



# Guiding the Way

Single-blade tool supported by guide pads overcomes the difficulties of cam boring.

**M**achining cam bores in automotive cylinder heads is not for the faint of heart. The tight tolerances on diameter, roundness and straightness, the requirement for visually perfect, mirror-like surfaces, and the long length and relatively small diameter of the interrupted bore are all factors that make cam boring an extremely demanding operation.

The design of these boring tools and the precision with which they are manufactured are the critical elements for their successful application.

## Stable by Design

Tools that feature a single, replaceable blade, usually made of carbide and sometimes tipped with PCD, provide enhanced performance when boring aluminum cylinder heads. The blade is rigidly supported in the bore by multiple guide pads. This design allows the tool to achieve an accurate bore size with a fine surface finish and superior hole geometry.

Because conventional multifluted reamers are guided by their cutting edges, they generate a slightly irregular hole geometry when finishing cam bores. The single-blade, pad-guided design separates the cutting and guiding functions of the tool so that each function can be optimized. Because the cutting blade is independent of the tool body, it can be microadjusted over a limited range and preset to a specific cut diameter, which the tool achieves

with consistent accuracy. Pads that are independent of the blade guide and support the tool in the bore. This balances cutting forces with the pad-support reaction force for enhanced tool performance.

Single-blade, pad-guided tools share numerous special features:

- They are long in relation to their

diameter and are typically made from heavy metal for greater strength and rigidity.

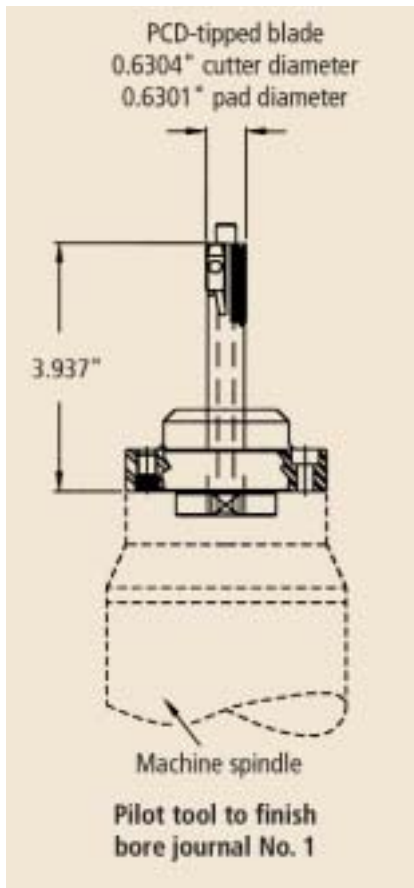
- The multiple guide pads have extended lengths for enhanced stability and alignment.

- Special internal coolant porting provides adequate coolant flow to the



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Hole-finishing tools with a single, replaceable blade supported by multiple guide pads are effective for demanding cam-boring operations.



For some cam-boring applications, a short tool machines the first journal, producing a qualified pilot hole for the longer tool that follows.

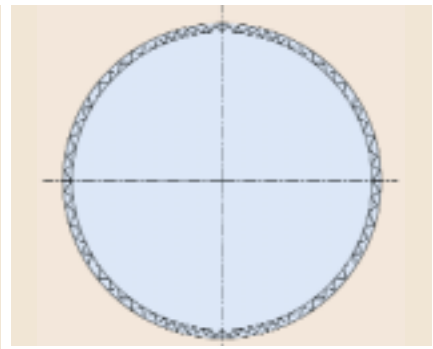
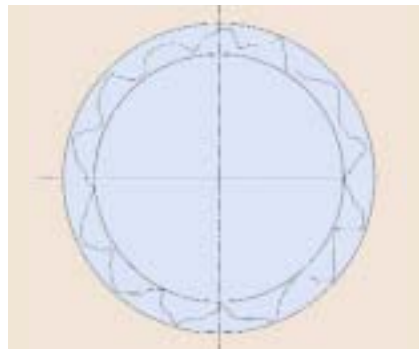
cutting edge and guide pads.

■ An optional PCD-tipped blade achieves long tool life in cutting cylinder heads made of cast aluminum.

### In Application

There are several ways to approach a cam-boring operation. Cam-boring tools can be run on a transfer line or on a machining center. When running on a transfer line, the tools are installed in a specialized machining station.

Cam boring is usually accomplished with the use of a special spindle unit, commonly known as a “squirt-out” spindle. It incorporates an outboard ro-



A typical lobed-hole geometry generated by a conventional multifluted reamer (left), compared to the hole geometry without lobes and only surface finish irregularities produced by a single-blade, pad-guided tool.

tating bushing, which provides critical support and alignment as the tool enters the first journal. As successive journals are machined, the guide pads offer support in the previously machined journals and in the bushing.

One automotive manufacturer applies semifinishing and finishing single-blade, pad-guided tools to machine cam bores. Running on a transfer line, the cutting tools achieve a consistently accurate size of 27.0mm, within the close tolerance range of  $\pm 12.5\mu\text{m}$  ( $\pm 0.0005$ ”). And the surface finish of 8 to 10  $R_a$  is much better than the required finish of 30  $R_a$ .

The PCD-tipped tools are applied at a feed rate of 0.005 ipr and a spindle speed of 4,000 rpm to machine the camshaft bores in the aluminum cylinder heads. The concentration of the semisynthetic coolant is 10 percent. The PCD blade produces 100,000 parts before needing to be replaced.

In some transfer line applications, the rotating bushing is not used. A short tool is used to machine the first journal. It then serves as the bushing for the longer tool to machine successive journals.

This was the scenario for another automotive manufacturer that was also machining camshaft bores in aluminum cylinder heads. Its tools were also run at a 0.005-ipr feed and a spindle speed of

4,000 rpm. The concentration of semi-synthetic coolant was 10 percent. A 10  $R_a$  finish was imparted to the 0.6299” bore. Tolerance was  $\pm 0.0007$ ”.

Running cam-boring tools on machining centers is becoming more common. A two-tool combination, similar to the tool design described in the second application, is used. A short tool machines the first journal, producing a qualified pilot hole for the longer tool that follows. Guide pads provide support for the longer tool as each successive journal is machined, with each machined journal functioning as a bushing while the next journal is machined.

In many of these applications, semifinishing and finishing are accomplished with the same tool, which machines both cuts sequentially in a single pass.

When it comes to tackling the demands of machining cam bores in automotive cylinder heads, tools with a single, replaceable blade supported by guide pads offer an effective solution.

### About the Author

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