

# THE EXTRA MILE

Engine Building and Power Techniques

BY SCOTT SEHR



Absolutely. The Most Motor For Your Money! *Guaranteed*

## THE BALANCING ACT

Engine balancing is one of those engine machining processes that is often overlooked. It can increase horsepower, rpm, fuel mileage and engine life. Balance can be described as a shaft spinning in equilibrium. In an automotive engine there are several forces affecting the balance; reciprocating motion of the connection rods and pistons, flywheel and harmonic balancer. The centrifugal forces of the imbalance will cause the engine to shake unless the weight is removed from the heavier areas.

To give an example of the effect of an imbalance, if the out of balance amount is only one ounce and is 3-1/2" from the centerline of the crankshaft (about the same as a counterweight on most crankshafts) at 500 rpm that imbalance has the effect of 7 ounces. At 5,000 rpm that same one ounce has now ballooned to 44 pounds. If we move that same one ounce out to 5-1/2" from centerline, to the edge of a flywheel or flex plate and it has swelled to over 100 pounds.

These kinds of dynamic forces are in no small part responsible for reducing oil film thickness and destroying main bearings. Besides the potential for damage to the engine, these same forces rob engine power because it has the same affect as riding a brake. Dragging that imbalance around the crankshaft at operating rpm creates a lot of heat and wear and produces no work.

Balancing process begins with documenting and equalizing the weights of the pistons; the big and small end weights of the connecting rods. Equalizing is done by bringing all components down to the weight of the lightest component. This is done by removing weight in a safe area, so as not to compromise the strength of the part. After the weights are equalized, if the engine is a V-8 or a V-6 configuration, a bob weight is assembled using

the equalized weights of the rods, pistons, piston pins, rings, locks, and rod bearings. The crankshaft with the bob weights attached is spun at 500 rpm and the machine records the imbalance in degrees of rotation and the amount of weight that needs to be removed or added to achieve balance. Depending on the application and the engine configuration, power and throttle response can be increased by a procedure called over balancing or under balancing in which the counterweights are slightly heavier or lighter in relation to the bob weights. Some engines are externally balanced which means that the crankshaft needs the offset weight built into the flywheel and harmonic balancer.

The typical allowance for imbalance from the factory is the one ounce we started with. Here at Sehr Performance we feel that 1-1/2 grams gets you balanced. One gram is about the volume of one normal sized paper clip. There are 28.33495 grams in an ounce. It's another one of the little things that we do that add up to a big difference in the quality of your engine and that allows you to go 'The Extra Mile'.



Bob weights attached



Dynamic balancing