Essential Heavy-Duty Damper Service

BY **BRIAN LEBARRON**

An over-the-road diesel truck engine comes in for a 500,000 mile overhaul. Everything in the pre-packaged rebuild kit is installed; pistons, sleeves, bearings, gaskets. The technician skillfully examines the main engine components and reassembles it. The satisfied customer goes back to hauling deliveries and within 50,000 miles the crankshaft breaks resulting in catastrophic engine failure. Without having to ask what happened or who's responsible, the reputation of the engine builder is already at risk. Warranty remediation ensues.

This is based on an actual engine builder's inquiry to Vibratech TVD. Vibratech TVD is an American headquartered manufacturer of crankshaft vibration dampers for heavy duty diesel and gas compression engines. They are also a leading developer of viscous dampers for OEM powertrain companies and experts in crankshaft torsional vibration analysis. After inspecting and opening the crankshaft vibration damper, Vibratech TVD determined that the damper was not replaced at the recommended 500,000 mile interval.

"This scenario occurs more often than you think," comments Vibratech TVD Sales and Technical Consultant, Lynn Livermore. "There is a big misconception that it's nothing more than a heavy solid weight balancing the engine. It does not balance the engine. In fact, proper knowledge and service of the crankshaft damper directly affects customer relations and their reputation. Unexpected downtime is costly for everyone involved."

New viscous damper silicone is clear and approx. 45,000 thicker than 30w oil. These dampers (pictured right) came from heavy duty diesel engines that had been rebuilt but the damper was not replaced. The internal deteriorated conditions of these dampers were a major factor in engine failure. Polymerization of the silicone will solidify in spots before completely hardening. Once polymerization begins, approx. 500,000miles/15,000hours in most heavy-duty diesel applications, the damper's ability to control destructive torsional vibration gradually diminishes.

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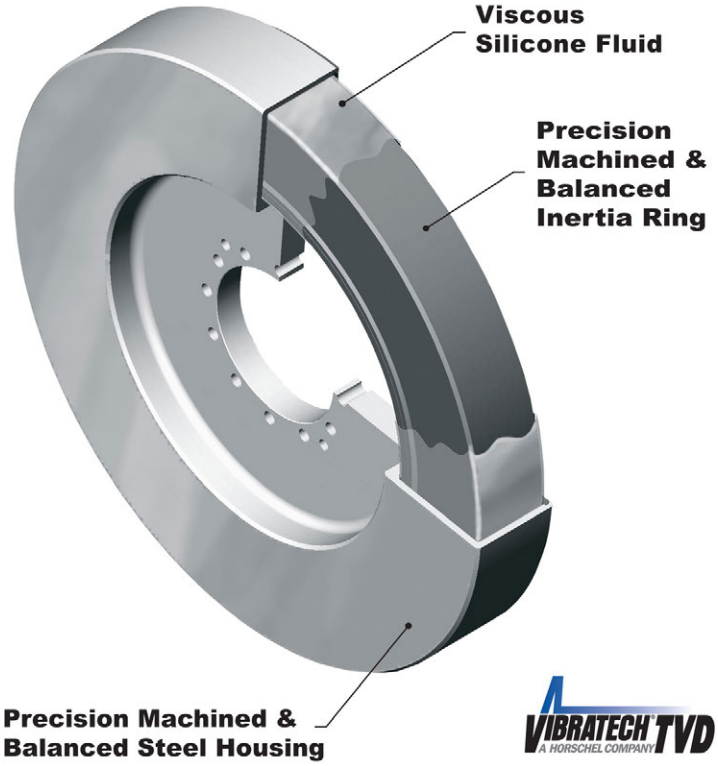
Crankshaft Vibration Dampers

The crankshaft vibration damper is a vital mechanical component that contributes to an engine's overall efficiency and durability. Heavy duty diesel and gas compression engines dominantly use a viscous type damper for superior life over common automotive elastomer types. Viscous dampers are designed to handle high cylinder mean effective pressure and the associated crankshaft torsional vibration over continuous run cycles. Torsional vibration is the end-to-end twisting of the crankshaft caused from internal combustion; which is different than axial (forward and backward) or orbital (circular) vibration.

A viscous damper is constructed of three main components; a balanced outer housing, a balanced free rotating internal inertia ring and a thin layer of specialized silicone fluid between the two. Silicone is a proven damping medium because of its wide thermal stability. When an engine is operating, crankshaft torsional vibration causes the inertia ring to move in and out of phase with rpm. This shearing motion through the silicone transforms vibration to heat, which then radiates through the outer housing.



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Not a Fluidampr. Replacement is Needed.

Viscous dampers are so widely accepted in the engines that move our economy that by the mid-1980s professional race engine builders requested Vibratech TVD to apply their technology to motorsports. The popular Fluidampr performance damper was born. What was discovered in motorsports was that the Fluidampr version will last the life of the engine. It doesn't work hard enough to wear out. Heavy duty diesel and gas compression technicians need to know this is not true for their applications due to the combination of larger displacement, longer life cycle, continuous higher torque output, and often extreme ambient temperatures.

"There are several factors that determine the rate of silicone degradation in a heavy duty viscous damper," mentions Vibratech TVD Sr. Product Engineer, Aaron Neyman. "Engine duty cycle, vibration amplitudes, operating temperatures, plus the refinement and dissolved oxygen levels of the silicone used are only a few. Each factor needs to be taken into account when determining damper life. Each application is different."

There are also variations between damper manufacturers. Vibratech TVD offers the following general recommendations based on their 70 year historical record on viscous dampers. Depending on use, most Vibratech TVD over-the-road commercial truck engine viscous dampers typically begin to wear out at 500,000 miles or 15,000 hours. At that point silicone will break down and gradually undergo polymerization. This process changes silicone viscosity and the effectiveness of the damper to control destructive torsional vibration. Eventually, the silicone can harden and minimize the

A metallic ball gradually falls through a silicone sample taken from a heavy duty diesel engine damper exceeding 15,000 hours. Dark spots show where polymerization has begun to occur. New silicone is completely clear.

movement of the internal inertia ring. Once this occurs the damper is no longer functioning properly. When the silicone completely polymerizes (hardens) the inertia ring can literally friction weld to the inside of the damper housing.

In addition to mileage and operating time guidelines, other common signs that can be attributed to a crankshaft vibration damper wearing out or not properly functioning for class 8 and stationary engines:

- Loosening or broken bolts.
- Throwing or slapping of belts.
- Broken accessory brackets.
- Accessory drive gear wear.
- Loss of torque and horsepower.
- Loss of fuel economy.
- Driver fatigue.
- Excessive bearing wear.
- Broken camshaft(s).
- Broken crankshaft.

Training technicians to look for these signs is valuable preventative maintenance. "Torsional twisting is a bad thing," remarks Bruce Mallinson, owner of Pittsburgh Power, the famously known independent service facility for over-the-road trucks. "It breaks crankshafts, camshafts, accessory drives, brackets… it will even knock the springs out of a clutch disc. So the damper needs to be changed at a half-million miles."

This 56-1/2" 7,000lb viscous damper controls torsional vibration on a 12,000hp continuous pumping engine and features a removable cover so that it can be rebuilt at scheduled service intervals. In comparison a 5-7/8", 6-1/2 lb. Fluidampr performance damper for a 2.0L Honda K series application rests on the cover.

Servicing a Heavy-Duty Viscous Damper

Replacing or servicing a worn out damper does not correct damage already done from abuse, but it will help protect your rebuild investment, contribute to overall operating efficiency and prolong engine life.

There are three main types of heavy duty viscous dampers. Most commercial applications, such as over-the-road trucks and work boats, utilize a sealed housing and are not serviceable. Hermetically sealing the housing contributes to the damper's long life span by preventing contamination and oxygen from degrading the silicone. While recommended replacement intervals vary depending on the engine manufacturer, the average is about 500,000 miles (15,000 hours) or at major engine overhauls and in-frame rebuilds.

Industrial applications, like locomotives and off-highway

A damper inspection during routine services can identify early wear and prevent unexpected engine failure.

equipment, may use the former non-serviceable type or incorporate a removable inspection plug on the sealed outer housing. Dampers with inspection plugs are designed with overbuilt internal bearings and are intended to have the silicone sampled, analyzed and replaced at pre-determined intervals. Vibratech TVD manufacturers highly technical silicone sampling equipment to be used in the field.

Large continuous operating industrial applications, such as gensets and natural gas pumping engines, may have a viscous damper or fluid-type damper with a bolt-on removable outer housing cover. These dampers are intended to be rebuilt with new bearings and silicone on regular intervals.

While scheduled intervals are good guidelines, they are best when incorporated with other inspection practices during routine maintenance checks and/or when the damper is removed. Immediate damper replacement is recommended if any of the conditions are found below:

1. Look for any visible signs of a fluid leak. Viscous damper silicone is an extremely thick (about 45,000 times thicker than 30w oil) and tacky substance.
2. Inspect for any dents in the outer housing.
3. Measure several points for overall thickness on the outer housing with a micrometer. The difference should be no greater than 0.02" (note: be sure not to measure on any stampings). Although small, this type of bulge may indicate that the damper silicone is overheating from excessive engine performance.
4. Place a surface contact temperature gauge on the damper after the engine has been operating through its normal range. A viscous damper removes vibration by transforming it to heat. Therefore the damper should read warmer than the rest of the engine bay. If a viscous damper is cold, it is not functioning.

Thomas Heinsohn, Tech Support Rep for Waukesha Pierce Industries, Inc. acknowledges that the external temperature of the damper will vary depending on a number of factors, including ambient air temp and air circulation. He provides the follow advice for stationary engine technicians to establish their own testing:

"One of the recommendation that I make to operators which wish to monitor the condition of the torsional damper on VHP Waukesha engines is monitor the operating temp of the damper from a point when a new engine or a overhauled engine is put in service. Check the damper temp with a surface contact type t/c device just after shutdown at each scheduled service to begin building a base line temp. If something changes in the driven equipment or the engine which increases or decreases the torsional vibration in the crankshaft then the damper temp will reflect that change as either more or less work and heat which must be dissipated."

"If the loading and engine operation does not change and there is a temp change in the damper

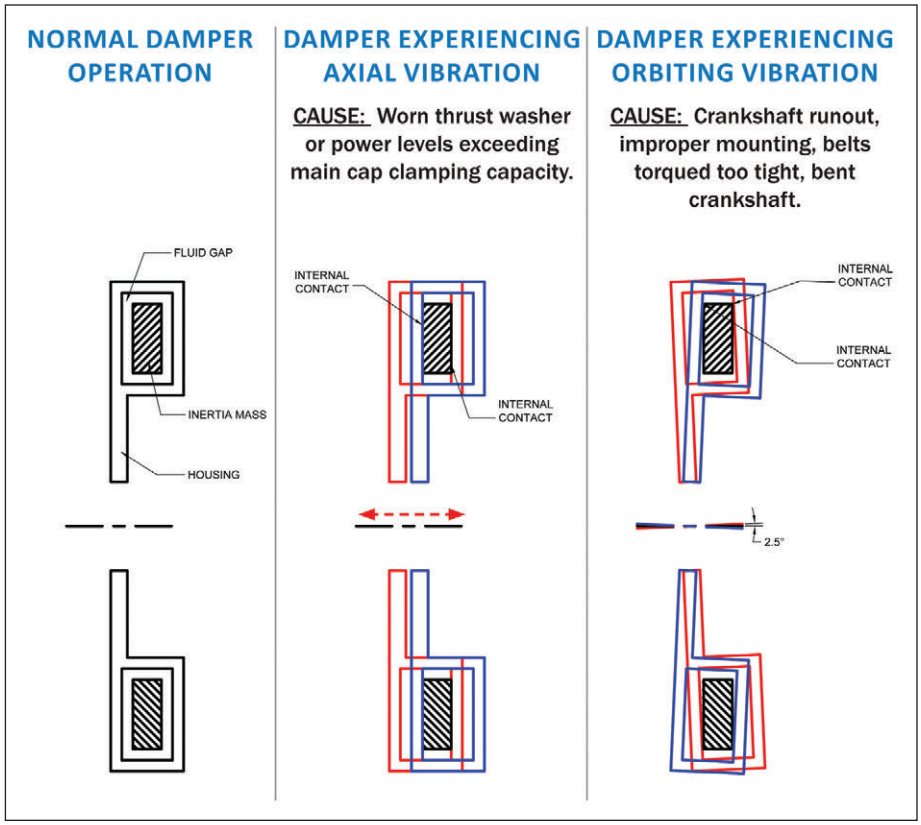
then that would be an indication that something within the damper may be changing and either creating more heat due to abnormal friction or silicone fluid changing. To the other degree, perhaps the silicone fluid is degrading and the damper is becoming less effective and therefore performing less work and thus less heat. That would be an indicator that the damper is performing less work or is less effective and there is very likely increased torsional vibration in the crankshaft."

Handling and Installing a Viscous Damper

A viscous damper needs to be handled carefully. There is only a small gap between the outer housing and internal free rotating inertia ring. In some applications this gap may only be 0.020" or about the thickness of five sheets of copy paper. If a dent in the housing locks the ring, the damper will not function. General guidelines include:

- Never lift an engine by the damper.
- Never use a chain wrench on the damper to rotate the engine.
- Never install or remove a damper with a hammer.
- Do not drop. The weight of the damper itself will dent the housing.
- If painting, do not paint the mounting surface.

When installing a viscous damper be sure to follow the recommended mounting bolt and drive belt torque specifications set by the OEM. Heavy duty viscous dampers are zero balanced and designed to operate with very minimal runout or axial movement from the engine. Modern advances in non-metallic bearing materials inside the damper have greatly increased its ability to compensate for such movement, however consideration should still be given when assembling the overall configuration. This is especially true with older engines not intended to operate at today's production demands. Power levels exceeding main cap clamping capacity and/or a worn thrust washer can induce axial vibration of the damper. This will accelerate bearing and silicone wear inside the damper. Crankshaft runout, improper mounting, belts torqued too tight and/or a bent crankshaft can induce orbiting vibration of the damper. This will also accelerate damper wear and reduce expected life.



Inventory Check

The goal in commercial and industrial applications is to reduce downtime. For engine builders it is equally important to reduce warranty claims and build a reputation of exceptional trust and quality. It is highly recommended to create a routine damper inspection and maintenance program based on your business to achieve this. Vibratech TVD can help establish such a program through their extensive historical database and sophisticated computer modeling.

The next step is to ensure you have an adequate supply of crankshaft dampers in inventory. As in the scenario at the beginning, installing a worn damper on a fresh rebuild can negate the entire investment in short order. Engine rebuild kits do not come with a damper and it is a component you'll want to include during the same time allotment as will take advantage of minimal additional shop labor. The odometer / hour reading is proof of wear and provides the opportunity for your service writer or technician to make the recommendation.

Quality matters. The machining tolerances, bearing material and silicone grade of a viscous damper are all very critical to performance. "Vibratech TVD has been manufacturing torsional viscous dampers across a wide variety of industries and applications for 70 years," concludes Livermore. "As diesel and gas compression engines, plus drivelines, continue to advance so have the Vibratech TVD dampers needed to protect them from destructive crankshaft torsional vibration."

Seemingly simple and often overlooked, the crankshaft vibration damper found on heavy duty diesel and gas compression engines are truly an essential precision made engine component. Having a basic knowledge of them and installing a quality brand can save you and your customers exponentially more over the long term.■

VIBRATECH® TVD
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Headquartered in Springville, New York, Vibratech TVD is a leader in torsional viscous damper design and development for the engines that power our global economy. For more information, please contact Brian LeBarron at (716) 592-1000 or go to, www.vibratechtvd.com.