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▶ BY SUSAN WOODS, ASSOCIATE EDITOR

ON Location

Locating devices play a key role in ensuring the accuracy of workholders.

Much of the material in this article was adapted from information presented in a Tooling University workholding class—Ed.

The cutting forces generated during machining make strong and effective workholders a necessity. Locators are an important component of a workholding system because they contribute to its overall operation and accuracy.

Workholders consist of a tool body, locators and clamps. The tool body acts as the base for the workholder, locators position the workpiece in a precise location and clamps hold the workpiece in place.

The purpose of locators is to resist the primary cutting forces that occur during machining. Locators support the workpiece from the bottom, and position it within a specific area on the horizontal plane. Clamps are only intended to hold the workpiece against the locators.

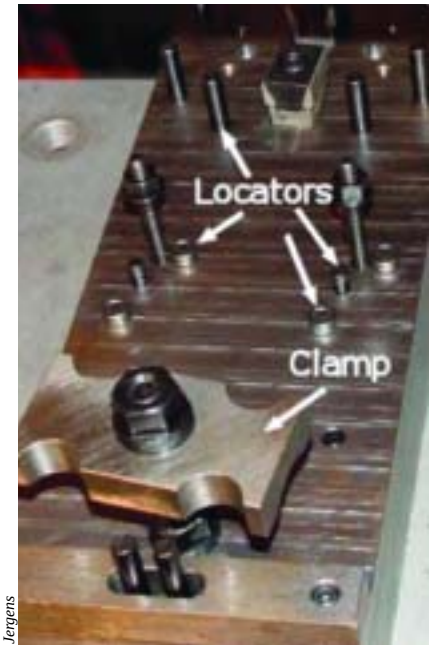
"The locators must be strong enough to maintain the position of the workpiece and to resist the cutting forces," said Ray Okolischan, vice president of Carr Lane Mfg. Co., St. Louis. "This points out a crucial element in workholder design: Locators, not clamps, must hold the workpiece against the cutting forces."

There are two basic types of locators: integral and assembled. Integral locators are built directly into the tool body. Assembled locators are separate components attached to the tool body.

In most cases, assembled locators are preferable to integral locators. This is especially the case for workholders built for long production runs. As parts are machined, locators wear. If an integral locator wears out or is damaged, the whole tool body must be replaced. With an assembled locator, only the locator needs to be replaced.

Fixed Locators

Assembled locators can be further grouped into fixed and adjustable styles. Fixed locators locate a workpiece in a fixed position; they are not movable or adjustable. Adjustable locators incorporate springs, threads or other devices that accommodate small differences in workpiece sizes. Fixed locators are more accurate than adjustable locators. Many workholders use both fixed and adjustable locators.



Jergens

Workholder using locating devices and a clamp.

According to John Winkler, CEO, part of the office of the president at J.W. Winco Inc., New Berlin, Wis., for individual or multiple workpieces, where multiple positions are needed to machine multiple points, an adjustable locator, such as an indexing plunger, is a real benefit.

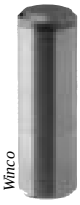
For example, a dividing table with the workholder mounted on it may need to be turned to the workpiece's specific location points that need to be machined. The adjustable locator allows the locating pin to be retracted so the table can rotate freely and move to its next position to begin the next machining process. When all the machining steps are completed, the next workpiece can be mounted on the workholder and the process can be repeated.

The most common, and most basic, fixed locators are locating pins. Locating pins can be external or internal. External pins are used to locate an outer surface of a workpiece, and internal pins work by fitting into a hole drilled into a workpiece. Many types of locating pins can be used both internally and externally.

Locating pins are available in a variety of styles and come with or without shoulders. A shoulder prevents the pin from being pushed into the tooling

plate. Locating pins are usually press-fit directly into the tool body.

"A locating pin with a shoulder is used when the pin needs to withstand greater loads," said Greg Arnold, marketing specialist, Jergens Inc., Cleveland. "A shoulder can also be used to support a workpiece."

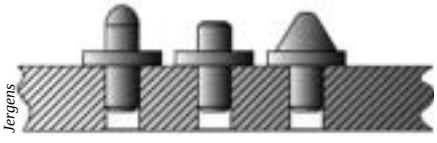


Winco

A round locating pin.

Shorter pins, called rest buttons, both support and locate the workpiece from below. Like locating pins, rest buttons are available in a variety of styles with and without shoulders.

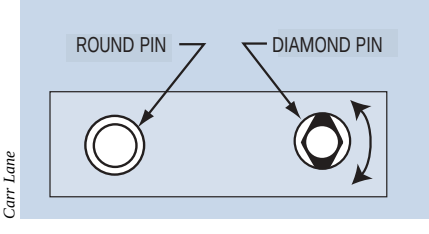
Other styles of locating pins are bullet-nose and cone. These are mainly for internal location. Their shapes facilitate easier loading of workpieces over the pins. "The most common application for these locating pins is the alignment of workholder components, rather than locating workpieces," said Okolischan.



Jergens

Illustration of bullet-nose (left), round (middle) and cone locating pins.

Many workholders use relieved locating pins in conjunction with round ones to locate an internal surface. The most common relieved locating pins are diamond-shaped, which means they have four flat sides. Because there is less contact between the pin and workpiece hole, it is easier to slide parts in and out of the workholder. Relieved locating pins are also available with a shoulder that can support the workpiece and prevent the pin from being pushed into the tool body.



Carr Lane

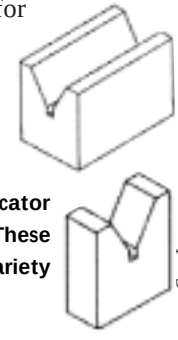
Illustration of an internally located workpiece with round and relieved, or diamond-shaped, locating pins.

One of the most secure ways to locate a workpiece is to internally locate it at two positions. A round locating pin and a relieved locating pin are often used to accomplish this task. The round pin does most of the work. It locates the workpiece; the only possible movement would be that the workpiece could spin around the pin. The relieved pin prevents the workpiece from spinning. A clamp holds the workpiece securely on the pins.

One of the most effective ways to locate a cylindrical workpiece is with a V-locator. This fixed locator has an angled interior, or V, that positions a cylindrical surface. It is available as either a long block or smaller pads.

Long cylindrical workpieces can be effectively held in a V-locator block. One of the advantages of locating the workpiece in this manner is that the angled interior automatically centers the workpiece. Forces exerted during machining push the workpiece into the V-locator.

A workpiece that has one or more cylindrical sides can be held effectively with V-locator pads. V-locator pads are well suited for corner mounting a square or rectangular workpiece as well, according to Okolischan. The corner selected for locating a workpiece should be a machined right angle; this helps ensure accuracy.



Carr Lane

Illustrations of a V-locator block (top) and pad. These devices can locate a variety of shapes.

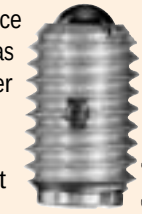
Another fixed locator that is occasionally used for complex parts is a locating nest. A locating nest completely surrounds the surfaces of a workpiece to hold it in place.

One drawback of a locating nest is that it may be difficult to remove the workpiece after machining. Some locating nests incorporate devices that help eject a completed part. An alternative is to build a partial locating nest that surrounds only portions of the workpiece surfaces.

In general, locating nests are not recommended because they tend to

Indexing

Occasionally, a manufacturer needs to drill holes in a circular pattern on a part. For this type of job, an indexing jig is often used. The jig positions the workpiece and holds it in place as each hole is drilled. After the first hole is drilled, the part is turned and locked in place. The next hole is drilled, and that same hole is used to lock the part in place for the following hole. This process is repeated until all the holes are drilled.



Carr Lane

A ball plunger.

A retractable plunger or an alignment pin can be used to lock the part in place.

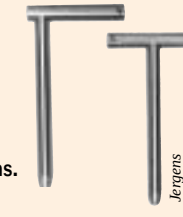
Jergens

A pull-ring style hand-retractable spring plunger.

Plungers include ball plungers, which contain a hardened ball as the plunger, and hand-retractable spring plungers, which have a spring that advances the plunger into the hole.

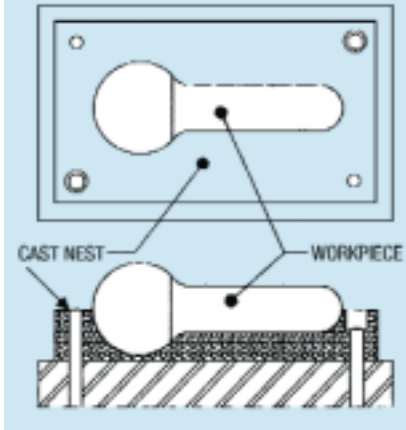
Alignment pins are manually pulled in and out of the hole. Alignment pins come in many styles, including L-pins, T-pins, jig pins and clamping pins.

—S. Woods



Jergens

L- and T-style alignment pins.



Carr Lane

Illustration of a locating nest.

Glossary

ADJUSTABLE LOCATOR
A locator that can be adjusted to accommodate variations in workpiece size. Adjustable locators are less accurate than fixed locators.

ALIGNMENT PIN
A pin that is used to lock a workpiece into position on an indexing jig.

ASSEMBLED LOCATOR
A separate locator that is attached to the tool body of a workholder. Assembled locators can be easily replaced if worn out or damaged.

BULLET-NOSE LOCATING PIN
A locating pin, shaped like a bullet, that is mainly used for internal location.

CLAMP
A device that resists secondary cutting forces during machining. Clamps are used to hold a workpiece against the locators.

CONE LOCATING PIN
A locating pin, shaped like a cone, that is mainly used for internal location.

CUTTING FORCES
Forces that are generated by a cutting tool as it machines a workpiece. Cutting forces are divided into primary and secondary cutting forces.

EXTERNAL LOCATING PIN
A locating pin that is used to locate an outer surface of a workpiece.

FIXED LOCATOR
A locator that is designed to maintain a fixed position for a workpiece.

INDEXING JIG
A jig that is designed to locate a part in multiple positions, one after another. Indexing jigs are often used to drill holes around the surface of a cylindrical workpiece.

INTEGRAL LOCATOR
A locator that is built directly into the tool body of a workholder.

INTERNAL LOCATING PIN
A locating pin that is used to locate an interior hole of a workpiece.

LOCATING NEST
A fixed locator that completely surrounds the surfaces of a workpiece. The workpiece rests within the locating nest.

LOCATING PIN
A locating device that can be used to locate either an outside workpiece surface or an interior hole. Locating pins are available in numerous shapes and sizes.

LOCATOR
A device that resists primary cutting forces during machining. Locators can be used to support a workpiece from below or locate it on a horizontal plane.

PARTIAL LOCATING NEST
A locating nest that only surrounds portions of the surfaces of a workpiece.

PRIMARY CUTTING FORCES
Cutting forces that are directly generated by the motion of the cutting tool during machining. Primary cutting forces occur in the same direction as the cutting tool movement.

REDUNDANT LOCATION
The use of an extra or duplicate locator that does not add to the accurate positioning and supporting of a workpiece surface.

RELIEVED LOCATING PIN
A locating pin with a diamond shape that is used to locate a workpiece in only two opposite directions. Relieved pins are most often used with an internal pin.

REST BUTTON
A short locating pin that is used to both support and locate a workpiece from the bottom.

RETRACTABLE PLUNGER
A spring-loaded device that is used to lock a workpiece into position on an indexing jig.

SECONDARY CUTTING FORCES
Cutting forces that are generated in response to the primary cutting forces. Secondary cutting forces include vibration during machining and forces that attempt to lift a workpiece after a drill penetrates it.

SHOULDER
A ring or collar on a locating pin that enables the pin to withstand greater loads. Shoulders can also be used to support a workpiece.

SPRING-TYPE PIN
An adjustable locator with a metal or plastic bulb that pushes a workpiece against fixed locators on the opposite side.

SPRING STOP BUTTON
An adjustable locator with a metal button or tang that pushes a workpiece against fixed locators on the opposite side.

THREADED ADJUSTABLE LOCATOR
A threaded locator with a knob that pushes against the workpiece.

TOOL BODY
The foundation of a workholder. Various components, such as locators and clamps, are fastened to the tool body to make each workholder unique.

V-LOCATOR
A fixed locator that has an angled interior to position and center the cylindrical surface of a workpiece.

WORKHOLDER
A device used to locate and hold a workpiece. The workholder references the cutting tool performing the machining on a workpiece being held.

locate more surfaces than necessary. "These locators normally should be avoided due to their redundant location," said Okolischan. "However, for complex castings without a machined locating surface, locating nests are sometimes the only choice."

Adjustable Locators

Generally, it is better to use fixed locators than adjustable ones. Adjustable locators should only be used when workpieces vary in size. Technically speaking, these devices are not "true" locators because they are not designed

to resist primary cutting forces. Instead, these devices push the workpiece against the actual fixed locators during machining.


Winco

An adjustable threaded locating screw.

Okolischan said: "Adjustable locators and supports require less precision to mount on the tool body. For a typical workholder, they are mounted at approximately the correct position and then adjusted to the exact location. The specific design or configuration of an adjustable locator is normally left to the designer."


Carr Lane

A spring-type pin.

Common types of adjustable locators include:

- Those with a threaded screw that, when turned, pushes a knob against the workpiece.
- Spring-type pins that have a plastic or metal bulb that pushes a workpiece against fixed locators on the opposite side.
- Spring stop buttons that function similarly to spring-type pins except they exert more force against the workpiece. These locators are for larger workpieces or where greater holding force is needed.


Carr Lane

A spring stop button.

Both adjustable and fixed locating devices come in a variety of types and styles. These devices have been around for years, but the quick-change mentality that pervades the machining industry has affected locating devices also.

"Quick-change is a real focus," said Winkler. "Spring-loaded devices allow more opportunity to do quick change-overs or quick repeatablities."

The following companies contributed to this report:

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Jergens Inc.
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