Harmonic Dampers And Balancers Tackle Racing's Toughest Challenges

NO matter how strong or well balanced, a crankshaft will vibrate in torsion because of the forces on it. That's why a crank balancer or damper is desirable. We spoke to the manufacturers of several of these devices, which can be based on elastomeric, viscous, or purely mechanical-inertial principles. Each offers specific advantages in countering particular challenges.

"Higher combustion pressures increase the amplitude of crankshaft deflection," noted Kevin Winstead of TCI Automotive, Ashland, Mississippi. "In a 90-degree, evenly fired V8, the predominant orders of vibration are 2.5 order and 4th order. Our Rattler balancers are designed to attack those two orders. Elastomer-type dampers can't target specific orders, but our mechanical design can. Without elastomeric parts to deteriorate, the Rattler doesn't need a rebuild every few years. And its timing marks are etched into the body, so they can't move relative to the hub."

The Rattler's design relies on steel rollers ("centrifugal pendulums," Winstead called them) that roll forward during the compression stroke and backward on the power stroke, storing and releasing energy back into the crankshaft rather than converting it to heat. "Most of our newer designs feature an integrated pulley, for easier packaging in tight engine compartments," he added.

"High rpm contributes to vibration frequency," said Brian LeBarron of Fluidampr, Springville, New York, "and high-frequency vibrations, even if they are beyond the range of a crankshaft's resonance-failure frequency, are still damaging to the bearings, oil pump gears and timing components. So a quality damper needs to protect against multiple orders of vibration throughout the entire rpm range. Additionally, we use Finite Element Analysis (FEA) to determine our dampers' structural integrity throughout the rpm range. Our materials, precision CNC manufacturing, and computer balancing processes often provide three or four times the safety factor required by SFI."

Fluidampr recently released new dampers for the Scion FRS/Subaru BRZ, Mitsubishi Evo X, and Volkswagen TSI, all of which are popular in road racing; while sales of Fluidampr dampers for GM LS engines continue to grow.

He also reminded us that Fluidampr balancers operate on the principle of viscous damping; they "contain an inertia ring that shears through a very thin layer of heavy fluid," converting potentially damaging vibrations to heat. "Viscous dampers are used in high-end supercars from Lamborghini, McLaren, Ferrari and Audi; and on the 6.7-liter Cummins diesel in Ram trucks. Race-proven for 25 years, Fluidampr balancers will last the life of the engine, and remain compatible with any new harmonic frequencies that result from engine upgrades."

A high-quality harmonic damper must protect against multiple orders of vibration throughout the entire rpm range, noted one of our sources, who reinforced the point that "high-frequency vibrations, even if they are beyond the range of a crankshaft's resonance-failure frequency, are still damaging to the bearings, oil pump gears and timing components."

"The quest for more power, resulting in higher rpm, etc., increases the demand on all components, including harmonic balancers," said Don Weber of Engine Pro, Wheat Ridge, Colorado. "For that reason, our SFI Race Series balancers are designed for strength, with a precision CNC-machined, AUSI 1045 forged steel hub bonded to a forged steel inertia ring. Our steel hubs are stronger and more wear-resistant than aluminum, which is especially important in the oil seal and crankshaft nose areas; yet our dampers are lighter in weight than most steel units. Timing marks are computer-etched.

"Our Engine Pro Street Performance Series are designed for both street performance and race classes such as late model stock," Weber continued, "where an OE-style balancer is required. As with our Race Series, the balance ring is rubber-bonded to the hub in a long-cure process in which a 220-ton bonding cycle follows a five-stage preparation, to eliminate the possibility of component separation up to 6500 rpm. The balance ring and hub are high-strength SG nodular iron."