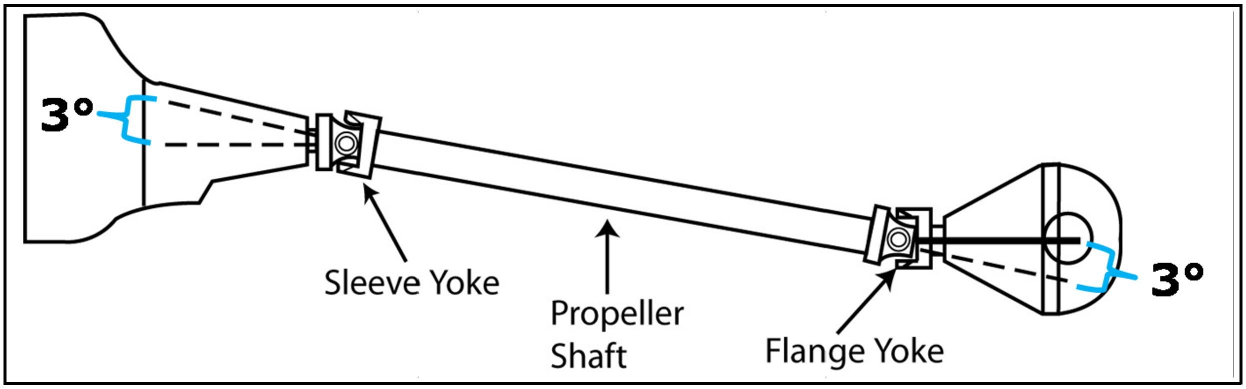
A worn center bearing will change the angles of the two sections of the propeller shaft, resulting in a vibration. If the bearing is bad and requires replacement, mark all components prior to disassembly so they are correctly aligned during reassembly.

Alignment of the propeller shaft requires more than just measuring the angle of the propeller shaft installed in the vehicle.

- Engine Crankshaft
- Front section of the Propeller Shaft (Vehicles with Two-Piece Propeller Shaft)
- Rear Section of the Propeller Shaft (Vehicles with Two-Piece Propeller Shaft)
- Differential Pinion Shaft

As you make your measurements, record all of your readings. You can make changes by shimming the rear transmission mount, or shimming the center bearing support. Remember, changing any of the angles will affect the others. For example, shimming the center bearing up will change the angles of the front and rear propeller shaft sections in relation to the engine/transmission assembly and to the differential.

On a vehicle with a one-piece propeller shaft such as illustrated below, equal working angles on the front and rear universal joints will cancel the 2nd order vibration.

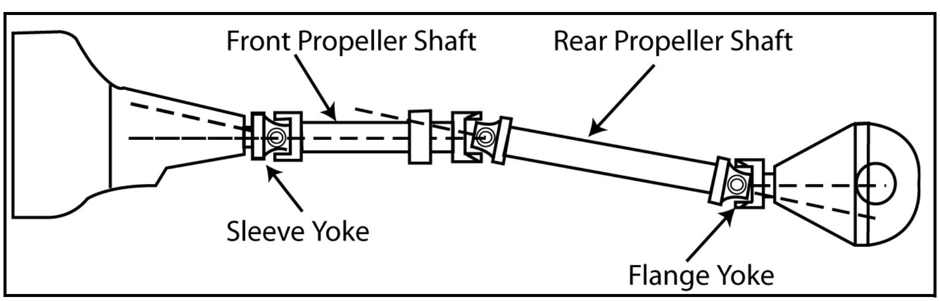


As a general rule, the smaller the angle the less vibration is likely to occur. Some manufacturers suggest that working angles should not exceed 4 degrees.

TSB NTB07-054b describes a procedure for shimming the rear axle spring seats on the Nissan Titan. This procedure changes the working angle at the flange yoke and addresses a problem with steering wheel vibration between 25 and 40 MPH.

Two-piece propeller shafts have three working angles present instead of two as with the one-piece system.

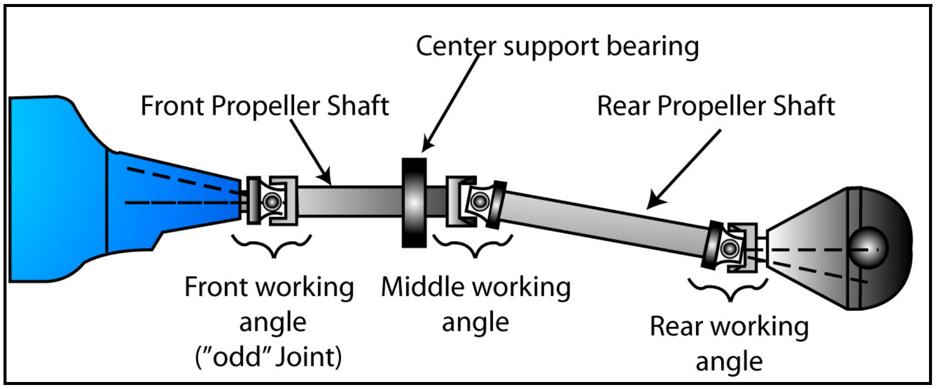
- The first, or front working angle is formed by the angle of the output shaft of the transmission and the angle of the front propeller shaft.
- The second, or middle working angle is formed by the angle of the front propeller shaft and the angle of the rear propeller shaft.
- The third, or rear working angle is formed by the angle of the rear propeller shaft and the angle of the pinion yoke of the rear axle.



This means there is an ‘odd’ joint in the system which does not have another joint to provide cancellation. When addressing a system with three working angles, the rear working angle and the middle working angle act as a pair of joints canceling each other out as with a one-piece system.

The front working angle is considered the ‘odd’ joint, because it does not have another joint providing cancellation. The working angle of the ‘odd’ joint should be kept below ½ degree.

The idea is to keep the working angle of the 'odd' joint to a minimum so there are not any great fluctuations in speed that need canceling out. The front U-joint is used as the 'odd' joint because it does not change with suspension movement, jounce, rebound, or axle wind-up. This makes the front propeller shaft an extension of the transmission output shaft.



On a vehicle with a two-piece propeller shaft, try to attain no angle difference between the engine crankshaft and the front propeller shaft, and equal angles on the center and rear universal joints. As a rule of thumb, front and rear angles should be within 1° of each other. The working angle should be no more than 4°.

Symptoms of Second-Order Driveline Vibration

The following are signs and symptoms of second-order driveline vibrations.

- They are always vehicle speed sensitive.
- Second-order vibrations are usually torque sensitive and generally are worse as the vehicle is under a load during start out or under acceleration.

The most common type of second-order driveline vibration is 'launch shudder.' This is when the vibration occurs from a standing start at speeds of 1 to 25 mph. The vibration appears as a low-frequency shake, wobble, or shudder. The vibration is generally felt in the seat or steering wheel at low speed (0 to 15 mph), and increases in frequency as vehicle speed increases. Eventually, it feels more like a driveline roughness at higher speeds (15 to 25 mph). Above this speed the vibration generally disappears. Because of the transitory nature of the vibration, it is generally difficult or even impossible to acquire frequency information with the Sirometer or EVA unit.

Lateral Alignment

Use the following procedure when a two-piece propeller shaft is out of alignment due to an incorrectly aligned center bearing. The lateral alignment should be inspected and adjusted if necessary before measuring and adjusting driveline angles.

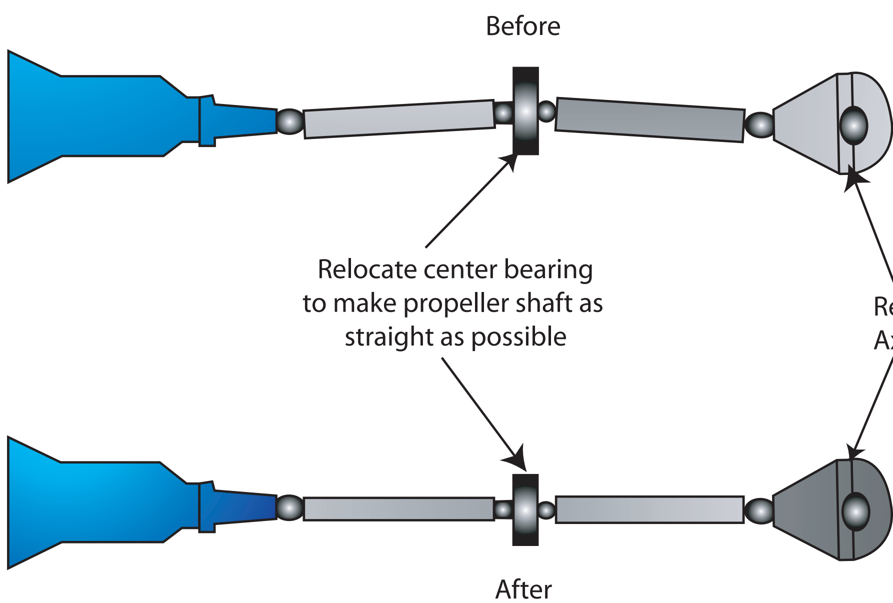
1. With the vehicle on a hoist and the rear axle supported by either the hoist or tall support stands, run a string down the center of the rear axle to the center of the transmission output shaft.
2. Inspect the center bearing for placement in a straight line between the rear axle and transmission.

3. If the propeller shaft is not straight due to a center bearing support bearing off to one side, the center support bearing should be repositioned to make the propeller shaft assembly as true or straight in-line as possible.

To relocate the center bearing support hanger:

1. Support the propeller shaft with a tall jackstand.
2. Remove the center bearing hanger bolts.
3. Move the hanger to either side of the body as needed without removing the propeller shaft from the rear of the transmission or transfer case. (slip yoke type)
4. Drill two new holes in the hanger support frame member and reinstall the bolts.
5. Run a string down the center of the rear axle to the center of the transmission output shaft verifying true alignment of the propeller shaft.
6. Lower the vehicle and perform another road test validating your repair.

If the launch shudder is still present, inspect driveline angles as mentioned previously.



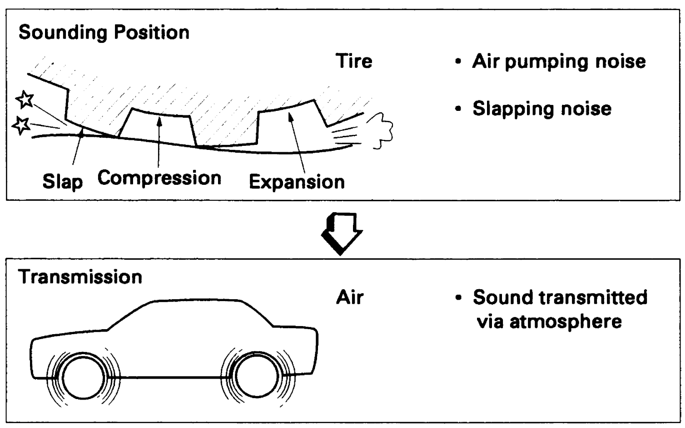
Recheck

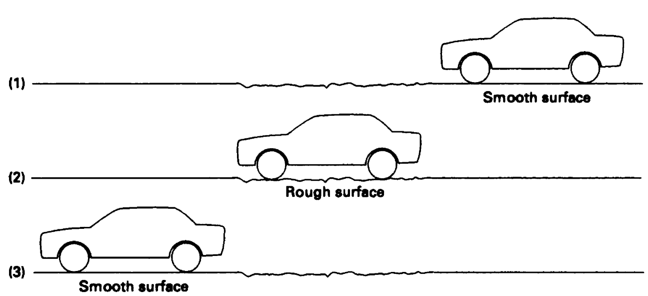
The repair should be rechecked under the same conditions used to verify the concern. Make sure that the original vibration has been repaired and no new vibrations have appeared.

ISOLATING TIRE AND ROAD NOISES

Noises that are related to motion are caused by suspension parts, body panels, tires or road conditions. To isolate the cause of such a noise:

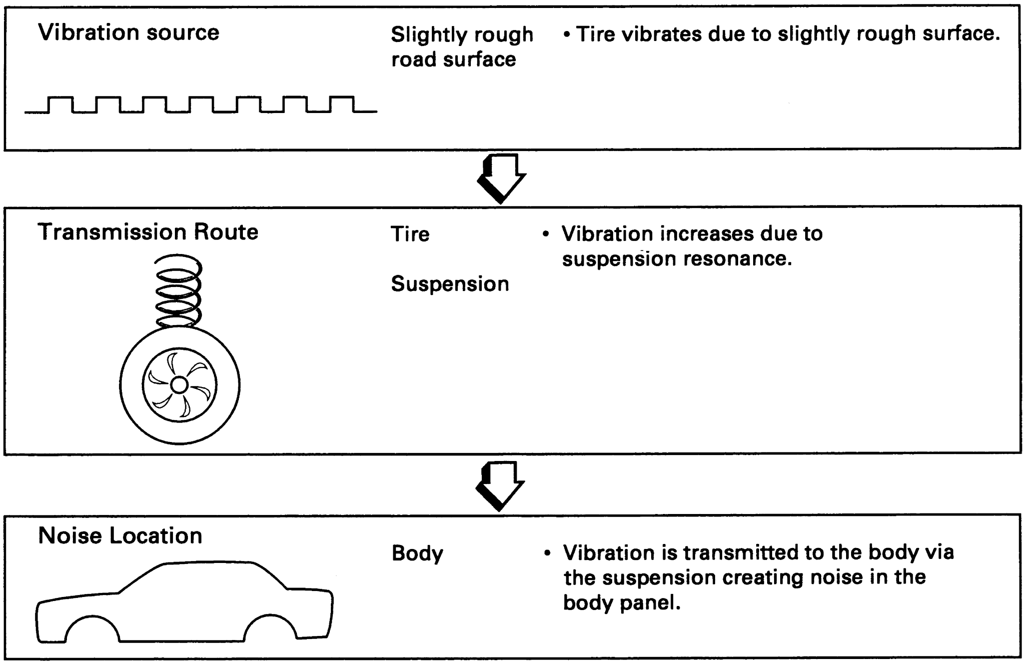
- Inspect the shock absorbers and spring mounts. Be sure the mounting bolts are tight and that the mounting bushings are not deteriorated.
- Check for wind noise. Wind noise results from air entering the passenger compartment.
- Check for wind turbulence. Turbulence is caused by air passing around components such as mirrors, bumpers, antennas or moldings.
- Check for tire pattern noise. This noise is caused by the tread patterns of certain tires on the road surface.
- Tire pattern noise is airborne, meaning that it is transmitted through the air to the passenger compartment.
- Check for road noise. Road noise is caused when the tires run across uneven or unusual road surfaces.





Tire Related Noises

Road noise is created as the tire vibrates due to rough road surfaces. High frequency vibrations occur due to suspension resonance. These vibrations are transmitted to the body via the suspension, creating noises in the body panels which are heard in the passenger compartment.



To isolate road noise from tire pattern noise, travel over a smooth section of road then a rough section of road. Road noise will be more pronounced on rough road surfaces, whereas tire pattern noise will only be audible on smooth road surfaces.

Solid Borne Noise	**Airborne Noise**
Tire Vibration	Road Surface Noise Caused by Tires
Suspension Vibration	Noise Entering the Vehicle
Body Vibration	Noise Heard in the Vehicle

To further isolate tire pattern noise, install tires that have a different tread pattern and road test again to determine if the noise has changed. If tire pattern noise is determined to be the cause, you can minimize the noise by adding sound deadener to the inner fender panels. Since pattern noise is transmitted through the air, insulating the noise transmission path by adding additional insulation is an effective means of reducing the noise.

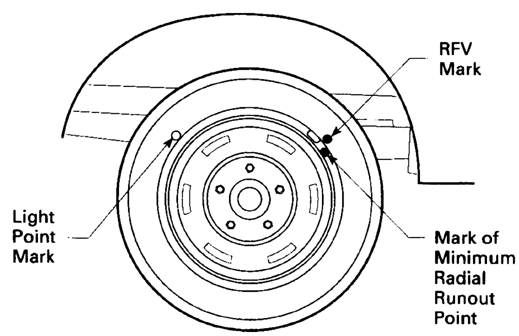
If road surfaces are causing the noise, add additional sound deadening material under the carpets in the passenger compartment floor boards. Since road noise is transmitted through the body, adding insulation to the body may reduce the noise. If the noise is not sufficiently reduced, replacing the tires with ones that feature a different tread design may reduce the noise.

Radial Force Variation

Radial Force Variation (RFV) is the term used to describe variations in stiffness in the sidewall of a tire. All tires have some sidewall variation due to the overlapping of the plies during the construction of the tire. However, this condition does not cause a problem unless the stiffness variation is excessive. The most common symptom of a tire with excessive RFV is a first order vibration which produces a shake. Today's vehicles with smaller side walls create greater stiffness, which may increase RFV.

All tires have some RFV. Factory tires and wheels are assembled to minimize the effect of RFV on vehicle performance. The illustration that follows shows the markings that are used to indicate how the tire is positioned on the wheel to reduce the effects of RFV. A red paint mark or a yellow tape strip on the tire indicates the point of the greatest tire RFV. The green, gray or white paint mark on the wheel is the point of minimum wheel runout. During assembly, these marks on the tire and wheel are aligned to minimize the effect of RFV on ride smoothness.

In addition, factory installed tires have a yellow paint mark at the lightest point on the tire.



NOTE: In the event that a non-factory or replacement wheel is installed on the vehicle, this mark can be aligned with the wheel valve stem opening to minimize the weight required during balancing.

Isolate RFV symptoms by:

- Visually inspecting the tires and wheels. If the vehicle is equipped with factory tires and wheels, check the alignment of the factory paint marks. If they are out of alignment, reposition the tire on the wheel, rebalance the assembly and conduct another road test.
- Increase tire pressure and conduct another road test. Higher tire pressure produces higher RFV and a higher amplitude shake. Lower tire pressure produces a lower amplitude shake.
- If the intensity of the vibration changes with different tire pressures, excessive RFV is likely. Substitute the suspected bad tire/wheel with a known good assembly, then road test again to determine whether the vibration has changed.
- If the vibration does not change, remove the tires and wheels and check the balance, then conduct another road test.

- If the vibration is not wheel balance related, measure the radial runout of the tire and wheel. Nissan and Infiniti do not provide specs for runout measured at the tire. Common industry standards are approximately 1.5mm (0.060”). If the runout is greater than 1.5mm (0.060”), shift the phase of the tire on the wheel in increments of 90 degrees until the smallest amount of tire/wheel runout is attained. This is known as **indexing** the tire to the wheel.
- Typical allowable radial and lateral runout for aluminum wheels is 0.30mm (0.012”) and vehicles with steel wheels list 1.5mm or (0.060”) as wheel specification.

Hunter GSP9700

The Hunter GSP9700 measures RFV and provides a precise system for diagnosing and resolving problems caused by Road Force Variation in wheel / tire assemblies.

The load roller shown under the machine hood is pushed against the rolling wheel assembly during testing.

The machine can provide both balance and RFV data.

If equipped, software in the machine can then identify the best way to resolve vibration or tire pull that is caused by RFV.

Follow these general procedures when using the GSP9700 to measure RFV:

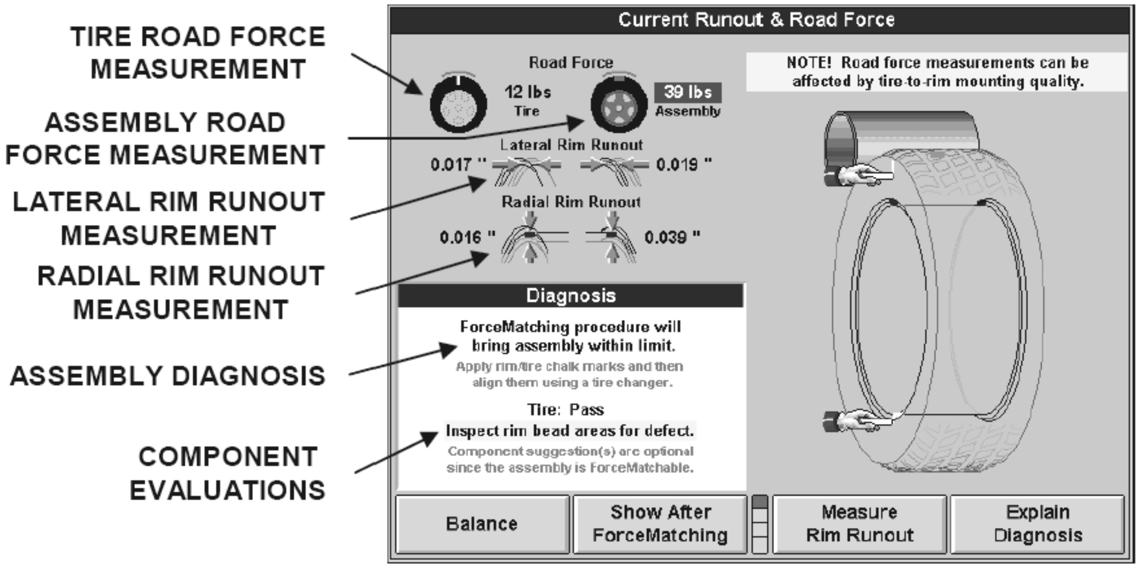
- Set tire inflation to the recommended PSI
- Drive the vehicle at highway speed for about 20 miles. This usually eliminates tire ‘flat spots’
- Confirm vibration is still present
- Refer to ASIST. There are TSBs for specific Nissan and Infiniti vehicles that detail the proper procedures for testing RFV and may provide RFV specifications
- (Q45 had recommended limits of 27 lbs RFV for the front axle and Maxima recommend 15 lbs or less per wheel / tire assembly)

Follow the GSP9700 instructions for mounting and measuring RFV and note the readings for each wheel / tire assembly.

Hunter Engineering recommends less than 26 lbs as a general rule for RFV, but some vehicles will require the readings below that recommendation.

Check ASIST for Nissan or Infiniti TSBs that provide specific RFV specifications. If applicable, follow instructions to set the Road Force Limits for the 1st and 2nd Radial Harmonics on the GSP9700.

RFV Measurement

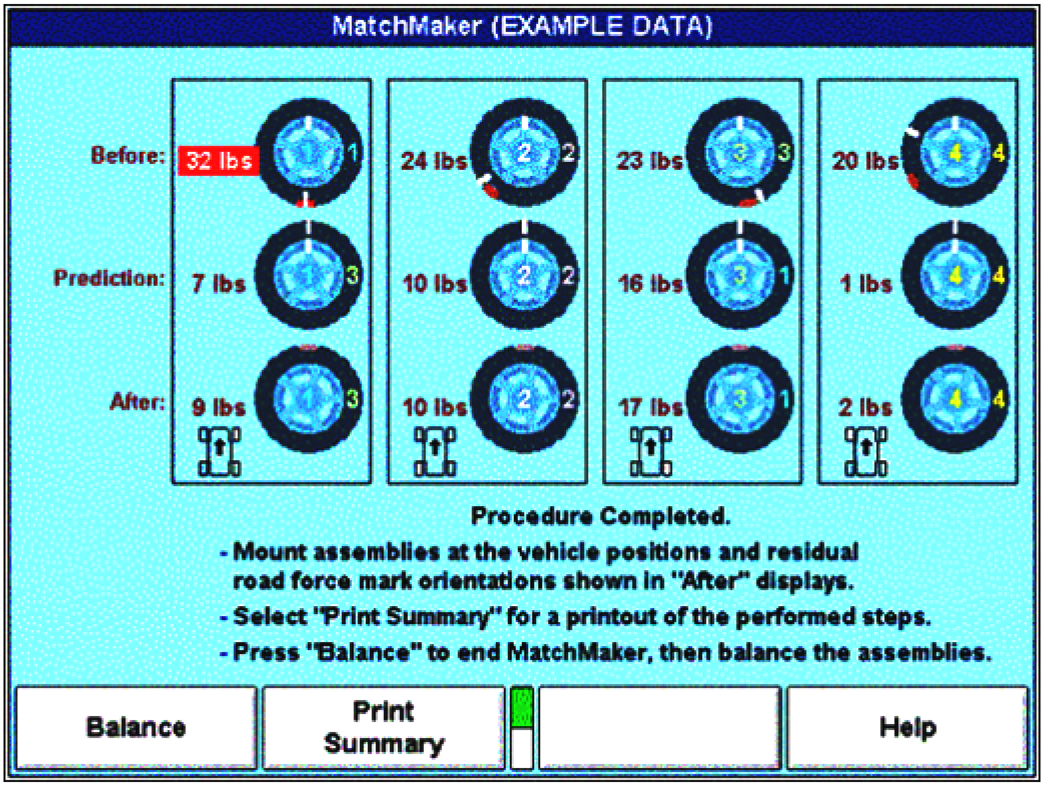


In this example the assembly measures 39 lbs RFV. The tire measures 12 lbs and the wheel has significant radial runout. By matching the high RFV point of the tire with the low runout point of the wheel, the total RFV can be reduced to within acceptable Hunter limits.

The tire would need to be remounted to the wheel to resolve this excessive RFV reading.

The GSP9700 displays a hand marking the rim and tire in the locations that should be matched to minimize RFV. By selecting the 'Show After Force Matching' button on the bottom of the screen display, you could view the estimated RFV after remounting the tire with the chalk marks aligned.

MatchMaker



RFV can cause a tire pull in addition to vibration. MatchMaker is a software program that enables the GPS9700 to calculate the best possible tire and wheel placement to minimize either condition.

In the example above, each wheel / tire assembly has been tested for RFV. The GSP9700 indicates the greatest RFV for each tire and the point of least radial runout for each wheel.

The screen recommends that tires 1 and 3 be switched to wheels 3 and 1. By force matching all 4 sets of wheels and tires RFV is dramatically reduced.

This process would rarely be required to solve a vibration problem, but gives technicians options to solve a customer complaint that might avoid replacing tires or wheels.

The GSP9700 will indicate when Force Matching would not reduce RFV, and in those cases, the tire would need to be replaced.

Recheck

Following repairs, road test the vehicle a final time to be sure the problem has been resolved. The road test should reaffirm that the vibration that was felt during the verification step is no longer present, and that there are no other vibrations or noises in the vehicle.

BRAKE NOISE

There are three different types of brake noise, each caused by different vehicle conditions, and each requiring a different repair approach. The three types of noise are: 1) squealing or squeaking, 2) groaning, and 3) creeping.

Brake Squeal or Squeak

Squealing or squeaking occurs on both disk and drum type brakes, usually under light brake pedal application, and often when the brake components are still cold in the morning, or when humidity is high. The noise can be either constant or intermittent and usually occurs at vehicle speeds below 30 MPH. The noise is due to changes in the frictional force between the rotor and pad or between the brake shoe and drum. However, brake squeal or squeak is more often associated with disk brakes than with drum brakes.

On a disk brake system when the brakes are applied, hydraulic pressure forces the pads into the rotor. As the edge of the pad is drawn into contact with the rotor surface, the pad cocks slightly in the caliper. While this movement is slight, the result is that the pad is no longer parallel to the rotor. The frictional force of the pad skidding along the rotor surface causes the pad to vibrate, generating the squeal or squeak.

Nissan and Infiniti bulletins have recommended the use of original equipment NAO (non-asbestos organic) compound brake pads. In some cases, semi-metallic pads may be available at lower cost. Semi-metallic brake pads may squeal more during normal brake use than NAO pads.

Brake Groan

Brake groan resembles road noise, and in extreme cases it may feel as though there is metal to metal contact, as if the brake pads are worn out. Symptoms of brake groan usually occur at vehicle speeds below about 20 MPH, and mainly during warm temperatures. Brake groan is caused by accumulation of brake dust on the surface of the brake pad, giving the pad a cloudy appearance. As the pad contacts the rotor, the dust changes the coefficient of friction between the pad and rotor, producing the groaning noise.

Brake Creep

Brake creep is a normal condition and does not indicate a brake problem or adverse braking performance. Creep noise is caused by an imbalance in the force necessary to move the vehicle and the applied braking force. For example, if a vehicle with an automatic transmission is in D range with moderate pressure on the brake pedal, the vehicle will be held stationary. Reducing the brake pedal pressure slightly produces a rumbling noise as the vehicle “creeps” forward. Brake creep can be eliminated by increasing foot pressure on the brake pedal.

The occurrence of brake creep is higher today because more cars are equipped with automatic transmissions and engines which develop high torque at low RPM for better acceleration. Additionally, health concerns have meant that semi-metallic brake pads are being used in place of asbestos pads. Semi-metallic pads have a different friction coefficient, and therefore increase the potential for noise.

During the diagnosis and repair of brake noise symptoms, always follow the Four Step Repair Process. The four steps are: Verify, Isolate, Repair, and Recheck. Each step is listed below along with activities and information that will help you to complete a thorough and accurate repair.

Verifying Brake Noise

Before attempting to resolve any brake noise condition, first determine the type of noise and the conditions under which the noise occurs. Begin by road testing the vehicle and applying the brakes with light, medium and heavy pressure. Listen for the noise and try to determine whether it is a squealing or squeaking, brake groan or brake creep. During verification, also note the conditions at the time the noise is present. For example:

- What does the noise sound like?
- Is it most noticeable with the brakes warm or cold?
- Is the noise always present, or does the noise only occur after a long drive, or first thing in the morning?
- Does the noise occur under a variety of pedal application pressures?
- Does it occur when the brakes are first applied, during the entire time the pedal is applied, or just when the vehicle is almost stopped?
- Is it more noticeable under certain humidity or weather conditions?

Isolating Brake Noise

If you need to further isolate the noise to the front or rear brakes, drive the vehicle at a slow speed on an unoccupied road or parking lot. Apply the parking brake and try to duplicate the conditions under which the noise occurs. If the noise remains the same, it is being generated by the rear brakes. (On some vehicles the parking brake is separate from the rear service brakes. Refer to the service manual to identify such vehicles.)

After this step, begin a preliminary visual inspection. Check the condition of the brake hardware, such as springs, clips, calipers and wheel cylinders. Inspect the pad or lining material for glazing, presence of brake dust, wear limits, oil residue or other wetness. Finally, look at the rotors and drums. Are they scored or discolored or are there uneven wear patterns?

Repairing Brake Noise

Following noise isolation, determine the necessary repair. In some cases this means parts replacement but confirm that new parts are necessary. Refer to the chart at the end of this section for a summary of repairs for common brake noise symptoms.

Refer to the Symptom Diagnosis section in ASIST. In many cases, TBSs will provide specific procedures or replacement parts to address brake noise issues.

NTB00-033d and ITB00-024e are TSBs that identify various brake related noises and provide general service recommendations. Use only the recommended lubricants for brake system service.

PBC (Poly Butyl Cuprysil) or Molycoat 77 are usually specified for the high temperature applications like the brake pad shims or the contact area on the backing plate for brake drums.

Squealing or Squeaking Noise on Disk Brakes

A major cause of brake squeal or squeak is the accumulation of brake dust on the drums or calipers. Remove the dust in an approved manner.

CAUTION:

Never use compressed air to blow the dust off the brake components. In addition, always wear a dust mask or respirator when removing brake dust from calipers, pads and rotors. Brake dust is potentially harmful if inhaled. Check the condition of the shim behind the brake pads. If it is deteriorated or missing, a new one must be installed.

Squealing or Squeaking Noise on Drum Brakes

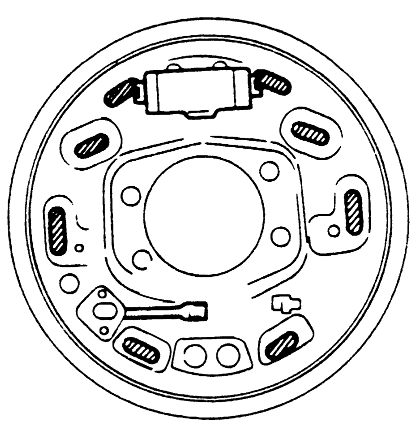
If brake dust is present on the friction surfaces of drum brakes, a squeal or squeak can result.

CAUTION:

Never use compressed air to blow the dust off the brake components. In addition, always wear a dust mask or respirator when removing brake dust from calipers, pads and rotors. Brake dust is potentially harmful if inhaled.

Rear drum brake noise can also be caused by the brake shoe as it rubs against the backing plate during brake application. During repairs, coat the shoe contact points on the backing plate with high temperature brake grease. Refer to the illustrations below for typical backplate lubrication points.

Backing Plate Lubrication Points



Groaning Noise on Disk Brakes

As with brake squeal or squeak, the presence of brake dust on the friction surfaces can cause the disk brakes to groan.

The following chart summarizes the recommended types of service for eliminating brake noises, noting the effectiveness of each type of repair (countermeasure).

Corrective Action (Countermeasure)			
Recommended Service	**Type of Noise Concern**		
	Squeal/Squeak	**Groaning Noise**	**Creeping Noise**
Use of rubber coated shim behind the disk brake	O	X	O
Removal of wear dust	O	O	O (Temporary)
Replace pad (select one with the same friction material)*	O (Temporary)	O (Temporary)	O (Temporary)
Replace rotor or drum**	X	X	X
Replace caliper	X	X	X
Replace pad (select one with different friction material)***	O	O	O

Chart Legend:
O = Effective countermeasure
X = Ineffective countermeasure
* If the suspected brake pad is replaced and there is no sign of overheating of the pad material, brake noise will recur because this will only produce a temporary change to the pad surface condition.
** Replacement of the disk rotor will not eliminate brake noise unless the rotor is worn abnormally. The noise can be improved temporarily by grinding the friction surface of the pad.
*** All Nissan brake pads are designed for a specific vehicle application. In some cases, if the caliper design is the same, pads designed for one specific vehicle may fit on another and reduce brake noise. If such a repair is performed, the customer should be informed the replacement pads may change the performance characteristics and perhaps wear differently than the original pads.

Recheck

Brake noise is a major customer concern. Following the repair of any noise, always road test the vehicle again making certain that the symptom has been corrected. Some service procedures covered in this section may only temporarily eliminate the condition. For example, if a squeal or squeak was caused by the presence of brake dust on the calipers, as the brakes are used the dust will again collect, and the noise will return. Always explain to the customer that some noises develop as a result of use and may reoccur after the car has been driven.

WIND NOISE AND TURBULENCE

As a vehicle travels at highway speeds it pushes aside the air in front of it, creating wind noise and turbulence. The air flow at the front of the car is deflected around the windshield and 'A' pillars creating high and low pressure areas in body surfaces behind it. As the air passes over the windshield it creates a low pressure area along the windshield and the side windows. This low pressure tends to pull the side windows outward away from their sealing surfaces.

Wind noise can be caused by misalignment of doors and body panels or by a torn or pinched weatherstrip. Air turbulence can be caused by body components like outside mirrors, wiper blades and antennas that disrupt the normal airflow over the body's exterior surfaces. Air turbulence may also create objectionable noise, depending on its severity.

Wind noise is usually caused by air leaks that can be isolated and repaired but turbulence is another matter. Turbulence is created when the outside air rushes over the car's aerodynamic body and is then disturbed by an external projection. This causes the air to swirl around the object, thus creating turbulent noise. Turbulence is a noise factor that is more difficult to isolate than wind noise since the noise is audible, yet there is no air entering the passenger compartment.

Isolating Turbulence

Air flow around the car can be disturbed by any protruding object, a misaligned body panel or any loose parts.

Isolate by completing a thorough visual inspection looking for conditions such as:

- The leading edge of a door that is set out from the body which will disturb air flow.
- Components like outside mirrors, wiper blades and antennas that disrupt the normal air flow over the body's exterior surfaces.
- Loose pieces of molding that can cause turbulence and also create additional noises.

Turbulence can also be caused by the conditions described in the following sections.

Air Leaks

The majority of air leaks are caused by air rushing OUT of the car and not into it. When the windows are closed with either the air vents open or the air conditioner ON, the interior of the car becomes pressurized. This interior high pressure tries to equalize with the exterior low pressure and air will EXIT (push out) through any body panel or window seal opening.

On frameless windows, the air pressure differential will actually force the upper edge of the glass out and away from the seal. The majority of air leaks usually occur around the upper area of the car, around the windshield and down to about a foot below the belt line.

Loose Molding

Any loose exterior molding, especially the leading edge, will disturb the air flow.

Check all pieces of molding around the hood, front fascia, doors, windows, and sun roof for looseness.

Gaps Between Body Panels

Gaps between the main body panels, the hood, the doors and trunk lid will disrupt the air flow and cause noise. Make sure all body panels are aligned correctly.

Drip Molding Turbulence

Check the metal drip molding attached to the upper edge of the body along the top section of both the front and rear doors. Make sure the molding is snug up against the body and that there are no gaps along its entire length.

Sun Roof

Gaps between the sun roof trim and the roof body panel will disrupt the air flow and cause noise. Make sure all trim pieces are secured and are aligned correctly.

Externally Mounted Accessories

Any after market accessory that has been installed can cause turbulence. This is especially true of after-market items not designed specifically for the vehicle, which may disrupt normal airflow.

Examples:

- Bug Screens
- Wind Deflectors
- Headlight Covers
- CB Radio/Telephone Antennas
- Flaring - Ground Effects

Wind Noise Inspection

Overview

Begin with a thorough check of the vehicle, especially in the area where the customer thought the noise was located. Wind noise, just like a water leak, can occur in one location and seem to be coming from another, so don't isolate your search to one area only.

Make a thorough inspection of the weatherstrips around the doors. The sealing surfaces are quite complicated on some doors where the rubber seal may be sealing against the door frame or against another weatherstrip. On some models, the drip rail is an integral part of the upper section of the door weatherstrip. Its purpose is to direct water away from the door, not to provide a seal.

Road Test

1. Prior to conducting a road test, be sure all loose items are stored properly and are secure. Lower the radio antenna and unscrew the cellular phone antenna (if so equipped).
2. During the road test, have another technician accompany you. It is dangerous to try to drive and isolate a noise at the same time.
3. Road test on smooth, straight streets. Make turns, so all directions are covered. There should be minimum traffic to allow you to drive the car at cruising speeds. Avoid the freeway since there is a high noise level.
4. Drive the car at the speed in which the noise was noticed by the customer. **Stay within legal speed limits.**
5. During the road test, verify the symptom by answering the following questions:

   A. What type of noise is it?

      a. Whistle

      b. Roar

      c. Rush

   B. Under what driving conditions does the noise occur?

      a. At what speed do you notice the noise?

      b. What were the road conditions?

   C. Is the noise apparent when all accessories are in the OFF position, or does it occur with the air conditioner or heater on?

   D. Where is the location of the noise?

      a. Internal

      b. External

6. To determine the origin of an external noise following the road test:

   A. Visually inspect for protruding components and misaligned body parts as described in this text.

   B. Starting at the front of the car, use masking tape and mask off different parts of the body one area at time. With the tape in place, road test the car again to isolate the source of the noise. If the noise disappears or changes with the tape in place, you know you have located the possible problem source. Repeat the taping and removal process until you have isolated the exact location.

7. To determine the origin of an internal noise during the road test:

   A. Use an EngineEAR®, stethoscope, or a piece of small diameter hose as a listening device. Place one end of the hose near your ear and then run the other end along the wind noise area. This will help to pinpoint the exact location. If successful, mark the locations and complete a visual inspection following the road test.

Visual Inspection

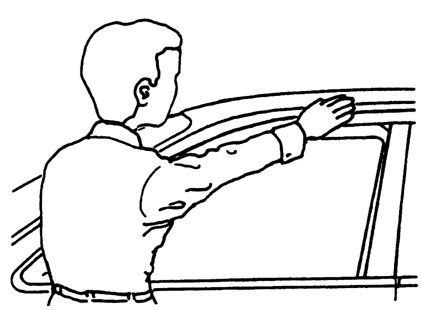
1. Check for body panel alignment. Run your hand along the side of the body panels and also sight along the length of the car from both the front and rear and look for any protruding body panels.
2. Check the leading edges of the doors and sunroof to make sure they do not protrude from the body. If the leading edge of the door or sunroof sticks out, it will funnel air into the interior of the vehicle, resulting in wind noise.
3. Check the weatherstrips around the suspected air leak areas for deterioration, cuts, abrasions or deformation. A small cut or hole can create a loud noise at highway speed.
4. Check the sealing area where the body and weatherstrip meet. Check for any raised surface area or voids in the body that could prevent air- tight contact with the weatherstrip.

Pressurization Check and Inspection

Following a visual inspection, pressurize the passenger compartment to check for air leaks. To do this:

1. Tape off all vehicle pressure relief valves in the trunk and doors, roll up all windows and close the sunroof panel.
2. Turn the ignition ON and set the RECIRC switch to the fresh air position to allow outside air to enter the passenger compartment.
3. Set the air conditioning blower motor to the highest speed.
4. Get out of the vehicle and close the door. Allow the air pressure to build up in the passenger compartment.
5. Lightly moisten your hand with water to help you feel any air that is escaping from the vehicle interior and slowly run your hand around the window and door openings to feel for air leaks as shown here

Testing for Air Leaks from a Pressurized Interior.



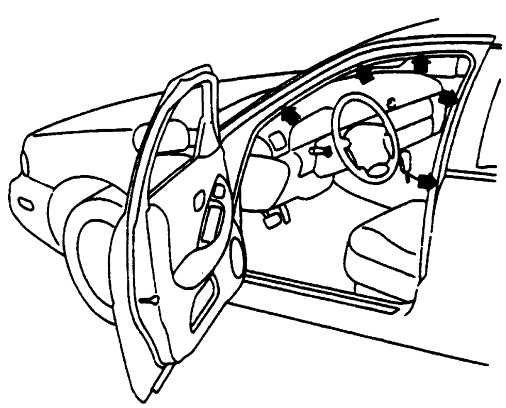
6. To locate small air leaks that cannot be felt with your moistened hand, use a small diameter hose as a stethoscope and move the hose around the window and door seals.
7. If available, you can also use the EngineEAR® to listen for air leaks.
8. Use masking tape to mark any areas where you feel air getting past a weatherstrip or where you hear the leak.

Chalk Inspection

Another method that can be used to isolate air leaks is a chalk test. To conduct a chalk test:

1. Open the door and thoroughly clean the sealing surfaces for the door weatherstrip, and wipe off the door frame sealing surface. This will insure good contact after the chalk has been applied.
2. Use soft non-permanent carpenter's chalk and completely coat the sealing surfaces of the weatherstrip.
3. Hold the exterior door handle in the released position and **slowly** close the door. Do not close the door completely or open it quickly as some the chalk will be blown off the weatherstrip by the sudden rush of air, producing a fuzzy print. Slowly open the door and check the chalk print on the door jamb and weatherstrip.
4. If you have trouble getting chalk to transfer, apply a light coat of auto body wax to the weatherstrip contact surface. Don't wipe the wax off once it dries. The coat of wax will more easily hold the transferred chalk print.
5. After the chalk has been transferred to the door jamb, slowly open the door and inspect the chalk print. The chalk print transfer should be consistent around the entire perimeter of the door opening. If there is a gap or the print is light in some areas, this indicates the weatherstrip is not making complete contact. The illustration below shows typical area to inspect.

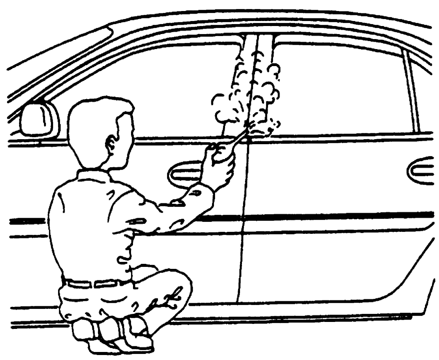
Weatherstrip Inspection Points (Partial)



Powder Inspection

A powder inspection can also be used to isolate air leaks. Begin by covering the seats, carpets and instrument panel to protect them from powder residue. Then:

1. Roll up all windows and completely shut all the doors.
2. Fill a small rubber bulb syringe with talcum or baby powder.



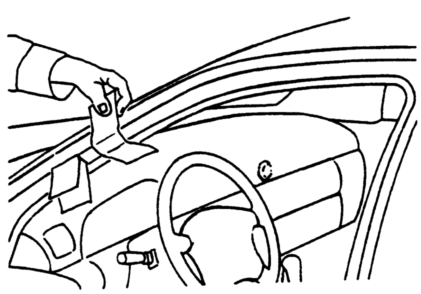
3. From the outside of the car, aim the syringe directly at the door opening and squeeze powder around the entire perimeter of the door edge.
4. After the powder has been blown into the door edge, slowly open the door and inspect for traces of powder that has passed through. Powder on the inside indicates that the weatherstrip is not making contact in that area.
5. Clean off all powder residue from the door jamb and the weatherstrip. If necessary, vacuum the interior to remove all powder residue before returning the vehicle to the customer.

Paper or Dollar Bill Inspection

To conduct this test, begin with a piece of flexible paper such as newsprint or a well-used dollar bill.

1. Thoroughly examine the various weatherstrips around the doors and determine the purpose of each. Does the weatherstrip redirect water from the drip rail area or does it seal the interior? You may get a false indication if you test the drip rail area and believe you have found a sealing problem.

Dollar Bill Test



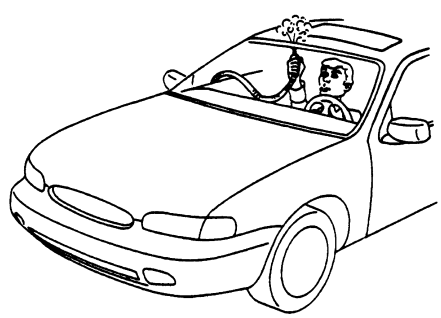
2. Position the paper over the door frame and then close the door. Don't slam the door as the seal will be crushed and this test won't work. Slowly pull the piece of paper out and check how easily it can be removed. There should be a moderate amount of pressure required to remove the paper. Go around the door frame in the suspected area or around the entire perimeter. Any area where the paper pulls out easily indicates insufficient contact to form a good seal, and a possible leak point.
3. This test can also be used to check the sealing ability of window glass to door frame or channel(s). Repeat the same test by placing the paper between the glass and the door frame or channel. Put the paper in place and then roll up the window. You should feel the same moderate pressure as in the previous test. If the paper can be easily removed, either the window glass needs adjusting or the window run channel needs to be replaced.

Soapy Water or Glass Cleaner

A final method for isolating air leaks involves the use of a solution of soapy water or spray glass cleaner and compressed air. Begin this test by:

1. Rolling up all windows and closing the sunroof.
2. Apply the soapy water solution to the vehicle exterior around the area where the noise exists.

Soapy Water Test



1. From inside the vehicle, apply light air pressure to the suspected leak areas. If there is air leakage, bubbles will form on the vehicle exterior. Don't stop after you've tested just one area. Test the entire weatherstrip sealing surface since there may be more than one leak.
2. Following the test, wash the tested area to remove all soapy residue.

Overview

Verification and isolation are only the first two steps in the Four Step Repair Process. After the isolation is complete, there are various techniques that can be used to eliminate wind noise caused by air escaping past weatherstrip sealing surfaces.

Weatherstrip Repair Procedures

Inspection

Visually inspect the weatherstrip in the problem area. If the weatherstrip is out of place, reinstall it. Use the following repair procedures for other problems.

Heat Gun to Solve Distortion

If the weatherstrip is only slightly distorted or wrinkled, it may be possible to reshape it using a heat gun:

- Heat the distorted area until it is soft and pliable. Don't overheat.
- Smooth out the distortion or wrinkle as the weatherstrip cools.
- Hold the shape until it cools.

This procedure may have to be repeated several times for the weatherstrip to regain its original shape.

Use of Adhesive

A loose weatherstrip can be caused by broken or missing mounting clips or damage to the weatherstrip. If the problem is limited to a small area, the weatherstrip can be bonded to the body with adhesive. Thoroughly clean the body surface with a body solvent:

- Apply a small amount of black RTV silicone adhesive/sealant to the backside of the weatherstrip.
- Hold in place with tape until the silicone adhesive/sealant has cured.

Body Lip Damage

Some types of weatherstrips are installed on a raised lip of the body sheet metal. It is possible for this lip to become bent out of alignment and prevent the weatherstrip from sealing. To repair this type of damage:

- Carefully pull the weatherstrip off the raised lip.
- Straighten the lip with pliers or body tools.
- Reinstall the weatherstrip and check it for correct alignment.

Shim to Increase Sealing Pressure

If an air leak is small and occurs in only a short section of the weatherstrip you may be able to eliminate the problem with a piece of plastic shim material:

- Attach a small shim or a piece of closed-cell sponge sealing material under the weatherstrip.
- Press the weatherstrip into place. This will exert additional pressure on the weatherstrip sealing surface and improve the seal along the sealing surface of the body.

Body Repair

It is possible for the body surface where the weatherstrip seals to be distorted. If you have identified either a high or low body area during your isolation step, it must be repaired to restore the seal of the weatherstrip:

- Low spots can be filled with plastic body filler, caulking, or sealer, and then repainted.
- High spots must be ground down and then repainted. If the problem area is severe, refer this repair to a body shop.
- Gaps between the glass and its sealing surface can be repaired by aligning the glass.
- Door adjustments can eliminate air or water leaks caused by the weatherstrip not sealing properly.
- An adjustment can also eliminate outside air turbulence.
- Realignment of the sunroof panel can eliminate air and water leaks.

To make these repairs, follow the procedures described in the BT section of the service manual.

Window Adjustment

If there are gaps between the glass and its sealing surfaces, align the glass as described in the BT section of the Service Manual.

Door Adjustment

If large sections of the weather strip are not sealing properly along the door edges, the door may be out of alignment. Align the door as described in the BT section of the service manual.

Sun Roof Adjustment

If the glass and its sealing surfaces are out of alignment, align the glass as described in the BT section of the Service Manual.

Recheck

As a final step, always complete a recheck of the repairs you have performed. The recheck is the final step in the Four Step Repair Process, and will insure a complete and acceptable repair.

SQUEAKS AND RATTLES

In order to improve dealership F-1 (Fixed Right the First Time) performance in squeak and rattle repairs, Nissan North America, Inc. has identified three primary areas for improvement by talking to dealerships, like yours.

The areas are:

1. Clarification and improvement of **Warranty Policies**
2. **Understanding the customer's complaint** through improved communications between the Customer, Service Advisor and the Technician
3. Improved, timely, **Technical Information** utilizing ASIST®

This Squeak & Rattle information is designed to highlight the changes in each of the above areas and provide you with a process for improving your performance/diagnosis in these areas at your dealership.

Warranty Policies

The warranty coverage for squeak and rattle repairs is as follows:

Nissan Warranty coverage for all non-component replacement squeak & rattle repairs is 36 months or 36,000 miles. Infiniti coverage for all non-component replacement squeak and rattle repairs is 48 months or 60,000 miles Not 12/12

Straight-time is available for non-component replacement (labor only) repairs. ▪ Requires completion of Diagnostic Worksheet ▪ Test Drive as required ▪ No Trouble Found (NTF) will be reduced by process ▪ Cannot be sublet ▪ All normal straight-time claims documentation policies apply

Refer to claims bulletin WB / 98-021a for details of the warranty policy.

Understanding The Customer's Complaint

In this section of the seminar, we will provide you with information that you can use to improve the process of writing up the squeak and rattle work orders.

Areas of emphasis will include the **Diagnostic Worksheet** and the **Test Drive.**

Responsibilities

Customer
Describes Concern to the Service Advisor

⬇

Service Advisor
Gathers the Information from the Customer, Communicates the Symptom to the Technician

⬇

Technician
Diagnoses and Repairs the Noise

Service Advisor Process

The Service Advisor:

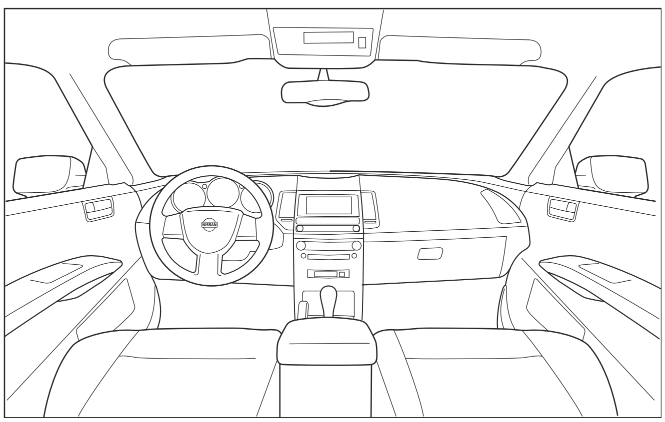
- Completes the Diagnostic Worksheet
- Determines test drive requirements
- Defines the type of noise from the customer information
- Confirms this information with the customer
- Writes the work order
- After the repair, explains the repair to the customer
- Follows-up with the customer

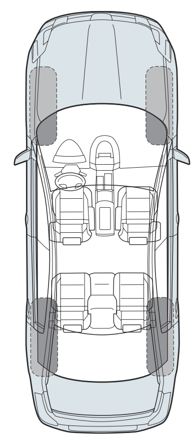
The Diagnostic Worksheet is a helpful tool to improve communications and is required for warranty payment.

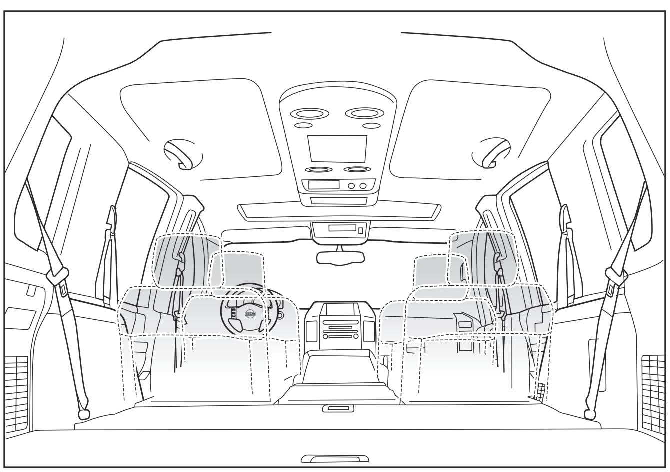
Dear Nissan Customer:
We are concerned about your satisfaction with your Nissan vehicle. Repairing a squeak or rattle sometimes can be very difficult. To help us fix your Nissan right the first time, please take a moment to note the area of the vehicle where the squeak or rattle occurs and under what conditions. You may be asked to take a test drive with a service advisor or technician to ensure we confirm the noise you are hearing.

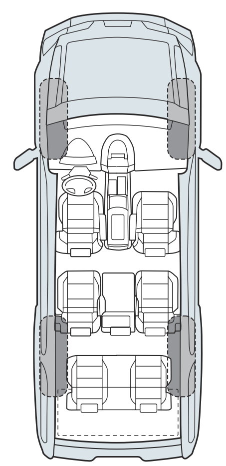
SQUEAK & RATTLE DIAGNOSTIC WORKSHEET

I. WHERE DOES THE NOISE COME FROM? (circle the area of the vehicle)
The illustrations are for reference only, and may not reflect the actual configuration of your vehicle.









Continue to page 2 of the worksheet and briefly describe the location of the noise or rattle. In addition, please indicate the conditions which are present when the noise occurs.

SQUEAK & RATTLE DIAGNOSTIC WORKSHEET - page 2

Briefly describe the location where the noise occurs:

____

____

II. WHEN DOES IT OCCUR? (please check the boxes that apply)

- ☐ anytime
- ☐ 1st time in the morning
- ☐ only when it is cold outside
- ☐ only when it is hot outside
- ☐ after sitting out in the rain
- ☐ when it is raining or wet
- ☐ dry or dusty conditions
- ☐ other:

III. WHEN DRIVING:

- ☐ through driveways
- ☐ over rough roads
- ☐ over speed bumps
- ☐ only about ____ mph
- ☐ on acceleration
- ☐ coming to a stop
- ☐ on turns: left, right or either (circle)
- ☐ with passengers or cargo
- ☐ other: ________________
- ☐ after driving _____ miles or _____ minutes

IV. WHAT TYPE OF NOISE

- ☐ squeak (like tennis shoes on a clean floor)
- ☐ creak (like walking on an old wooden floor)
- ☐ rattle (like shaking a baby rattle)
- ☐ knock (like a knock at the door)
- ☐ tick (like a clock second hand)
- ☐ thump (heavy, muffled knock noise)
- ☐ buzz (like a bumble bee)

TO BE COMPLETED BY DEALERSHIP PERSONNEL

Test Drive Notes:

____

____

____

	YES	**NO**	**Initials of person performing**
Vehicle test driven with customer	☐	☐	________
- Noise verified on test drive	☐	☐	________
- Noise source located and repaired	☐	☐	________
- Follow up test drive performed to confirm repair	☐	☐	________

VIN: __________________ Customer Name: __________________

W.O.# __________________ Date: ____________

This form must be attached to Work Order

Squeak and Rattle Diagnostic Worksheet

- The Worksheet can be completed by the customer or by the Service Advisor while working with the customer.
- It's critical that the worksheet be filled out completely and correctly. This will greatly assist the Technician in repairing the customer's complaint the first time.
- The location of the noise should be identified on the front of the worksheet. If the customer circles a broad area, work with them to better define the location of the noise.
- The back of the worksheet covers when the noise occurs. This includes:
    - The time of day and conditions
    - Driving conditions
    - Type of noise.

Again, try to pinpoint exact conditions with the customer.

- The bottom portion of the backside of the worksheet should be completed by dealership personnel.
- This information verifies that the dealer has taken the proper steps to diagnose, repair and recheck the noise.

The types of noises or noise characteristics are also on the back of the worksheet. The noise characteristics are provided so the customer, Service Advisor, and Technician are all speaking the same language when defining the noise.

- **Squeak** -(like tennis shoes on a clean floor)
- **Creak** -(like walking on an old wooden floor)
- **Rattle** -(like shaking a baby rattle)
- **Knock** -(like a knock on a door)
- **Tick** -(like a clock second hand)
- **Thump** -(heavy, muffled knock noise)
- **Buzz** -(like a bumble bee)

The following tips provide methods for obtaining information during a customer interview:

Completing the Diagnostic Worksheet

- **Listen carefully** and avoid drawing conclusions or making assumptions
- **Ask open ended questions** to gain specific information
- **Confirm** the customer's complaint

Completing the Diagnostic Worksheet

- **Test drive** the vehicle if necessary
- **Communicate** through the work order

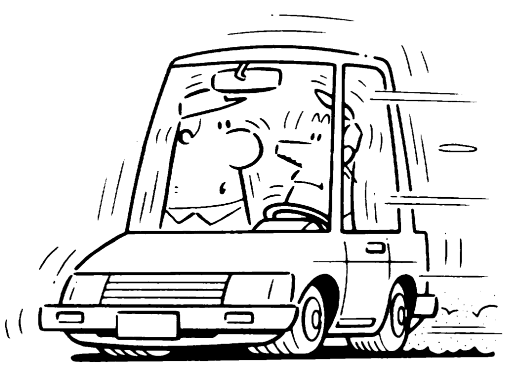
Questions?

- Where is the noise located?
- When does the noise occur?
- What does the noise sound like?
- When did the noise start?

The Test Drive

The Test Drive is a critical step in the squeak and rattle repair process.

Test Drive



- With customer to verify the complaint
- By the same person to check the repair

Test Drive

A Test Drive is required when the:

- Type of noise
- Location of the noise
- Conditions under which the noise occurs

cannot be determined and confirmed through other means

Tips for Completing the Test Drive

- Both test drives must be performed by the same person under the same conditions to insure that the problem repaired was the customer's original concern.
- At times it may be necessary to drive the vehicle with the customer a third time to have them verify the repair. This is important when dealing with possible Lemon Law customers.
- The key is to gather the information and confirm it with the customer. If the information is not confirmed with the customer, you may end up repairing the wrong noise.
- Gathering squeak and rattle information may require the Service Advisor to spend more time communicating with the squeak and rattle customer than with other customers. Good communication skills can make this interaction as efficient as possible.
- Squeak and rattle customers should be scheduled when the Advisor has a sufficient amount of time to spend with them. This usually isn't during the morning write-up or closing time pick-up.
- If your dealership makes appointments, inform the customer at the time the appointment is made that a test drive may be required and prepare them for the time needed.
- If a squeak and rattle customer uses the early bird service, leave them a Diagnostic Worksheet to complete when they drop off the vehicle.
- As mentioned earlier, it's important that the person who test drove the vehicle to verify the concern is the same person to drive the vehicle to re-check the repair. This insures that the correct noise has been repaired. This can be the Service Advisor, Shop Foreman or Technician.

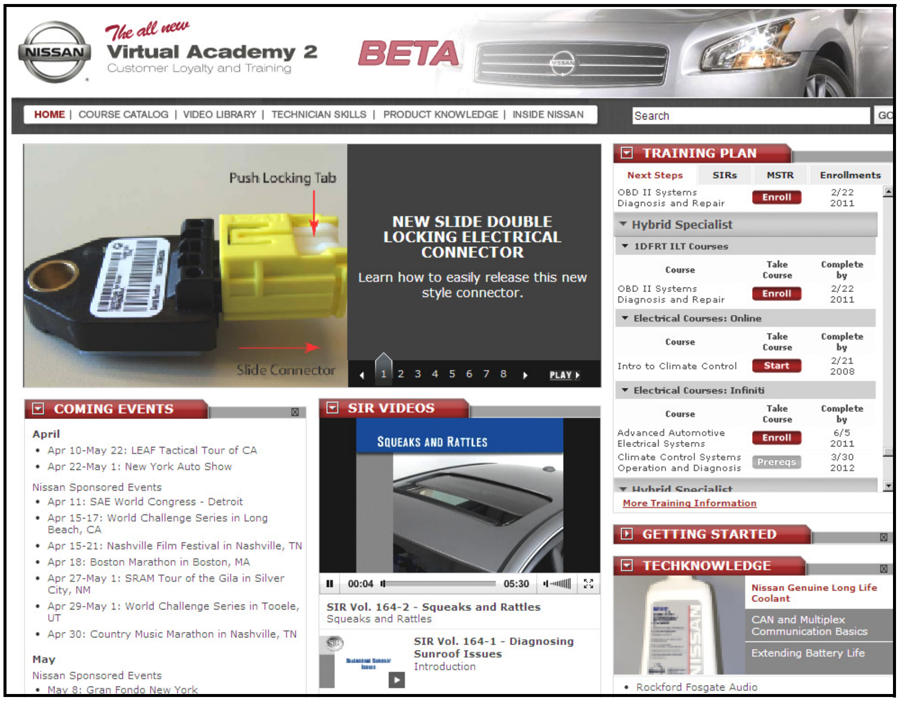
Theory of Squeak and Rattle Repair

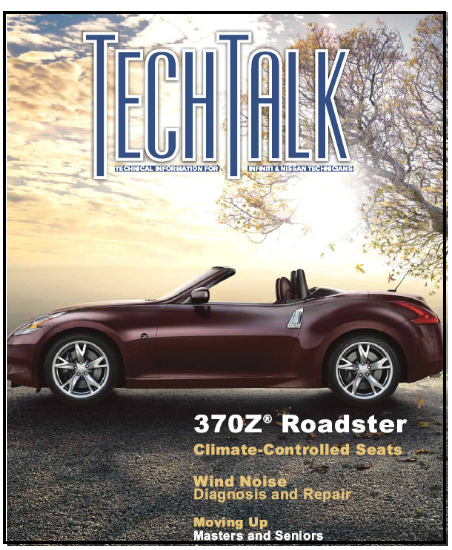
Squeak and rattle diagnosis and repair may sometimes seem more like a nuisance than a critical repair procedure. When diagnosing squeaks and rattles, always keep two items in mind:

1. The problem is very real to the customer. It is more than a nuisance; it's a reflection of overall vehicle quality.
2. Like all other incidents, squeak and rattle diagnosis and repair can benefit from a planned diagnostic process like the one that follows:
   - Make sure you can **verify** the noise
   - After identifying the type of noise, **isolate** the noise in terms of its characteristics
   - Apply the necessary techniques and materials to **repair** the noise
   - **Recheck** your repair and make sure you have caused no new noises

The following information contains generic procedures for diagnosing and repairing squeak and rattle incidents.

Squeak and Rattle Resources



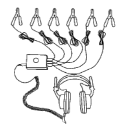
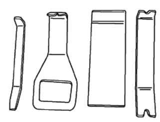


SIR videos can be viewed on the Technician Home screen of Virtual Academy 2. Tech Talk features articles that address problems with squeaks, rattles and in this example - wind noise. Lastly the ASIST 'Search' function can be used to check for applicable TSBs.

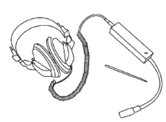
Squeak and Rattle Repair

Special Service Tools

The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

Tool number (Kent-Moore No.) Tool name		Description
(J-39570) Chassis ear		Locating the noise
— (J-46534) Trim Tool Set		Removing trim components
(J-43980) NISSAN Squeak and Rattle Kit		Repairing the cause of noise

Commercial Service Tools

Tool name		Description
Engine ear		Locating the noise

The ESM lists some of the Special Tools available through Kent-moore, as well as commercial tools.

This manual suggests the Engine Ear as a useful listening tool.

The Squeak and Rattle section of the Body Interior chapter of the ESM listed these particular tools.

In the section below, the small copy of the ESM troubleshooting section is typical of the new Squeak and Rattle information in Nissan and Infiniti ESMs.

Generic Squeak and Rattle Troubleshooting

INFOID:0000000006766202

Refer to Table of Contents for specific component removal and installation information.

INSTRUMENT PANEL

Most incidents are caused by contact and movement between:

1. The cluster lid A and instrument panel
2. Acrylic lens and combination meter housing
3. Instrument panel to front pillar garnish
4. Instrument panel to windshield
5. Instrument panel pins
6. Wiring harnesses behind the combination meter
7. A/C defroster duct and duct joint

These incidents can usually be located by tapping or moving the components to duplicate the noise or by pressing on the components while driving to stop the noise. Most of these incidents can be repaired by applying felt cloth tape or silicone spray (in hard to reach areas). Urethane pads can be used to insulate wiring harness.

CAUTION:

Do not use silicone spray to isolate a squeak or rattle. If you saturate the area with silicone, you will not be able to recheck the repair.

Squeak and Rattle Escalation Policy

There are a series of three steps to follow when dealing with squeak and rattle comebacks.

1st Repair - Check for repair information using ASIST®

2nd Repair - Check ASIST® for new information, then call TECH LINE (put the TECH LINE incident number on the work order)

3rd Repair - Check ASIST® for new information, call TECH LINE for new information, then contact your DTS for assistance before proceeding with the repair. (DTS instructions must be documented on the work order) The following materials are contained in the Nissan Squeak and Rattle Kit. Each item can be ordered separately as needed.

Nissan Squeak and Rattle Kit

The following materials are contained in the Nissan Squeak and Rattle Kit. Each item can be ordered separately as needed.

Urethane Pads (thin)

Three different sizes to insulate connectors, harnesses, etc.

76268-9E005: 1.5 mm thick, 100 x 135 mm
76884-71L01: 1.5 mm thick, 60 x 85 mm
76884-71L02: 1.5 mm thick, 15 x 25 mm

Insulator (foam blocks)

Two different sizes. Insulates components from contact. Can be used to take up space behind a panel.

73982-9E000: 45 mm thick, 50 x 50 mm
73982-50Y00: 10 mm thick, 50 x 50 mm

Insulator (light foam block)

80845-71L00: 30 mm thick, 30 x 50 mm

Non-woven Cloth (FELT) Tape

Used to insulate where movement is not required. Ideal for instrument panel applications.

68370-4B000: 15 x 25mm pad
68239-13E00: 5 mm wide tape roll

The following materials, not found in the kit, can also be used to repair squeaks and rattles.

UHMW (teflon) tape

Insulates where slight movement is present. Ideal for instrument panel applications.

3M part # 051131-06356: 10 mm wide tape roll

Silicone grease

Used in place of UHMW tape when tape will be visible or tape will not fit.

Note: Will only last a few months.

999MP -AB002

Silicone Spray

Use when grease cannot be applied.

999MP -A3010

Duct tape

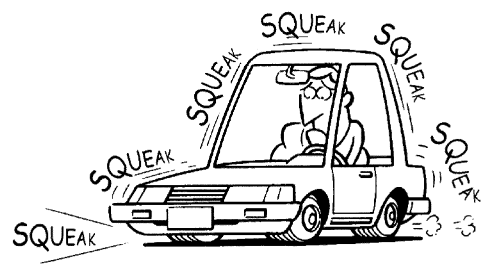
Used to eliminate movement.

Squeak and Rattle Characteristics

Squeak

Like tennis shoes on a clean floor. Squeak characteristics include the following:

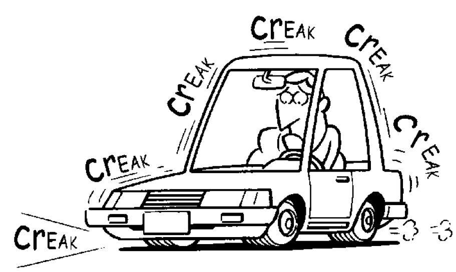
- light contact
- fast movement
- brought on by road conditions
- hard surfaces = higher pitch noise
- softer surfaces = lower pitch noises
- edge to surface = “chirping”



Creak

Like walking on an old wooden floor. Here are some characteristics of a creak:

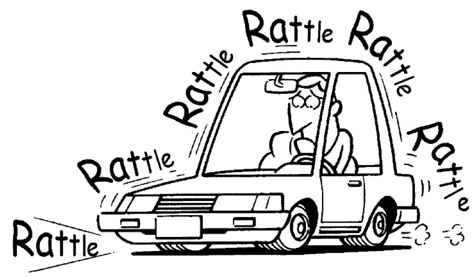
- firm contact
- slow movement
- twisting with a rotational movement
- pitch dependent on materials
- often brought on by activity



Rattle

The sound that a baby rattle makes is similar to the rattles a vehicle can make. These are the characteristics of a rattle:

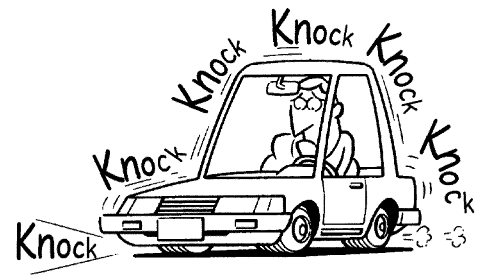
- fast repeated contact
- vibration or similar movement
- loose parts
- missing clip or fastener
- incorrect clearance



Knock

A door knock is the most common "knock" sound. Here are some knock characteristics:

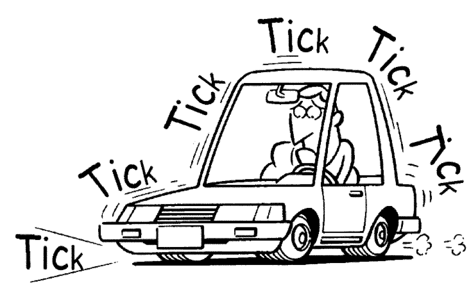
- hollow sounding
- sometimes repeating
- often brought on by driver action



Tick

A clock makes the most common "tick" sound. Common tick characteristics include:

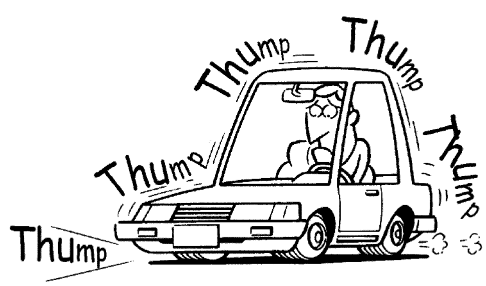
- light contact of light materials
- loose components
- can be caused by driver action or road conditions



Thump

A heavy, muffled knock noise.Here are some thump characteristics.

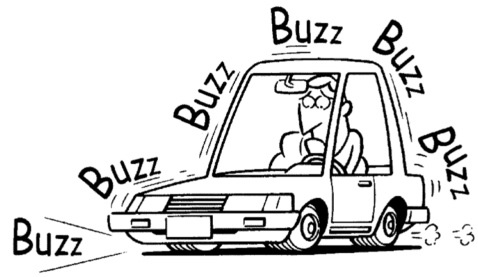
- softer knock
- dead sound often brought on by activity



Buzz.

A hummingbird or bumblebee makes a buzzing noise

- high frequency rattle
- firm contact



Squeak and Rattle Verification and Repair Steps

Squeaks and rattles are normally caused by a simple problem, but finding the source can be difficult.

The following will help you save time when troubleshooting squeak and rattle problems:

Verification Techniques
Duplicate / verify noise:
▪ Recreate conditions (starts, stops, turns, accel, decel, braking, etc.)
▪ Drive on rough roads
▪ Recreate with pressure
▪ Jounce / bounce the vehicle
▪ Use floor jack to recreate vehicle “twist”

Isolation Techniques
Isolate / change noise to verify:
▪ Secure components
▪ Remove parts to expose source
▪ Press on parts to stop noise
▪ Look for loose components
▪ Look for witness marks of contact
▪ Use mechanics stethoscope
▪ Use Steelman Chassis Ear®

Squeaks and rattles can be caused by many different components and conditions. Therefore, the correct material, or repair procedure is important when fixing the noise.

Repair Techniques

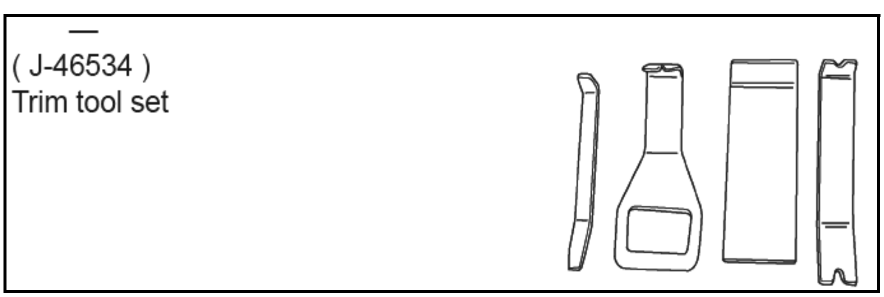
- Use ASIST® and the Nissan Squeak and Rattle Kit
- Stop Movement
- Remove contact
- Insulate
- Lubricate
- Tighten or loosen component

Nissan and Infiniti recommend the use of **Krytox GPL-105** lubricant to resolve a problem with a ticking or creaking noise caused by body side seals. NTB05-027 and ITB05-013 provide instructions for applying this lubricant to the side seals to eliminate this noise.

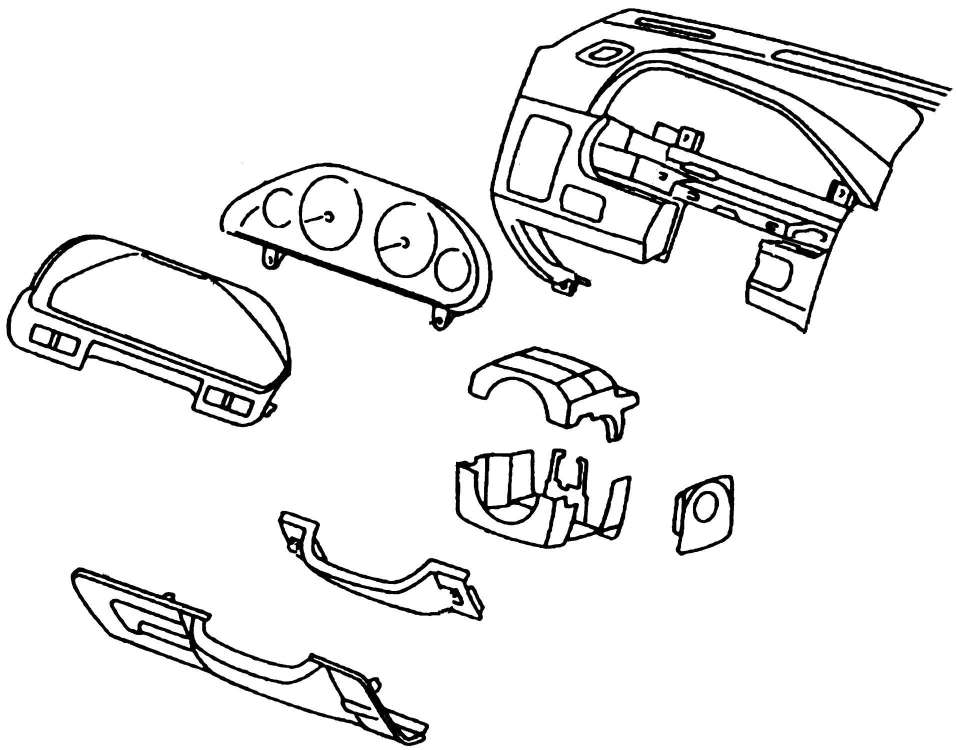
Instrument Panel

The instrument panel and gauge cluster are prime areas for squeak and rattle concerns. Most incidents are caused by contact and movement between:

1. The cluster lid (1) and dash (2)
2. Acrylic lens (3) and gauge cluster (4)
3. Dash pad to "A" pillar garnish
4. Dash pad to windshield
5. Dash mounting pins
6. Wiring harnesses behind the gauge cluster
7. A/C defroster duct and duct joint



This set of plastic trim tools will aid in removing interior trim components when isolating squeaks or rattles.



Most of these incidents can be repaired by the application of non-woven cloth tape or silicone spray in hard to reach areas. Urethane pads can be used to insulate wiring harnesses.

CAUTION:

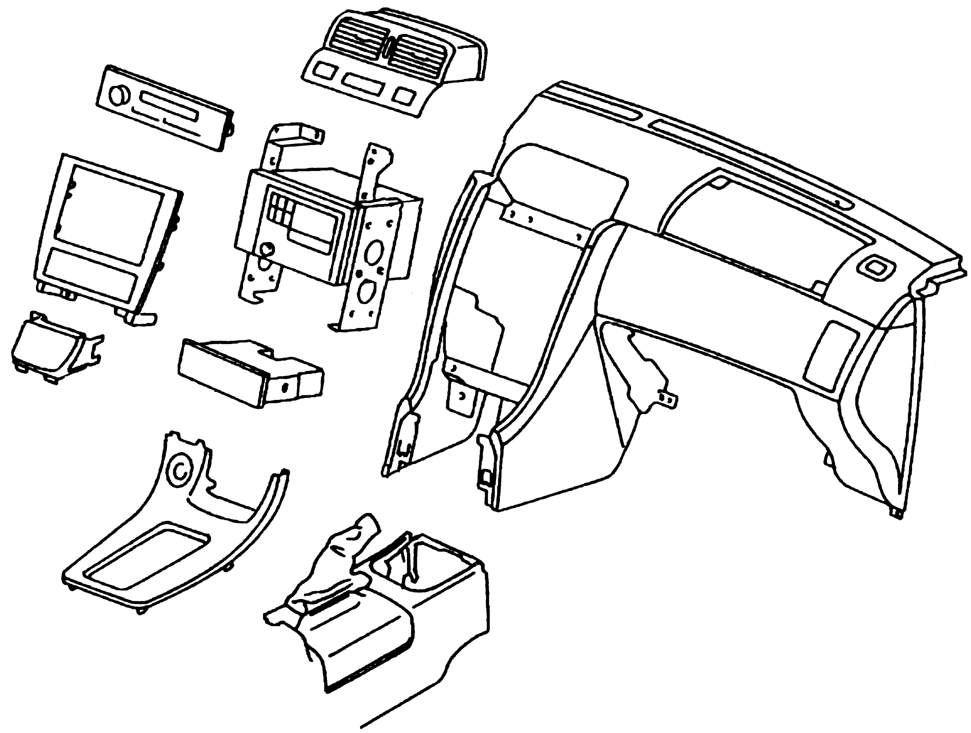
Do not use silicone spray to isolate a squeak or rattle. If you saturate the area with silicone, you will not be able to recheck the repair.

Center Console

The center console is another area with high incidents of squeaks and rattles. Components to pay attention to include:

1. Shifter assembly cover to finisher (1)
2. A/C control and radio cover (2)

3. Wiring harnesses behind radio and A/C control unit



These incidents can usually be isolated by tapping or moving the components to duplicate the noise or by pressing on the components while driving to stop the noise.

Most of these incidents can be repaired by the application of non-woven cloth tape or silicone spray in hard to reach areas. Urethane pads can be used to insulate wiring harnesses.

CAUTION:

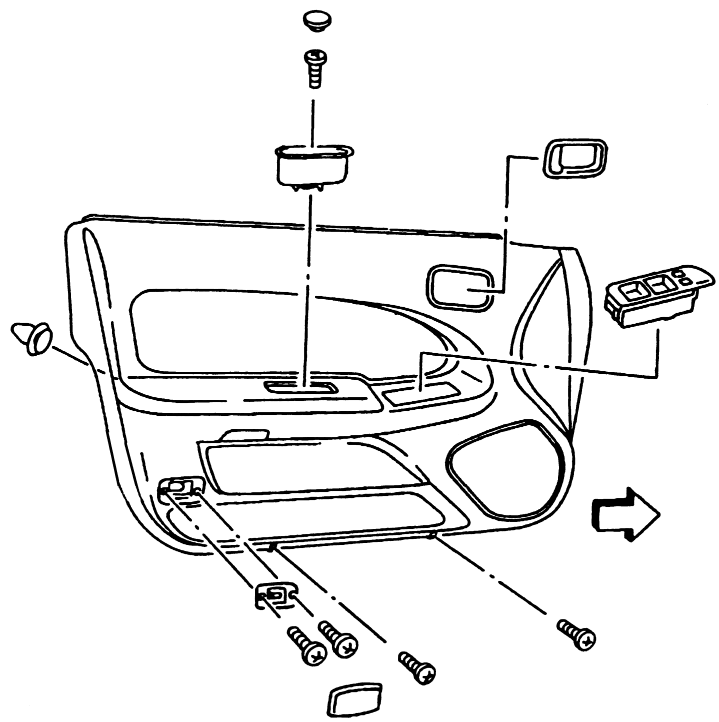
Do not use silicone spray to isolate a squeak or rattle. If you saturate the area with silicone, you will not be able to recheck the repair.

Doors

The doors and door panels are also common areas for squeaks and rattles. Pay attention to the:

1. Finisher and inner panel making a slapping noise
2. Door handle escutcheon (1) to door finisher (2) squeak
3. Wiring harnesses tapping

4. Door striker out of alignment causing a popping noise on starts and stops



Tapping or moving the components or pressing on them while driving to duplicate the conditions can isolate many of these incidents.

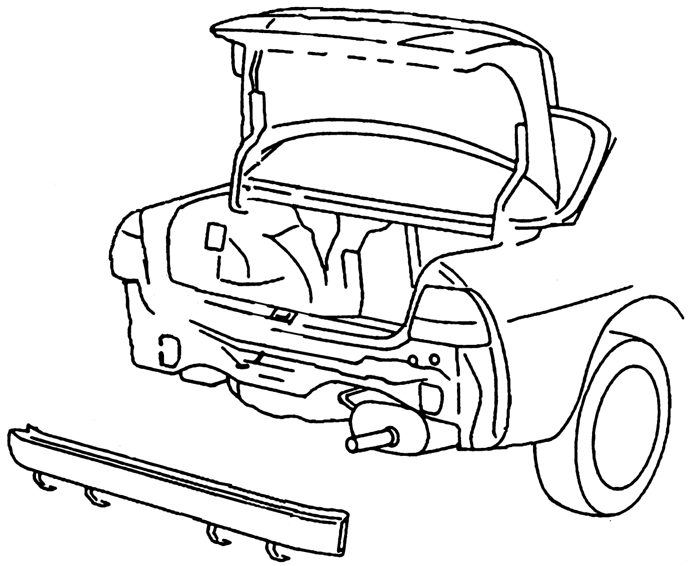
You can usually insulate the areas with non-woven tape or insulator foam blocks from the Squeak and Rattle Kit to repair the noise.

Trunk

Trunk noises are often caused by loose jacks or items put into the trunk by the owner. In addition look for:

1. Deck lid bumpers out of adjustment
2. Latch striker out of adjustment
3. The deck lid torsion bars knocking together

4. A loose license plate or bracket

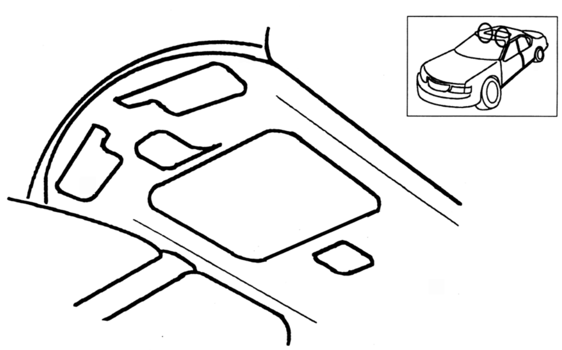


Most of these incidents can be repaired by securing or insulating the item(s) or component(s) causing the noise.

Sunroof/Headliner

Noises in the sunroof/headliner area can often be traced to one of the following:

1. Sunroof lid, track, linkage or seals making a rattle or light knocking noise
2. Sunvisor shaft shaking in the holder
3. Front or rear windshield touching headliner and squeaking



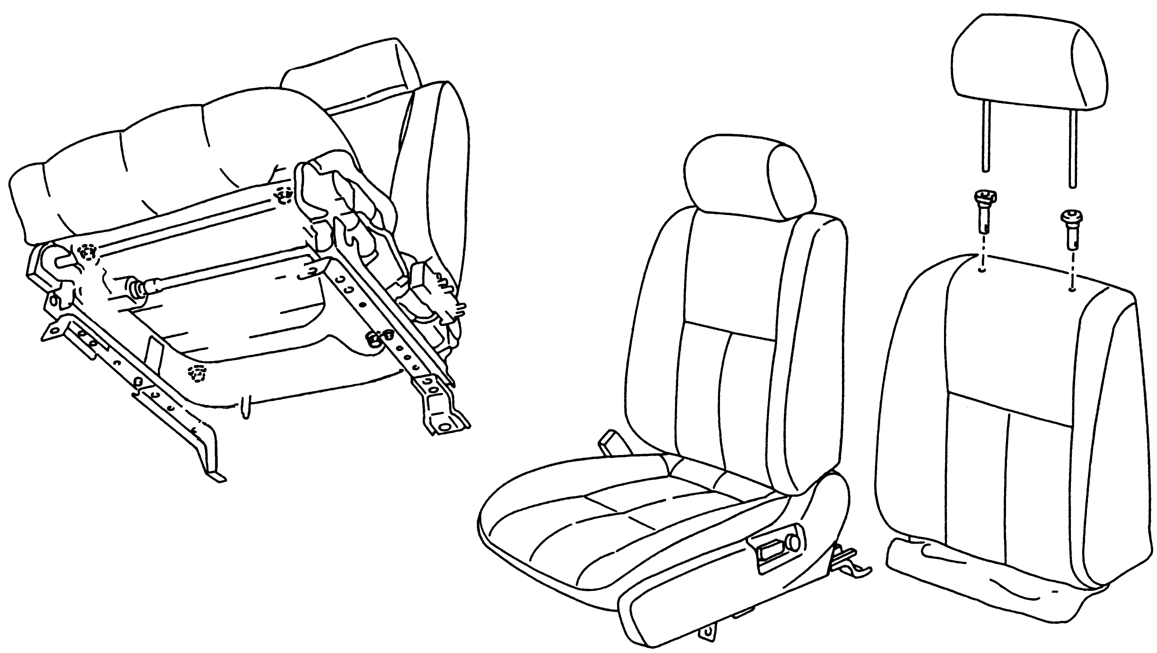
Again, pressing on the components to stop the noise while duplicating the conditions can isolate most of these incidents. Repairs usually consist of insulating with non-woven cloth tape.

Seats

When isolating seat noises it's important to note the position the seat is in and the load placed on the seat when the noise is present. These conditions should be duplicated when verifying and isolating the cause of the noise.

Causes of seat noises include:

1. Headrest rods and holders that rattle (1)
2. A squeak between the seat pad cushion and frame (2)
3. The rear seat back lock and bracket rattle (3)



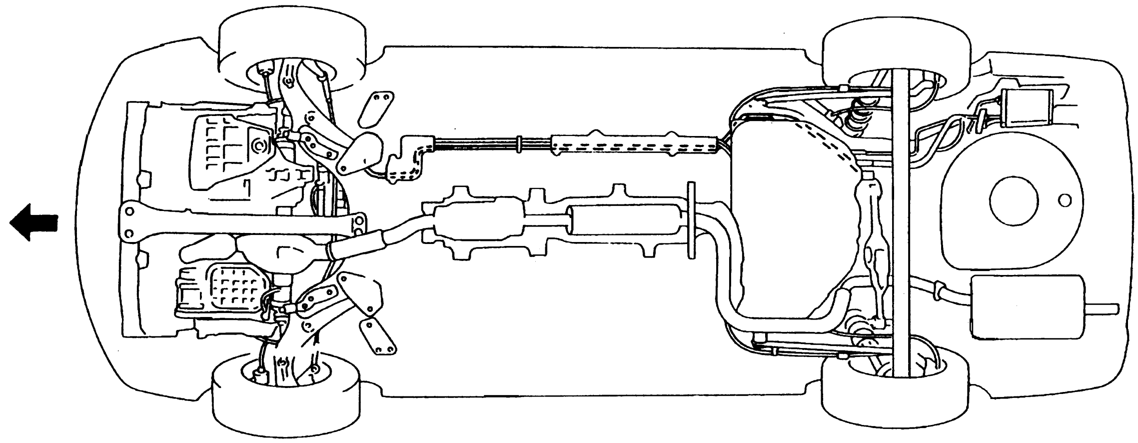
These noises can be isolated by moving or pressing on the suspected components while duplicating the conditions under which the noise occurs.

Under Floor

The most common causes of under floor noises are the exhaust system and suspension. Look for:

1. Exhaust or muffler brackets broken or out of alignment
2. Other bent exhaust system components
3. Loose or damaged heat shield

4. Suspension problems



Be careful, under floor noises can be transmitted to different components, making isolation difficult. A STEELMAN ChassisEAR® is an excellent tool for isolating suspension and other under floor noises.

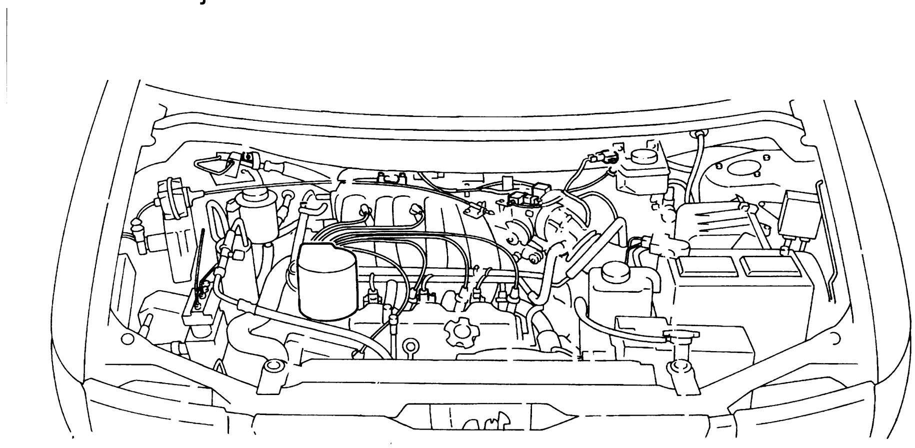
Underhood

Some interior noises are actually caused by components under the hood or on the engine wall that are transmitted into the passenger compartment.

These include:

1. Any components mounted to the engine wall
2. Components that pass through the engine wall
3. Engine wall mounts and connectors
4. Loose radiator mounting pins
5. Hood bumpers out of adjustment

6. Hood striker out of adjustment



These items can be tricky to isolate since they cannot be reached from the interior of the vehicle. The best isolation strategy is to secure, move or insulate one component at a time and test drive the vehicle. Also, engine RPM or load can be changed to isolate the noise.

Repairs can usually be made by moving, securing or insulating the component causing the noise.

General Component Removal Approach

Automotive interiors are designed for assembly, not disassembly. Care must be used when repairing noise incidents. Many clips can be broken or lost during the repair, resulting in the creation of new noises.

Use the following strategy when removing components you are unfamiliar with.

1. Use the Clip and Fastener information in the BT section of the Service Manual to identify proper clip removal procedures. Each fastener is identified by a symbol or number in the diagrams found in the BT section.
2. Use ASIST®to find the latest information on particularly hard to remove fasteners.
3. Identify and remove all screws, nuts, and bolts first.
4. Next remove all clips and other fasteners by gently prying on the component with the appropriate tool. Try removing the piece from different angles if it doesn't easily move. DO NOT use too much force.
5. Make note of existing noise reduction materials when removing a component. The material may be ineffective due to improper installation or age. Many problems are repaired by applying noise reduction materials over existing materials.
6. Don't apply too much noise reduction material. The component still needs to function properly after the repair is complete.

GLOSSARY OF TERMS

Amplitude - The maximum movement from zero during a single vibration oscillation.

Beat Noise - A pulsating noise produced by a combination of two different close frequency sounds.

Booming Noise - A prolonged, low frequency resonant sound like distant thunder or artillery, due to the cavity resonance of the passenger compartment.

Brake Chatter - Abnormal vibration during braking due to grabbing surfaces, usually accompanied by noise.

Brake Squeal - Shrill, high-pitched sound during braking often caused by hardened pads or uneven pad contact with the rotor.

Buffer Rod - An engine mounting insulator used on front-wheel drive vehicles to absorb engine vibrations.

Decibel (dB) - The unit of measurement of sound.

Driveline - All components that develop and transmit driving power from the engine to the driving wheels.

Dynamic Balance - The equilibrium of a rotating object on its axis.

Dynamic Damper - A damper comprised of a weight and spring, designed to absorb resonant vibration at its original resonant point.

Engine Accessories - Accessories driven off of the engine, such as the alternator, power steering pump and air conditioning compressor.

First Order Vibration - The vibration that results from imbalance, occurring one time per revolution of an object.

Force Variation (of tires) - Variation in tire sidewall rigidity that produce variations in tire rotation. Variation occurs in three directions: radially (radial force variation, RFV); laterally, (lateral force variation, L.F.V.), and; circumferentially, (tractive force variation, T.F.V.).

Frequency - The number of times a periodic vibration repeats itself in one second, measured in Hertz (Hz).

Hub Bolt Center - The method of centering the road wheel that uses the tapers of the wheel nuts to position the wheel.

Hub Boss Center - The method of centering the road wheel that uses the wheel centerhole to position the wheel.

Idle Vibration - Body vibration produced when the vehicle is stationary and the engine idling.

Joint Angle -The relative angle of the propeller input and output shafts.

Lateral - Relating to the side or sides; sideways.

Loudness - Relative greatness in volume.

Masking - Phenomenon whereby a louder noise drowns out a lower noise.

Mass Damper - A weight added to shift the resonant frequency to the lower side, thus absorbing the vibration at the original resonance point.

Natural Frequency - The characteristic frequency at which a component vibrates. It is determined by the weight of the mass and the strength of the spring.

Noise - A sound that is loud, disturbing or uncomfortable.

Off-the-Car Balancer - Equipment to measure and correct tire and wheel imbalance.

On-the-Car Balancer - Equipment attached to a vehicle to measure and correct the imbalance of not only the tire and wheel, but also all components that rotate along with the tire and wheel.

Oscillation - A regular fluctuation in position, as the regular swinging of a pendulum.

Pattern Noise - Expansion noise as the air pressed between the tire tread and road surface expands. Occurs with some tire tread patterns when driving on smooth road surfaces.

Phase - A particular stage in a periodic phenomenon.

Pitch - The auditory property of a note is conditioned by its frequency relative to other notes.

Radial - Lines, rays or spokes that emanate from a central point.

Radiator Mounting -The method of isolating and attaching the radiator to the vehicle frame. On front wheel drive vehicles, the radiator mounting acts as a dynamic damper for vibrations.

Resonance - Sound produced by a vibrating object in synchronization with a neighboringsound source.

Road Noise - Noise produced by the vibrations of the tires due to harsh road surfaces.

Second Order Vibration - The vibration that occurs two times per revolution of an object.

Shake - Vibrations of the body and steering wheel in vertical or lateral direction at high

vehicle speeds.

Static Balance - The condition of equal torque on the left and right side of the axis of rotation.

Steering Shimmy - Vibration of the steering wheel about its rotational axis at high speeds, often caused by tire imbalance. Sometimes occurs over bumpy roads at low speeds.

Squeak - A short shrill cry or high-pitched sound, like scratching on glass.

Squeal - A high pitched noise, like tires when a vehicle brakes suddenly.

Tire Balance -The dynamic equilibrium of the rotating tire and wheel assembly. A tire and wheel assembly that is dynamically balanced is also statically balanced.

Tone - The quality or character of a sound.

Vibration - Periodic motion about an equilibrium position, such as the swinging of a pendulum.