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# Boring Tools Get... Interesting

**Productivity increases through advancements in boring tool designs.**

Boring tools are often regarded as the best method for producing accurate holes in parts of every size and configuration. A steady stream of productivity increases have come about through advancements in the design of boring tools.

Four newer developments include:

- digital readout displays in precision boring heads;
- aluminum construction;
- combination boring tools; and
- self-balancing tools.

## Digital Readout Displays

CNC and coordinate measuring machines that utilize digital displays have been around since the beginning of NC technology. And, micrometers and vernier calipers with electronic digital displays are commonplace.

Adapting electronic display technology to precision boring has been slower because of the coolant and the high rotational speeds used when boring. Coolant has a way of getting into any tool used on a machining center, so extreme care must be taken to prevent it from entering any electronic device.

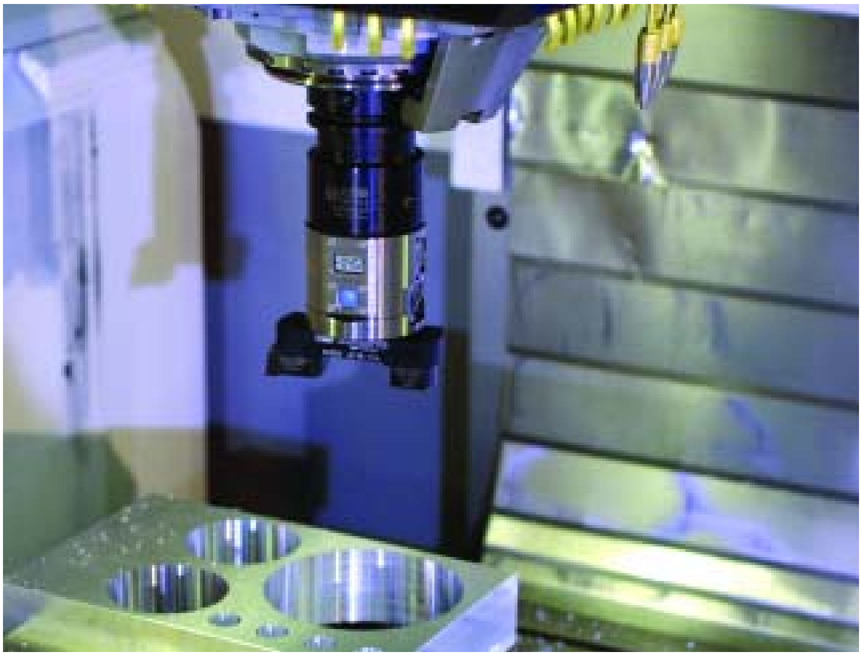
With newer designs, through-coolant tools are possible. The coolant is directed through internal passages that are completely isolated from the digital display. The exterior of the tool is also sealed to keep coolant from contacting the electronics.

High rotational speeds, centrifugal loads and any inherent unbalance can cause vibration severe enough to damage sensitive digital displays. High rotational speeds are achievable by using an internal balancing feature that reduces or eliminates this potentially harmful vibration. Precision boring heads are available with digital displays that can handle speeds up to 16,000 rpm.

The digital display of the boring head shows the movement of the boring tool slide, rather than the rotation of a lead screw. Because the boring bar is mounted in the tool slide, the digital readings are a true measurement of tool movement. The digital display gives a true backlash-free reading. This feature enables quicker and more accurate diameter changes and allows for deflection or tool wear compensation.

Most boring tool settings are determined with the cut-and-measure process. This involves boring a small portion of the hole being produced, then gaging it. Frequently, this means the boring tool is removed from the machine and put on a tool presetter in order to make the small corrections necessary to obtain the proper hole size. The process is required because the vernier dials commonly seen on boring heads can be difficult to read and set on the machine. However, the process introduces the possibility of boring oversize holes and scrapping the part.

Because of unpredictable tool-point deflection in the machine setup, the cut-and-measure process is required.



*All images: Wohlhaupter*

**A boring tool machines aluminum.**

However, with an easy-to-read digital display, small diameter changes are possible right on the machine. Diameter changes of 0.0001" can be made with the tool in the machine spindle. If the tool must be removed from the machine to change diameter settings because of spindle access restrictions, the digital display makes this a quick and precise task.

### Aluminum Construction

Aluminum's relatively light weight makes it a common material for tool bodies. Weight reduction is critical with today's higher-speed, and sometimes lighter, CNC machines.

Most of these machines' toolchangers have weight limits. By using aluminum construction, boring tools can be produced that stay under these weight limits while still being able to bore holes from 4" in diameter on up. (Generally, tools smaller than 4" in diameter, whether made of aluminum or steel, meet toolchanger weight limits.) The reduced weight lessens spindle deflection, which results in more accurate bores. There is also less wear and tear on the machine spindle itself.

There is a considerable productivity gain if the need for loading large, heavy boring tools into the machine by hand or with the aid of an overhead crane is eliminated. For example, one shop in Kansas replaced a 14"-dia. steel boring tool that weighed approximately 40 lbs. with an aluminum tool that weighed less than 25 lbs. The customer went from manual loading with a jib crane to using his automatic toolchanger.

Aluminum construction is also beneficial because of tool-balance issues at high speeds. Because asymmetric mass is less with aluminum than with conventional steel construction when using the same manufacturing process, balancing problems are greatly reduced or eliminated.

For any aluminum tool, durability is always a concern. However, durability isn't an issue with an aluminum boring tool coated with a hard aluminum oxide coating.

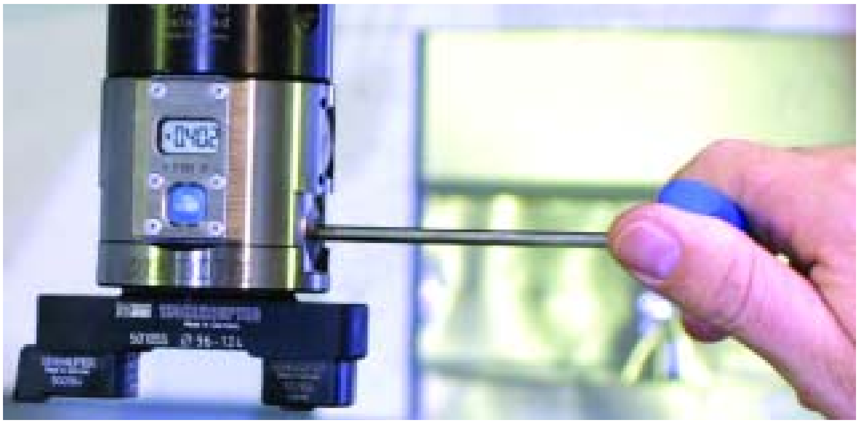
The coating method is a special acid-electrolyte oxidation, where aluminium in the surface area is transformed to aluminium oxide. The result is a case depth of up to 0.008" with a surface hardness of 56 HRC.

The coating protects the tool from being damaged by chip abrasion and corrosion. With finish-boring applications, abrasion problems are limited because the chips are usually small and have less force when hitting the tool body. The wear resistance of the surface-treated aluminum is excellent for finish boring even though it may not match the impact resistance of a steel tool.

The hard coating also benefits aluminum bodies used to rough-bore large diameters (from 8.07" to 40.15") in materials that produce long or abrasive chips. (Smaller diameter rough boring tools are usually made of steel.) The combination of virtually unrestricted chip flow, which reduces chip impact and abrasion, and the hard coating makes it practical to rough bore these materials without excessive tool body wear.

**Boring tools with digital readout displays.**

**A combination boring tool.**



**Setting a boring tool with a digital display can be performed without removing the tool from the machine.**

### Combination Boring

Traditional boring applications usually require rough and, sometimes, semifinish passes prior to finish boring. This is a reliable but time-consuming process.

With the advent of near-net-shape castings, particularly aluminum die castings, the need for multiple passes has been reduced or eliminated. In many instances, the hole that requires finish boring has been created on the same machine that will do the finish boring. Consequently, concerns about stock condition and eccentricity are greatly reduced.

Therefore, the application of a combination boring tool makes a great deal of sense. Boring tools are available that incorporate two cutting edges, allowing holes to be finished in one pass. One cutting edge removes the majority of stock, and a second, trailing cutting edge finishes the bore to size. Differences in tool life between the two inserts can be accommodated with a different grade of carbide in each pocket, if required.

The finishing cutting edge is mounted in an adjustable insert holder that is positioned with a precision lead screw and conventional vernier scale. Thus, accurate holes can be produced to a tolerance of 0.001" in one pass. Feed rates must be set accordingly, but the net gain of eliminating rough or semifinish passes greatly increases productivity.

## Self-Balancing Boring

The benefits of highly balanced boring tools have long been recognized. With today's high-speed machines, balancing is more important than ever, and considerable expense and effort goes into it. Even small out-of-balance conditions can produce problems with surface finish, hole size, roundness and tool life. They can also cause chatter.

Balancing features have been added to many standard boring tools over the past few years. These usually consist of movable weights that can be adjusted to suit the final-diameter setting of the tool, since diameter adjustments are the normal cause of out-of-balance conditions. These adjustments are effective but time-consuming, and the mechanisms are prone to suffer from exposure to coolant, chips and dirt.

Boring heads are available with internal self-balancing features. Simply stated, as the insert holder is adjusted for diameter in one direction, a counterweight is moved in the opposite direction through a mechanical link. This internal mechanism is completely sealed against coolant and chips.

This approach works quite well in most applications performed on modern CNC machines. If the job requires even more demanding balance specifications, these tools should still be balanced as an assembly using a state-of-art balancing machine. Bridge-type boring tools, whether aluminum or steel, should always be balanced manually with counterweights.

Boring tools that are self-balancing or have aluminum construction, combination boring tools and boring heads with digital displays all allow manufacturers to increase productivity. Although these are not revolutionary developments, they can have enough of an impact to significantly improve boring applications.

## About the Author

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