TOGGLE OR DIRECT-ACTING CLAMPING?

Options for securing a tube for bending

An alternative uses a ball screw and an electric servomotor. This type allows the operator to adjust the clamping force by changing the amount of power applied to the servomotor. It’s a green alternative in that it uses no hydraulic fluid.

OVER-CENTER TOGGLE MECHANISM

An over-center toggle mechanism is similar to a DE-STA-CO clamp. The over-center approach makes use of a mechanical advantage, like that used by any common lever. The amount of clamping force it develops is much larger than the force needed to close it. The clamping force, in turn, can prevent the tube from moving during bending (see Figure 3).

Most over-center devices have some sort of pressure adjustment via a manually adjusted screw.

However, this doesn’t necessarily provide the fine touch needed to bend thin-walled tubing to a tight centerline radius. A direct-acting clamp or pressure die (or both) allows the small pressure adjustments that often are necessary to make a complex bend successfully.

Despite the lack of fine adjustment, over-center toggle mechanisms have several advantages. First, this type of system gives the operator a visual confirmation that the mechanism is engaged and providing clamping force. Second, it is suitable for a range of wall thicknesses; it works well for thick-walled tubing and can provide the force necessary to pinch thin-walled tubing.
Whether the clamp is direct-acting or over-center, three types of actuator commonly are used to create the holding force: pneumatic, hydraulic, or all-electric. They have a variety of pros and cons.

A direct-acting pneumatic actuator requires an air source and generates substantial noise. Also, because air is compressible, the air may compress in the middle of a bend (allowing the clamping cylinder to move), which can lead to wrinkles in the bend zone.

A hydraulic system can run quieter and maintains pressure, but uses hydraulic fluid, so it comes with the costs associated with purchasing and disposing of the fluid and the time spent cleaning up occasional spills. An electric system is the quietest of the three types and doesn’t use hydraulic fluid, but it comes with a higher initial price tag and requires a different set of troubleshooting skills.

A pneumatically powered, direct-acting clamp die may work well when working with an easily bent material, such as 1/8-in. copper tubing (see Figure 4). The tubing is light and malleable, and 80-pounds-per-square-inch (PSI) shop air is sufficient for applications of this sort. However, 80 PSI wouldn’t handle 1-in.-dia. steel tubing on a 2-D bend. The air’s compressibility may be the cause of several process problems.

An over-center toggle mechanism works well for most bending applications. However, some cases require the gentle touch of a direct-acting mechanism. When considering purchasing a bending machine, it’s important to consider the requirements of the bending applications, the capabilities of the machine, and the versatility of the clamping system.