Crankshaft Dampers 101

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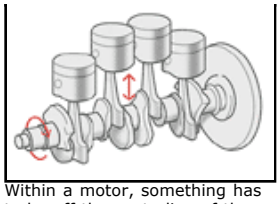
I have been around dampers for a long time and traveled to different engine shops around the country to test actual crankshaft twist for the past 8 years. Throughout these years I have collected a lot of information that allows me to make informed decisions on “how much” damper certain engines need. When given the crank weight, peak normal operating RPM, horsepower, rotating system materials, rules about the damper specifications (if racing), and the application of the engine (road racing, oval or drag), I can make a good prediction of how much weight and what sort of dampening device your vehicle will need.

Let’s stop for a second and think about the way a crankshaft is designed. On one end, you have your flywheel, torque converter, or a clutch. On the other, you have your timing chain / belt / gear drive, and then a small “snout” sticking out on which to bolt your damper and any needed accessories. In between all of that, you have a few main caps and bearings that hold your crankshaft in the motor. Sometimes there are two, four, or, on newer engines, even six main caps that go over the crankshaft and then bolt to the actual engine block. This keeps your crankshaft where it should be. Finally, you have the rods, pistons, wrist pins and rings. This is where all of the crankshaft twist and harmful harmonics are truly started.



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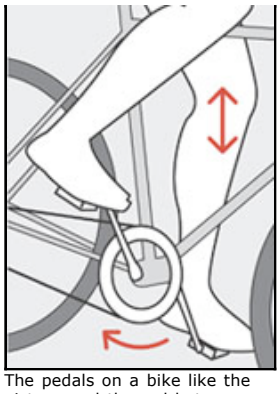
Your pistons and components have to travel up and down the cylinder, to the top of the motor and then to the bottom. If you think about that motion within a motor, something has to be off the centerline of the crankshaft so that as the crankshaft turns one revolution, a piston is pushed to the top and then pulled to the bottom. However, if that stroke is a firing stroke, where fuel is combusted, that piston is then also pushed downward and that is what actually produces your power.

Think about riding a bicycle and the way you pedal the bike to move. The pedals themselves are like the pistons and the rod between the pedal and the crank sprocket is just like your connecting rods. The pedals have to be off the centerline of the crank in order for you to make a circle with the pedals and move your bike. Your crankshaft and pistons can be viewed in the same light. Because something has to be off the centerline of the crankshaft in order to function, the leverage of that connection to the crank is very high. That is why the crankshaft will twist as the system is forced to rotate.



The pedals on a bike like the pistons and the rod between the pedal and the crank sprocket is just like your connecting rods.

While your motor is running, you have some pistons that are being pushed downward on a power stroke, some that are being pulled down by the crankshaft, and then there are some that are being pushed upward by the crankshaft. Now think about this entire system happening 8,000+ times per minute! Even further, think about all of these different actions that are taking place, and then imagine them happening on the same piece of metal - the crankshaft. These actions make that shaft twist in one direction away from its natural home location, and then when it tries to come back to that home location, its momentum makes it travel past its original location and farther in the other direction. This is what I measure when I am damper testing and the name of that action is, Degrees of Twist – Peak to Peak. That is crankshaft twist. That is what breaks parts and robs you of horsepower when there is nothing to counteract and eliminate the

twist. In this system, the worst torsional vibrations, or twist, will always occur at the farthest point from the greatest load, or the heaviest mass.

Once these vibrations get to the front of the motor, something there needs to counteract that motion. That is where the damper comes into play. The damper's job is to absorb and counteract as much of the twist as it possibly can. If you have the right damper on your motor, almost all of the twist can be eliminated. With the wrong damper, however, virtually all of the twist can remain.

You may be wondering what that has to do with HP? Remember from above what is also at the front of your motor - your camshaft drive. If the front of your crankshaft is twisting, then your camshaft drive is also twisting. If your camshaft position is being changed or varies, then the engine cannot properly induce, combust and remove the fuel. That means a loss in power!

You must have a reliable damper that is capable of properly combating these vibrations and twist. Your stock damper, or stock style damper, is simply a piece of soft steel that has a rubber ring that has been melted in between another steel ring. The inherent problem with that design is that there is no way to maintain concentricity of the inertia ring during manufacturing. Therefore, the damper has to be machined and balanced after the inertia weight has been bonded to the rubber strip. That means when the outer ring slips you lose your timing marks, damper balance and concentricity! The stock damper works just fine as long as you do not make many changes to the motor, such as HP or RPM, from when it was stock and if the damper is not very old. When you start changing those things, you cannot count on your stock damper to do its job. Not to mention if that damper is old and worn out, the outer ring has a good chance of slipping or even separating from the rest of the damper and coming off your engine completely! Many different styles of aftermarket dampers are available. Through many years of testing and tuning, the O-ring style Elastomer damper has proven to be the best choice for performance applications, especially when high RPM is being applied. Additionally, this style is rebuildable and even tunable for your particular engine. A good resource for more in-depth research is an SAE paper called, "A Practical Treatise on Engine Crankshaft Torsional Vibration Control" by Robert C. Bremer Jr. (SAE Paper SP-445, June 1979). An excerpt can be found here.

Aftermarket dampers are available from 5 to 15 lbs, in steel and aluminum, with serpentines, HTD, Gilmer, V groves, magnets in the shell, or just about anything you could ever want on them. These dampers also vary widely in the outside diameter of the damper itself. One of the biggest size challenges comes with the new tuner or import market. These small motors are making lots of HP and turning lots of RPM!

The stock Japanese dampers are not any different than stock American dampers in design, except for their size. The average size of the Import stock damper is around 5 ½". The biggest problem with a smaller damper is that you have to be able to have enough inertia weight to make the damper do its job.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Think about your common "power pulleys." They may add some power by slowing down all of your accessories, but they will hurt your engine life and your power at some RPM ranges. Power Pulleys are not the right way to make power. In the long run power pulleys will yield failures in your engine and components on your car. That stands true for Imports and American cars. You can read more about the Dangers of Power Pulleys here.

Hopefully, this article has cast some light on crankshaft dampers. They are not black magic, just something that most people never think about. Chances are that your stock damper is old, and that the rubber has started to crack and wear out. Or you might have a cheaper aftermarket damper that is nothing more than a polished up stock damper design. Like I said, most people never check out their damper because they never realized what a critical component it is.

Tech Articles

- Popular Hot Rodding article featuring a typical damper test
By David Vizard

- Danger of Power Pulleys & Understanding the Harmonic Damper
by Steve Dinan

Use of the Optimum Damper Concept
by Bremer Jr., R. C.

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