## 1.0 Flange Heights - Straight Bends

1.1 Flange Channel Sections

Table 1 indicates the minimum flange channel section height versus material thickness in obtaining a satisfactory flange with in-house equipment, tolerance per DS 50. Refer to Figure 1.

**FIGURE 1 - FLANGE CHANNEL SECTION HEIGHT**

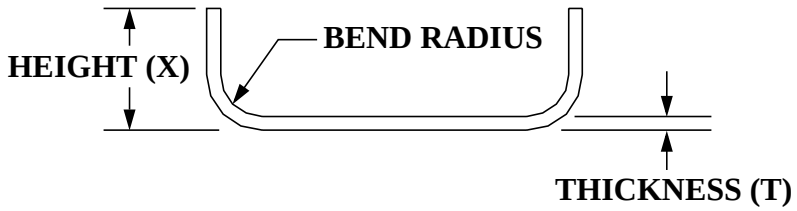


**TABLE 1 - FLANGE CHANNEL SECTION MINIMUM HEIGHT VS. THICKNESS**

| THICKNESS (T)(inches) | MINIMUM HEIGHT (X)(inches) |
|---|---|
| .020 | .21 |
| .025 | .23 |
| .032 | .25 |
| .040 | .35 |
| .050 | .35 |
| .063 | .40 |
| .071 | .50 |
| .080 | .60 |
| .090 | .68 |
| .100 | .70 |
| .125 | .80 |

Table 1 is a general guide and is applicable to flange forming (straight bend) of all sheet aluminum alloys and tempers used in-house considering a bend radius of approximately three times the thickness (3T).

| LIST OF CURRENT SHEETS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PAGE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
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Consult Methods on specific flange height requirements since the forming method, solution heat treat, bend radius and complexity of forming must also be taken into consideration. For the Bend Radius refer to DS 130. For the flange height where rivets exist on the flange refer to DS 135 for the distance from the centre of the rivet to the start of the bend radius, and refer to DS 122 for the distance from the centre of the rivet to the edge of the material.

1.2 Flange Top-Hat Sections

Table 2 and Figure 2 show acceptable flange top-hat section dimensions.

**FIGURE 2 - FLANGE TOP-HAT SECTIONS HEIGHTS**

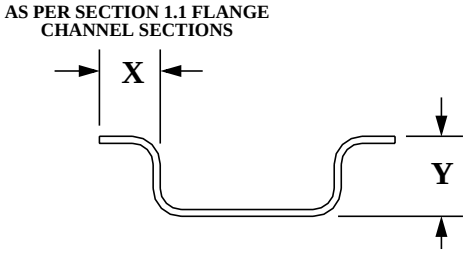



**TABLE 2 - MINIMUM FLANGE HEIGHT FOR TOP-HAT SECTIONS (INCHES)**

| MATERIAL THICKNESS (inches) | "Y" MINIMUM (inches) |
|---|---|
| .000 to .040 | .46 |
| .041 to .072 | .60 |
| .073 to .125 | 1.25 |

## 2.0 Forming Flanges on Curves

The forming of curve flanges can be classified into two types of operations:

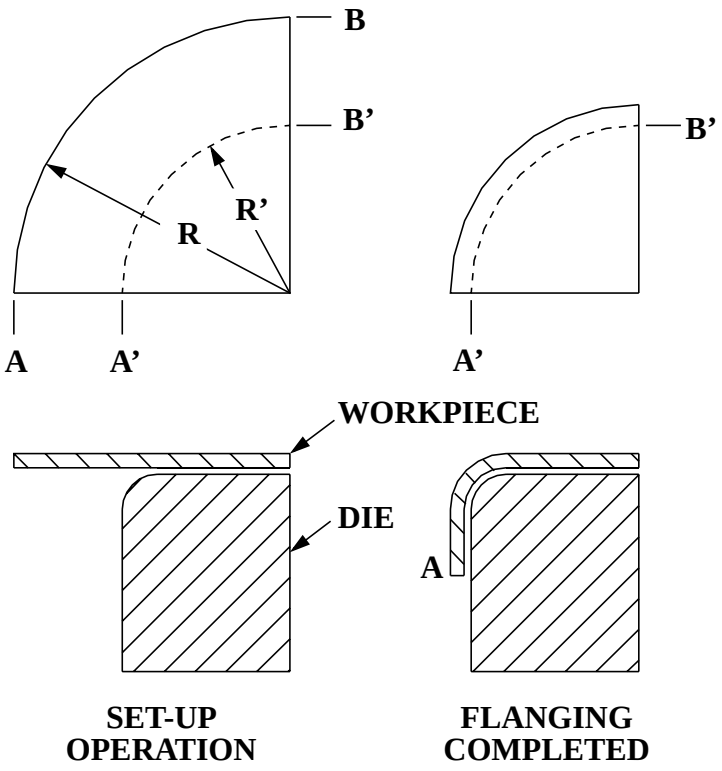
1) Shrink Flanging

2) Stretch Flanging

2.1 Shrink Flanges (Convex Flanges)

a) Shrink flanges occur when a flange is formed on a circular or convex shaped piece of sheet metal. See Figure 3. On forming, the flange periphery is compressed from its longer length in the flat pattern to the shorter length of the finished flange.

**FIGURE 3 - SHRINK FLANGE**

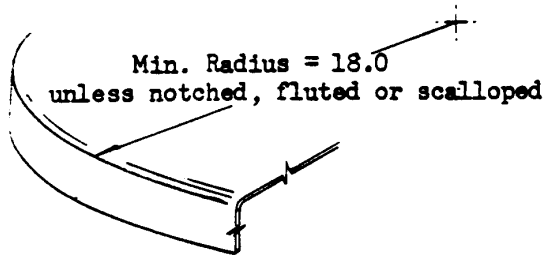



b) Shrink Flange Limitations - Limiting shrink flanges for Aluminum Alloys in Temper "O" and Condition "W" (1-hour), annealed Corrosion Resistant Steel (304, 347) and commercially pure Titanium.

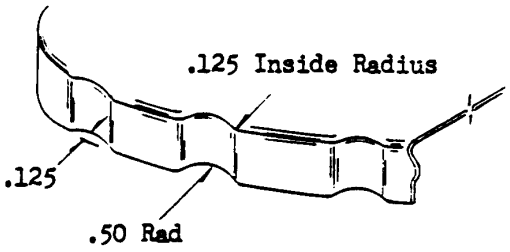
Flange cannot be formed on small radii curves without wrinkling and buckling the edges unless wiper plates or similar auxiliary tooling is used, which results in increased manufacturing cost.

## FIGURE 4 - TYPES OF CONVEX FLANGES

### PLAIN FLANGE




### CYLINDRICAL FLUTES

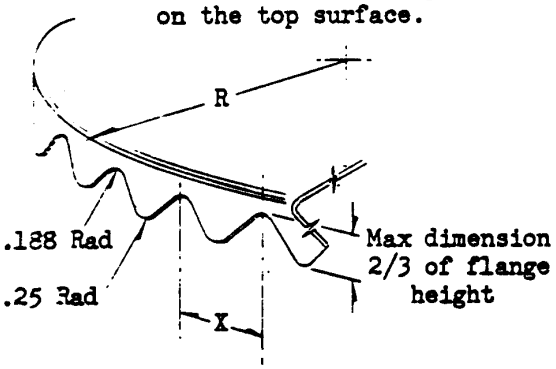



Used where conical flutes may lock on die.

Spacing approx. the same as conical flutes.

### SCALLOP FLANGE

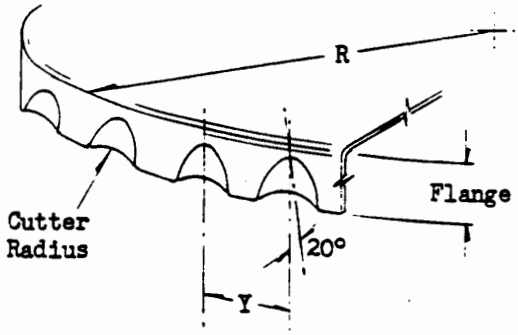
Used where cut-outs are not permitted on the top surface.




| Radius "R" | Dim "X" |
|---|---|
| 6.50 to 8.0 | 1.0 |
| 8.00 to 18.0 | 2.0 |

### CONICAL FLUTES

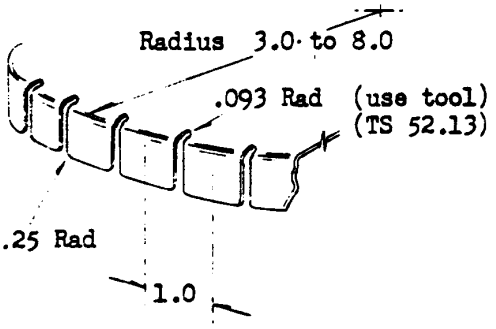
| Maximum Flange | Radius "R" | Spacing "Y" | Cutter Radius |
|---|---|---|---|
| .625 | 8.0 to 12.0 | 1.50 | .375 |
| .625 | 12.0 to 18.0 | 2.00 | .375 |
| .625 | 18.0 to 30.0 | 3.00 | .375 |
| 1.50 | 30.0 to 60.0 | 4.00 | 1.00 |
| 2.00 | over 60.0 | 5.00 | 1.50 |




Max gauge that can be fluted is .064.
Absolute min rivet spacing is 1.25.

Note - Conical flutes dispose metal properly and should be used except where closed bevel would lock on die.

### NOTCHES



Where a continuous flange is not necessary for strength considerations, the alternative of notches, scallops or flutes should be used to accommodate the excess metal in forming as shown in Figure 4.

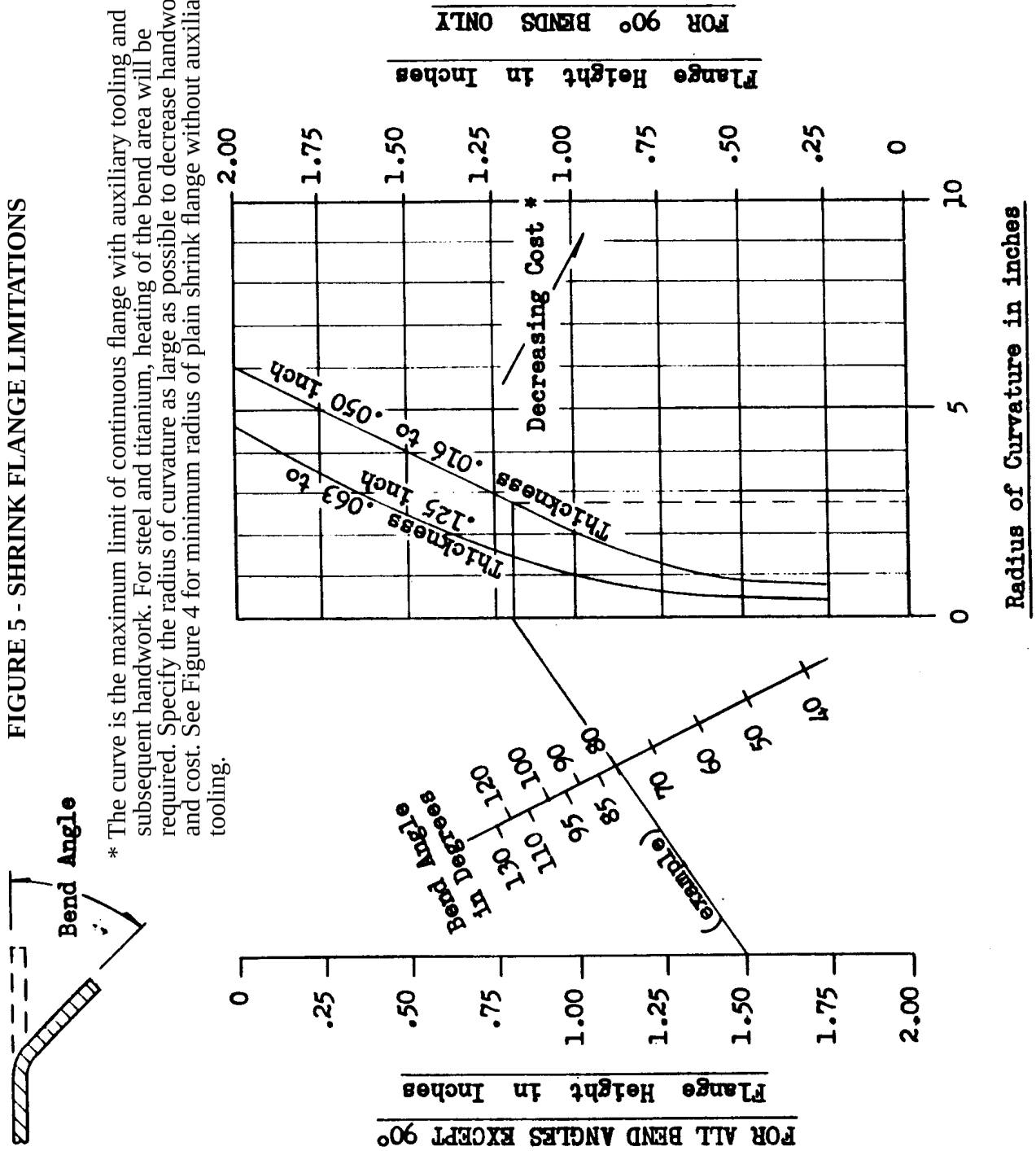
When notches or scallops are not called for in the initial design of a part and later deemed necessary, the detail should be decided during tool proving in conjunction with Methods.

c) Limitations for Forming of Continuous Shrink Flanges -

1) Plain flange without auxiliary tooling has minimum radius = 18 inches. See Figure 4.

2) Plain flange with auxiliary tooling should refer to Figure 5 for limitations.

FIGURE 5 - SHRINK FLANGE LIMITATIONS

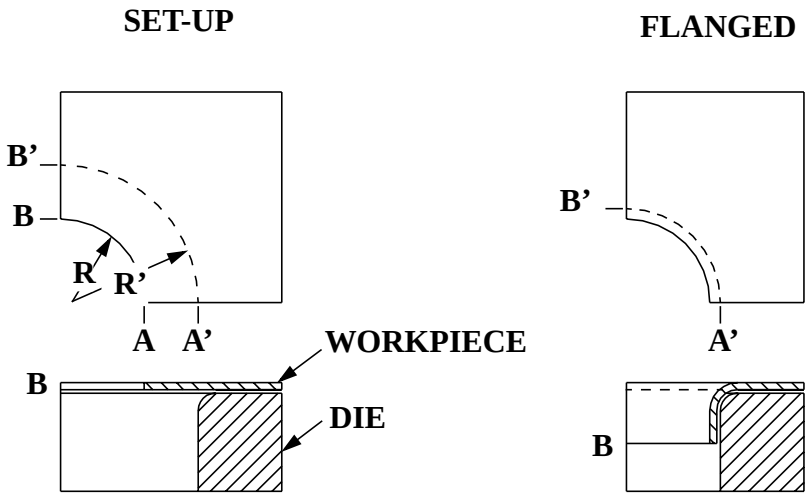



* The curve is the maximum limit of continuous flange with auxiliary tooling and subsequent handwork. For steel and titanium, heating of the bend area will be required. Specify the radius of curvature as large as possible to decrease handwork and cost. See Figure 4 for minimum radius of plain shrink flange without auxiliary tooling.

2.2 Stretch Flanges (Concave Flanges)

a) Stretch flanges occur when a flange is formed on a hole or a concave shaped piece of sheet metal, see Figure 6. On forming, the flange periphery is stretched from its shorter length in the flat pattern to the longer length of the finished flange.

**FIGURE 6 - STRETCH FLANGE**




b) Variables affecting the stretch flanges - these are the flange height and bend angle (if less than 90 ), the radius of curvature, the material gauge and temper.

c) Limitations for Forming of Stretch Flanges -

1) For unrestricted flanges (on open ended sections) such as formers, refer to Figure 7 and Figure 8 for limitations.

2) For flanged lightening holes, refer only to DS-11 and DS-12.

FIGURE 7 - STRETCH FLANGE LIMITATIONS

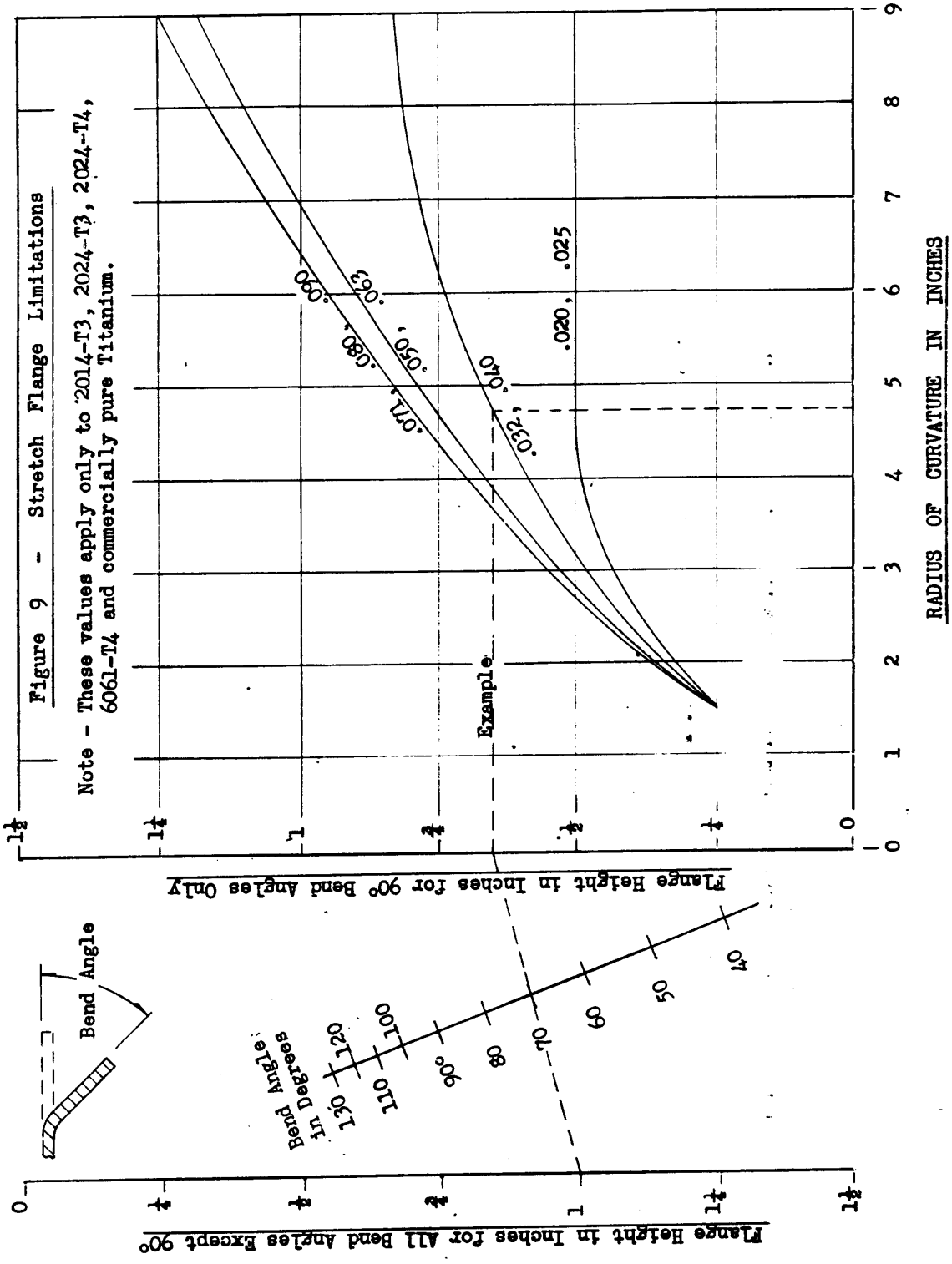



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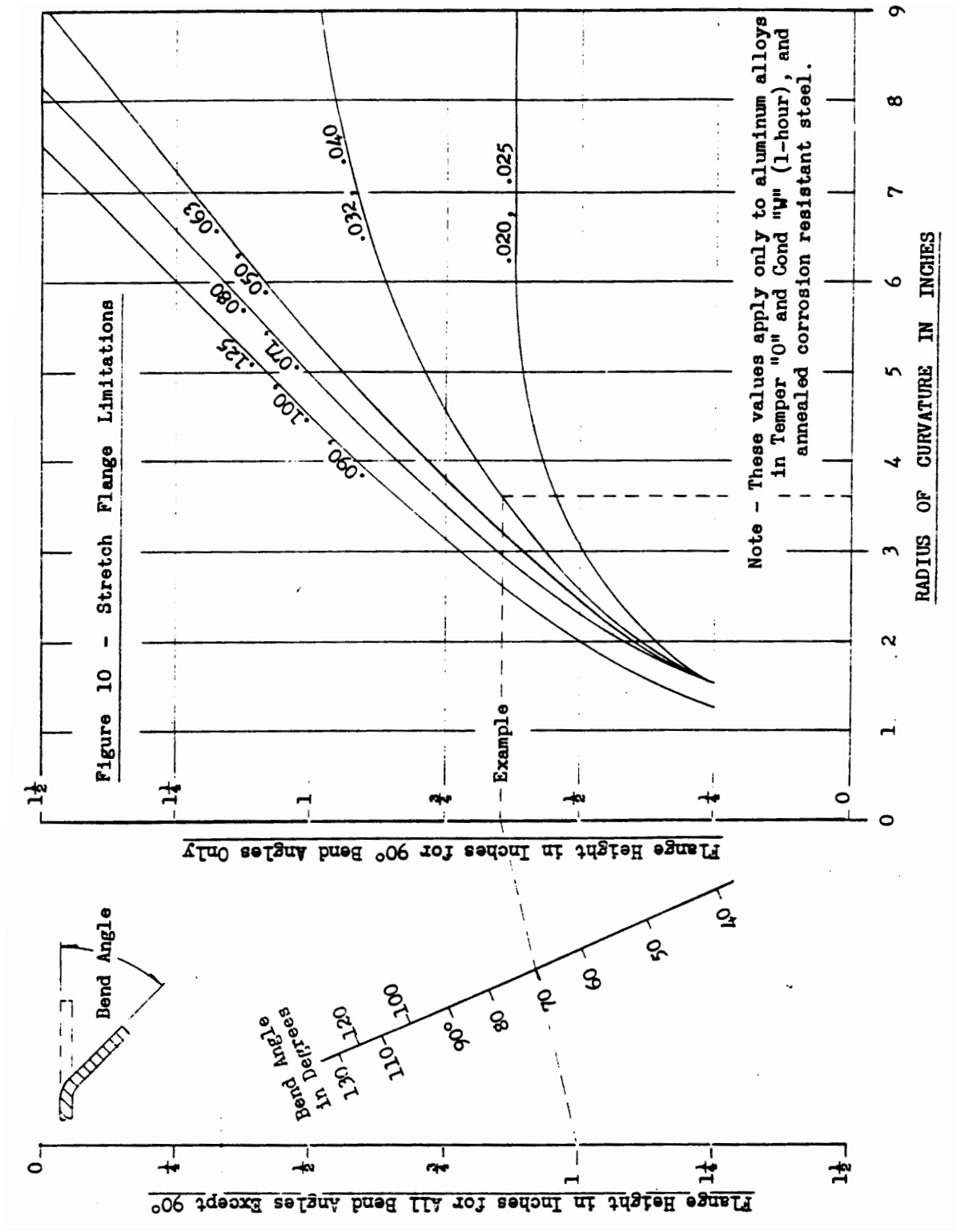
FIGURE 8 - STRETCH FLANGE LIMITATIONS

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| STRESSED | E. CROMIE |
| APPROVED | S. SCHRATTNER |

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2.3 Notes for Design Considerations

The location of tooling holes to properly retain the blank on the bend block during forming operation will be determined between Methods and the Designer.

Lightening holes and swages (or beads) should always be formed on the same side as the flange, that is, the inside.

Channel section parts must not have angles greater than 90°, as this will result in the formed part being “locked” on the form block. This does not apply to the angle sections.

The forming of very narrow flanges, especially if the bend is sharp and the metal is thick or hard, is a difficult operation on the Rubber Press and should be avoided.

For flanges that attach to external surfaces affecting the aircraft contour such as the wing, fuselage and control surfaces. Refer to DS50 for flange angle tolerances.