Bump radius bending

There is a way that a large radius bend can be performed on the press brake. It is by bumping the radius to the required angle and radius.

It is of particular value for the production of proto-types or when special tools are unavailable. In order to produce a bump radius there are some new terms that need to be explained.

First is the arc length as measured along the inside surface of the radius, figure 1. There are many different ways this length can be calculated, one of the easiest is:

\[ \text{Arc length} = \left( \frac{\text{Bend Angle complementary}}{360} \right) \times 2 \pi \times \text{Inside Radius} \]

or

\[ \text{Arc length} = 6.28 \times \text{Inside Radius} \times \left( \frac{\text{Bend Angle complementary}}{360} \right) \]

Second is the "Radius Pitch"; this is the number of "bends" or "steps" used to form the radius and bend angle. The number of times that a bend must be made to achieve the desired workpiece varies greatly depending on the desired results.

It comes down to time or cosmetics. The greater the number of steps the smoother the outside of the radius will be, figure 2.

Assuming that a smooth outside radius is desired, we begin by dividing the bend angle by two. If the bend is 90°, the number of individual bends will equal 45°. This makes the angle of each bend about 2°, regardless of the final bend angle. The distance between each individual bend is found by simply dividing the arc length by the number of steps in the bends.

Die Width Selection (bump radius)

This die selection process differs from the ways we have covered earlier, because we will not be penetrating the die space to any great depth, only about 2° per bend.

This means that we can use a slightly smaller die width than normally would be used. The optimum die width as we would normally compute it would be much too large for reasons that we have not covered yet.

The optimum die width for a bump radius bend is equal to two times the radius pitch, figure 3. This smaller die opening allows the workpiece to lie flat across the top of the die set, instead of having one side of the part resting on a flat and the other resting on the radius.

If a large die is used, you will never be sure that you consistently made contact with the backgauge. Consequently each step could be in a different location, causing the final radius and angle to vary greatly from end to end. Except
for some special occasions, the optimum die width for a bump radius bend would be expressed as:

\[
\text{Die width} = (RP) \text{ radius pitch} \times 2
\]

**Punch radius**

The required radius of the punch is, to some extent, irrelevant. However, it is best to use a punch radius that is not in the “sharp” bend realm, e.g., using a punch nose radius less than 63% of the material thickness. The reason for not using a sharp radius punch is simple; a “sharp” bend punch radii will leave a more distinct bend line in the work piece. This, in turn, will make for a rougher outer surface.

**The Depth of Penetration**

The amount of penetration into the die space has a direct relationship to the die width selected. If you were to select your die width as described above, the depth of penetration would be about 2” for a smooth outer surface. This will not be much deeper than the pinch point. Still, watch your tonnage loads. The pinch point is defined as the point where the punch nose is firmly holding the sheet material.

A depth of penetration’s starting point for the test bend can be expressed as:

\[
\text{depth of penetration} = \left(\frac{\text{die width}}{2}\right) + Mt - 0.02
\]

**The Process**

Making the process easy requires you to be extremely precise, both in angle and flange dimension. Take the time to ensure the bend angle is consistent down the entire length of the part. Set up the tooling and check the angle by producing an angle somewhere between 60 and 80°; anything but 90°; this ensures an air form. Once accomplished, the press brake is ready to be set to 2°, an air form.

Next, make sure that there is ZERO taper in the backgauges. Now you are ready to program the part.

The starting location will equal the leg (edge to tangent) of the workpiece added to the length of the arc. This will be your starting point as shown in figure 4. It also shows how the workpiece is pushed out toward the operator as the forming process occurs.

This video outtake is courtesy of Prima Power and shows the concept of bump radius forming. As a point of note, the bends in the clip were done robotically instead of manually as described above.

**Up down folding**

Bump Radius Bend

*Outtake courtesy of Prima Power*

A large radius mage through a series of small bends.