BUZZ OFF

Exorcizing that Relax-a-Cisor effect or, curing those pesky vibration problems.

Vibration caused the damage you see here. Just think what it can do to your muscle Mopar.

By Richard Ehrenberg, SAE

One of the most daunting, frustrating problems you guys ask us about—regularly—is vibration. While your tech editor (who is himself slightly buzzed most of the time) believes firmly the following: A moderate amount of vibration and harshness is one of the components that makes a classic Mopar comfortable on long trips (really!)...it keeps the driver non-comatose, anything that your tush and/or fingertips reports back to your brain as *excessive*, probably is.

Diagnosing vibrations isn't terribly difficult, it just requires a scientific, planned troubleshooting approach. We say there are two basic categories of vibration: engine, and everything else (chassis/driveline, etc.). Each of these categories has two subcategories: Parts failures, and owner-induced problems. So getting your malady localized to one of the resulting four general areas is a huge step in the right direction. Usually, the fix is then pretty straightforward. So… let's get buzzin!

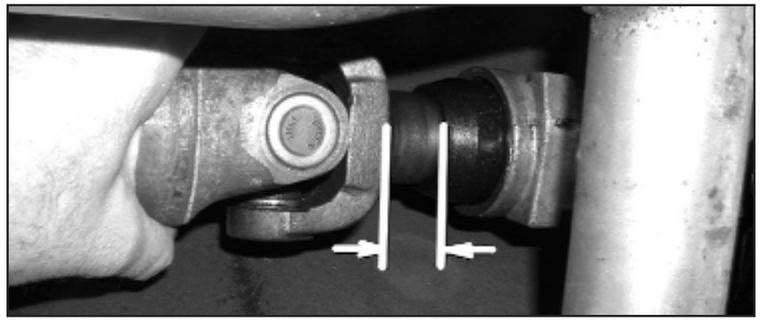
Excepting mismatched components, typically vibration dampers and flywheels/torque converters, true engine vibration problems require complete disassembly. Usually, it's not a good thing if this suddenly occurs. However, one failure that's easy to correct is a bad engine mount (any of the three). Even spool type mounts (above), theoretically fail-safe, are not immune to failure. While the engine won't fall out onto the macadam or smash though the hood like the one on the right, failure will transmit lots of vibration to your pampered butt.

IS IT THE ENGINE?

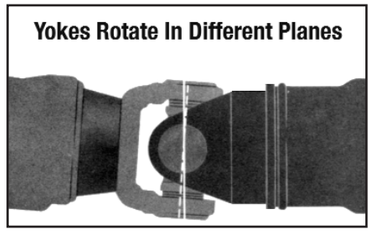
This is really pretty simple, yet we're constantly amazed by the number of people who can't figure out how to make this diagnosis. Simply run the engine, car stationary and in neutral, slowly up the RPM band. One thing that helps change a "subjective feel" judgment, into something you can see, is a simple saucepan or soup plate of water, placed on the hood. If the H_2O begins to dance wildly at a certain RPM point, you've found your problem area. If you can run the engine, car stopped, at all speeds without feeling what bothers you on the highway or track, you can (whew!) cross the engine off the list.

OK, you say the engine makes more vibes than a porn star's jumbo 16-D-cell "unit". What can you do? 99% of engine vibrations are there from day one. Read: you (or your engine builder) did something wrong! The first step is to be sure the defect isn't caused by some external accessory. Do this by removing all belts and repeating the test. (Obviously, with no water pump or fan rotation, you don't want to take 45 minutes doing this test!) Vibes gone? The fan is the number one culprit (bent, blade missing, etc.), followed by—believe it or don't—the alternator, mainly because it rotates at many times engine speed, and correct internal balance is, therefore, quite critical. Reinstalling belts one at a time can help you pinpoint the problem area.

Wheels and tires cause more than their share of vibration problems. Remember, even a perfectly balanced setup will vibrate like mad if there's excessive runout. This can be checked on or off the car. Be sure to check the mounted tire, and then, finding excessive runout (generally, anything over 0.030˝-0.040˝), check the wheel—both radially and laterally.



Checking propshaft length is just a visual thing (see text), and checking U-joints and the tranny output bushing is a simple matter of grab 'n' shake.



With our RWD non-CV joints, the propshaft speeds up and slows down twice per revolution. Hence, both balance and angle are pretty critical.

Next stop is the mounts. This is, typically, a visual-inspection thing. If the rubber's torn, fagged out, fossilized and rock hard, or just plain *missing*, you're home, Vern. Missing fasteners, especially at the rear engine mount (called the "transmission mount" by the whole world, except Chrysler Engineering), are also pretty common. Can you say: "Loctite"? (Yes, we know it's really Henkel, a German outfit. So is DaimlerChrysler. But both are still good stuff.)

Of course, if you've installed mounts with firmer-than-stock insulating material, a certain amount of vibration, at certain RPM, can be expected and is normal. This is a small price to pay for the improved durability and torque-handling capacity these mounts provide.

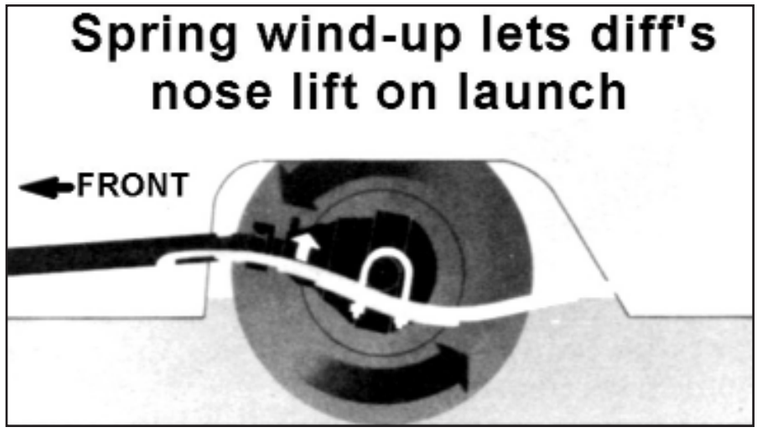
About the only other "failures" you'll find are internal to the torque converter, and a massive engine problem, like, one con rod is disconnected and no longer moving, or half the plug wires are disconnected or misconnected. However, if you haven't already figured out those defects by the other, much more macroscopic symptoms close this

The factory U-joint angle tool, Miller p/n 7336 or C-4244 (bottom, call 800-801-5420 to get one, it's cheap!), makes checking a cinch. A standard magnetic angle finder (top) can also get the job done....

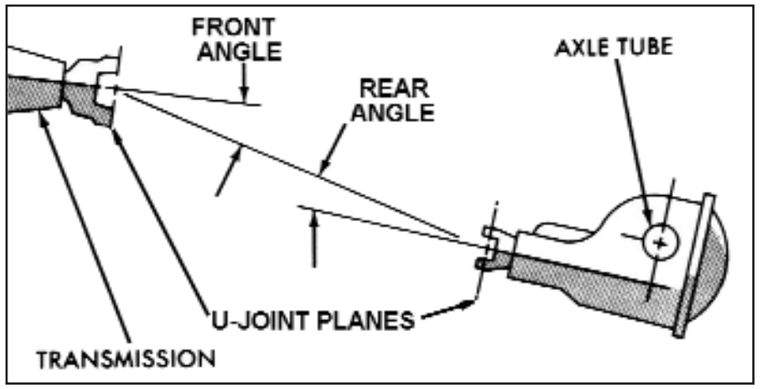
...but then, in addition to the easy part—measuring the propshaft tube, you must measure the axle's angle at the pinion bumper machined surface, and the tranny angle at a square and parallel surface such as the engine oil pan rail. This also requires some arithmetic, since you need to find the difference in angles between the components, and the tool will only tell you the angle to the ground.

magazine immediately. You qualify as a lifetime Mopar Muscle reader. Congratulations!

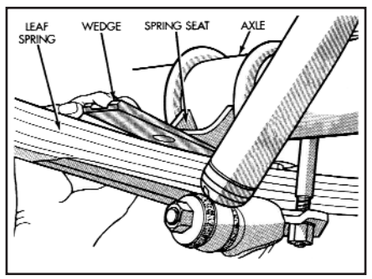
Beyond this, any vibration is almost certainly something you—or your engine builder—did wrong. Usually, this boils down to incorrect external balance components. Yes, it is possible that a torque converter weight came unglued, but this is extremely rare. More likely, you simply have the wrong torque converter, flywheel, or vibration damper for your combination. There are myriad possibilities here, and we don't have space for all of 'em. So let's just get to the bottom line: Excepting 318s, all cast-crank Mopars were externally balanced (some forged motors were, too, mainly early-'70s 440s), and there was precious little interchangeability between the stuff. Got a 360? You need a 360 damper, and it's gotta be one from the right generation, too: '71-'92, or '93-up. Etcetera. Dampers *do* fail,



On a leaf-spring drag car, you need a fairly severe pinion angle to compensate for the axle windup on launch. Short term, angles of as much as four degrees are acceptable. But not for highway driving!



For normal hi-po highway use, you'd like a front U-joint angle of about 0.5 to one degree, and up to 1.5 degrees at the rear.



Within limits, U-joint angles can be corrected with shims at the rear axle (shown, available from MP), or between the transmission extension housing and rear engine mounts (those thick rectangular flat washers that were sometimes supplied in a non-functioning position under the bolt head.)

and Pioneer, Inc., has provided us with this list of additional warning signs, accompanying the vibration problem:

- A leaking timing cover seal;
- Visible deterioration of the rubber between the balancer hub and outer ring;
- Visible cracking or warping of the balancer hub or outer ring;
- Slipping, squealing drive belts, belt damage, accelerated belt wear;
- A highly polished spot on pulley grooves (from warped balancer);
- Elongation of the balancer keyway or wear on the balancer hub/crankshaft snout;
- Alternator, power steering pump, air conditioner or water pump failure;
- Engines that do not run properly when adjusting the timing, or poor performance and irregular idle (inaccurate TDC, outer ring slipped).

On the back end, wrong stuff means dropping the tranny—with one exception: if you've erroneously used an external-balance (counterweighted) torque converter, just chiseling off the large weight usually does the job. Again, this may not be Swiss-watch precision, but 99% sure, it will cure the symptom!

Wrong manny-tranny flywheels can be redrilled (if you've erroneously used a zero-balance one in an external-balance engine, specs are in the MP Chassis book), and rebalanced to zero at a machine shop if you erred the other way. As we mentioned,

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external-balance converters can have the weight chiseled off. Also, internal-balance ones can have the correct weights added via the MP weight kit. Alternately, you can use one of the aftermarket's balance-correcting drive (flex) plates. In fact, if your buildup is currently in process, this has become our preferred method of handling this hassle.

Beyond this, you've really screwed up. Like, you've used 360 rods in an early 318, or Six-Pack rods in an earlier 440, etc., without rebalancing the engine. Vern, you made your bed, now you've gotta lie in it. Pull the sucker out and do it right.

OK, SO IT'S NOT THE ENGINE

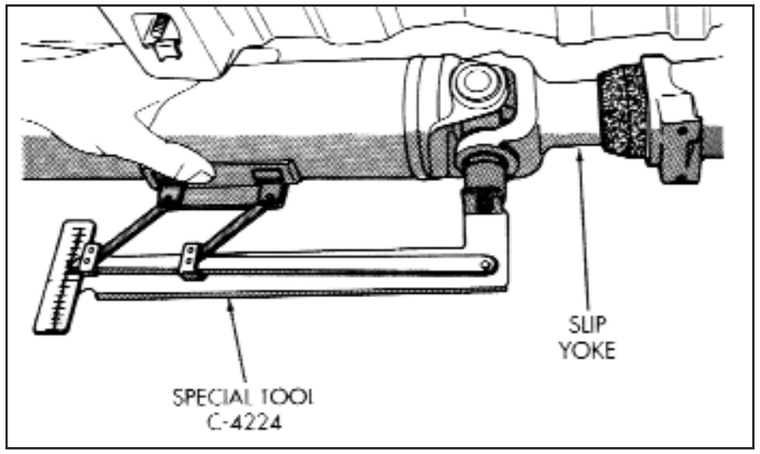
Chassis and driveline vibration problems can be a real hassle. But we'll simplify your life right here: 75% of the problems relate to *wheels and tires*. (Remember last month when you locked all four at 85 MPH, avoiding the 20 MPH Chevette? Can you say "D-shaped skins?") Alright, you just had your fancy new rollers computer balanced, and they're perfect. No argument from this camp. But see if you agree with this statement: A perfectly *square* wheel and tire could be perfectly *balanced*. It's true. Hey, your crankshaft isn't perfectly round, and *it* can be balanced. A balanced see-saw isn't round, either!

Now picture how smoothly the car will run (not!) with square rolling stock. Got the picture? Runout, lateral and radial, counts even *more* than perfect balance! We'll not dwell on how to fix your rolling stock—you'll get it right eventually, even if you have to enlist the aid of a local tire shop. Just one hint: The lowest point on a steel wheel rim is marked by the valve stem hole. The highest point on a tire is marked by the little paint dot or sticker on the sidewall. They should be mounted adjacent to either other, the theory being that, if your stars are also properly aligned that day, the respective wheel / tire runouts will cancel each other. Yeah. Right. But it's a start and can't hurt.

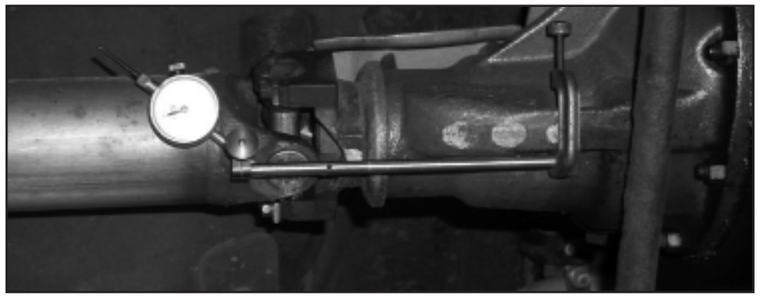
The bottom line is this: The very first thing you should do, once the engine has passed the vibe test, is substitute another complete known-good set of wheels and tires. Begged, borrowed, confiscated, outright stolen, whatever it takes—just do it. Don't chintz out on this, it will come back to bite you later. After you've spent a few hours in the room with the rubber walls.

STEERING WHEEL OR BUTT VIBES?

Once you've eliminated the engine, and wheels 'n' tires, as the vibration source, you need to continue the narrowing-down process. Generally, we can easily categorize the symptoms as driveline related, which, although they can shake the entire vehicle, can be felt strongly through the seats, and front-end shaking, which can be sensed most strongly through the steering wheel. Discounting the occasional out-of-balance brake rotor or drum, most front-end maladies aren't truly vibrations; they are more akin to a shake. If a rotating component is even slightly out of balance, and there's slop in a tie-rod end or ball joint, the symptom can be greatly magnified. Luckily, a simple physical inspection (yanking on steering joints, prying under a tire with the car jacked by the lower control arm, observing steering box or coupler play, etc.) will quickly pinpoint these defects, repair and correction is usually straightforward.



With the factory tool, reading are direct, and unaffected by vehicle or ground slope (as long as the car is supported by the wheels and/or the weight is on the suspension).



Propshafts need to be checked for runout—a simple matter with a universal dial test indicator. Limits are 0.010" at the ends, and 0.015˝ in the center.

Driveline problems are the biggest headache for most classic Mopars. In this area, there's a multitude of pitfalls, ranging from simple worn components, to mismatched parts, incorrect angles, etc. But *why* is the propshaft area so damn critical? Simple! It rotates at 3 to 4 times rear axle and wheel RPM, and it's a length of relatively thin steel tubing totally unsupported over its span of quite a few feet.

If you think about the way the U-joints on our classic Mopars operate, you'll come away amazed that vibration isn't actually *more* of a problem! With any operating angle greater than zero, the entire propshaft must speed up and slow down twice per revolution. This is why any defect, excessive angle, bent or twisted shaft, bad rear engine mount, etc., results in a truly annoying, destructive cyclical, droning vibration. In other words, it sucks.

If your Mopar is stock, and the vibration just showed up one day, troubleshooting is usually pretty simple. First on the list would be checking the U-joints, front and rear, for any slop. Failing that, visually inspect the following: All three engine mounts, paying special attention to the rear mount, for collapsed rubber and/or missing hardware, as we mentioned earlier. Inspect the driveshaft for obvious road hazard damage. Inspect the rear springs for broken sagged or leafs, or loose U-bolts. On cars with the sliding-spline style transmission yoke (all 1965-'66-up Mopars), physically grasp the propshaft in the area of the front U-joint and attempt to move it vertically. Finding any noticeable play means the tranny's output bushing is toast (at that point, also inspect the yoke for excessive wear patterns.)

Many vibration issues arise when an engine and/or tranny swap is made. Often, the propshaft installed will either be simply incorrect for the application (length wrong), or damaged, out of round, or out of balance.

The propshaft *length* must be correct. The simplest way to check this is a visual observation, which must be made with the car either sitting on all four wheels (or a drive-on type of service hoist or alignment rack,) or with jack stands placed under the rear axle housing or shock plates. Assuming a sliding-spline front U-joint, the front edge of the yoke should be anywhere from just barely touching (but not compressing) the seal boot, to about 1.25˝ rearward. If the boot is significantly compressed, the shaft is too long and will bottom out. If too short, the trans's output bushing will be eaten alive—quickly.

Much has been written over the years, mainly in factory publications, about "field balancing" propshafts, typically using clamp-on weights consisting of gear-type hose clamps. Our advice: *forget it*. Waste of time, for several reasons. With the RPM most of us see at least occasionally, a professional balance job, and nothing less, is needed. Secondly, if the shaft needs balancing—all of a sudden—you need to ask yourself: Why? Odds are that the shaft is bent, twisted, or otherwise damaged. A quick, on-the-car runout check will bring this defect to your attention, but, bear in mind that a worn tranny output bushing (again!) can make the shaft *seem* defective.

We've saved the gnarliest for last: U-joint angles. This is a helluva can of worms for most folks. The factory information written over the years has been both contradictory and confusing. But there's actually a reason for their seeming madness: Different applications require different angles. A leaf-spring-equipped drag car requires a significant nose-down pinion angle, to assure that the angle is in the "normal" range during that all-important first 60 feet (see drawing on page 32), much has been written about this setup by Mopar Performance. Since the main target audience for this article are folks who drive their Mopars on the road, yet occasionally hit the strip (with street tires), we'll make our usual bold recommendation for that group: The front pinion angle should be approximately 0.5 to a maximum of one degree, and the rear should be 0.5 to 1.5 degrees. (Ideally, the front angle should be zero, but this results in the grease hardening from lack of friction-induced heat.) Excluding a drag-only car, in no case should the difference between the front and rear angles exceed 1.5 degrees.

Driveline vibration can be diagnosed, to a certain extent, with the car parked in your driveway. Just support the rear axle with stands, and, for safety, be sure the car is either tied down securely, or nosed into an immovable object, and run 'er up through the gears. This type of testing is also useful in locating an out-of-balance rear brake drum, because the car can be "driven" with *no* drums at all.

CONCLUSION

The key to economical, rapid vibration diagnosis and repair is a logical, step-by-step approach—throwing parts (read: money) at the car is useless. Hopefully, we've pointed you in the right direction.