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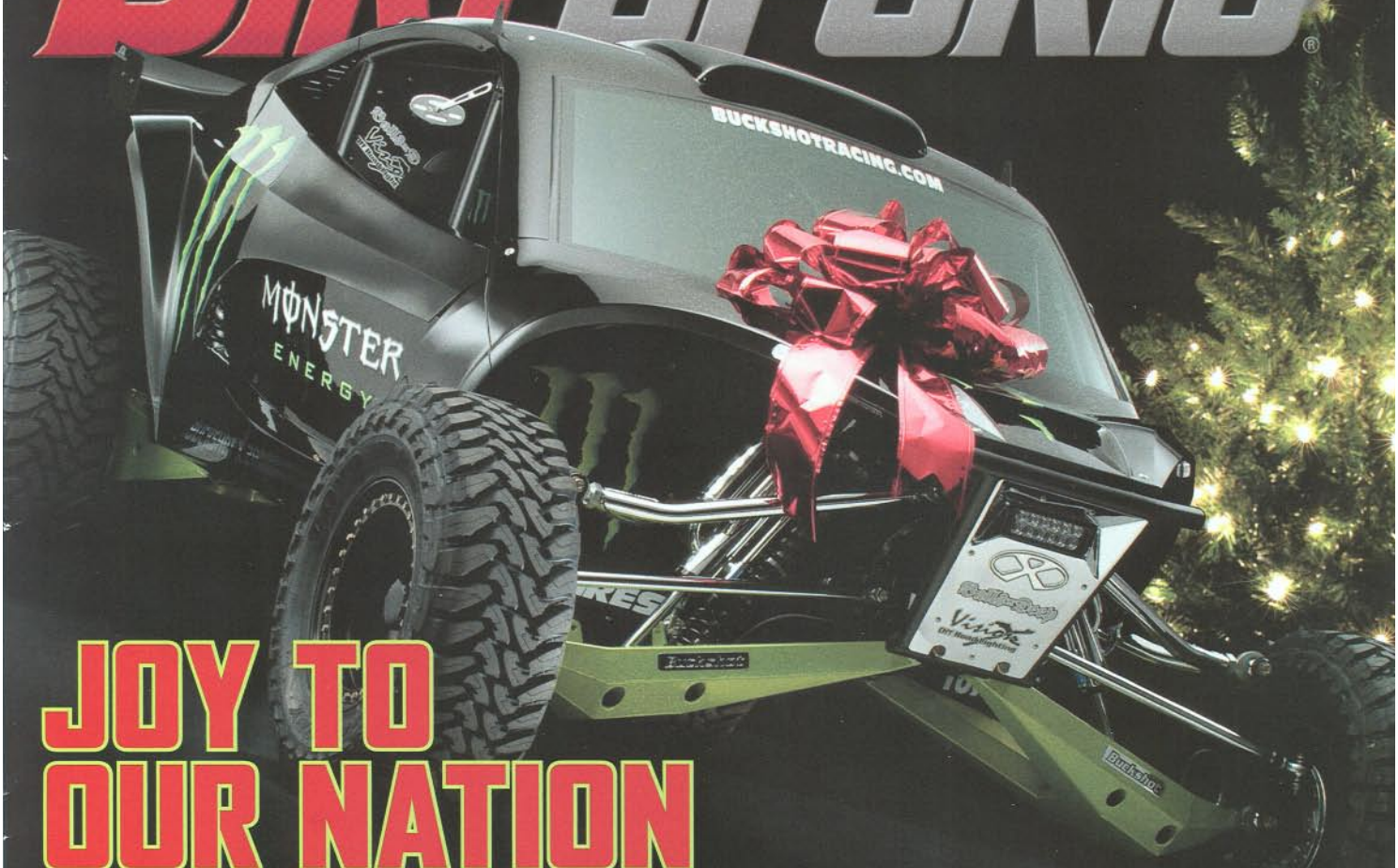
DIRT SPORTS 5 YEARS

THE VOICE OF OFF-ROAD MOTORSPORTS

DIRTSPORTS



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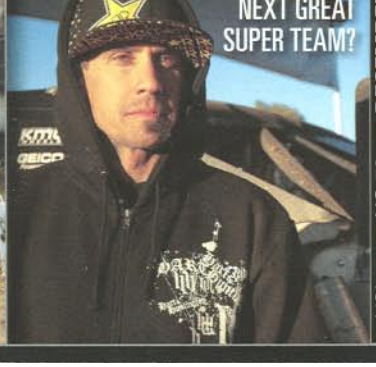


VOL.5 NO.58 DECEMBER2009

WORDS & IMAGES CRAIG PERRONNE

FINDING A BALANCE

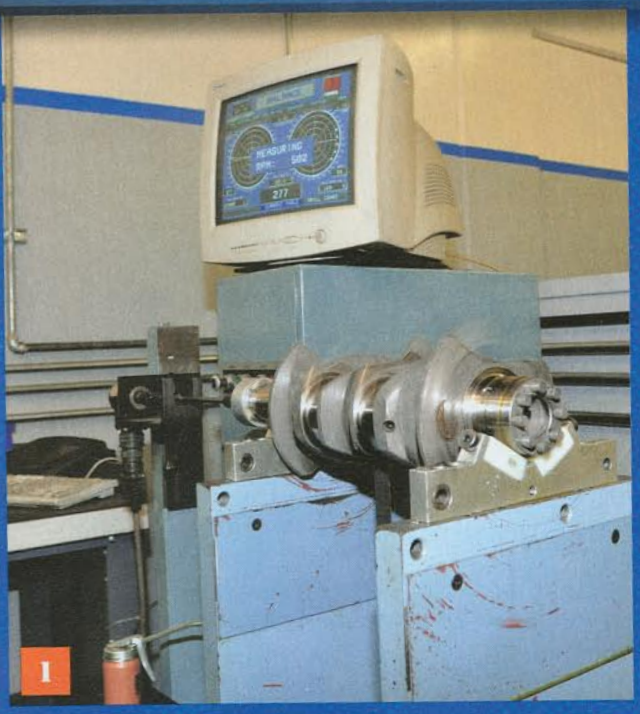
THE ART AND SCIENCE OF ENGINE BALANCING

Without a doubt, engines used in motorsports have extremely harsh lives and off-road racing offers one of most brutal environments in which to operate. Constantly shifting rpm, heavy loads, hours of hard use and lots of dirt increase potential for engine failure. That is why any competent motor builder stacks the deck in their favor by using every trick in the book to make a power plant last.

One of these "tricks" is balancing the rotating assembly of an engine. While this won't increase horsepower, balancing adds longevity and reliability. Most critical components which rotate at high speed (such as tires and wheels) need balancing to keep vibrations down while providing proper rotation. The crank, connecting rods and pistons are no exception. It might seem like a trivial process, but balancing greatly improves bearing life as it drastically reduces side loads. That is why every engine that goes into a race vehicle is, for the most part, balanced.

When assembling our well-documented VW stroker for the revitalized Project Elf, we wanted our 2,000cc mill to have every advantage available to it. Before heading out to Wik's Racing Engines, we took our EMPI parts to long-time balancing gurus Automotive Balancing Services (ABS). Trusted by Gale Banks, Carroll Shelby, Ed Iskenderian, Don "The Snake" Prudhomme and many others, ABS has an impressive list of clientele and enjoys a solid reputation. In business for over fifty years, ABS was recently acquired by Gale Banks Engineering and operates out of the same facility as the diesel specialists but with all the specialized machinery from ABS' previous shop.

With our rotating assembly in hand, the ABS team quickly went to work in a process that is a unique combination of science, skill and art. Of course, the proper machinery and experienced technicians are also a mandatory part of that process. Follow along as the professionals at ABS show what goes into properly balancing an engine. DS

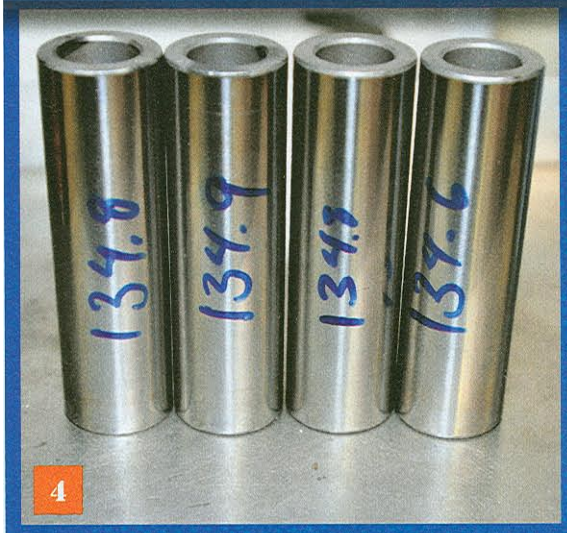


LEFT: The first step is to put the crankshaft on the Hines balancing machine, where it is set into a jig and then rotated at about 500 rpm. The computer splits the crank into two planes (front and rear) and, while the crank is spinning, it tells where to add or remove weight for a precision balance. Since Volkswagen cranks are opposing, they usually do not need much balancing; ours needed 10.8 grams off the front and 3.66 grams off the back. The computer also indicates from where weight should be removed.

RIGHT: Next, weight from the crank is removed starting with the front. Once some material is removed, ABS technician Mike Keegan puts the crankshaft back onto the balancing machine where is rotated again to see how much weigh still needs to come off. The idea is to creep up on the target weight to avoid removing too much. It is a very slow process, as Keegan notes you need to get within a half a gram. The trick is knowing where to remove weight so you don't chase the balance around the crank. There is little room for error, so experience matters.

LEFT: On bigger cranks (such as this V-8 unit) it is often necessary to add weight. ABS does this through a variety of different processes depending on how much weight required. This crank was drilled using ABS' massive drill press and then tungsten cylinders were pressed in for a precision balance.

TECH IMAGERY CRAIG PERRONNE



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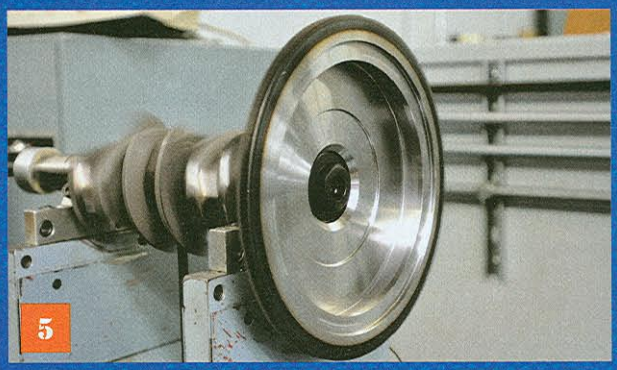
LEFT: One at a time, the wrist pins and pistons are carefully weighed on a very accurate scale; they need to be within one gram of each other to achieve a proper balance. Wrist pins that weigh slightly more or less can be matched to pistons that vary in weight as well to balance the whole set. If the weight is too much out of sync, parts can also be grinded to remove material. Keegan notes that with the improvements made in modern manufacturing processes, most of these parts need little work nowadays.

RIGHT: The flywheel must also be balanced. It is attached to the crankshaft and spun at the same RPM. The parameters for the balancing machine's computer are changed to read only in one plane to help properly balance the flywheel.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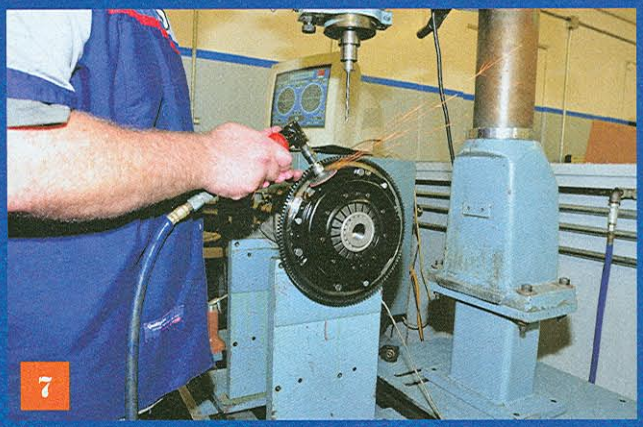
LEFT: To remove mass from the flywheel and balance it, a small hole is carefully drilled in the spot indicated by the computer where the flywheel is heavy. Just like the crankshaft, the idea is to slowly remove weight. After careful drilling, the flywheel is spun again and more drilling occurs if needed.

RIGHT: The clutch is also balanced and is attached to the flywheel and spun along with the rest of the crankshaft. To achieve balance, a small amount of material is removed from the clutch with a die grinder in the spot indicated by the computer.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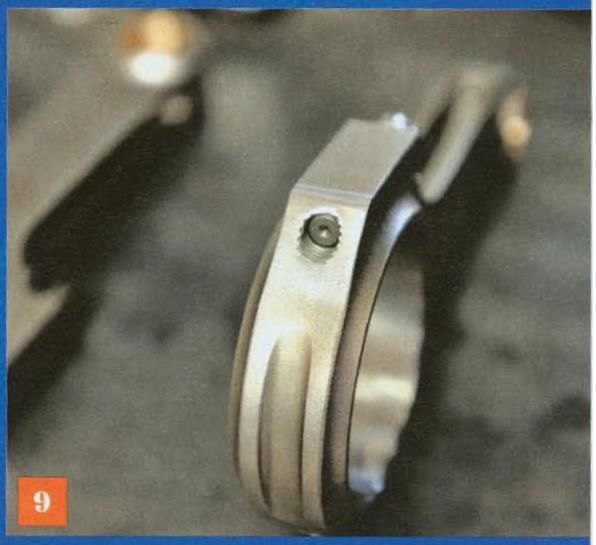
ABOVE: The connecting rods must be carefully weighed to within one gram of each other.

RIGHT: Balancing the entire rotating assembly is a very precise process. Plenty of skill and experience comes into play knowing exactly how much material needs to removed. On this rod, only a very small amount was shaved away (visible as the small shiny spot by the connecting rod bolt) to achieve balance. Go too far by removing too much material and the part can become worthless.



LEFT: For bigger, non-opposing cranks, ABS has these billet weight holders that attach directly to the crank while it is spun. Weight can be added or subtracted to match the exact weight of the connecting rods and pistons. This helps in the balancing process as it mimics the effect of the connecting rods and piston on the crank during rotation. While the whole process is tedious and exacting, the results are worth it. DS

SOURCES

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