

## Angles Untangled

From beveled corners to dovetail grooves, there are many ways to define angles in the machining world. Not surprisingly, there are many cutting tools to choose from when milling an angle. When selecting the right tool, one has to consider how the angle is being measured, whether it is from the centerline of the tool or off the horizontal of the workpiece (line perpendicular to the centerline of the tool). Below we offer some definitions, images, and formulas to help make any tool selection process quick and easy.

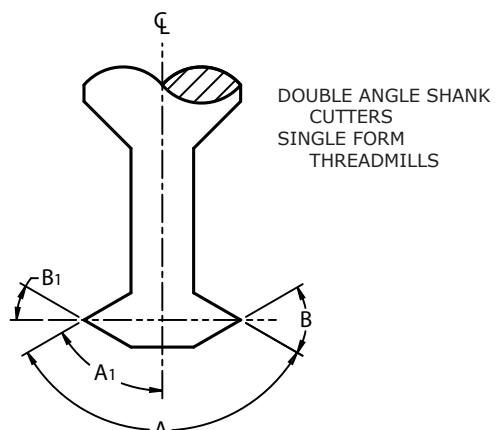
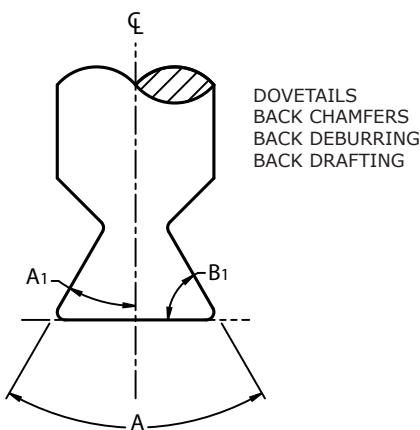
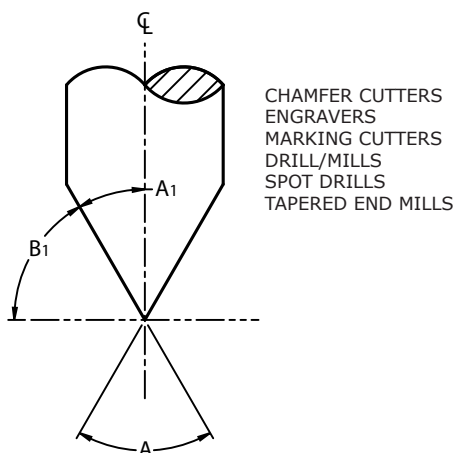
### Definitions

A – Included angle measured from the centerline of the tool

A<sub>1</sub> – Angle per side measured from the centerline of the tool

B – Included angle measured from the perpendicular line of the tool

B<sub>1</sub> – Angle per side measured from the perpendicular line of the tool



### Formulas

$$A = 2 \times A_1$$

$$A = 180 - 2 \times B_1$$

$$A = 180 - B$$

$$A_1 = A/2$$

$$A_1 = 90 - B_1$$

$$A_1 = 90 - B/2$$

$$B = 2 \times B_1$$

$$B = 180 - 2 \times A_1$$

$$B = 180 - A$$

$$B_1 = B/2$$

$$B_1 = 90 - A_1$$

$$B_1 = 90 - A/2$$

### Example

Item #23842, .488" Diameter Dovetail

$$A = 48^\circ$$

$$A_1 = 48/2$$

$$A_1 = 24^\circ$$

$$B_1 = 90 - 48/2$$

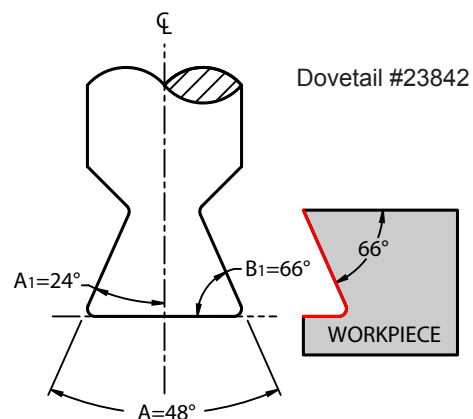
$$B_1 = 90 - 24$$

$$B_1 = 66^\circ$$

In this example, Dovetail #23842 has an included angle of 48° and will leave a 66° angle off the horizontal of a workpiece.

For additional included angle conversions, please see the following page.

Good luck angulating!



## Angle Conversion Charts

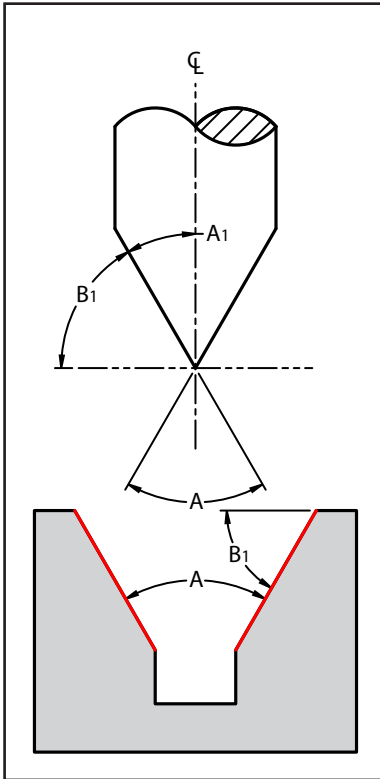


Image represents the angle orientations for Chamfer Cutters, Drill/ Mills, Marking Cutters, Engraving Cutters, Spotting Drills, and Tapered End Mills

### Chamfer Cutters

A1	A (A = A1 * 2)	B1 (B1 = 90 - A1)
15°	30°	75°
17.5°	35°	72.5°
20°	40°	70°
22.5°	45°	67.5°
25°	50°	65°
27.5°	55°	62.5°
30°	60°	60°
32.5°	65°	57.5°
35°	70°	55°
37.5°	75°	52.5°
40°	80°	50°
41°	82°	49°
42.5°	85°	47.5°
45°	90°	45°
50°	100°	40°
55°	110°	35°
60°	120°	30°
65°	130°	25°

### Tapered End Mills

A1	A (A = A1 * 2)	B1 (B1 = 90 - A1)
0.5°	1°	89.5°
1°	2°	89°
1.5°	3°	88.5°
2°	4°	88°
3°	6°	87°
4°	8°	86°
5°	10°	85°
6°	12°	84°
7°	14°	83°
8°	16°	82°
9°	18°	81°
10°	20°	80°
15°	30°	75°

### Drill/Mills

A	A1 (A1 = A / 2)	B1 (B1 = 90 - A / 2)
60°	30°	60°
82°	41°	49°
90°	45°	45°
100°	50°	40°
120°	60°	30°
140°	70°	20°

### Marking Cutters

A	A1 (A1 = A / 2)	B1 (B1 = 90 - A / 2)
30°	15°	75°
40°	20°	70°
45°	22.5°	67.5°
50°	25°	65°
60°	30°	60°
82°	41°	49°
90°	45°	45°

### Engraving Cutters

A	A1 (A1 = A / 2)	B1 (B1 = 90 - A / 2)
10°	5°	85°
15°	7.5°	82.5°
20°	10°	80°
25°	12.5°	77.5°
30°	15°	75°
40°	20°	70°
45°	22.5°	67.5°
50°	25°	65°
60°	30°	60°
70°	35°	55°
82°	41°	49°
90°	45°	45°
100°	50°	40°
120°	60°	30°

### Spotting Drills

A	A1 (A1 = A / 2)	B1 (B1 = 90 - A / 2)
60°	30°	60°
82°	41°	49°
90°	45°	45°
100°	50°	40°
120°	60°	30°
140°	70°	20°
150°	75°	15°

## Angle Conversion Charts (cont.)

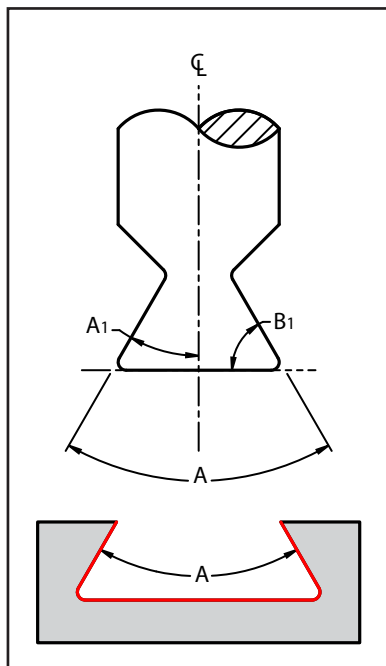


Image represents the angle orientations for Dovetail Cutters

<b>Dovetail Cutters</b>		
<b>A</b>	<b>A1</b> ( $A_1 = A / 2$ )	<b>B1</b> ( $B_1 = 90 - A / 2$ )
4°	2°	88°
6°	3°	87°
8°	4°	86°
10°	5°	85°
14°	7°	83°
20°	10°	80°
30°	15°	75°
40°	20°	70°
45°	22.5°	67.5°
48°	24°	66°
50°	25°	65°
60°	30°	60°
90°	45°	45°
100°	50°	40°
120°	60°	30°

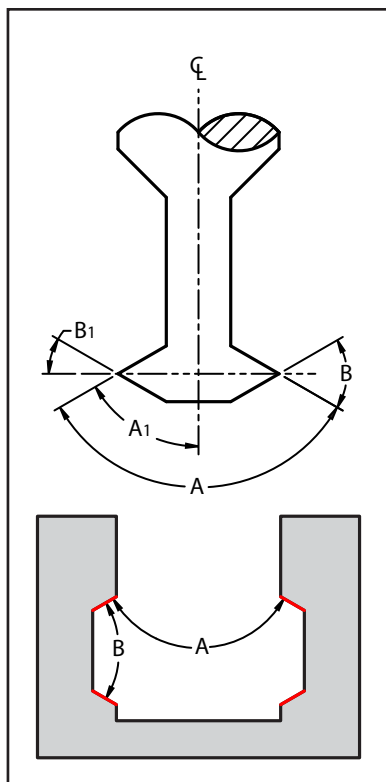


Image represents the angle orientations for Double Angle Shank Cutters

<b>Double Angle Shank Cutters</b>			
<b>B</b>	<b>B1</b> ( $B_1 = B / 2$ )	<b>A</b> ( $A = 180 - B$ )	<b>A1</b> ( $A_1 = 90 - B / 2$ )
30°	15°	150°	75°
40°	20°	140°	70°
45°	22.5°	135°	67.5°
50°	25°	130°	65°
55°	27.5°	125°	62.5°
60°	30°	120°	60°
80°	40°	100°	50°
82°	41°	98°	49°
90°	45°	90°	45°
100°	50°	80°	40°
120°	60°	60°	30°