

# Angle-Rolls: Reliable Tube Bending, without the Glamour

**ANGLE-ROLLS HAVE BENT TUBE AND CHANNEL ON THE SHOP FLOOR FOR YEARS. BEING A MANUAL MACHINE, IT REQUIRES CAREFUL SETUP. BUT GOOD RECORDKEEPING CAN SHORTEN THE LEARNING CURVE FOR NEW OPERATORS.**

**T**he manual angle roll represents an old standby among metal fabrication equipment. It's far from the centerpiece of most metal manufacturing shops, but, like the ironworker and other "old standbys," it's there when needed. It can, with little glitz and glamour, reliably bend tube and channel for years.

A single-pinch-roll angle bender boasts a straightforward operation. It takes a straight round or box tube, extruded metal or beam, and turns it into a radiused piece (Figures 1 and 2).

The center roll bears pressure on the material to form the radius, which can change by moving the center roll up or down. The two other rolls in the pyramid stay fixed. On some older-style machines, the rolls are moved up and down manually. Most models, though, have digital displays that show the center roll's exact position. A pass is represented by each time the center roll moves down a specified distance, and the goal is to bend the material with as few passes as possible.

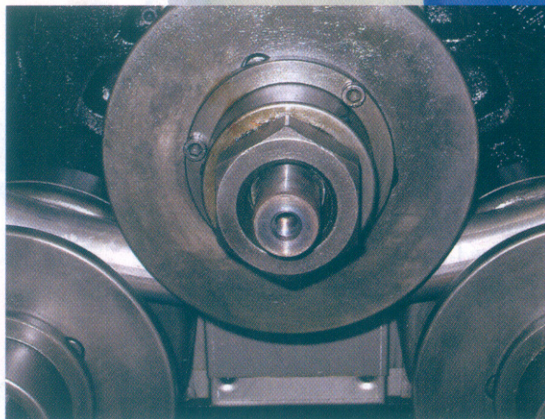
This month, *Fabricating & Metalworking* talks with Scott Tunis, general manager, CML USA Ercolina, Davenport, Iowa, about the basics of manual single-pitch angle-roll bending.

**F&M: Explain the conventional setup of this machine.**

**Tunis:** First, note that this is a manual machine. Technology is out there that can shave down this setup time, but a lot of additional cost comes with that. But with good recordkeeping and work practices, a shop can dramatically reduce required setup time.

You should plan to have at least two workpieces on the initial setup. First, take a general pass to determine how much deflection a material has when the rolls release, which varies depending on the material's tensile strength. For this reason, it's always good practice to include a "dead" or "free" pass at the end of the operation. A dead pass is where the tube progresses without taking any down-feed pressure, to ensure the bend is consistent. With the proper gauge you can measure the radius to determine the amount of flex you have on the first pass of "X" value, then make subsequent passes of equal or less value depending on what your final radius needs to be.

Be patient. Don't overwork the material, since an over-bend



Figures 1 and 2. The single-pinch-roll angle bender has been a reliable tool on the shop floor for years.

usually means you have to scrap the part—not a good thing, particularly with raw-material costs how they are.

**F&M: Describe the bend characteristics of different material types, say mild steel versus chrome-moly and stainless?**

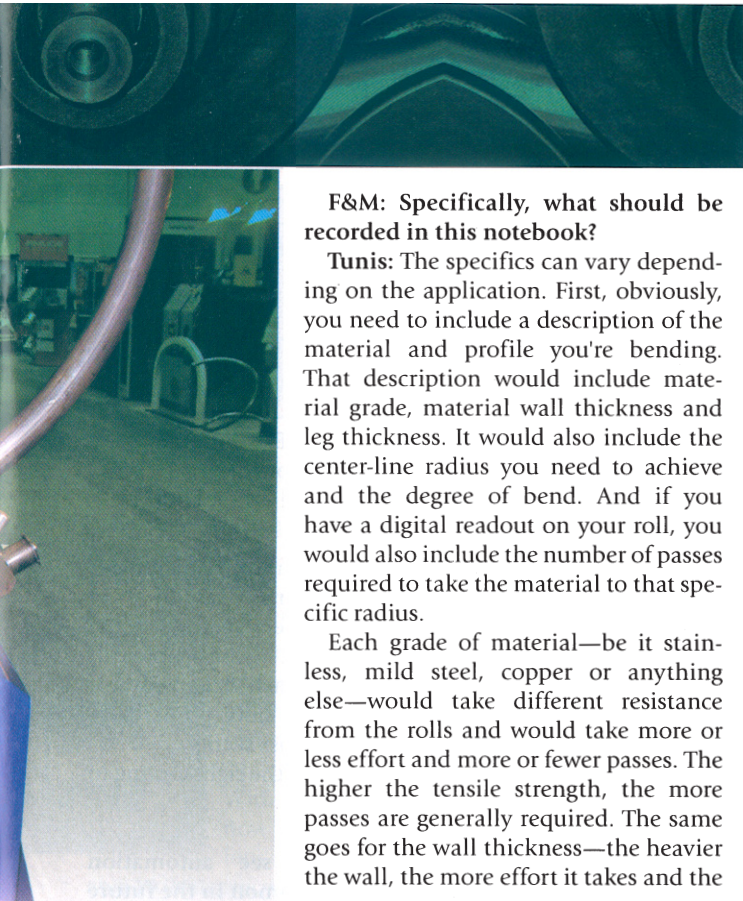
**Tunis:** The chrome-moly and stainless steel would require more bend time. You need to increase the pressure on the center roll slightly due to the materials' higher tensile strength.

**F&M: Describe ways to reduce this setup time without making the investment in a more expensive machine?**

**Tunis:** Machine vendors do have guidelines for minimum radii that can be achieved, but the specifics really depend on the material and the particular application.

A good notebook (Figure 3) can help slash setup time immensely. Pay attention to how much pressure it takes to bend a material to a certain radius. Over time, you can develop a library for different materials—this, in turn, minimizes future setups.

It all comes back to experience. An experienced operator can walk up to a machine, touch off a part, make the proper pass and be very close on the first piece. With a new operator, it's a different story, and that's where this notebook comes into play. It helps that new person develop a working knowledge of the machine faster.



**F&M:** Specifically, what should be recorded in this notebook?

**Tunis:** The specifics can vary depending on the application. First, obviously, you need to include a description of the material and profile you're bending. That description would include material grade, material wall thickness and leg thickness. It would also include the center-line radius you need to achieve and the degree of bend. And if you have a digital readout on your roll, you would also include the number of passes required to take the material to that specific radius.

Each grade of material—be it stainless, mild steel, copper or anything else—would take different resistance from the rolls and would take more or less effort and more or fewer passes. The higher the tensile strength, the more passes are generally required. The same goes for the wall thickness—the heavier the wall, the more effort it takes and the more passes.

That kind of information, recorded, well-organized and placed near the machine, will over the long haul help the operator gain a better understanding of each material. This notebook, in essence, builds an "experience library."

Consistent definition of terminology is required. For instance, "center-line radius" differs from the "bend angle." Center-line radius represents the dimension from the center of the arc to the center of the profile of material, whereas the degree of bend represents how many actual degrees the material is bent under the roll.

**DON'T OVERWORK THE MATERIAL, SINCE AN OVER-BEND USUALLY MEANS YOU HAVE TO SCRAP THE PART —NOT A GOOD THING, PARTICULARLY WITH RAW-MATERIAL COSTS HOW THEY ARE.**

If you roll a 360-degree (bend angle) circle, stick a pin into the middle of the circle and measure to the center of the tube—if that distance is, say, 6 inches, that 360-degree bend angle would have a 6-inch center-line radius.

It's a forgotten step, particularly if a fabricator doesn't have true prints or documents to look at. Many say, "I want a 90-degree bend." But they forget a 90-degree bend can be at a 10-inch radius or 20 inch radius and so on.

**F&M:** Are there any special tooling considerations?

**Tunis:** You want the entire cross section supported properly, and that of course depends on the material geometry.

Consider a 3-inch box tube. With conventional tooling, you would have a half-inch shoulder on the left and right. The profile would rest on those shoulders; as you would work that center roll down and deform the material, the box tube

## Sample Record for an Angle-Roll Bending Operation

Material Description	Material Grade	Desired Centerline Radius	Maximum Degree of Bend	Spiral or Pitch	Number of Passes Required	Center Roll Downfeed per Pass	Total Downfeed Movement
1-inch square tube	Mild Steel 1018	48 inches	180	None	4	0.25 per	1 inch

Figure 3. Sample information recorded for a particular bend operation. Records like this for each operation can greatly reduce setup time, particularly for

inexperienced operators. Source: CML Ercolina USA. (Note: This is for illustration purposes only; actual parameters will vary depending on the application.)

would be deformed into that shoulder slightly, creating sharp edges. To avoid this, you would insert spacers in the center of the flanges. Those spacers fill up the entire three-inch cross width of the material, so you have proper support for the entire cross section.

In short, you need the right tooling to fit your profile.

**F&M:** Do you see automation becoming more common in the future to help reduce setups?

**Tunis:** I do, but typically automation

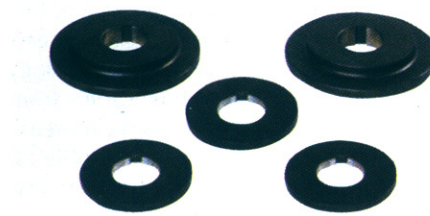


Figure 4. Modular tooling for the angle roll.

comes with a pretty big price tag when you're talking about rolling, and many rolling applications don't warrant the productivity levels that price tag would require.

Larger shops are candidates for CNC rolls. However, with that said, you still have the tooling challenges and you still have the material specifications that have to be reviewed. So it doesn't take the operator skill out of it just because it's a CNC roll.

A lot of misconceptions exist about bending, but when you break it down and do your homework, it then becomes a lot easier.

*Editor's Note: Artwork courtesy of CML USA Ercolina, [www.ercolina-usa.com](http://www.ercolina-usa.com).*