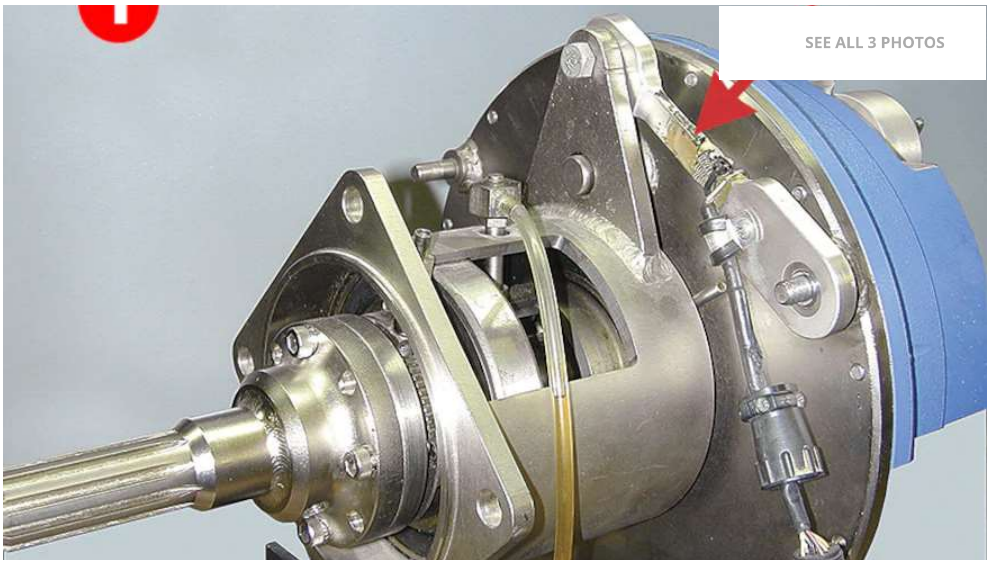
Dyno Testing



Marlan Davis - writer | Dec 8, 2008

Starting engine dynamometer pulls at low rpm is hard on the dyno and hard on the engine.

Today, engine dynamometer testing is an integral part of many HOT ROD engine buildups and product tests. Typically these tests start no lower than 2,800 rpm, and often higher. Readers often ask us why we don't test from off-idle, or at least from an extremely low rpm-point. These readers feel that at least on a streetable combination, knowing how the engine performs at low rpm is nearly as important as the peak torque and power numbers. Rest assured this is not an arbitrary decision on our part; there are several practical, real-world reasons why we don't routinely conduct engine dyno tests from such a low rpm.

First and foremost is the limitations of the test equipment itself. An engine dynamometer's power-absorber unit is kind of like an automatic transmission's torque converter. Like a torque converter, the absorber has a vaned rotor and a stator, but the fluid running through it is water rather than the hydraulic fluid of an automatic trans. Just as torque converters have different stall speeds (and a high-stall converter can't hold an engine down low), dyno absorbers have different load capacities. There is a certain rpm range the absorber can work in. For the most widely used engine dynos, this is typically about a 4,000-rpm effective operating range.

If the absorber is set up to work down low, it is more inaccurate on top measuring the peak power and torque numbers. This also dovetails to servo capacity. The dyno servo dumps off excess fluid (water) to let the engine rev up higher. A lot of water is needed on the bottom to manage the torque—not so much on top. If the servo is adjusted to allow additional water down low, it is unable to dump sufficient water fast

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adjusted to allow additional water down low, it is unable to dump sufficient water fast enough on top, leading to greater inaccuracies. The dyno may even unload completely on the top-end and fail to complete the run.

The higher the engine's torque output and the lower the rpm at which the torque output occurs, the more difficulty the absorber and servo have in controlling the engine and getting an accurate reading. Larger-displacement and big-block engines tend to develop more torque than smaller-displacement or small-block engines. Hence big-block dyno runs must usually be started at a higher rpm point than a small-block test.

Some high-end dynos have more sophisticated absorbers and in theory can make a true wide-band pull. But even assuming the dyno can successfully make such a low-rpm pull, it's still not a good idea because it's very hard on the engine. Under low-rpm, wide-open-throttle (WOT) conditions, cylinder pressures are extremely high, increasing the chances of detonation. But because rpm is still low, the piston is moving relatively slowly and has insufficient time to get out of the way and avoid damage.

Dynos also load engines differently than in a real car. On today's dynos, an acceleration pull is normally conducted at a 300-600 rpm/second rate. Dynos, after all, don't have transmissions—they effectively operate in high gear all the time. By contrast, a car pulling away from a stoplight may accelerate in low gear at a 1,000 rpm/second rate. This makes pulling an engine from low-rpm on a dyno lots dicier compared to an equivalent off-idle run as installed in a real car—in other words, dyno spends more time in the dangerous, detonation-sensitive, low-rpm speed/WOT regimen than a real-world vehicle would.

PHOTO 1/CLICK TO ENLARGE: Engine dynos calculate torque with a strain gauge (arrow) that measures the torque reaction between the rotating element and the stationary element of the engine-driven absorber. How much the strain gauge "stretches" provides a signal that is measured and converted into an engine torque number. Standard SuperFlow dynos like this one can measure 1,000 lb-ft of torque.

PHOTO 2/CLICK TO ENLARGE: The dyno's rotor is driven by the engine being tested. The exchange of energy happens here, between the rotor (rotating element) and the stator (stationary element). Most hot-rod dynos mount the absorber in a water-filled cavity. The water passing through this section must be exchanged at a high rate so the heat is carried away.

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