0.075 in. steel can form steel sheet 0.070 to 0.080 in.—the design gauge therefore is 0.080 in. In this example, processing material thicker than 0.080 in. may result in cracking or breaking out some roll parts. At the very least, excessive roll pressure will cause thinning of some sections.

Alternately, forming thinner material in the rolls (see Fig. 2) will result in larger bend radii than those obtained when forming the design gauge. Operators should measure the material thickness before processing a new coil or batch of sheets and relate the thickness to any changes in the final profile.

Shops sometimes find it necessary to achieve isolated thinning of the rollformed shape. For instance, to obtain sharp corners, you can coin the material along the corner before forming it. Or, some products, such as ball-bearing slides, require a smooth surface in the ball track—this can be achieved by coining the material with excessive roll pressure. Note that in these cases the rolls should be designed specifically to coin portions of the material, and the machine sized to handle the extra pressure.

Adjusting Roll Gaps for Backlash

Each part in the stands (Fig. 3) mounted on a rollforming machine is manufactured to create clearance between it and its mating part so that the parts can be moved within the assembly. When there is no material in the roll gaps, the adjusting screws hold up the weight of the bearing-box assemblies, spindles and rolls.

When material enters the top and bottom rolls, it pushes the top spindles up. Clearances between the individual parts allow them to move slightly—this movement is called backlash. On small to medium rollforming machines, the top spindles can move as much as 0.010 in. when material is introduced into the passes. The final turn of the adjusting screws on a rollformer should always be to close the roll gap. For example, to move a top spindle up 0.002 in., turn the screw until a 0.004- to 0.005-in. upward movement is indicated for the top rolls. Then turn the screw in the opposite direction to close the gap until the movement is up 0.002 in. from its original position.

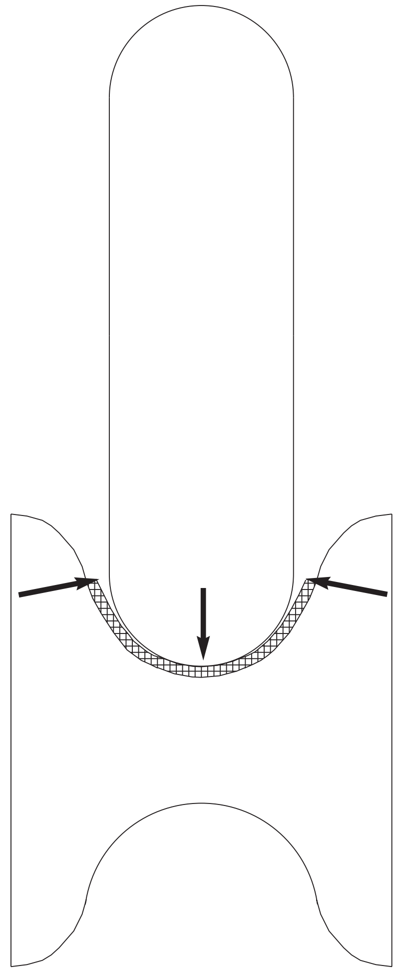

Fig. 2—Forming material thinner than the design gauge results in a larger radius, as shown here. Material not contained by the rolls bends at the points indicated.

Roll Diameters and Speed

Every time a roll makes one revolution, any spot on the roll travels in a circle. All parts of the material moving through the rollforming machine travel at the same speed. Different parts of the turning rolls move at different speeds depending on how far they are from the center of the roll. Obviously, parts of the material slip against the rolls forming them and some parts of the rolls travel at the same speed as the part.

When the engineer designs the forming rolls, he selects the points on the rolls that revolve at the same speed at which the part travels through the machine. Those points are called the drive points, and the drive diameter of a roll is the diameter of the circle formed by the rotating drive point. Typically, the engineer will slightly increase the diameters of the rolls from the entry to the exit ends of the machine. This practice increases the speed of the drive points as the part progressively forms, which puts a slight pull on the material and keeps it in tension. Without roll step-up, the workpiece may buckle between passes, especially when it is initially threaded into the machine. And, without matching speeds of the drive points on the top and bottom rolls for a given pass, the rolls will fight each other, trying to drive the profile at a different speed.

Search & Destroy Roll Fight

There are several ways to determine if the top and bottom rolls in a pass are fighting each other. One is to examine the rollformed corners in the part and look for hatch marks, or small Vs, formed on the surface of the material by the roll tooling. One cause of these marks may be rolls designed for an equal-geared machine being used on an unequal-geared rollformer.

Another way to check for roll fight is to look at the gears driving the passes. If the rolls have been operating on the machine for any length of time, all gears will show excessive wear when there is fight in the whole roll set. If the gears show more wear in one pass, it indicates roll fight in that pass.

When regrinding rolls, be sure to maintain the relationship between the drive points or else roll fight can result. Grinding just the bottom or top rolls in a pass will create fight between the opposing rolls. If only one pass is reground, any step-up will be changed and excess pull will be placed on the material. Or, the

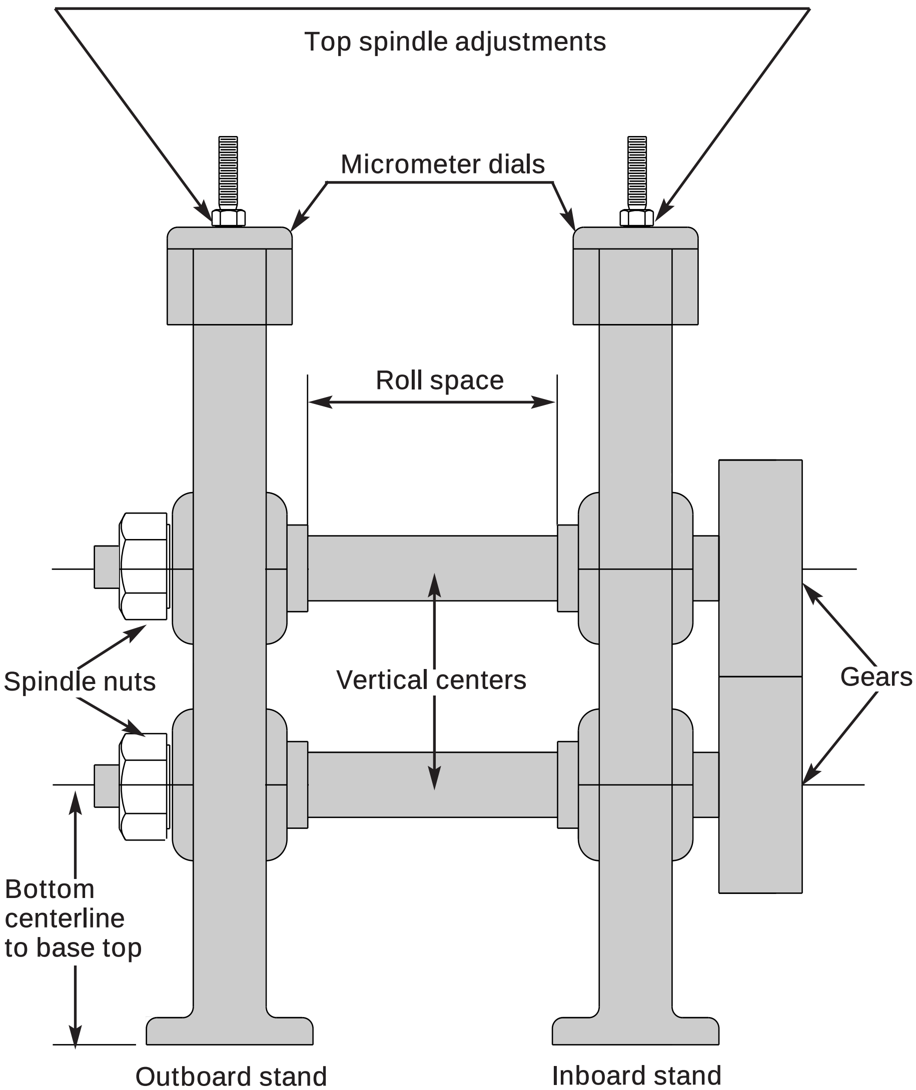

Fig. 3

material will buckle between passes.

When regrinding the rolls, be sure to rework all passes. A more cost-effective approach might be to replace any badly worn pieces with new ones of the same size. The pieces on either side of those being replaced and the opposing ones should be sent to the roll manufacturer to match the new pieces to the existing ones. Otherwise, roll gaps might be uneven, marking the material or putting a twist into it.

One way to combat roll fight in a pass is to disconnect the drive to the top-roll spindle by removing a gear or universal drive shaft.

The fact that the tooling engineer selects the roll drive points and drive diameters does not guarantee they will coincide with the actual ones. Therefore, the manufacturer should test the rolls, before they are shipped to the user, on a machine with the same horizontal centers as the production machine.

Statistical-process-control methods have shown that it is possible to produce an acceptable part in test, but not consistently in production. After debugging the rolls in test, have the roll manufacturer run a full coil of parts, or the equivalent in cut-to-length sheets, before approving the tooling. If you can, before accepting rolls, use SPC to confirm that they perform consistently.

Rolls want to drive the material being formed where they grip the material, at a bend point. Tooling engineers may set the drives at theoretical points in space that lie vertically between bend points. In those cases, any change in roll pressure will shift the actual drive points up or down and affect the roll performance.

Operator Access to Roll-Design Drawings

Tool engineers take pride in the features that they incorporate into roll design. However, operators may not be fully aware of these features and must discover them on their own. This, however, is not as difficult as it might first seem. The operator should always have access to the drawings of the roll tooling. When reviewing the roll design drawings, the operator should confirm the drive diameters to determine the pressure sensitivity of the rolls and the step-up between passes. From these drawings an operator can determine the gap between the top and bottom rolls—the design gauge for that set—and the role of each pass.

Comparing the gap from one pass to the next exposes what changes the engineer expected to make in the shape of the material at each station. A little common sense and a freehand sketch of all the gaps is all that is needed to determine where the material is bent in a pass, and how much. Advanced features become obvious.

Often an operator can predict how changing the pressure, by raising and lowering the top rolls in a pass to change the gap, might affect the profile. By combining a study of the progression—the series of roll gaps—with the experience gained in threading material through the rolls and making a production run, the operator also may be able to identify critical passes in the roll set.

The best profile is rollformed if all of the rolls are set to do their share of the work. Changing pass settings will adversely affect residual stresses in the final product, or its dimensions. The exception in every set of roll tooling is its critical pass, which can be adjusted to make modifications to the profile. **MF**