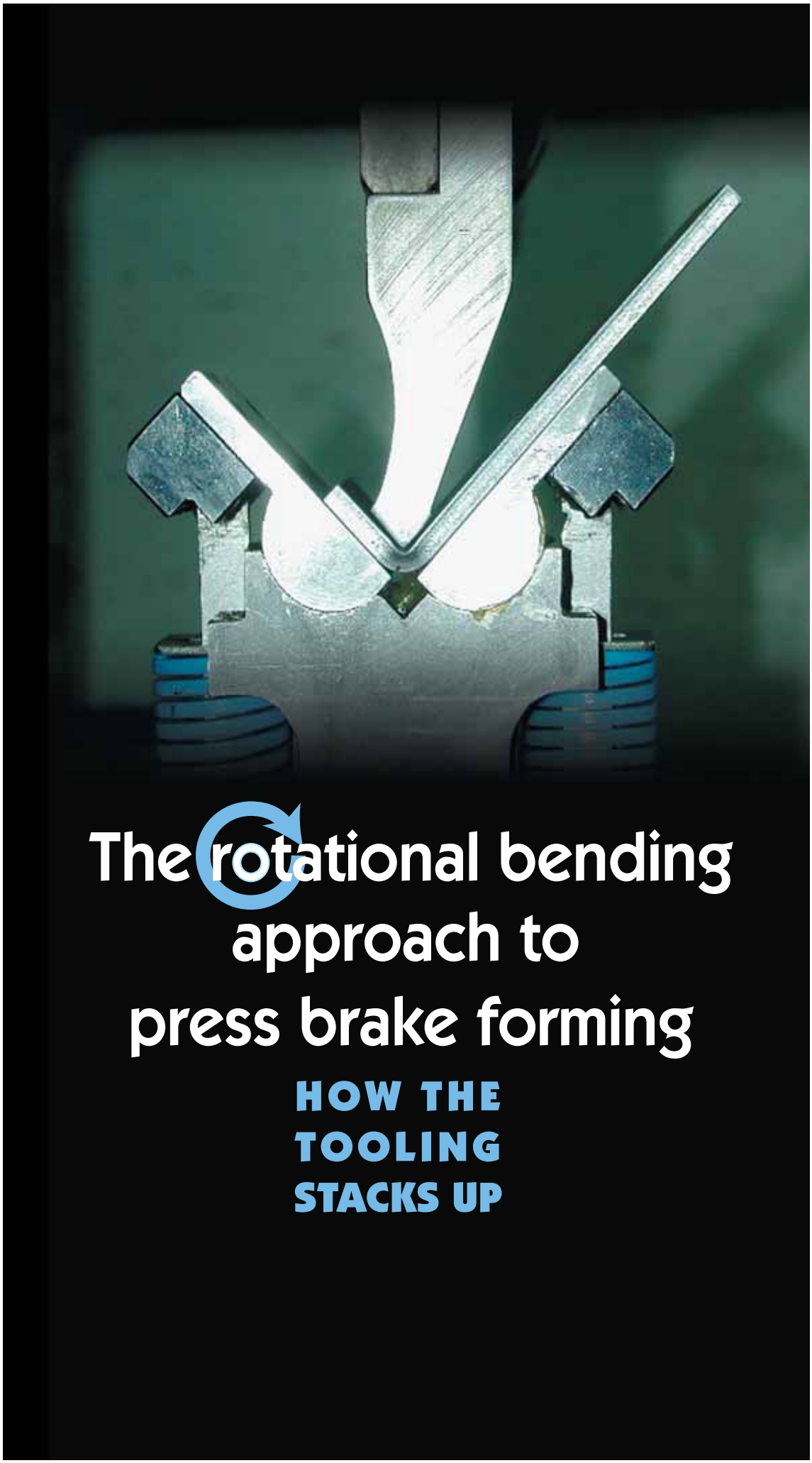

The rotational bending approach to press brake forming

HOW THE TOOLING STACKS UP

By John Wold

The movement in the fabricating industry toward just-in-time (JIT) manufacturing and small-batch production has presented significant challenges to today's sheet metal fabricators. Many of the parts that used to be formed with hard tooling in stamping presses now are being blanked on a laser or turret and directed to the press brake department for forming. Therefore, press brakes are frequently relied upon to form parts possessing characteristics that make them either difficult or impossible to produce using standard types of press brake tooling.

Not only are fabricators being asked to produce more difficult parts, but to remain competitive, they also are driven to produce their parts faster and more efficiently than ever before. In recent years, press brake manufacturers have made significant advancements in technology and are building faster, more productive machines. The improvements in programmability, speed, and accuracy have helped fabricators and have prompted the tooling industry to develop innovative products to further improve press brake productivity.

In recent years, the main focus of the tooling industry has been on reducing setup time. To acheive this, a variety of quick-change tooling styles and clamping systems have been developed and are used widely today. Additionally, the use of precision-ground tooling has increased significantly, in this author's opinion, because it leads to faster setups and minimizes the number of tool changes required. Although the reduction of setup time leads to increased throughput, this is only one piece of the productivity puzzle.

In addition to being challenged by difficult part configurations, fabricators' products are subject to extremely high quality standards relating to angular accuracy, dimensional accuracy, and aesthetics. As a result, fabricators frequently are forced to use often costly and time-consuming secondary operations to produce acceptable parts.

Realizing that eliminating the need for secondary operations would boost production efficiency and economy, tool designers began to explore new methods of forming sheet metal.

Rotary Bender Tooling

Experimentation with rotational tooling began as early as the 1950s, but it was not until 1982 that a proven, functional concept was introduced to the manufacturing community. This rotary bender tooling still is frequently used today.

Rotary bender tooling (see **Figure 1**) consists of three basic components: the saddle, rotor, and anvil.

The saddle, which retains the rotor, is manufactured with enough clearance to allow the rotor to rotate freely. As the die set begins to close, the clamping jaw of the rotor holds the part firmly in place against the anvil.

Simultaneously, the forming jaw continues to rotate and exert pressure, causing the material to form around the anvil. As the set opens, springs mounted in the saddle push against the rotor, causing it to return to its neutral position.

To prevent marking, a protective pad typically is used between the material and the clamping jaw. This leaves the top of the part completely mark-free. However, slight marking from the forming jaw may occur. If the finished part must be completely mark-free, the rotor can be made from Delrin® acetal resin or other, similar materials. These materials eliminate marking completely, but their service life is considerably shorter than that of steel.

Advantages and Limitations

Flanging large sheets of material with standard punch and V tooling can present significant challenges. If the workpiece is not properly supported as it travels upward during forming, back-bending will occur. Avoiding this problem frequently requires additional labor—and machinery when forming plate—and increases cycle time.

Perhaps the most beneficial aspect of rotary bender tooling is that it allows a press brake to function like a folding machine. Because the body of the part remains stationary while the flanges are being formed, whip-up is eliminated. This is particularly helpful when forming large panels.

To simplify material handling further, the rotor can be mounted in the bed of the press brake, causing the flange to form upward. This eliminates the need to lift the formed flange over the anvil to remove the part from the tool set.

The way in which rotary bender tooling functions makes it adaptable to a variety of forming tasks. By using dual anvils and dual rotors, these die sets can form multiple-bend parts, such as hat channels, in a single hit. Furthermore, if multiple anvils and rotors are employed and the material is properly supported, all four sides of a box or pan can be formed in a single stroke of the press brake.

While rotary bender tooling is versatile, it is not without limitations. In most applications, the material is formed around an anvil with its forming surface located on the press brake's centerline. Therefore, the maximum flange length capability is limited by the open height of the machine. As a general rule, the longest flange length that can be produced is about 5 inches shorter than the machine's net open height. In addition, the tall anvil sections required for long flanges are heavy and difficult to handle.

Another limitation inherent to this tooling design is that of maximum angle. Acute bends of up to 60 degrees (included angle) can be achieved by machining a larger angle in the rotor and relieving the anvil. Attempting to form tighter angles, however, will cause the rotor and material to lock behind the anvil.

Finally, these dies usually are manufactured to produce specific parts or families of parts. The clearance between the rotor and anvil must be approximately equal to the thickness of the material being formed to allow the set to function properly. While special rotary benders can be produced with adjustments for varying material thicknesses, the standard sets only can form thicknesses with a variance of approximately 0.040 inch.

Rotational Dies

The recently introduced rotational lower dies do not eliminate whip-up and are slightly wider than conventional V dies. The additional width limits the rotational die's ability to produce close-proximity opposing bends (offset bends). However, they do help reduce setup time and minimize the need for secondary operations. Because a single rotational die can form the complete range of material thicknesses from 22 gauge through 5⁄16 inch, it can eliminate most of the setups normally required.

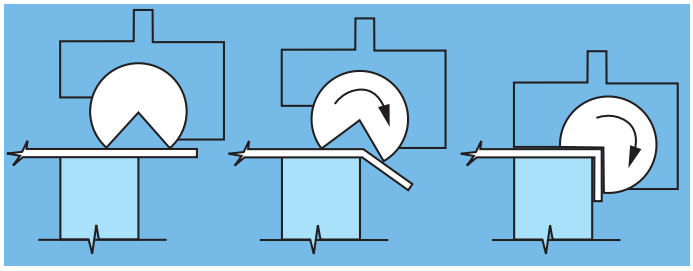

Figure 1
With rotary bender tooling for press brakes, the saddle, which retains the rotor, is manufactured with enough clearance to allow the rotor to rotate freely. As the die set begins to close, the clamping jaw of the rotor holds the part firmly in place against the anvil. Simultaneously, the forming jaw continues to rotate and exert pressure, causing the material to form around the anvil. As the set opens, springs mounted in the saddle push against the rotor, causing it to return to its neutral position.

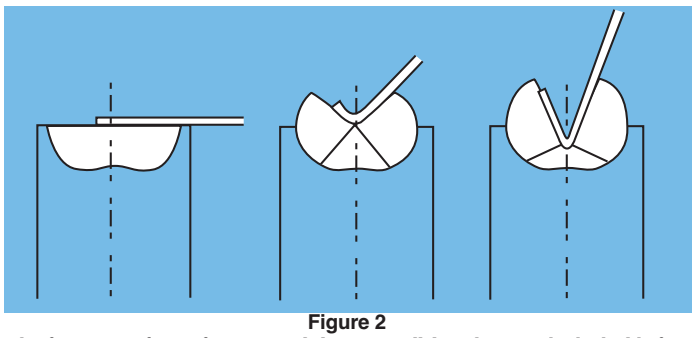

Figure 2
The forming surfaces of a rotational die are parallel to the press brake bed before forming begins. When downward pressure is exerted by the punch, the workpiece is held in static contact with the rotators while they move upward, forcing the material to assume the correct angle.

Unlike a conventional V die, the forming surfaces of a rotational die are parallel to the press brake bed before forming begins (see **Figure 2**). When downward pressure is exerted by the punch, the workpiece is held in static contact with the rotators while they move upward, forcing the material to assume the correct angle. Because the material is held in place during the forming process, die marking is nearly eliminated. If completely mark-free bending is required, urethane or nylon inserts can be used.

Rotational tooling also is helpful when forming parts with holes or slots near the bend line. Since the forming area is fully supported during the bending process, the material adjacent the cutout will be forced into position by the rotator, producing a uniform bend. This same principle explains how rotational dies are capable of forming short and tapered flanges more consistently than conventional V dies.

Weighing the Options

The demands placed upon sheet metal fabricators are constantly changing. Combined with traditional bending technologies, rotational forming with rotary bender tooling or rotational dies can help fabricators meet the challenges of today's industry. ■

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