BLANK DEVELOPMENT

For Formed Sheet Metal Parts

There are many systems employed by a variety of industries (aircraft, electronics, architectural, automotive, etc.) to account for what happens in a sheet metal part when bending it from its flat blank state to its final bent-up form: "Setbacks", "Bend Allowances" and "K Factors" are somewhat different approaches to arrive at a proper flat blank size and insure that features are correctly located on given part side after bending.

The system illustrated here is one developed by staff of a former precision manufacturer in Berkeley, CA. It has proven over many decades, when doing "coin" bending*, to produce extremely accurate and reliable results.

* Please Note: The following formulas for right-angle bends assume a bending process called "coin" (or, "bottom") bending ... as opposed to "air" bending.
DIMENSIONING WITH NON-90 DEGREE BENDS

Extension Line Dimensioning

Tangential Dimensioning
Illustrated here is the development of a blank for parts having a standard 90 deg. bend. Shown is a common dimensioning method and calculation of a Setback (bend deduction) *

\[ SB = \text{Setback: The amount to be subtracted from the sum of the outside dimensions of the two legs of the bent part; the object is to determine the correct length of the flat blank in preparation for bending. The formula for this is} \]
\[ SB = 0.43r + 1.372t \]

\[ r = \text{The radius on the inside curve of the bend.} \]
\[ t = \text{The thickness of the sheet or plate} \]

Developing the flat blank length for the above drawn part:
Calculate the Setback and then subtract it from the sum of two outside dimensions as follows -

Where \( r = 0.125 \) and \( t = 0.125 \),

\[ SB = 0.43(0.125) + 1.372(0.125) \]
\[ = 0.0538 + 0.1715 \]
\[ = 0.225 \]

Then \[ 2.000 + 2.000 \]
\[ = 4.000 - 0.225 \]
\[ = 3.775 \] This is the length of the flat blank.
In example #2 of flat blank development, everything is the same as example #1 except the metal thickness ("t" now = .062):

**EXAMPLE #2**

\[ SB = 0.43(0.125) + 1.372(0.062) \]
\[ = 0.0538 + 0.0851 \]
\[ = 0.139 \]

Then
\[
\begin{align*}
2.000 + 2.000 &= 4.000 \\
-0.139 &= 3.861 \quad \text{This is the length of the flat blank.}
\end{align*}
\]

**EXAMPLE #3**

\[ SB = 0.43(0.032) + 1.372(0.062) \]
\[ = 0.014 + 0.0851 \]
\[ = 0.099 \]

Then
\[
\begin{align*}
2.000 + 2.000 &= 4.000 \\
-0.099 &= 3.901 \quad \text{This is the length of the flat blank.}
\end{align*}
\]
NON-90 DEG. SETBACKS - EXTENSION LINE DIMENSIONING

$$SB = 2(r + t) \tan \left( \frac{a}{2} \right) - 2\pi \left( r + 0.4t \right) \frac{a}{360}$$

$a$ = Angle of bend, specifically the angle of deflection - in other words, the amount of bend away from the 180° starting point. (To find the deflected angles in these examples, subtract the included angles shown from 180°).

$r$ = The radius on the inside curve of the bend.

$t$ = The thickness of the sheet or plate

NON-90 DEG, SETBACKS - TANGENT LINE DIMENSIONING

$$SB = 2(r + t) - (r + 0.4t) \frac{A}{57.3}$$

Calculate: $1.863 + 1.863 - SB$
CALCULATE FLAT BLANK LENGTHS WITH THE FORMULA
SB = .43r + 1.372t
Calculate the flat-blank location of the center of the hole grid in the X & Y axes from the indicated reference edges:

X = _______________ Y = _______________