



FLAT STICK

Tool steel flat-tappet camshafts are making a difference

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Despite the popularity of the roller tappet both in a mechanical as well as hydraulic setting, typical flat-tappets, also known as lifters or followers, are still as popular as ever. While a roller tappet utilises a roller to roll along the camshaft's lobe profile, a flat-tappet simply rides directly on the lobe. To minimise wear, the base of the flat-tappet is ground on a convex shape and the cam lobe is tapered. The combination of the convex shape - which is almost indiscernible to the naked eye - and the tapered cam lobe forces the flat-tappet to rotate in the tappet bore of the engine.

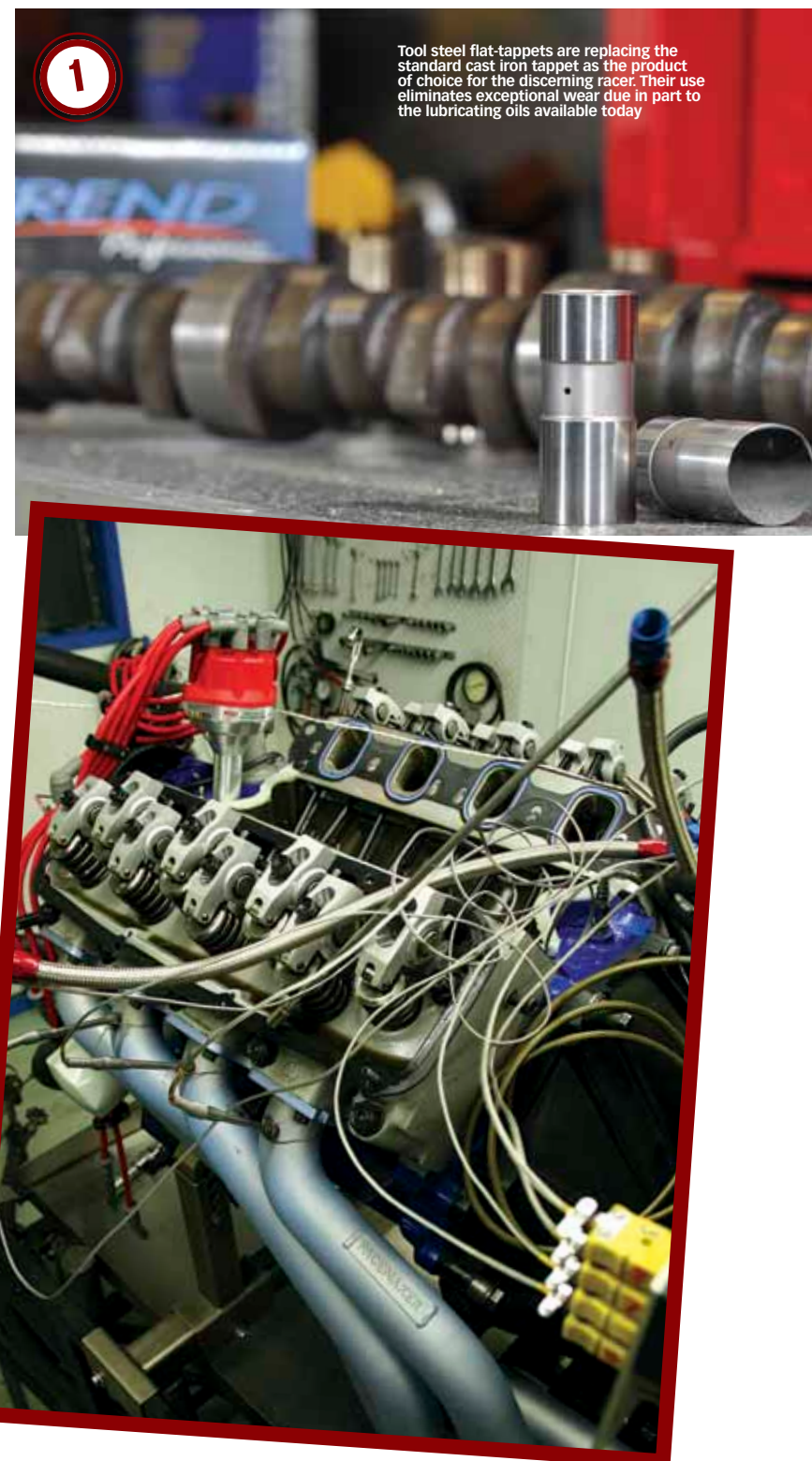
When all of this is operating properly, tappet and/or cam wear is held to a minimum. However, in recent years, cast-iron tappets and cam wear reached new heights. Engine builder Brian Tilburg of Tilburg's Racing Engines explains, "It's almost like playing Russian Roulette. You just never know when a cast-iron lifter is going to break and eat the cam." But using a proven grade of break-in oil and Trend's new tool steel lifters on a cast-iron camshaft seems to cure the problem. Trend Performance tells us their new tool steel lifters can last four to five times longer than the old cast-iron style and in addition, they can be re-ground if necessary.

Several years ago flat-tappet manufacturers were being criticised royally by engine builders and racers for trafficking products of poor quality as lifters were failing left and right. However, it's highly likely the blame should have been attributed to the lubricating oil, as without the proper lubrication between the two mating surfaces of the tappet and cam, both during initial break-in as well as continued operation, damage can occur.

The term break-in means the mating of two surfaces, making them smooth via a work-hardening process, in this case a cast-iron cam lobe with a cast-

iron or tool steel tappet. The process requires not only the use of special oil but also light break-in valve springs and consumes 20-30 minutes, plus the time to replace the springs.

When wide-band oxygen sensors and catalytic converters became commonplace, it was soon discovered that the zinc and phosphorous elements in engine oils damaged them. The answer for auto makers was to acquire lubricating oils that eliminated those elements. They also expanded their use of the more expensive roller tappets in production engines. Consequently the oil was duly modified, and continues to be, with the result that it has lost



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Tool steel flat-tappets are replacing the standard cast iron tappet as the product of choice for the discerning racer. Their use eliminates exceptional wear due in part to the lubricating oils available today.



here where Trend Performance utilised their engineering expertise.

Early last decade, in a moment of revelation, engines used on the NASCAR Cup circuit progressed from 5160 alloy steel cams with stellite-coated lobes to tool steel cams that operate in conjunction with DLC-coated tool steel flat-tappets. The combination excelled immediately, and it was inevitable uncoated variants of these tough, hard-wearing tappets would emerge for use on cast-iron camshafts.

"For years," said Bob Fox, head of Trend Performance, "we had supplied one-piece pushrods and, some time later, tool steel piston pins to the NASCAR teams. Then about four or five years ago, about the same time as the oil companies changed the constituents of their lubricants, we were invited to enter the tool steel solid flat-tappet market. Because the materials and processes used in the production of solid flat-tappets are so similar to those used in the manufacture of the piston pins, the decision was easy. For our first year or so, we requested an open exchange of information from a couple of Cup teams, which proved to be a big advantage."

Derived directly from Cup racing, these new uncoated versions

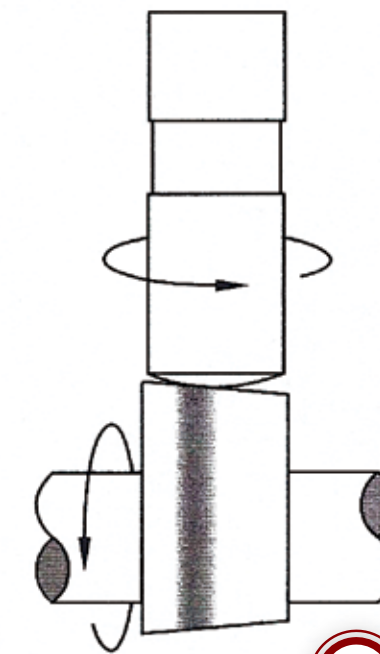
benefit from their NASCAR heritage. Obviously they are hard (63-64RC) and tough, but are also light (about 68grams) with an unsurpassed super fine surface finish (1-2Ra) on the contact base. But it is the economies of scale that have made them accessible to all types of racing.

"Trend is already engaged in large volume production tool steel solid flat tappets for NASCAR teams," said Bob Fox, "and we have all the processes in place to make this happen for the weekend racer too."

One real benefit to the new tappets is their ability to be reused over and over again. In most cases during break-in, a set of cast tappets will mate to a cast cam. Those tappets must remain mated to a particular cam lobe. These new tool steel tappets can be mated to any number of different cast cams as well as returned to the factory to be re-ground. All of which makes them more of an investment that can last indefinitely.

Cumming, Georgia engine builder Johnny Thomas often poses the question, "Have you ever noticed how some racers never have the money to do it right, but can always find the money to do it twice?"

Here are tool steel tappets that allow the racer to do it right the first time.



Camshaft law requires the crown of the flat-tappet to run properly on a wide contact pattern, while the crown of the tappet base and the taper of the cam lobe forces the tappet to rotate in its bore to minimise wear

Without the proper rotation of the tappet in its bore, damage can occur similar to the tappet on the right



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Though barely discernible to the eye, tool steel solid flat tappets, like their cast iron counterparts, have a crown on their contact area approximately 0.0015in high with a radius of 50in to 60in



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6 The use of high quality break-in oils is essential with flat-tappets. This oil contains enough of the required components, especially zinc and phosphorous elements, to eliminate excessive wear during the critical break-in period of an engine

As opposed to a flat-tappet, a roller tappet (also known as a lifter or follower), utilises a roller to ride against the cam lobe. Due to the roller's design, tappets are held together by a tie bar to keep them straight in their bores. In contrast, flat-tappets must spin to ensure even wear

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much of its lubricity and resistance to compression forces. To restore the racing engine to full health, new break-in oils were introduced. These are sturdy lubricants enriched by re-instating the very ingredients confiscated earlier.

"People think the zinc and phosphorous elements were removed from the lubricating oils, but they weren't," says oiling expert Kelly Tidwell of Pure Power, "they were, however, reduced." These reductions caused troubles, especially during the break-in process, and as a consequence the use of high quality break-in oil designed for cast-iron cams running with flat-tappets is essential.

While it is understood that the roller tappet can replace some flat-tappet combinations, there are still classes that require the flat-tappet to be used. And in general, flat-tappets outsell roller tappets by four to one primarily because of cost. Because of this, the demand for a better flat-tappet became paramount. In the majority of competition engines, cast-iron camshafts operate in conjunction with cast-iron solid flat-tappets. Typically the cam and tappets can last quite a while, but without the proper care, damage will soon result.

The first essential for achieving a better flat-tappet is to create one that outlives every other tappet, and it was

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