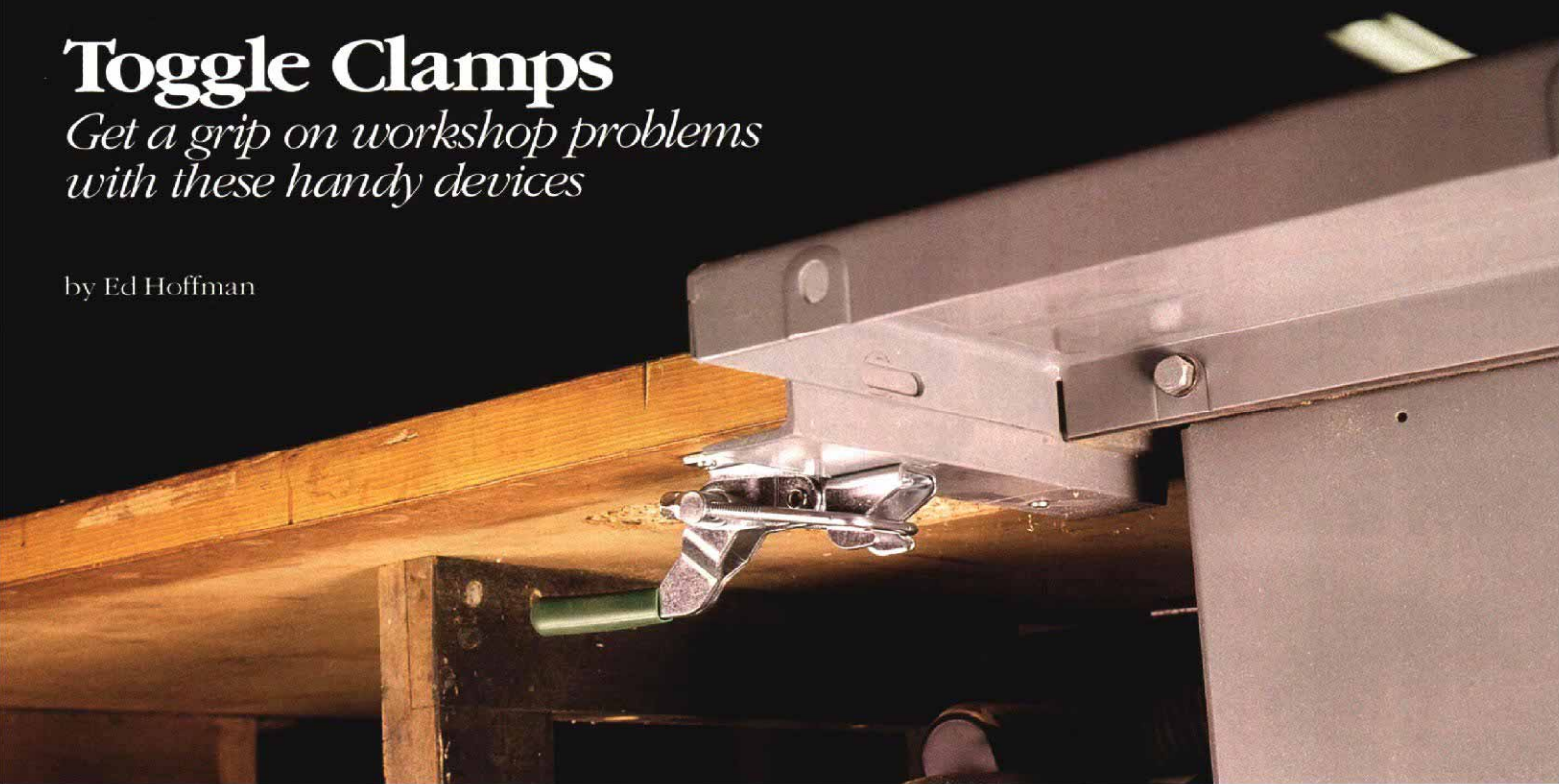


# Toggle Clamps

Get a grip on workshop problems with these handy devices

by Ed Hoffman



*Toggle clamps come in a wide variety of styles, shapes and sizes. Here, pull-action toggle clamps firmly, yet temporarily, attach an outfeed table mounted on wheels to a table saw. By just flipping a couple of handles, the table can be rolled away for other uses.*

**W**e've all done it—hand-held that small piece of wood to drill, shape or cut it on a power tool while thinking there must be a safer way to do the job. Those of us who were lucky can still count 10 fingers. The others will wish they had heard of toggle clamps before they made that cut. It's been more than 50 years since the Detroit Stamping Co., now De-Sta-Co, introduced the toggle clamp. Although there are more manufacturers today and toggle clamps are available from most woodworking mail-order sources, the clamps are just now appearing with regularity in woodworking shops. Toggle clamps exert exceptional holding force, have a positive locking action and are fast and easy to use with just one hand. These features combined with reasonable cost (\$5 to \$20 for most clamps) make toggle clamps

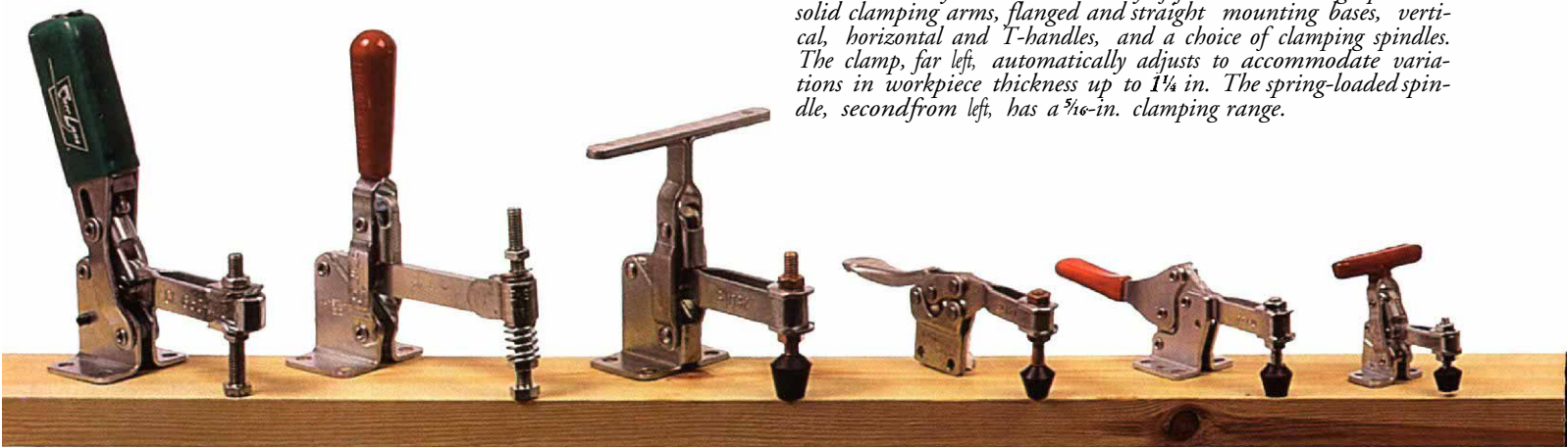
ideal for holding workpieces to jigs, fixtures and workshop tools.

Toggle clamps operate through a system of pivots and levers joined together so force applied to the knee lever (or handle) straightens the arrangement of pivot points and creates endways pressure on the mechanism (see the drawing). When fully extended to its locked position, the middle pivot point is moved slightly beyond the centerline of the outer pivot points. The clamping force now creates endways pressure to push the middle pivot point down against a stop, locking the toggle clamp in position.

## Mechanical toggle clamps

Toggle clamps come in a dizzying variety of styles. In fact, toggle clamps offer more mechanical, pneumatic and hydraulic varia-

*These hold-down toggle clamps are just a sampling of what is available. They illustrate a variety of features including open and solid clamping arms, flanged and straight mounting bases, vertical, horizontal and T-handles, and a choice of clamping spindles. The clamp, far left, automatically adjusts to accommodate variations in workpiece thickness up to 1¼ in. The spring-loaded spindle, second from left, has a 3/16-in. clamping range.*



tions than any other type of clamp. Some of the major differences in the mechanical clamps are the handle design (arrangement and placement), mounting styles and holding capacity. Holding capacity, which ranges from 60 lbs. to 16,000 lbs., is defined as the maximum amount of force that can be applied to the clamping bar in the closed position without permanently deforming the clamp.

The basic mechanical toggle clamp is available in four different types: hold-down, straight-line, pull-action and squeeze-action clamps, as shown in the photos below. The hold-down and straight-line types have proven to be the most useful in the wood-working shop. The straight-line clamps have a push or pull action, and some of these clamps can apply pressure at either end of the clamp stroke. Pull-action clamps draw parts together much like the lock on an extension table. And squeeze-action toggle clamps, also called toggle pliers, hold parts with a pinching action, operating like a parallel clamp or C-clamp.

**Hold-down clamps**—Hold-down toggle clamps offer the most design options, including a T-handle or a straight handle in a horizontal or vertical format; solid or open clamping arms with a high, low or angled profile; and flanged or straight mounting bases. The open-arm style has the greatest clamping flexibility because it allows the adjustable spindle assembly to be moved along the clamping arm and positioned to suit the task. The threaded spindle can be adjusted up and down to accommodate workpieces of varying thicknesses. To get the maximum holding force, the spindle assembly should be positioned close to the handle. For maximum reach, the spindle is moved to the other end of the clamp arm. The solid-arm clamps generally use a welded-on bolt retainer to mount the adjustable spindle. Or a customized workholder could be welded or bolted onto the arm. Although a flanged base is the most frequently used mounting system, hold-down clamps are available with a straight base for special applications. (The photo below shows a variety of handles, arm styles and mounting bases.)

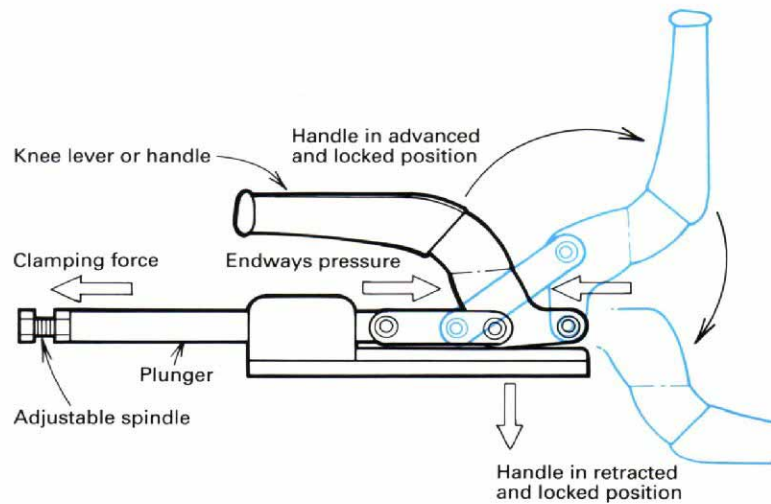
Hold-down toggle clamps can increase the quality of work when used, for example, to eliminate stock creep while crosscutting miters on the tablesaw, as shown in the top right photo on p. 76. These toggle clamps can also increase safety by keeping the fingers away from the cutters when template routing small pieces, as shown in the top left photo on p. 76.

**Straight-line clamps**—Straight-line toggle clamps provide a pushing or pulling action; most straight-line clamps will lock in the

*Straight-line clamps (two at left below) can push or pull and work well for jig and fixture applications. Pull-action clamps (two at right below) are great for making band clamps or for securing machinery and guards.*

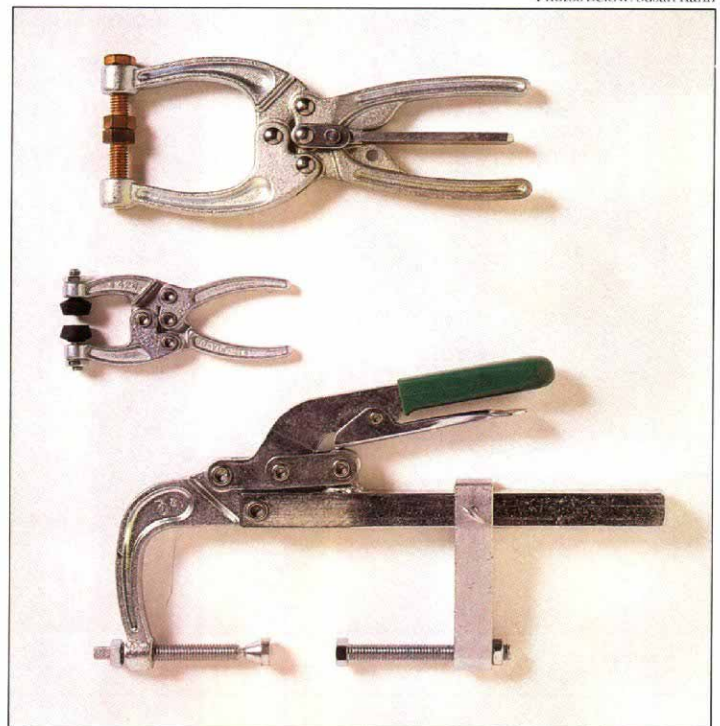
*Squeeze-action clamps (at right) are available as hand-held toggle pliers or in a larger form that can be machine mounted.*

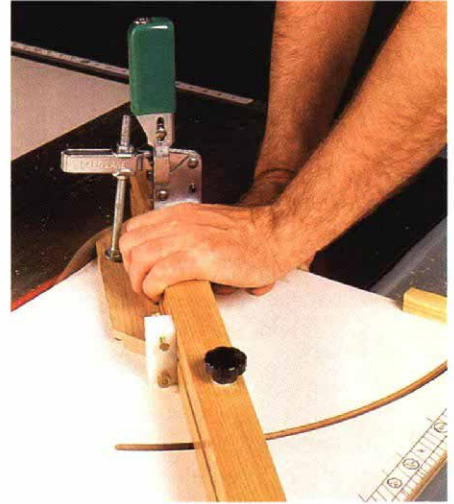
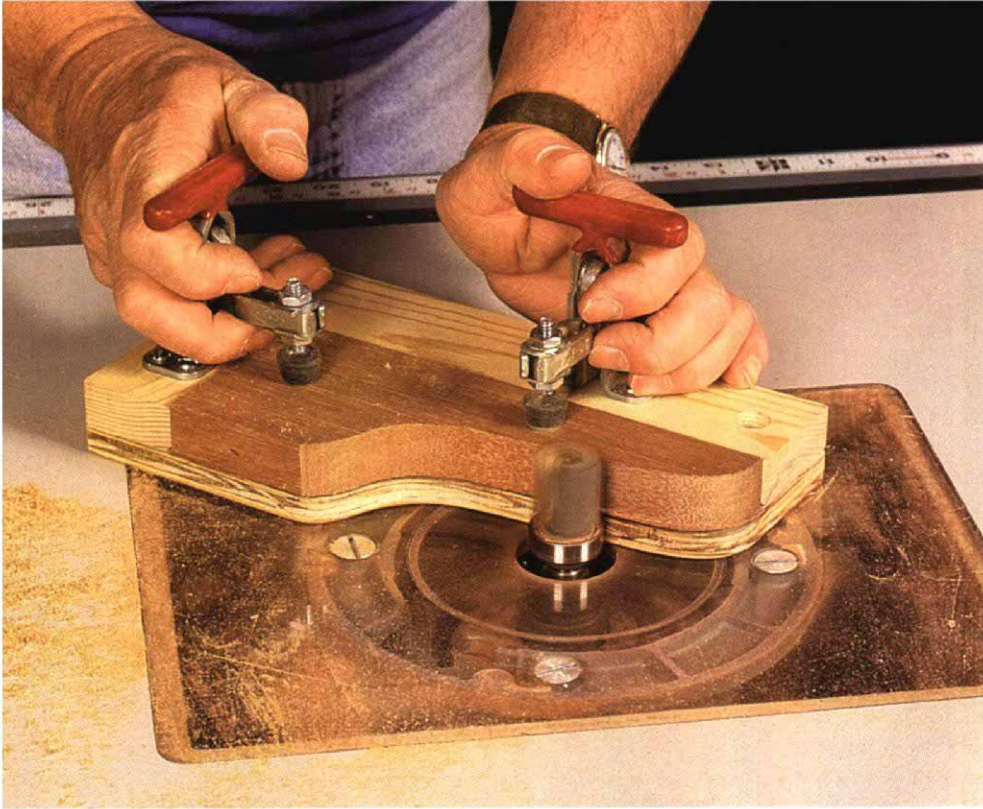
### Toggle clamp basics



*In the fully extended position, endways pressure on the lever from the clamping force pushes down on the middle pivot point, which is slightly below the centerline of the outer pivot points, to lock the clamp.*

Photos below: Susan Kahn





*A hold-down clamp quickly secures the workpiece for safer and more accurate work. The toggle clamp (above), unusual because it can automatically accommodate variations in workpiece thickness up to 1 1/4 in., prevents stock movement when cutting miters on a sliding table.*

*Jigs and fixtures should include a stop or fence (left) to resist the force of the tool and should support the workpiece opposite the clamping force to prevent distortion.*

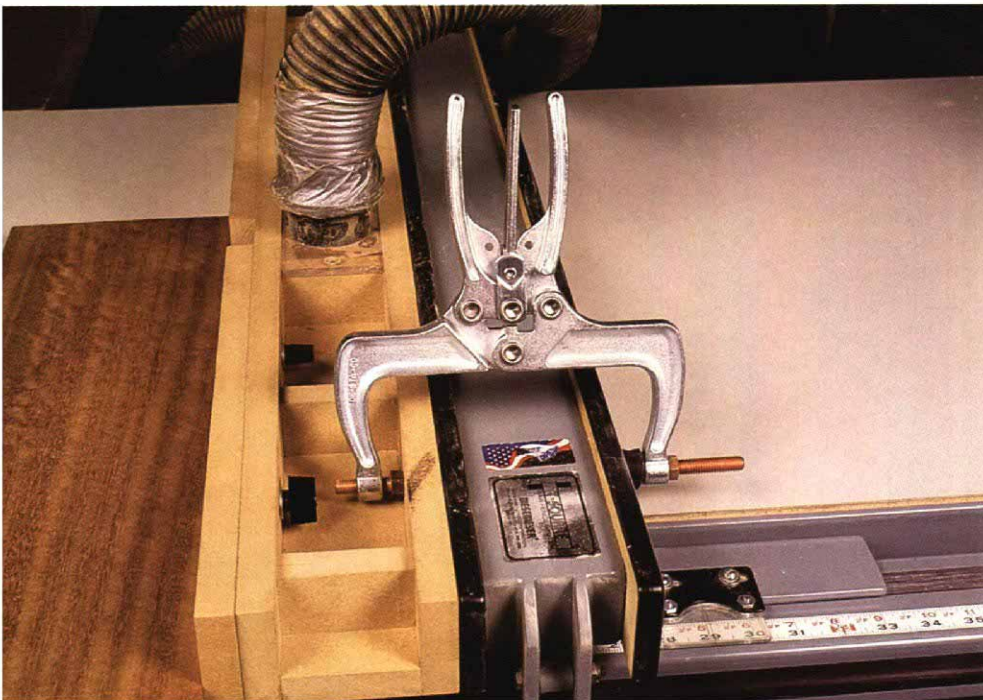
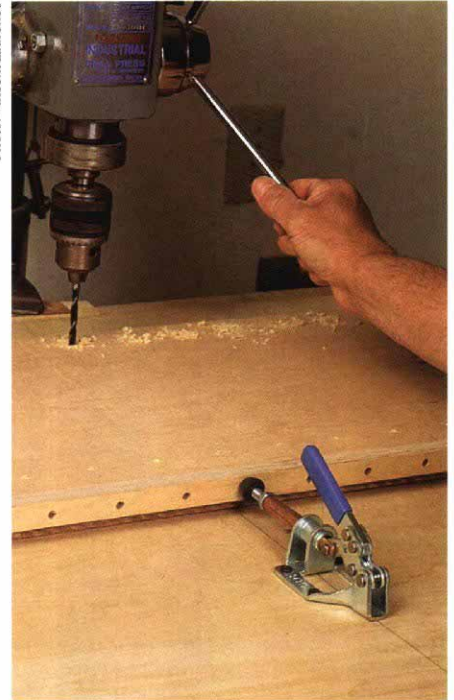


Photo: Vincent-Laurence



*A cone-shaped tip on this straight-line clamp (above) automatically registers the workpiece for shelf-bracket holes while holding the workpiece in place.*

*Squeeze-action clamps, or toggle pliers, (left) make easy work of clamping an auxiliary fence in place. These clamps are particularly useful when the clamped object is frequently adjusted or when it's removed and replaced.*

## Sources of supply

Due to their increased popularity in woodworking applications, toggle clamps are available from many hardware and tool stores, home centers and most mail-order catalogs. However, if you can't find the clamps locally or if you want a complete catalog, you can contact the following manufacturers directly.

Carr Lane Manufacturing Co., 4200 Carr Lane Court, PO Box 191970, St. Louis, MO 63119-2196; (314) 647-6200.

De-Sta-Co, PO Box 2800, 250 Park St., Troy, MI 48007-2800; (313) 589-2008.

Te-Co, 109 Quinter Farm Road, Union, OH 45322-9796; (513) 836-0961.

fully extended or retracted position. The plunger is generally internally threaded to accept a standard hex head bolt. The bolt serves as an adjustable spindle for fine-tuning clamping position and force. Some styles of this clamp have an externally threaded plunger to mount custom workpiece holders. Straight-line clamps are available with either a flange mount or a threaded body for mounting the clamp directly through a panel, plate or angle bracket.

For woodworking applications, straight-line clamps are handy for gluing jigs where items of the same size, like the frame parts for cabinet doors, are regularly assembled. Used with a special cone-tipped spindle, these clamps are also great for positioning and holding work (see the bottom right photo on the facing page).

**Pull-action clamps**—Pull-action clamps, or latch clamps, are designed to draw two parts together. A familiar application is the common toolbox latch. With this clamp, the handle is raised to advance the clamping element, usually a hook or U-bolt. Once the clamping element is engaged, the handle is moved to a horizontal position to pull the pieces together and lock the clamp. Threaded ends on the hook or U-bolt allow the clamps to be precisely adjusted. These clamps also are available in a right-angle configuration that pulls perpendicularly to the base. Pull-action clamps can make quick work of applying a band clamp, securing machinery guards or, as shown in the top photo on p. 74, for holding equipment in place.

**Squeeze-action clamps**—Squeeze-action clamps combine the normal grip of a pair of pliers with a toggle action. The hand-held type, often called toggle pliers, is designed for applications where C-clamps might ordinarily be used. These clamps use either one threaded spindle with a fixed jaw or two threaded spindles to set the clamping thickness. Most toggle pliers include a lever between the handles that will quickly release the clamp when squeezed. Toggle pliers are especially helpful when the clamped object needs to be repositioned frequently, such as the auxiliary fence shown in the bottom left photo on the facing page.

### Automatic toggle clamps

For all their many benefits, one drawback to standard toggle clamps is their limited ability to compensate for different workpiece sizes. Once set to a clamping height, most toggle clamps can only accept slight variations in stock thickness. Although an optional, spring-loaded spindle is available, it only increases the clamping range to  $\frac{3}{8}$  in. Larger variations often require readjusting the clamp spindle.

A new toggle clamp shown in the top right photo by Carr Lane Manufacturing Co. (see the sources of supply) has resolved this problem. A standard toggle clamp is made of fixed-sized components connected by pivot pins to provide the clamping action. With this new toggle clamp, however, one of the fixed components (the handle) has a variable length; the clamp correctly adjusts itself to fit the workpiece by automatically altering the pivot length within the handle with a self-adjusting and self-locking wedge arrangement.

In use, the adjustable spindle of the automatic toggle clamp is set at the average workpiece height. Once set, the clamp automatically adjusts to suit workpieces that are up to  $\frac{3}{8}$  in. thicker or thinner than this setting. The clamping force of the automatic toggle clamp can be adjusted, up to a maximum of 500 lbs., by turning the screw located in the end of the handle. □

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## Putting toggle clamps to work

by Douglas W. Ruffley, P.E.

Because of the wide variety of toggle clamps available, you should select the appropriate clamps for the job before designing any jigs or fixtures on which the clamps will be used. Clamps should be selected on the basis of holding force, action, configuration and mounting, as discussed in the main article. Once the right clamp is at hand, you also need to consider the clamp setup and proper jig design.

**Clamp setup:** The adjustable spindle can affect the clamp's exerting force (the force with which the clamp holds a workpiece). The exerting force can be adjusted from very light pressure up to the maximum-designed holding force (the point at which the clamp deforms) of the clamp. The force should be snug, but it should not be adjusted so tightly that the clamp becomes difficult to operate. Sixty lbs. is about the maximum amount of force an operator can exert repetitively; however, for safer and more comfortable operation, the spindle should be adjusted to require handle forces from 30 lbs. to 40 lbs. If the clamp is too hard to operate, the operator's hand may slip into the machinery. When applying force to a clamp handle, it is best to keep the wrist straight because the operator can generate more force with less stress on the arm's muscles and tendons.

**Optional spindles:** In addition to the standard adjustable hex head spindle, there are a variety of other spindles that are better suited to woodworking applications. Spindles tipped with a flat-bottom, molded-neoprene cushion, as shown in the top left photo on the facing page, help protect the wood from being damaged by the clamping force and help compensate for slight variations in stock thickness. The cone-shaped, neoprene tip, as shown in the bottom right photo, is excellent for clamping into holes, slots and corners. Also available is a swivel-foot spindle in a variety of materials with a steel, stainless steel or delrin clamping pad for holding sloped or irregular surfaces. A spring-loaded spindle that can compensate for up to  $\frac{3}{8}$ -in. variation in stock thickness is handy, but this unit requires welding the spindle retainer to a solid-arm clamp.

**Jig considerations:** Clamped parts should be positioned against a fence or a fixed stop so that tool forces are resisted by the stop, not the clamp. Be certain that the clamp bar, including the spindle, clears the area for easy loading and unloading of the part. Clamped pieces should be supported opposite the clamping force by the jig, fixture or work surface. Otherwise, parts could distort, and the part could vibrate and move out of position. If vibration or an overhead mounting position might cause a clamp to open accidentally, use a clamp with an added locking-release lever. And, finally, for the safety of tool and operator, be sure that all parts of the clamp clear the tool path. □

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