Engine happiness is in the balance

Phil Downs of Vibration Free measures a Ford Zetec crankshaft from a racing Caterham, the first part of the balancing process.

To describe Steve Smith as a balancing expert is to miss the point: his passion is making engines sing. Vibration saps power and breaks engines and reducing it is what he and assistant Phil Downs do best.

Though they’ll balance anything from a satellite to a drive shaft, cars form about 80% of their work. Customers range from historic racers to Le Mans teams, but the firm handles more than engines.

The Derby Bentley on the ramps came in with a vibrating overdrive unit. “We’ve isolated its frame from the chassis and the overdrive from the frame, plus balanced the o/d unit and its propshafts. We also do a lot of Vintage brake drums. They can be way out and make the front axle tramp. When the wheels and drums are in balance you can unwind the front dampers so the ride isn’t so hard.”

Smith’s obsession with vibration and balancing started when he worked for IRD Mechanalysis – involving everything from 300 tonne power station turbine rotors to space hardware. He still uses IRD balancers in his workshop: when he started up in 2000, he bought some of the machines he’d been selling and developed them. He was involved in balancing the Le Mans Jaguar V12 engines and recently helped Bentley with its Arnage V8.

The workshop is well-equipped with general machine tools – a gang of pillar drills, lathe and Bridgeport milling machine – and can handle rotors of up to 3000kg, and shafts of up to 15ft long. Two car ramps make it easy vehicle analysis a dodgle. But Smith’s pride and joy is the dynamic balancing table he developed, especially useful for “type 2” cranks (usually V engines) that are harder to balance. On this, an entire short engine, minus piston rings to cut down friction, can be spun up to detect uneven forces: the bed floats on bearings, and any movement is recorded by electronic sensors. “To ensure accuracy, first the pistons and conrods must be balanced. Then the weight of the rings is measured and added back to each piston in the form of washers super-glued to the crowns. When the engine is spun up, the amount of movement and where it happens in the unit’s rotation is the clue to where to remove weight. Here’s where it gets more low-tech, because unwanted metal is usually removed from the crank webs using a grinder. Forces remain linear after 240rpm, so a bottom end that’s in balance spinning relatively slowly on the dynamic table will still be good at 10,000rpm.

The other advantage of the table becomes apparent with classics: “Older cranks tend to be more whippy, so supporting them in all their bearings helps to reduce that. Also, we could never support some of the original heavy flywheels on a normal balancer.” The result is that long-stroke Vintage engines can potentially rev safely to 6000rpm.

The company can add mass to counterweights if necessary, by inserting tungsten rods which are twice as dense as steel: “Counterweights are critical to balance. There can be a ton of force acting on each crank pin at high revs.”

Then there’s the Rattler. Unlike a normal crankshaft vibration damper, which has dual masses of steel separated by an elastomer, the Rattler uses mechanical internals that give the crank a whack in the opposite direction to torsional forces to balance out vibration. Steve claims it eliminates torsional vibrations: “People tend to lighten everything, which doesn’t matter for race engines which are regularly stripped down, but in others the crank will eventually break with fatigue. Old cars needn’t vibrate.”

Paul Hardiman

Any excess metal is simply ground off

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Specialism Dynamic balancing
Prices four-cylinder crank-set balance £193.88, V8 short-block balance £352.50

STEVE SMITH
Proprietor

What’s your philosophy? Vibration is unnecessary. Getting rid of it by understanding dynamic movement is what I enjoy.

Do you still get time to race? Not much, but I’ve booked in the Mustang and Alpine for Spa.

What’s the weirdest thing you’ve balanced on a car? Brake drums. They can be way out on Vintage cars, as much as 140g, and they make a big difference.

What’s your turnaround time? All being well, about a week.

What’s your latest project? It’s a 1956 15ft aluminium-hulled ski boat that’s now powered by an Alfa Romeo V6. It does 50mph at half throttle.

Any excess metal is simply ground off

Smith’s Mustang V8 on dynamic table