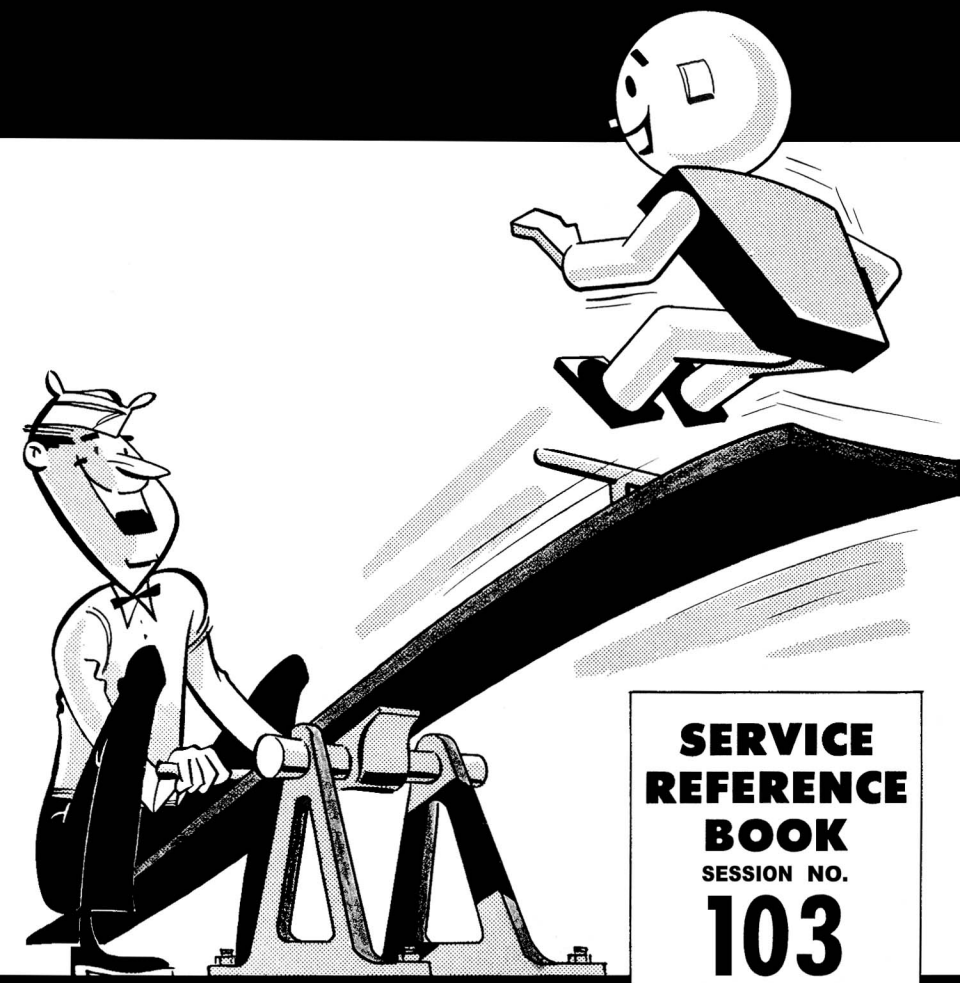
VIBRATION DIAGNOSIS



SERVICE REFERENCE BOOK

SESSION NO.

103

PREPARED BY CHRYSLER CORPORATION

PLYMOUTH • DODGE • DE SOTO AND CHRYSLER DIVISIONS

"VIBRATIONS SOMETIMES FOOL THE BEST OF US!"

TECH SEZ...

Tracking down the source of a vibration can sometimes fool the best of us. That's because a vibration that develops is often telegraphed and relayed from one part of the car to another. It can even masquerade as the sound from a normally operating unit!

But the man who knows how to road-test for a vibration, and the proper method to use in isolating the source, is rarely ever stumped. That's why this reference book explains the nature of vibrations, how to conduct a road test to pinpoint their causes, and outlines some of the corrective steps to take.

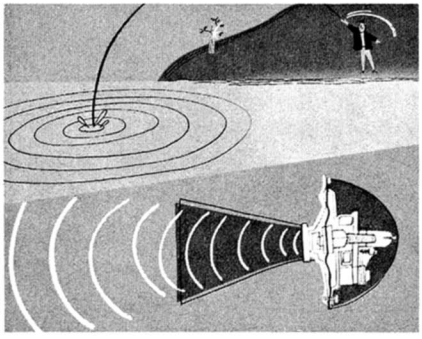
Here's where to find this useful service information:

VIBRATION FUNDAMENTALS

Why bother about vibrations? Well, most vibrations produce noise, and therefore are annoying to an owner. And, some vibrations can result in damage to an important unit. Besides that, the nature of a vibration can confuse a technician who tries to track down the source. Locating the cause isn't always easy.

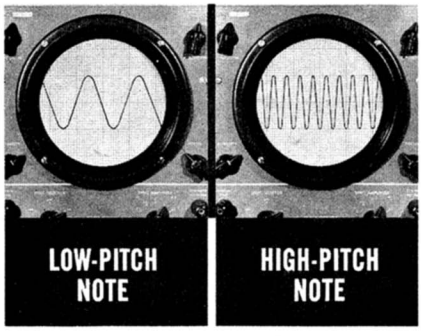
Once in a while, a vibration diagnosis is made without proper testing. That can lead to unnecessary replacement of parts, and the condition can still remain uncorrected. This means unnecessary expense to the owner as well as the service department.

One important thing to keep in mind about a vibration is that it involves movement. If the movement is fast enough, it produces a sound you can hear. All sounds, in fact, are the result of vibrations. Most of you know what happens when a pebble is tossed into a pond. Waves are set up. That's how sound acts, too. The vibrating diaphragm of an auto horn, for example, sets up sound waves and you can hear the horn.



You Can "See" Sound! You can actually get a picture of sound waves on an oscilloscope. This is an electronic instrument used by sound engineers. It shows the frequency of the vibrations.

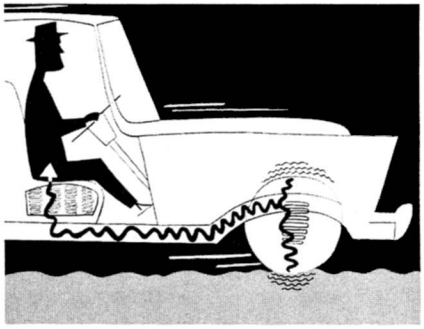
Maybe you're wondering how fast something has to vibrate before it can be heard. Some people can hear sounds that occur at the rate of 16 cycles per second. This *rate of vibration per second* is called the *frequency*. On an oscilloscope, 16 cycles per second would make a picture of a very *low-pitched* note. At the other end of the scale, some people can hear vibrations up to about 15,000 cycles per second. This is a very *high-pitched* note. The faster the frequency, the higher the note.



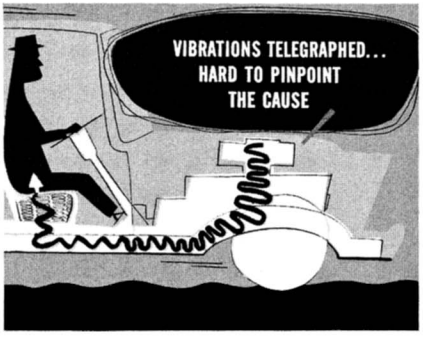
That can give you a general clue to the source of a vibration. If you hear a high pitch, look for something vibrating rapidly. A low pitch would point to something vibrating slowly.

You Can "Feel" Vibrations. Besides vibrations you can *hear,* there are those you can *feel.* Normally, this means something that is vibrating *too slowly* to hear. For instance, suppose an owner uses his brakes severely, or hits a curb occasionally, or some large chuckholes. That often causes wheel misalignment and results in uneven tire wear.

Uneven tire wear, in turn, can cause a vibration. The springs damp out some of the vibration. So do the shocks. The frame absorbs more, the seat cushions and springs a little more. But whatever is left, the driver feels through the seat of his pants.



That may not be enough to bother the owner. At other times, however, it may be enough to cause him slight discomfort. It's one example of how vibrations are telegraphed throughout the car. This relaying of the vibration from part to part makes it hard to pinpoint the cause. Sometimes the vibration sounds as though it is coming from underfoot—say from the transmission, or torque converter. Actually, it may be coming from the engine compartment.



Sympathetic Vibrations. Occasionally there are sympathetic vibrations. This happens when one vibrating part causes another part

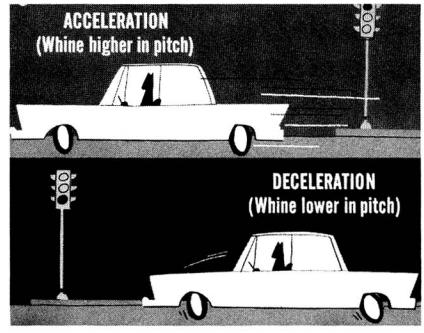
somewhere else to vibrate. Running down the source of such a condition requires very thorough testing.

Describing a Vibration. The most confusing thing about vibrations isn't what people *hear*. Instead, it's how people *describe* what they hear. An owner, for instance, may report that he hears a *squeal*. That same sound, to you, might be more like a *squeak*. To somebody else, it might sound like a *scream*.

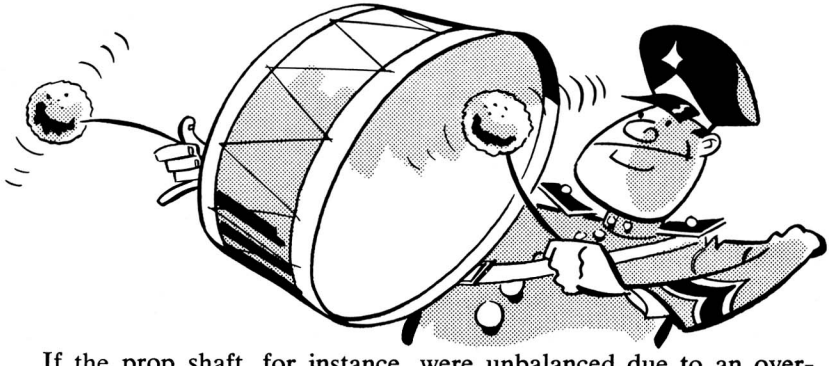
In short, there are many common names for vibrations. Because people interpret the same sound differently, there can be a lot of misunderstanding. Ask a group of people to describe a sound and they'll talk about a grunt–groan–a rumble–or a thump. All different words, and yet they might be describing the same vibration.

You can clear up this confusion easily by making a road test and letting the owner drive. That way you'll be sure you know exactly what the owner has in mind–no matter how he describes the condition. When you go out with the customer, drive on a smooth black-top road, if possible. On that type of road, it's easier to concentrate on the vibration because there won't be so much other noise, such as you get from expansion strips and other irregularities.

Characteristics of Rear Axle Whine. If you ever test a car that produces a *whine* on acceleration, one that *increases* in pitch as car speed increases, you might find the rear axle responsible. A vibration of this type could be caused by pinion-to-ring-gear tooth contact, or by the pinion shaft bearings. This whine could also come in on deceleration, but in this case it would *decrease* in pitch as the car slows down. It is possible to hear a rear axle whine on either acceleration or deceleration, but not on both. If there were a noise on both, it would be more of a *growl* than a whine. In this case, the more likely source would be differential *carrier bearings* rather than gear teeth.

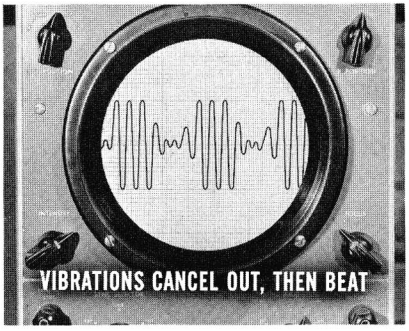


Characteristics of A "Beat" Vibration. Another vibration occassionally heard is called a "beat". This is a rhythmic kind of vibration. It comes in at regular intervals when the car is driven at a *constant speed*. Usually, it is caused by two or more vibrations.



If the prop shaft, for instance, were unbalanced due to an overspray from undercoating, it might vibrate at a low frequency. Now, if something else on the car also vibrated, but at a higher frequency, the two separate vibrations might combine to form a "beat".

Sometimes you can hear a "beat" that occurs, fades to zero, reoccurs, fades to zero, and so on. This will be a combination of vibrations where, at a certain period, they cancel each other. Then, they get out of step, make the beat, and cancel out again. A "beat" noise of any type can really annoy an owner. So, if you ever hear a "beat", be sure to make very careful tests.



ROAD-TEST PROCEDURE

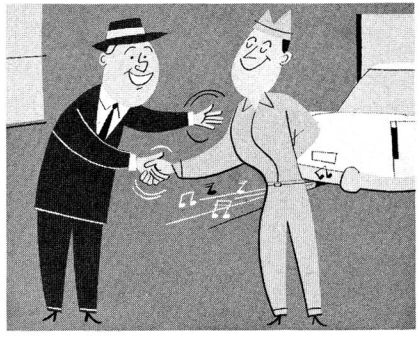
With the Owner. To begin with, always start your road test with the owner at the wheel. Ask him to drive at the speed or in the manner that brings in the vibration. And, if the condition is more noticeable on a certain kind of road surface, get him to pick out that particular type of road. Get him to point out the condition, so you will know exactly what he wants you to observe.

And, here's a tip. Just concentrate on the condition the owner reports. If you happen to recognize *other* conditions which, in your opinion, may be more objectionable, make mental notes to correct them later. Don't confuse the owner who is trying to demonstrate some other noise.

As you may know, once you agree to correct a condition, it's an admission that something is wrong. That puts the burden of proof on you and the owner expects you to eliminate the condition completely.

Get the Facts—Reassure the Owner. In general, play it safe until you get all the facts. Be sure, however, to put the customer at ease. He's usually mighty worried, or he wouldn't have brought his car in for the checkup. He might feel something's seriously wrong, or that the vibration could result in greater damage.

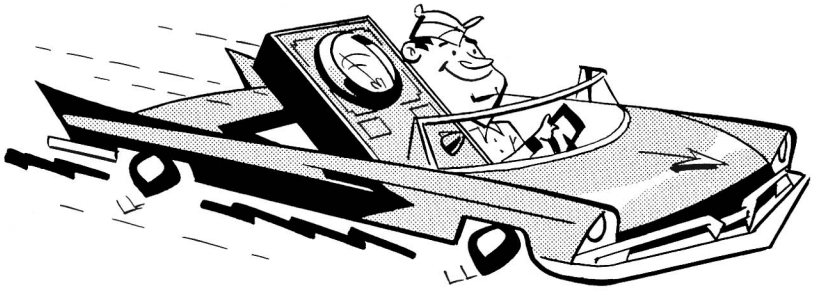
Actually, what the owner might be concerned about could be something most drivers accept as *normal.* It may even be a vibration that's too difficult, or even impossible, to minimize. In a case like this, if you're sure it is a normal operating vibration and one that won't cause trouble, explain it to the owner. Once he knows the cause, chances are he no longer will worry about it because he understands what it is, and that it isn't going to do any harm.



Basically, your job is to make sure you understand what's to be corrected. If the condition is not normal, assure the owner you'll do your best to find the cause, and then see what you can do to correct it.

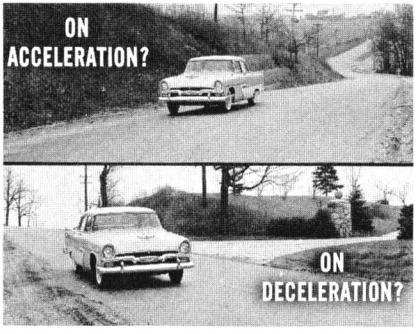
Said another way, it's a "selling" job. You keep the owner sold on the product, sell him into a better frame of mind, and you protect yourself at the same time. When you take time to explain what's behind the vibration, the owner accepts your explanation and is satisfied. What's more, he no longer listens for the condition because he knows no harm will come from it.

Without the Owner. On the other hand, once you know the condition is not normal, and you have an idea of what to go after, then you can make further tests to narrow down the possible source to either



the chassis or the engine. Your over-all road test with the owner should have pointed out certain clues, but there are additional tests you can make to help isolate the source.

When you start out on a road test, always connect a tachometer to the engine. Bring the instrument inside the car where you can watch the dial. Then, drive the car and observe the engine r.p.m. and the car speed at which a vibration appears. In many cases there's a definite connection. As you road-test the car, get an answer to this question: "Is the condition present while the car is in motion?" At the same time, find out if the condition comes in at *any particular car speed,* or is present *regardless of speed.* Use the tachometer and speedometer to relate the condition to engine and car speed.

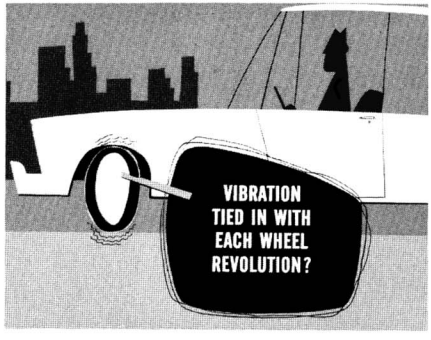


Next, if the vibration does occur at a particular car speed, find out if you can drive through it on *acceleration.* If you do drive through the noise, see if you can get the same vibration on *deceleration* at the same car speed. Both tests are important.

Another good test for separating engine from chassis sources is to get the car up *above* the speed at which the condition occurs. Shift to Neutral. Let the engine run at idle speed. Then, *coast down through the speed at which a vibration occurred,* and see if the condition is still noticeable.

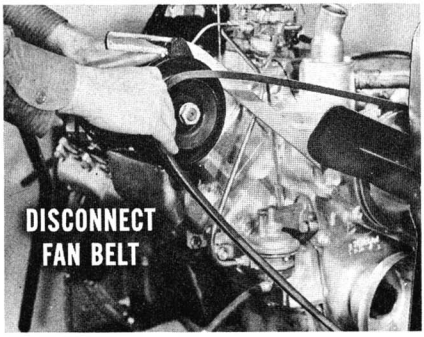
It also pays to see if you can bring in the same condition while the engine is running and car is *standing still.* Just remember to run the engine at the same r.p.m. as the tach showed when the vibration came in while the car was moving.

While the car is moving, see if the vibration is tied in with each wheel revolution. If so, it might be due to a tire bump, noticeable below 40 m.p.h., or a wheel assembly that's out of balance, noticeable above 50 m.p.h. Balancing the tires, or the entire wheel assembly, would soon correct this type of vibration.



Thorough road-testing, naturally, is a "must". Always try to isolate the condition to a general area. When you know what units are not related to the condition, it's easier to concentrate on those that might be responsible.

Isolating Engine Conditions. As an example, suppose you're fairly sure the vibration source is in the engine. Your next step, then, would be to eliminate parts of the engine. You might disconnect the fan belt and run the engine at the speed during which the condition was present. That would usually tell you if the fan, water pump, or generator were



involved. If running with the belt removed didn't bring in the vibration, install a belt that drives only the generator to see if it is the source. A further test would be to remove the fan blades and leave the fan belt in place. If the vibration's gone, it means the fan blades were responsible.

Isolating Chassis Conditions. When it comes to isolating chassis vibrations, more tests are involved. Take the prop shaft as a vibration possibility, for instance. If you road-test the car and notice that the vibration comes in at the same car speed whether the transmission is in low or direct drive, you have a right to suspect the prop shaft. Overspray from undercoating can unbalance a prop shaft. *Wrong angularity* at the rear joint can make it vibrate, too. If angularity is at fault, it's an easy thing to correct.

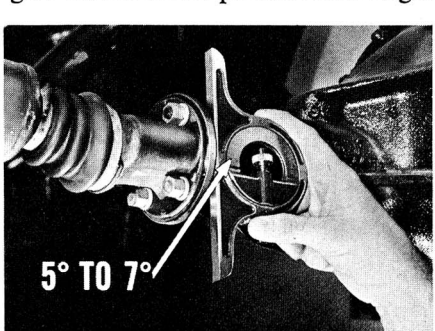
PROP SHAFT AND REAR UNIVERSAL JOINT ANGULARITY

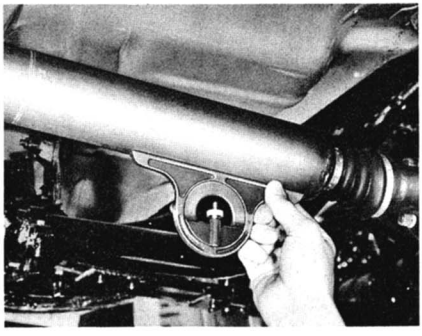
The rear universal joint must operate within a range of 5° to 7°. Any deviation, especially if the rear axle pinion tilts downward excessively, will result in a "shudder" or vibration. In time, this could cause early wear of the joint and dust cover, necessitating replacement.

NOTE: *Before you make any change in angularity, be sure there's 1,000 miles on the speedometer. It takes that much mileage to allow for normal setting, and for the differential pinion shaft to assume its normal operating angle.*

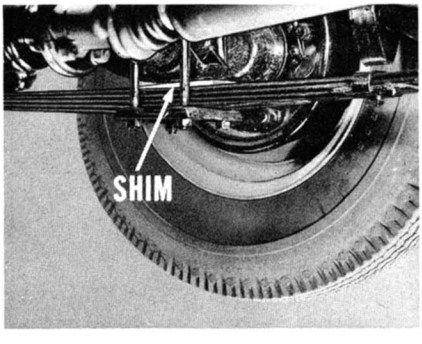
When you check prop shaft angle, be sure no extra weight is in the luggage compartment. Also, put the car on a drive-on hoist. A free-wheeling type lift may put a slight twist on the axle housing and springs that would be enough to give an incorrect pinion shaft angle.

First, place the protractor vertically against the back side of the rear axle pinion flange. This will show the number of degrees from a vertical position the pinion flange operates.





Next, place the protractor on top, or directly below the prop shaft and parallel to it. Adjust the spirit level to center the bubble and take your reading. Add the number of degrees the prop shaft is away from true horizontal, to the first reading. The total will give you the working angle.



If the total angle exceeds 7°, install a shim between the rear spring and the spring saddle on the axle housing. Try to bring the angle as close to 6° as possible. Install the shim with the flat side to the spring, and the thick portion toward the front of the car to tilt the rear axle carrier upward. Be sure the shim surface is free from burrs.

Shims are available as follows:

2°—Part No. 1673458
3°—Part No. 1538606
4°—Part No. 1634086

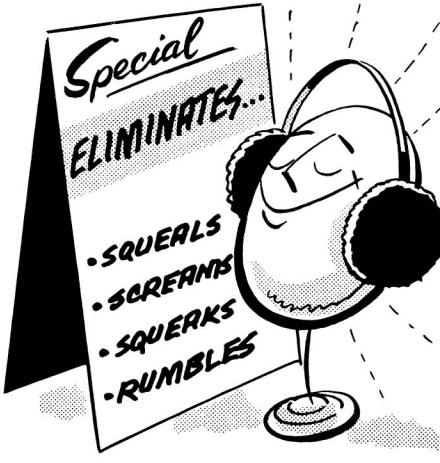
Incidentally, if the dust cover shows any wear or damage, replace it. Check the universal joints, too, and replace them if necessary.

On a De Soto, you may have to disassemble the front joint and examine the ball and roller assembly and joint body for scoring, roughness, or brinnelling. Replace the joint if it is damaged.

See that the ball and roller contact pattern is approximately in the center of the body. If the pattern is toward the rear, it means the engine is too far forward and is causing the joint to bottom in the body. To correct this condition, move the engine back on its mountings.

SUMMARY

Remember, vibrations are deceptive. They are often telegraphed through the car. So postpone any replacement of parts until you complete all tests needed for a thorough diagnosis.



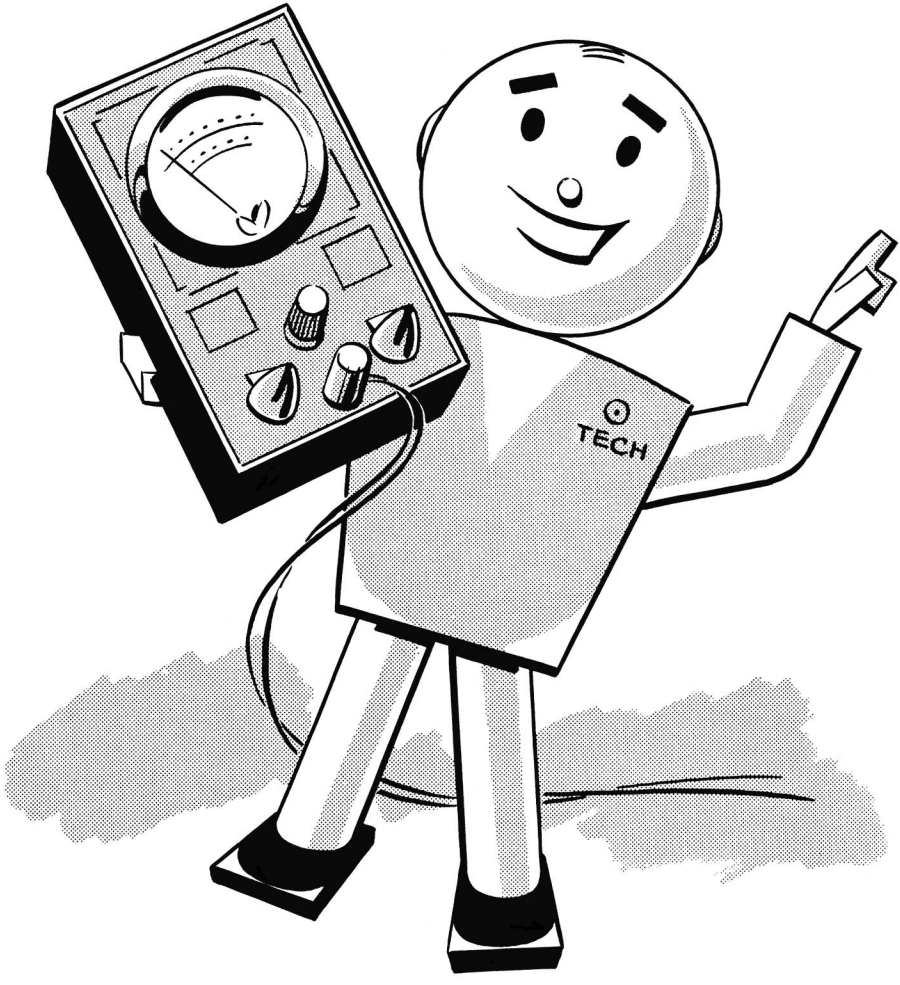
Since different road surfaces can be a factor, be sure you know on what kind of road the owner notices the vibration. Then, test the car on the same kind of road. Certain roads can scramble sounds together so that it's difficult to pick out the vibration.

Connecting a tachometer to the engine before making a road test is important. Both the tach and the speedometer readings should be noted during the road test.

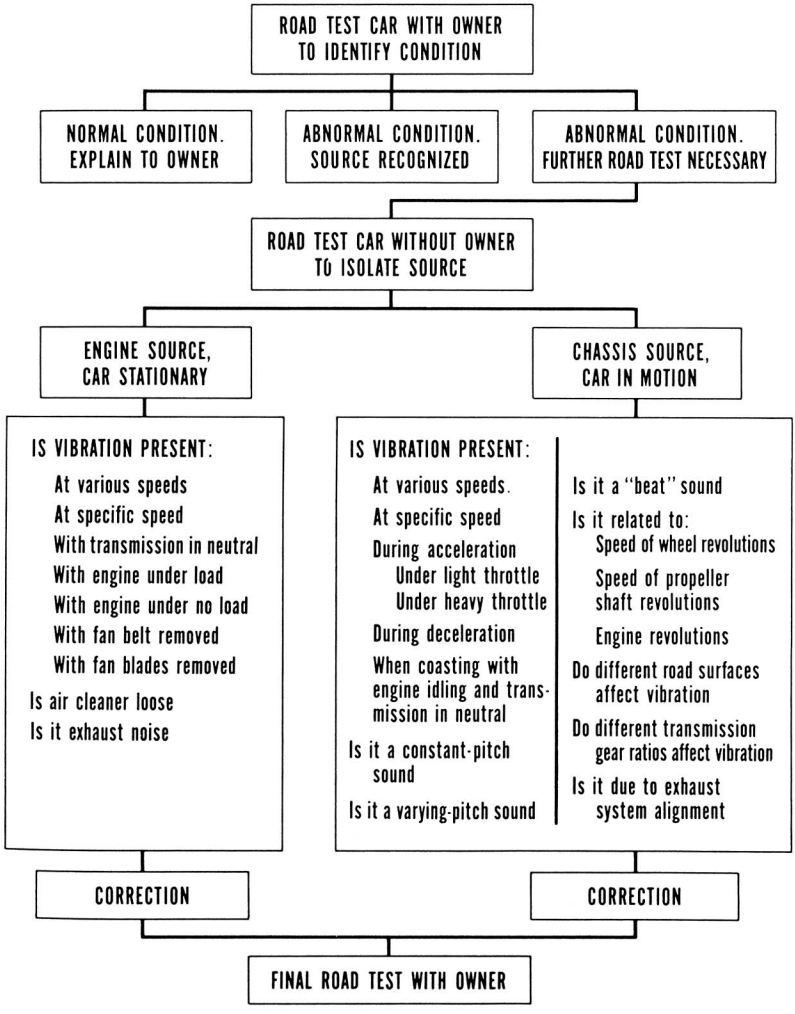
Follow the steps outlined in the Road-Test Procedure chart to isolate the condition to the engine or chassis.

On the following pages you will find diagnosis charts which list the various conditions under which vibrations occur, and the corrective measures to apply. The first chart deals with "Chassis Vibration Diagnosis" and the second deals with "Engine Vibration Diagnosis". Notice that in both charts, you'll see an "F", or an "H", in the column headed CONDITIONS. That indicates whether or not an owner can "feel" or "hear" the vibration. Occasionally, of course, an owner can experience both. In that case, both letters will appear.

DON'T FORGET . . . USE A PORTABLE TACHOMETER! One glance at the road-test chart on the opposite page and you'll see how *speed* figures in tracking down the source of a vibration. Road speed isn't all, remember; engine speed is important, too!



ROAD TEST PROCEDURE FOR VIBRATION DIAGNOSIS



CHASSIS VIBRATION DIAGNOSIS CHART

CONDITION	SPEED RANGE	CHARACTERISTICS	REMEDY
Acceleration—Wide-Open Throttle			
Tire and Wheel Unbalance (F)	More noticeable at speeds of 55 m.p.h. and up.	Present also on light throttle and coasting. If in front wheels, it is evidenced by steering wheel movement.	Balance tire and wheel assemblies.
Tire Roughness (F, H)	All speeds; is more noticeable at 30 m.p.h.	Present also on light throttle and coasting.	Make 50-lb. tire inflation test to locate offending tire.
Clutch (H)	25-30 m.p.h.	Is not present on coasting in gear or in neutral, or with clutch released.	Replace clutch disc only.
PowerFlite Transmission Rear Pump (H)	All speeds.	Can be mistaken for rear axle noise, except in this case noise reduces as oil heats up.	Inspect pump parts and replace as required.
Acceleration—Light Throttle			
Tire and Wheel Unbalance (F)	More noticeable at speeds of 55 m.p.h. and up.	Present also on wide-open throttle and coasting.	Balance all tire and wheel assemblies.
Tire Roughness (F, H)	All speeds; is more noticeable at 30 m.p.h.	Present also on wide-open throttle and coasting.	Make 50-lb. tire inflation test to locate offending tire.
Muffler—Exhaust System (F, H)	Usually more noticeable below 40 m.p.h.	Not present on coasting.	Usually misalignment. Realign exhaust system.
Propeller Shaft Unbalance (H)	Usually more noticeable at speeds of 60 m.p.h and up.	Present under all conditions.	Inspect outside surface for foreign matter, such as undercoating and caked mud. Balance or replace shaft and joints. Check transmission and rear axle companion flanges for excessive runout.

(F)—Feel (H)—Hear

CHASSIS VIBRATION DIAGNOSIS CHART (cont'd)

CONDITION	SPEED RANGE	CHARACTERISTICS	REMEDY
Acceleration—Light Throttle—Cont'd Propeller Shaft Angle (F, H)	25-30 m.p.h.	Noise reduces when passenger load is increased.	Check shaft angularity and correct as required.
Front and Rear Axle Wheel Bearings (H)	All speeds.	Similar to rear axle noise. Present under all conditions. Increasing pitch with car speed.	Axle shaft bearings rough or worn. Replace if necessary.
PowerFlite Transmission Rear Pump (H)	All speeds.	Can be mistaken for rear axle noise, except in this case noise reduces as oil heats up.	Inspect pump parts and replace as required.
Rear Axle Noise (H)	25-30 and 50-60 m.p.h.	Not present on coasting. Usually more noticeable with very light throttle. Tends to disappear with wide-open throttle. Becomes more noticeable as oil heats up.	Due to gear tooth contact or maladjustment. Inspect, readjust or replace parts as required.
Clutch (H)	25-30 m.p.h.	Is less intense than at wide-open throttle.	Replace clutch disc only.
Coasting In Neutral From High Speed Tire and Wheel Unbalance (F)		Present under all conditions, changing with car speed.	Balance tire and wheel assemblies.
Tire Roughness (F, H)		Present under all conditions, changing with car speed.	Make 50-lb. tire inflation test to locate offending tire.
Transmission Gear Rattle (standard 3-speed) (H)	In second gear, 10 m.p.h. to standstill.	Normal to a certain degree, but can be aggravated by excessive propeller shaft angle, or hand brake dragging.	Check and correct angularity or adjust hand brake at all three adjusting points to get equal clearance around drum.

(F)—Feel (H)—Hear

CHASSIS VIBRATION DIAGNOSIS CHART (cont'd)

CONDITION	SPEED RANGE	CHARACTERISTICS	REMEDY
Coasting In Neutral From High Speed—Cont'd Propeller Shaft Angle (F, H)		Noise reduces when passenger load is increased.	Check shaft angularity and correct as required.
Front and Rear Axle Wheel Bearings (H)		Similar to rear axle noise. Is the same regardless of torque.	Inspect bearings and replace as required.
PowerFlite Transmission Rear Pump (H)	All speeds.	Can be mistaken for rear axle noise, except in this case the noise reduces as oil heats up.	Inspect pump parts and replace as required.
Coasting In High Gear Tire and Wheel Unbalance (F)		Present under all conditions.	Balance all wheel and tire assemblies.
Tire Roughness (F, H)		Present under all conditions. If in front wheels, it is evidenced by steering wheel movement.	Make 50-lb. tire inflation test to locate offending tire.
Propeller Shaft Angle (F)		Rattle on deceleration.	Check shaft angularity and correct as required.
Front and Rear Axle Wheel Bearings (H)		Present under all conditions, changes with car speed.	Inspect bearings and replace if necessary.
PowerFlite Transmission Rear Pump (H)		Can be mistaken for rear axle noise, except in this case noise reduces as oil heats up.	Inspect pump parts and replace as required.
Clutch (H)	40-25 m.p.h.	Rattle.	Check for loose clutch linkage and correct. Replace clutch disc only if necessary.

(F)—Feel (H)—Hear

ENGINE VIBRATION DIAGNOSIS CHART

CONDITION	SPEED RANGE	CHARACTERISTICS	REMEDY
Acceleration—Wide-Open Throttle			
Torsional Vibration (H)	V-8 engine 2440 r.p.m. 6-cyl. 2700 r.p.m.	Not present on coasting or in neutral. Is more intense with wide-open throttle than light throttle. Condition is aggravated by other items, such as, fan blades, water pump, generator or flywheel.	Standard condition.
Water Pump (H)	700-800 r.p.m.	Light rattling noise.	Check for noise by removing fan belt. Replace shaft and bearings or complete pump.
Constant Speed			
Crankshaft (F, H)	Under 2000 r.p.m.	Unbalanced engine condition. Low frequency rumbling noise. Has specific point at which the noise is more prominent. There could be various points, and generally under 2000 r.p.m., where the vibration can be more felt than heard.	Check with transmission in neutral. Check crankshaft counterweight for drilled balance holes, indicating crankshaft was balanced.
Generator (F, H)	Under 1500 r.p.m. Generally at a particular speed.	High frequency noise.	Check for worn bearings, or damaged mountings by running engine with generator belt removed. Check for bent pulley, bent shaft or out-of-round pulley.
Engine Mounts (F, sometimes H)	Generally at all speed ranges, but is more noticeable at lower ranges because of lower road, wind, and engine noises.	Engine harshness.	May be due to hard or incorrect mounts. Loosen mounting bolts, run engine to allow it to shift into proper position. Then torque bolts to proper specifications.

(F)—Feel (H)—Hear

ENGINE VIBRATION DIAGNOSIS CHART (cont'd)

CONDITION	SPEED RANGE	CHARACTERISTICS	REMEDY
Constant Speed—Cont'd			
Connecting Rod and Piston Assemblies (F, H)	Under 2000 r.p.m.	Unbalanced engine condition. Low frequency rumbling noise. Has specific point of a speed range at which the noise is more prominent. There could be various points, and generally under 2000 r.p.m., where the vibration can be more felt than heard.	Check with transmission in neutral. Make sure assemblies are within four grams range. Replace if underweight. Correct if overweight.
Flywheel (F, H)	Under 2000 r.p.m.	Unbalanced engine condition. Low frequency rumbling noise. Has specific point of a speed range at which the noise is more prominent. There could be various points, and generally under 2000 r.p.m., where the vibration can be more felt than heard.	Check with transmission in neutral. Check balance of flywheel. Replace if out of balance.
Torque Converter (F, H)	Under 2000 r.p.m.	Unbalanced engine condition. Low frequency rumbling noise. Has specific point of a speed range at which the noise is more prominent. There could be various points, and generally under 2000 r.p.m., where the vibration can be more felt than heard.	Check with transmission in neutral. Check converter housing for loose and missing steel balancing weights.
Fan Blades (H)	Above 2500 r.p.m.	Generally indicated by a roaring sound.	Check fan shroud for centering around fan. Check for out-of-balance or bent blades by running engine with fan belt removed. Replace blades if out of balance or bent.

(F)—Feel (H)—Hear

RECORD YOUR ANSWERS TO THESE QUESTIONS ON QUESTIONNAIRE NO. 103

Vibrations can be classified as those you can "feel" and those you can "hear." RIGHT 1 WRONG

A vibration results from movement and, if vibrations are fast enough, they can produce a sound you can hear. RIGHT 2 WRONG

The slower something vibrates, the higher the note in pitch. RIGHT 3 WRONG

Diagnosing vibrations accurately is difficult because of the deceptive way they are often telegraphed throughout the car. RIGHT 4 WRONG

Best way to start diagnosing vibration causes is by road-testing the car with the owner to learn exactly what condition he has in mind. RIGHT 5 WRONG

On a smooth, black-top type of road, you can pick out vibrations easier because there will be less distraction from other noises. RIGHT 6 WRONG

You can hear a rear axle "whine" on both acceleration and deceleration. RIGHT 7 WRONG

Use a portable tachometer on a road test and see if the vibrating condition is tied in with a certain car speed or a certain engine speed. RIGHT 8 WRONG

One way to separate a vibration from engine or chassis sources is to drive above the speed where the condition occurs, shift the transmission to Neutral, and coast down through the speed while the engine idles. RIGHT 9 WRONG

You can eliminate parts of the engine by disconnecting the fan belt and running the engine at the speed at which the condition was noticed. RIGHT 10 WRONG

LITHO IN U.S.A.