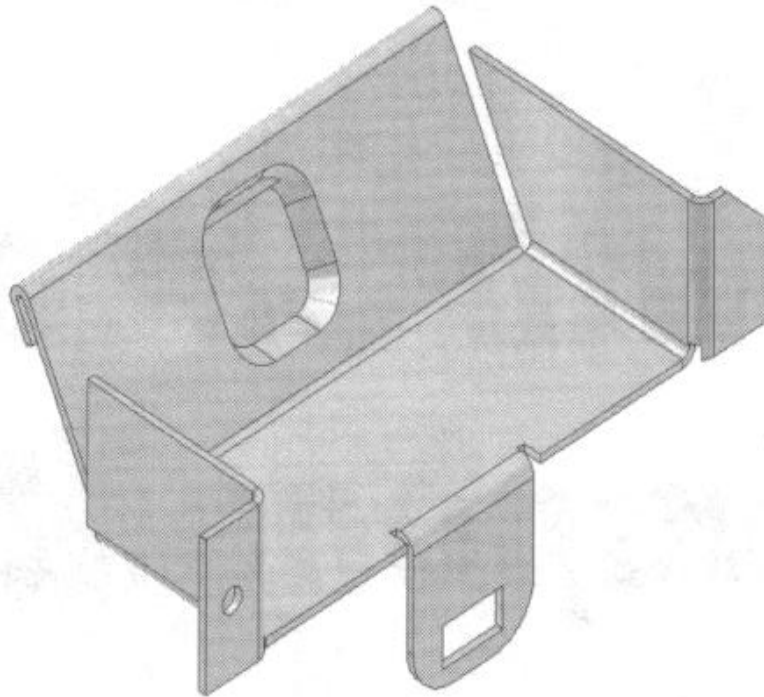


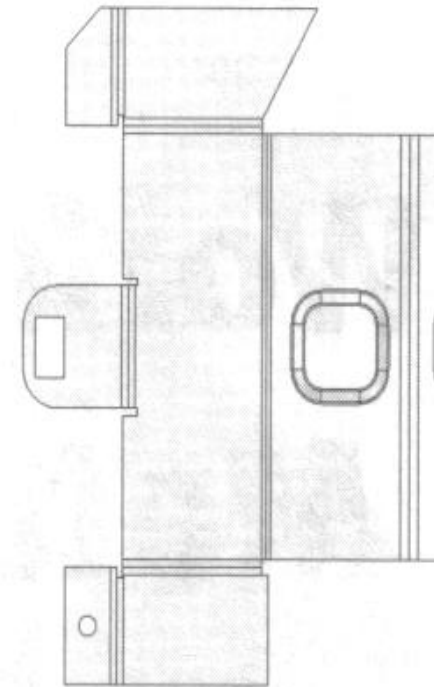
# Sheet Metal Work

Developments

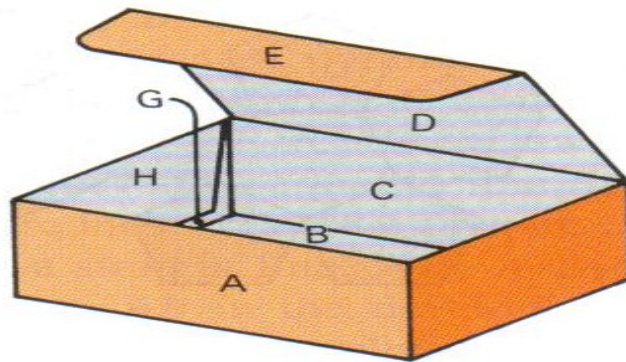
The component having a thickness greater than zero and less than 12 mm is called a sheet metal component. A sheet metal component is created by bending, cutting, or deforming an existing sheet of metal having uniform thickness,



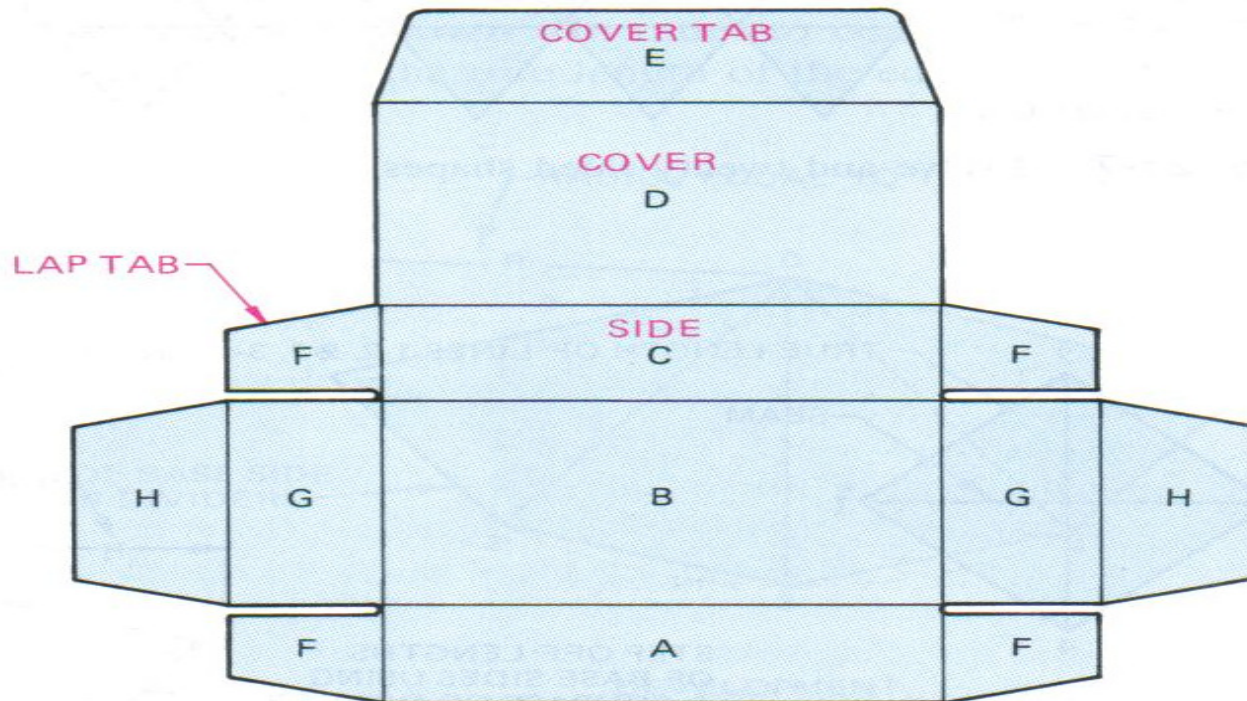
*A sheet metal component*



*Flattened view of the sheet metal component*



(A) FOLDED CARTON

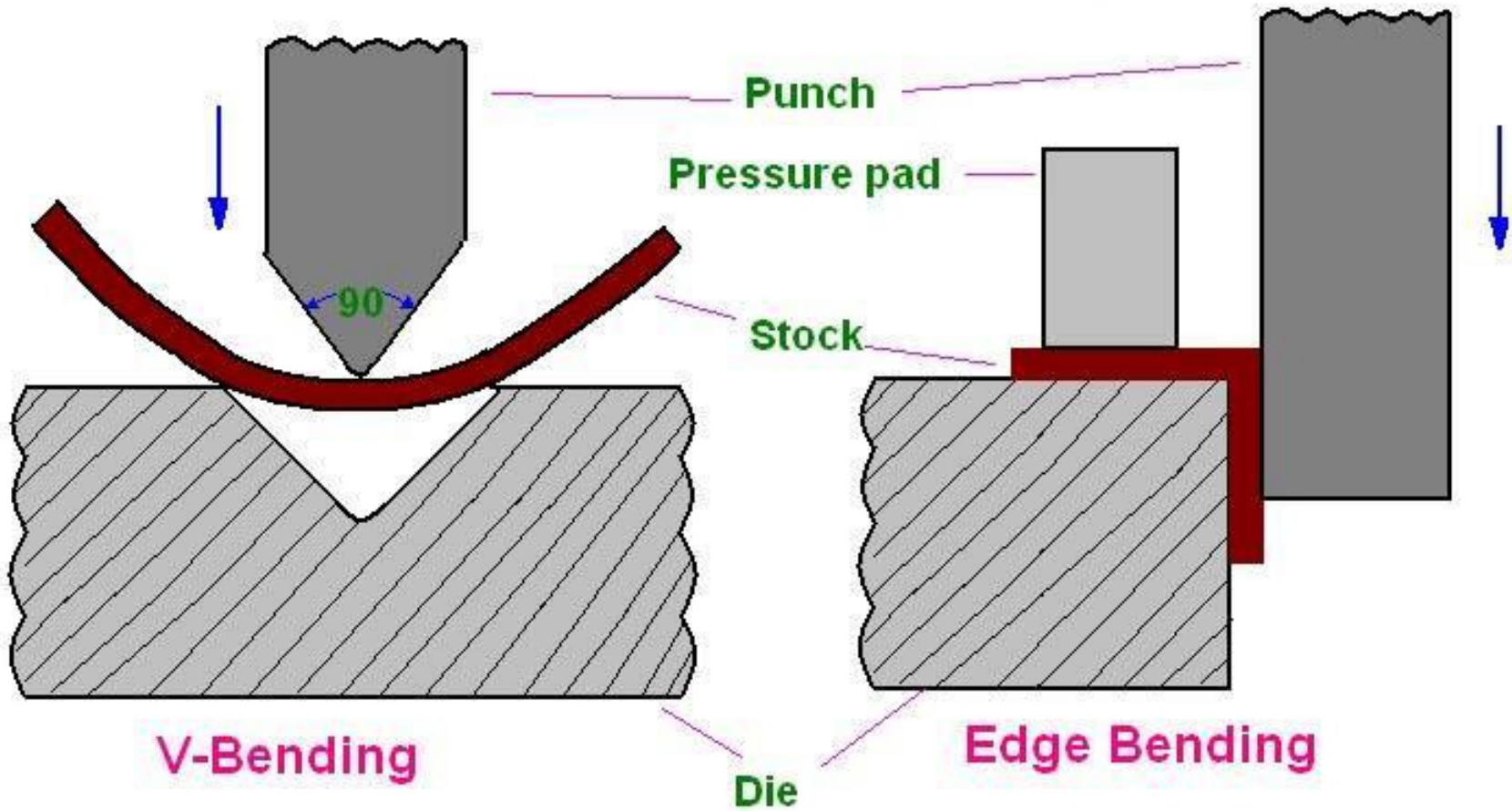


(B) DEVELOPMENT OF CARTON

Development of a one-piece carton with fold-down sides.

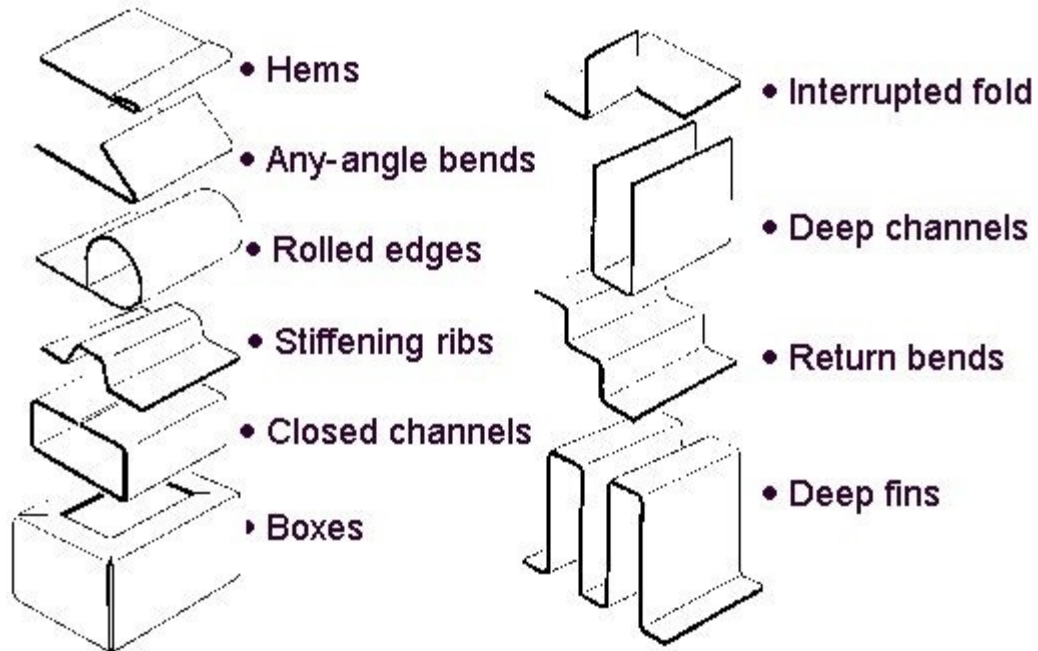
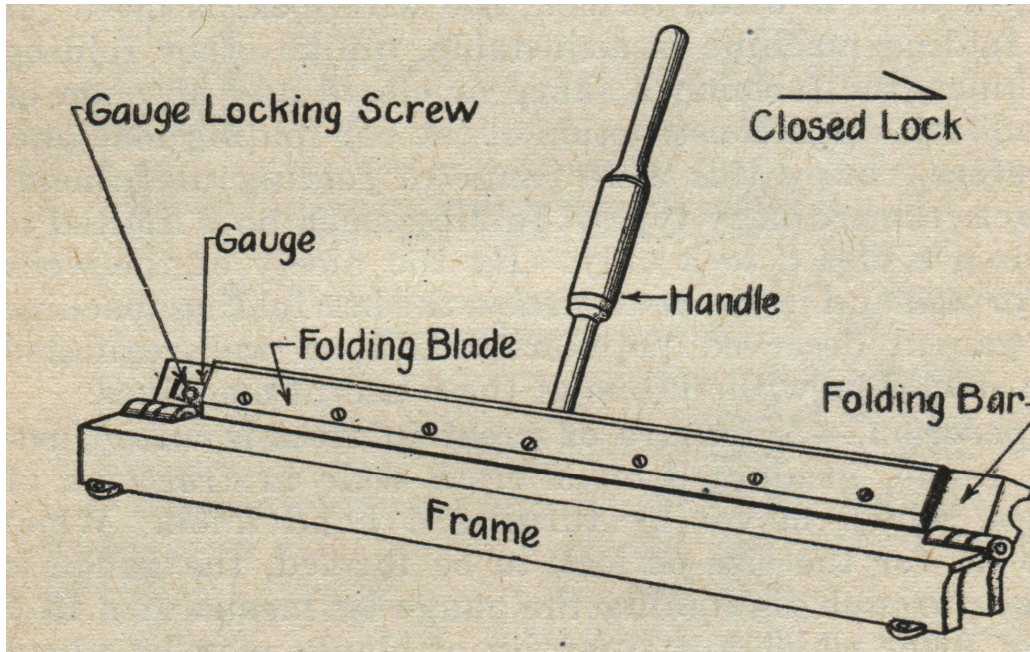
material	thickness (mm)	Aperture (mm)	Levha						Rulo									
			En (mm)	1000	1250	1500		2000		1000	1250	1500	2000	En (mm)				
			Boy(mm)	2000	2500	3000	6000	4000	6000									
Coil sheet	0.2	6																
	0.35	5																
	0.45	6																
	0.8	3																
Flat sheet	0.5	1																
	0.8	1.5																
	1.5	2																
	3	5																
stainless metal plate	0.5	1																
	0.8	1.5																
	1	2																
	2	5																
aluminium plate	0.5	1																
	0.8	3																
	1.5	2																
	2	4																
			Kalınlık (mm)	0.40	x	x						x	x			0.40	Kalınlık (mm)	
				0.50	x	x							x	x				0.50
				0.60	x	x							x	x				0.60
				0.70	x	x	x	x					x	x	x			0.70
				0.80	x	x	x	x					x	x	x			0.80
				1.00	x	x	x	x					x	x	x			1.00
				1.20	x	x	x	x	x	x			x	x	x	x		1.20
				1.50	x	x	x	x	x	x			x	x	x	x		1.50
				2.00	x	x	x	x	x	x			x	x	x	x		2.00
				2.50	x	x	x	x	x	x			x	x	x	x		2.50
				3.00	x	x	x	x	x	x			x	x	x	x		3.00
				4.00	x	x	x	x	x	x			x	x	x	x		4.00
				5.00	x	x	x	x	x	x			x	x	x	x		5.00
				6.00	x	x	x	x	x	x			x	x	x	x		6.00
				8.00	x	x	x	x	x	x			x	x	x	x		8.00
			10.00	x	x	x	x	x	x			x	x	x	x	10.00		

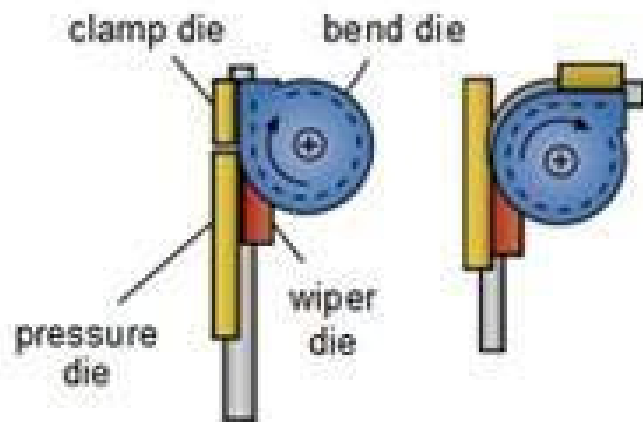
## Methods/Types of Bending



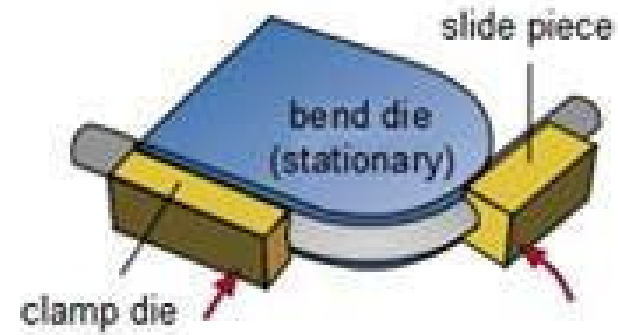
# Bending Machines



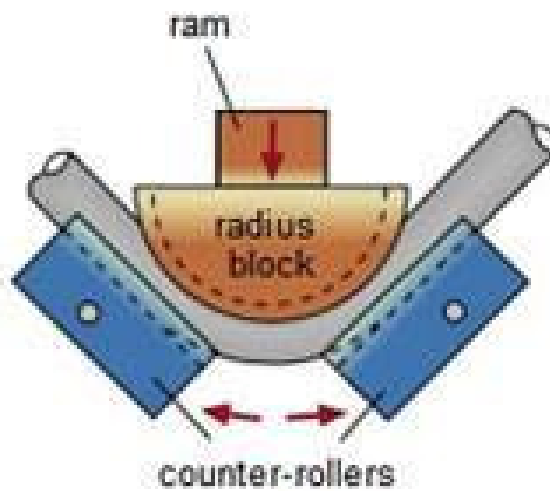




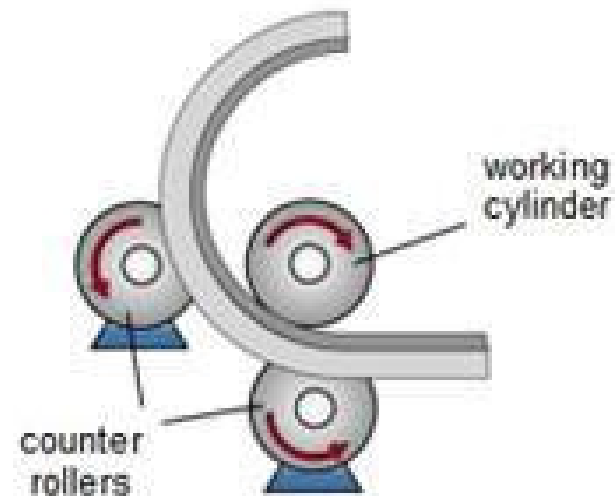
**Rotary draw bending**



**Compression bending**



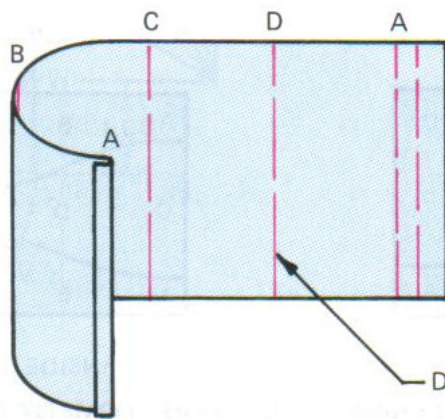
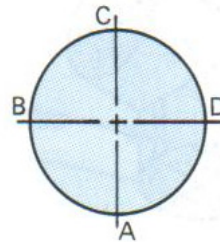
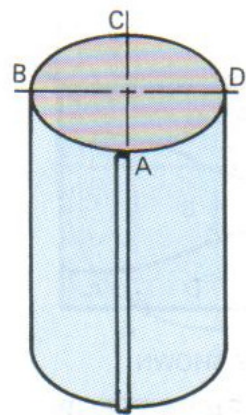
**Ram bending**



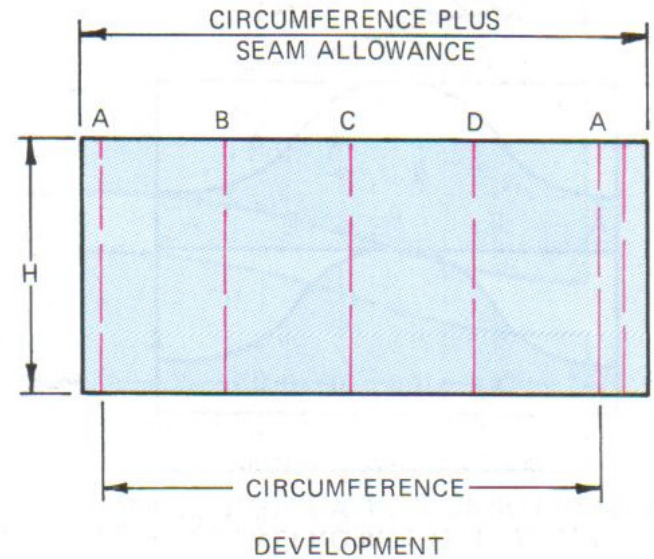
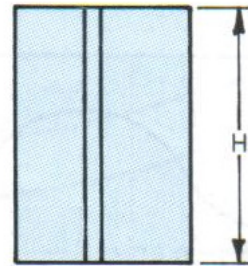
**3 roll bending**



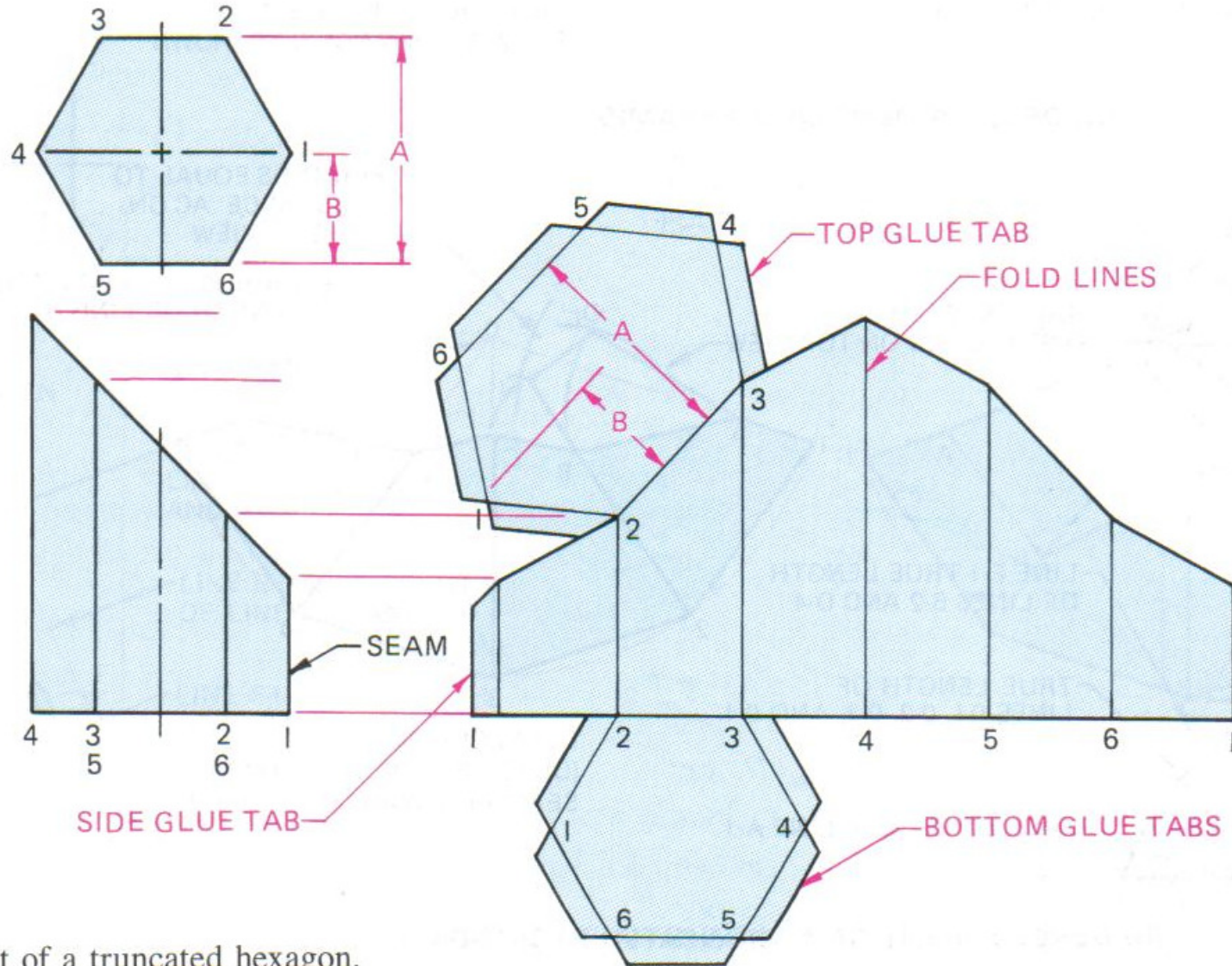
ENLARGED VIEW OF SEAM AT A



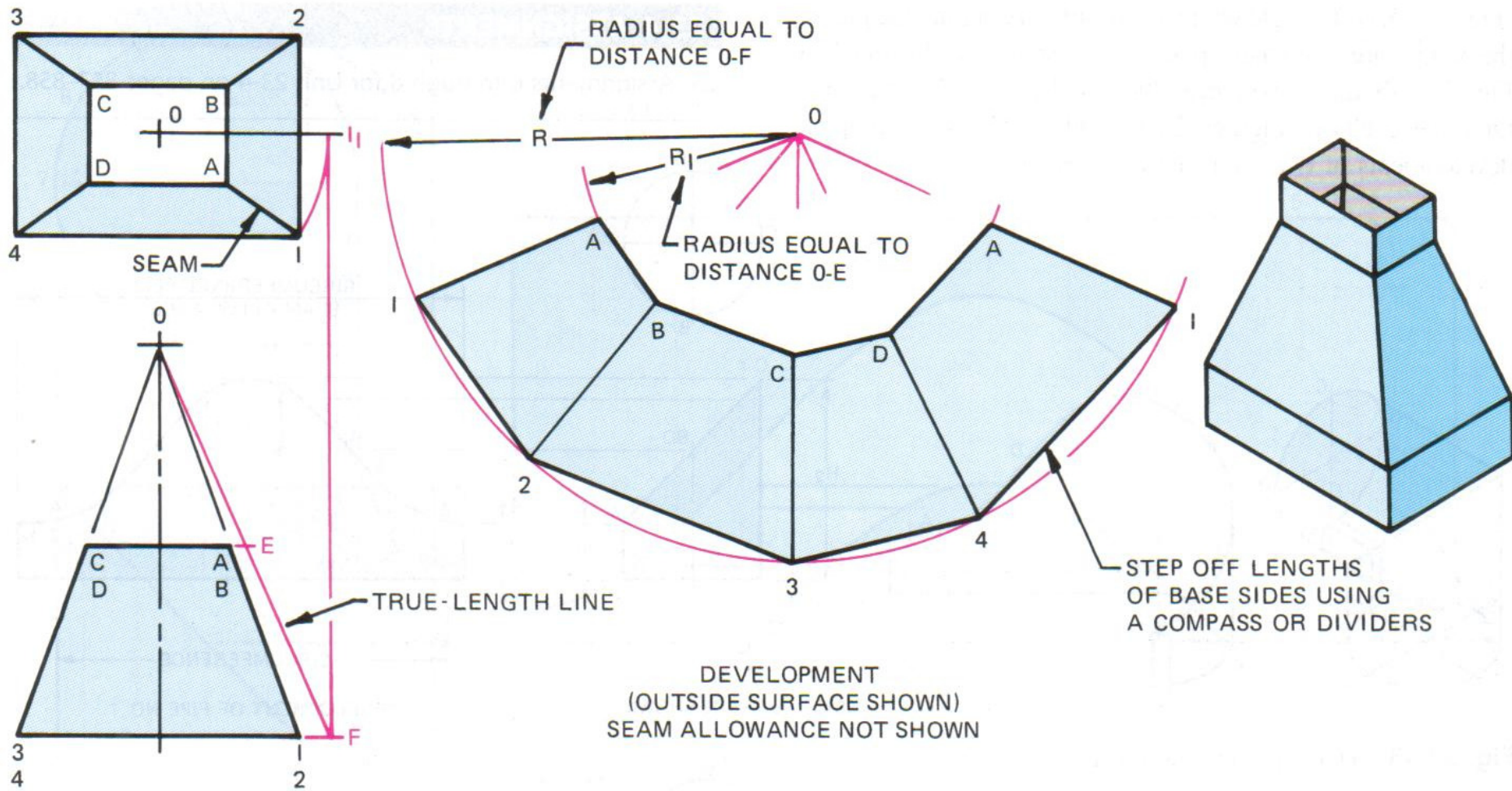
DEVELOPMENT LINES  
INSIDE SURFACE SHOWN



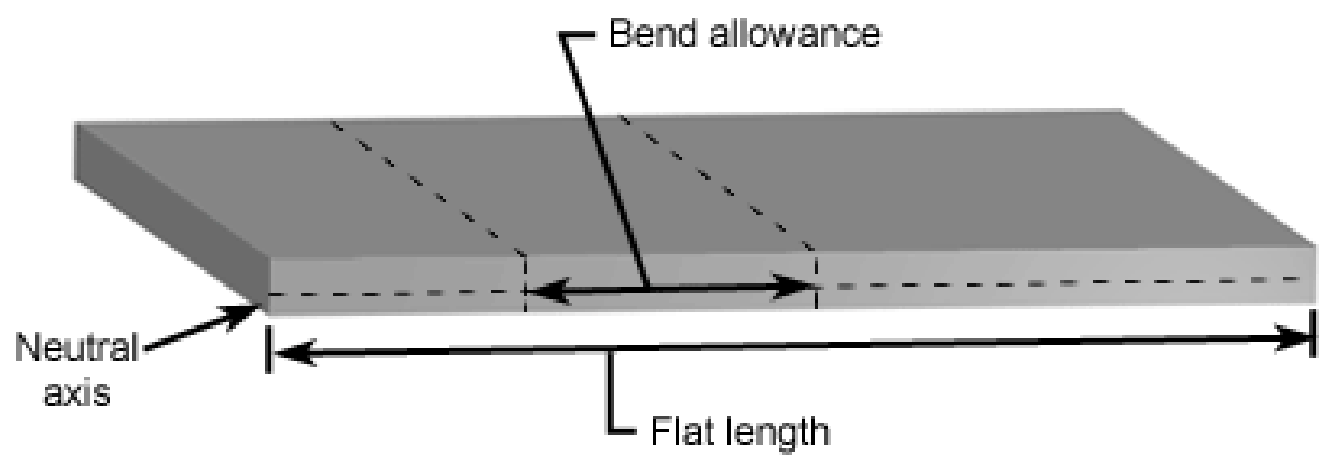
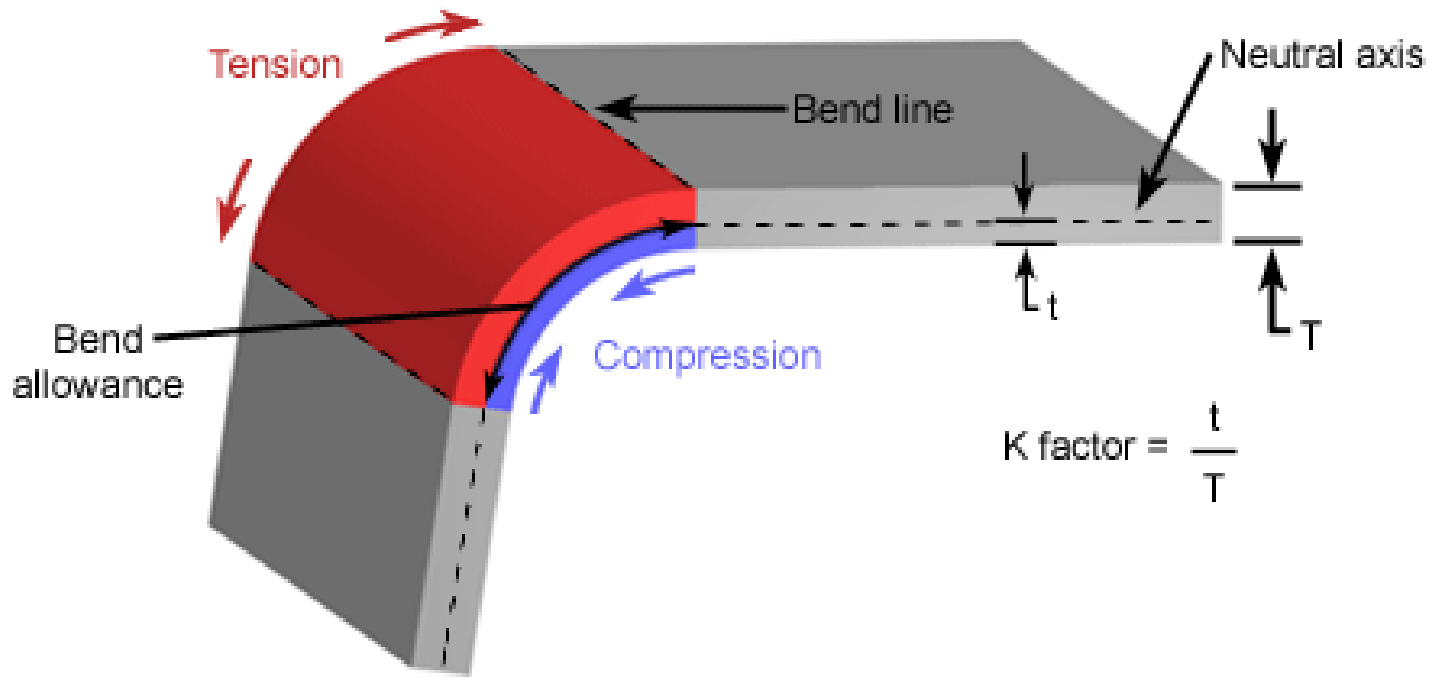
Development of a cylinder.



Development of a truncated hexagon.



Development of a transition piece.



<b>Generic K-Factors</b>	Aluminum		Steel
Radius	Soft Materials	Medium Materials	Hard Materials
<b>Air Bending</b>			
<b>0 to Thickness</b>	<b>0.33</b>	<b>0.38</b>	<b>0.40</b>
<b>Thickness to 3 x Thickness</b>	<b>0.40</b>	<b>0.43</b>	<b>0.45</b>
<b>Greater than 3 x Thickness</b>	<b>0.50</b>	<b>0.50</b>	<b>0.50</b>
<b>Bottoming</b>			
<b>0 to Thickness</b>	<b>0.42</b>	<b>0.44</b>	<b>0.46</b>
<b>Thickness to 3 x Thickness</b>	<b>0.46</b>	<b>0.47</b>	<b>0.48</b>
<b>Greater than 3 x Thickness</b>	<b>0.50</b>	<b>0.50</b>	<b>0.50</b>
<b>Coining</b>			
<b>0 to Thickness</b>	<b>0.38</b>	<b>0.41</b>	<b>0.44</b>
<b>Thickness to 3 x Thickness</b>	<b>0.44</b>	<b>0.46</b>	<b>0.47</b>
<b>Greater than 3 x Thickness</b>	<b>0.50</b>	<b>0.50</b>	<b>0.50</b>

BA = bend allowance

BD = bend deduction

R = inside bend radius

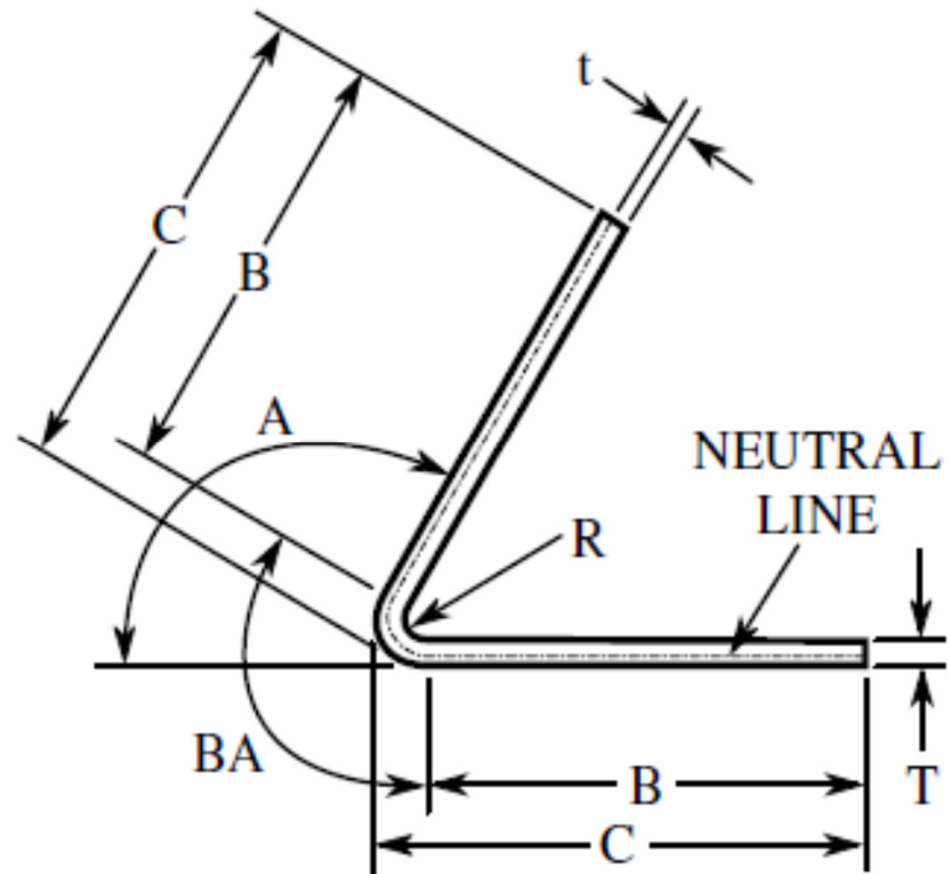
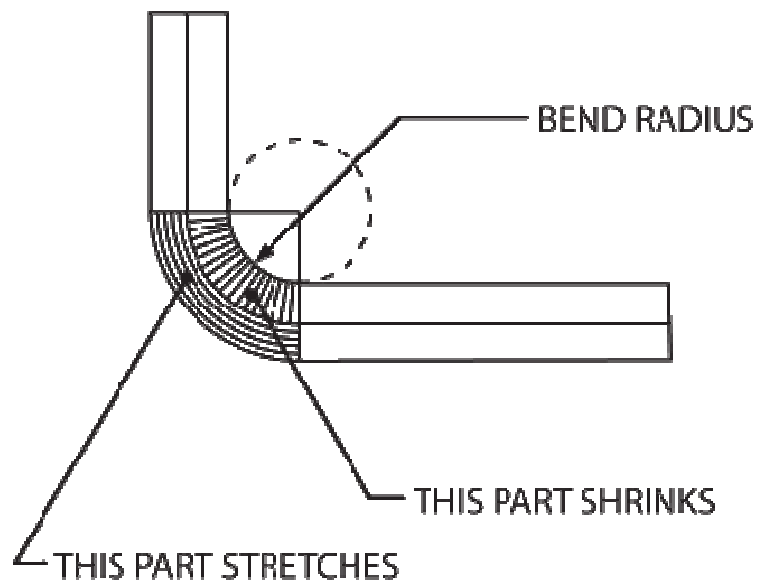
K = K-Factor, which is  $t / T$

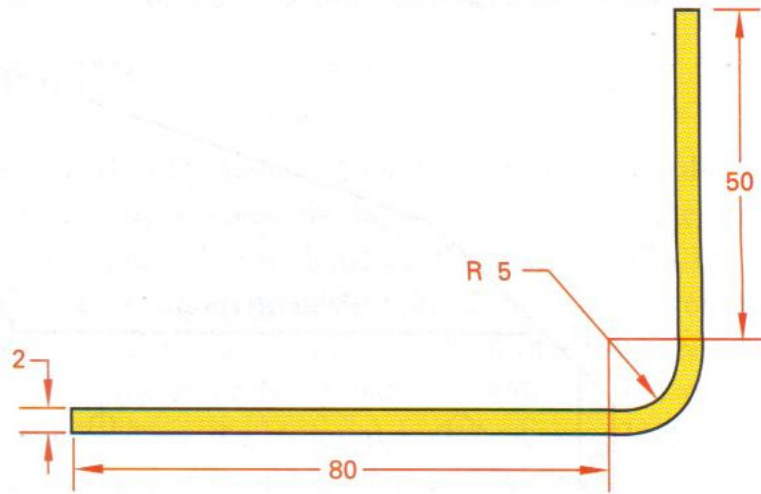
T = material thickness

t = distance from inside face to the neutral line<sup>[6]</sup>

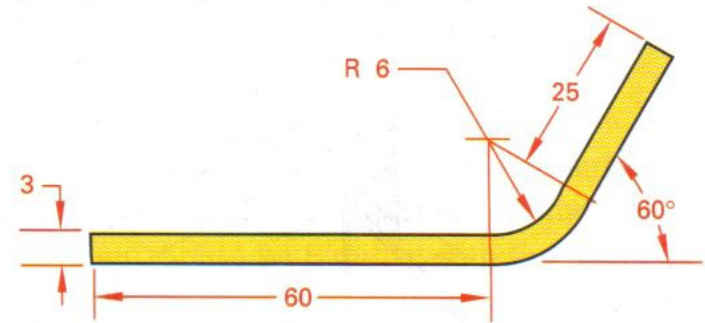
A = bend angle in degrees (the angle through which the material is bent)

$$BA = A \left( \frac{\pi}{180} \right) (R + K \times T)$$

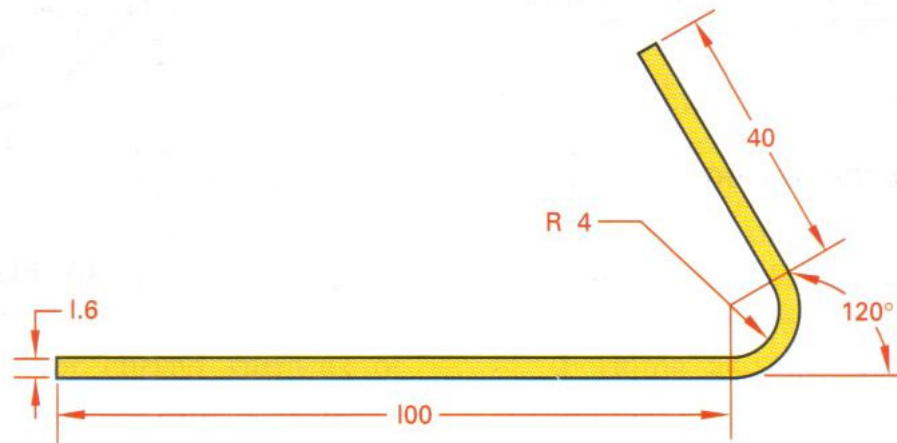




EXAMPLE 1 90° BEND



EXAMPLE 2 60° BEND

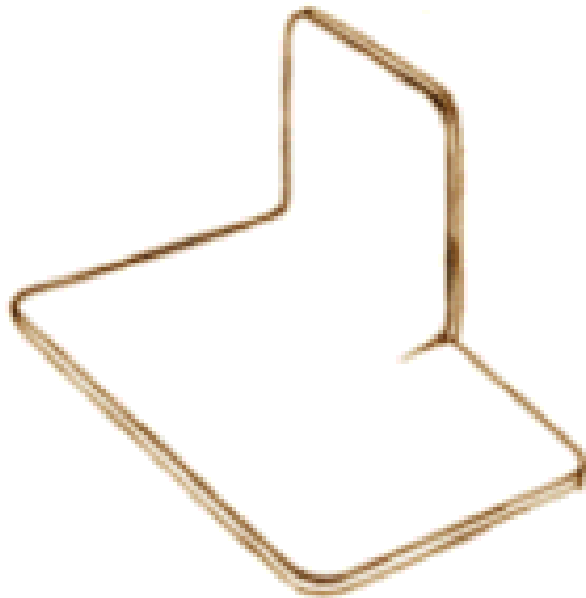


EXAMPLE 3 120° BEND

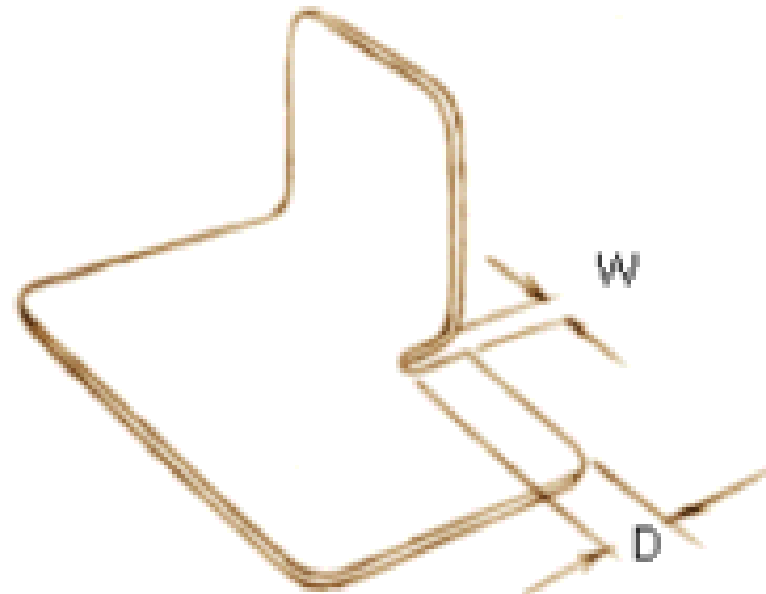
**Bend allowance for each degree of bend.**

Radius (mm)	Degrees	Minimum Metal Thickness (mm)													
		0.40	0.50	0.60	0.80	1	1.2	1.4	1.6	1.8	2	2.5	3	3.5	4
		Allowance													
0.5	1	0.011	0.012	0.012	0.013	0.015	0.016	0.017	0.018	0.019	0.020	0.023	0.026	0.029	0.032
	90	0.99	1.05	1.10	1.20	1.31	1.41	1.52	1.62	1.73	1.83	2.09	2.36	2.62	2.88
1	1	0.020	0.020	0.021	0.022	0.023	0.024	0.026	0.027	0.028	0.029	0.032	0.035	0.038	0.041
	90	1.78	1.83	1.88	1.99	2.09	2.20	2.30	2.41	2.51	2.62	2.88	3.14	3.40	3.66
1.5	1	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.037	0.038	0.041	0.044	0.047	0.049
	90	2.56	2.62	2.67	2.78	2.88	2.98	3.09	3.19	3.30	3.40	3.66	3.93	4.19	4.45
2	1	0.037	0.038	0.038	0.040	0.041	0.042	0.043	0.044	0.045	0.047	0.049	0.052	0.055	0.058
	90	3.35	3.40	3.46	3.56	3.66	3.77	3.87	3.98	4.08	4.19	4.45	4.71	4.97	5.23
2.5	1	0.046	0.047	0.047	0.048	0.049	0.051	0.052	0.053	0.054	0.055	0.058	0.061	0.064	0.067
	90	4.14	4.19	4.24	4.34	4.45	4.55	4.66	4.76	4.87	4.97	5.23	5.50	5.76	6.02
3	1	0.055	0.055	0.056	0.057	0.058	0.059	0.060	0.062	0.063	0.064	0.067	0.070	0.073	0.076
	90	4.92	4.97	5.03	5.13	5.23	5.34	5.44	5.55	5.65	5.76	6.02	6.28	6.54	6.80
3.5	1	0.063	0.064	0.065	0.066	0.067	0.068	0.069	0.070	0.072	0.073	0.076	0.079	0.081	0.084
	90	5.71	5.76	5.81	5.92	6.02	6.12	6.23	6.33	6.44	6.54	6.80	7.07	7.33	7.59
4	1	0.072	0.073	0.073	0.074	0.076	0.077	0.078	0.079	0.080	0.081	0.084	0.087	0.090	0.093
	90	6.49	6.54	6.60	6.70	6.80	6.91	7.02	7.12	7.22	7.33	7.59	7.85	8.11	8.38
4.5	1	0.081	0.081	0.082	0.083	0.084	0.086	0.087	0.088	0.089	0.090	0.093	0.096	0.099	0.102
	90	7.28	7.33	7.38	7.49	7.59	7.70	7.80	7.90	8.01	8.11	8.38	8.64	8.90	9.16
5	1	0.090	0.090	0.091	0.092	0.093	0.094	0.095	0.097	0.098	0.099	0.102	0.105	0.108	0.111
	90	8.06	8.12	8.17	8.27	8.38	8.48	8.59	8.69	8.79	8.90	9.16	9.42	9.69	9.95
5.5	1	0.098	0.099	0.099	0.101	0.102	0.103	0.104	0.105	0.106	0.108	0.111	0.113	0.116	0.119
	90	8.85	8.90	8.95	9.06	9.16	9.27	9.37	9.47	9.58	9.69	9.95	10.21	10.47	10.73
6	1	0.107	0.108	0.108	0.109	0.111	0.112	0.113	0.114	0.115	0.116	0.119	0.122	0.125	0.128
	90	9.63	9.68	9.74	9.84	9.95	10.05	10.16	10.26	10.37	10.47	10.73	10.99	11.26	11.52





No bend relief causes tearing



Bend relief eliminates tearing  
 $W = 2 \times \text{Thickness}$   
 $D = \text{Bend Radius} + \text{Thickness}$

Autodesk Inventor allows you to create the sheet metal components in a special module, called the **Sheet Metal** module, provided specially for the sheet metal components. This environment provides all the tools that are required for creating the sheet metal components. To invoke the **Sheet Metal** module, double-click on **Sheet Metal (mm).ipt** in the **Metric** tab of the **New File** dialog box,

