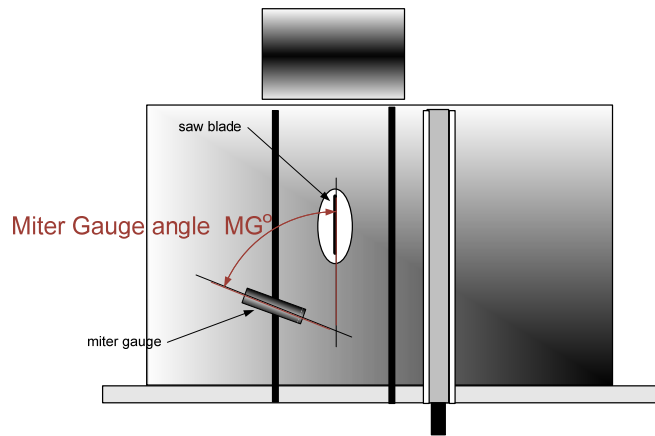
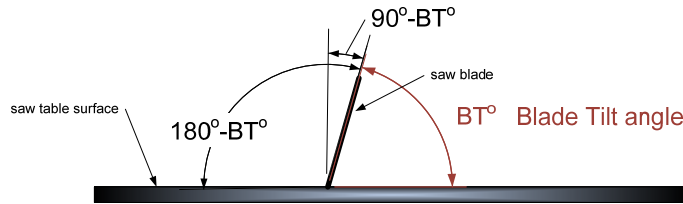


Compound miters are required for a variety of projects, including installing moldings and making multi-sided containers having sloping sides. Following are the formulas required for setting up a table saw to make the needed cuts. Two angles are needed. One is the angle that the saw blade must make to the surface of the table saw, and the other is the angle that the miter gauge must make with the saw blade (or miter slot if that is parallel with the blade). These angles are defined in the figure.



Nomenclature:

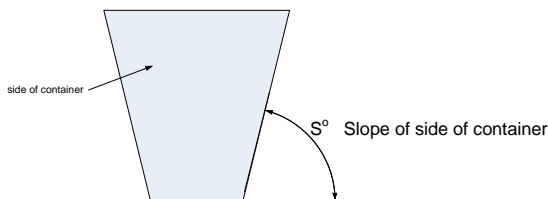
BT° Blade Tilt angle (degrees) measured from table surface
 example: $BT^\circ = 90$ is blade vertical

MG° Miter Gauge angle (degrees) measured from blade surface
 example: $MG^\circ = 90$ is cut perpendicular to blade

N number of sides to container
 example: $N = 4$ is a rectangular container

S° slope (degrees) of the container sides measured from base
 example: $S^\circ = 90$ is a container with vertical sides

$S^\circ = 80$ is a container with sides that slope ten degrees from vertical



Notes:

1. Blade tilt indicators on table saws usually show 0° when the plane of the blade is perpendicular to the surface of the saw. When setting the blade tilt using this indicator, use the complement of the blade tilt angle, which is $90^\circ - BT^\circ$, as the indicator angle.
2. When using an adjustable bevel gauge to set the tilt of the saw blade, it may be convenient to set the gauge and use the supplementary angle $180^\circ - BT^\circ$.
3. The drawing above assumes a table saw with a right (clockwise) tilting blade and a miter gauge in the left saw-table slot. These will be reversed for a saw with a left (counterclockwise) tilting blade.

Formulas:

$$\tan MG^\circ = \frac{1}{\cos(S^\circ) \tan\left(\frac{180}{N}\right)}$$

$$\cos(BT^\circ) = \sin(S^\circ) \sin\left(\frac{180}{N}\right)$$

Example. rectangular box with vertical sides.

For this, $N = 4$ and $S^\circ = 90$. Then, $\cos(S^\circ) = 0$, $\tan(180/N) = \tan(45) = 1$, so $\tan(MG^\circ) = \infty$, implying $MG^\circ = 90$ degrees. And, for the blade tilt angle, $\sin(S^\circ) = \sin(90) = 1$, $\sin(180/N) = \sin(45) = \frac{1}{\sqrt{2}} \approx 0.707$, so $\cos(BT^\circ) = \frac{1}{\sqrt{2}}$, implying $BT^\circ = 45$. The miter gauge is set 90 degrees to the plane of the blade, and the blade is set 45 degrees to the saw table surface.

Example. a container with seven sides that tilt seven degrees from the vertical.

For this, $N = 7$ and $S^\circ = 83$ degrees. Then, $\cos(S^\circ) = \cos(83) \approx 0.1219$, $\tan(180/7) \approx \tan(25.71) \approx 0.482$, so $\tan(MG^\circ) \approx 1 / (0.1219)(0.482) \approx 17.0196$, implying that $MG^\circ = 86.641$ degrees. For the blade tilt angle, $\sin(S^\circ) = \sin(83) \approx 0.9925$, $\sin(180/N) \approx \sin(25.71) \approx 0.434$, so $\cos(BT^\circ) \approx 0.4308$, implying $BT^\circ = 64.491$ degrees. The miter gauge is set to 86.641 degrees and the blade is tilted 64.491 degrees from the saw table surface.



heptagon vase ($N = 7, S^\circ = 83$)

Example. a container with six sides that tilt sixty degrees from the vertical.

For this, $N = 6$ and $S^\circ = 30$ degrees. Then, $MG^\circ \approx 63.435$ and $BT^\circ \approx 75.522$ degrees

References:

1. http://www.woodcentral.com/bparticles/miter_formula.shtml
2. <http://www.woodworkersguildofga.org/ShopHelpers/MiterCalculator.htm>
3. <http://www.woodworkersguildofga.org/ShopHelpers/CompoundMiterTable.pdf>
4. <http://jansson.us/jcompound.html>
5. <http://www.pdxtex.com/canoe/compound.htm>
6. *Guide to Compound Miters*, published by Bridge City Tool Works, Portland, Oregon.

Following is a Frink program to run on an Android platform.

CompoundMiter.Frink

```
// Calculates table saw settings for
//cutting sides of an multi-sided vessel
//having sides that slope.
// N  number of sides
// S  angle of the sides from horizontal (degrees)
// MG miter gauge angle (degrees) from plane of blade
// BT blade tilt angle (degrees) from saw surface
//Created By: D. L. Snyder 26 Feb 2011
//start.....
//user inputs
[N, S] = input["Vessel or Box Information",
              ["Number of sides",
               "Angle of sides from horizontal (degrees)"]]
//evaluate constants
```

```

S_deg = eval[S]
N_num = eval[N]
Corner_Angle = 360/N_num
a1 = sin[S_deg degrees]
a2 = sin[Corner_Angle/2 degrees]
b1 = cos[S_deg degrees]
b2 = tan[Corner_Angle/2 degrees]
//evaluate outputs
  BT = arccos[a1*a2]
  MG = arctan[1, b1*b2]
  MGsupplement=pi-MG
  BTcomplement = pi/2-BT
  BTsupplement = pi - BT
//display results
  g = new graphics
  g.font["SansSerif", 7 point]
  g.backgroundColor[0,0,0.3]
    g.color[0.5,0.5,0.5]
    g.fillRectSize[-8,-10,19,1]
  g.color[1,1,0]
  g.text["SETUP ANGLES FOR COMPOUND MITERS",1,-10,"center","top"]
  g.text["User Input Values",-9,-8.5,"left","center"]
    g.text[" Number of Sides = " + N_num, -9,-7.5, "left","center"]
    g.text[" Slope of Sides (from horizontal) = " + eval[S] + " degrees",-9,-6.5,"left","center"]
  g.text["Output: Saw Setup Values", -9, -5.5, "left","center"]
    g.text[" Miter Gauge Angle (from plane of blade) = " + format[MG, "degrees", 3],-9,-
4.5,"left","center"]
    g.text[" Supplementary Miter-Gauge Angle(180 deg – MG) = " + format[MGsupplement,
"degrees", 3],-9,-3.5,"left","center"]
    g.text[" Blade Tilt Angle (from saw surface) BT = " + format[BT, "degrees", 3],-9,-
2.5,"left","center"]
    g.text[" Complementary Blade-Tilt Angle (90 deg - BT) = " + format[BTcomplement,
"degrees", 3],-9,-1.5,"left","center"]
    g.text[" Supplementary Blade-Tilt Angle (180 deg - BT) = " + format[BTsupplement,
"degrees", 3],-9,-0.5,"left","center"]
  g.show[]
//.....end

```

Following are screenshots of an Android Hero cellphone when this procedure is run using as input $N = 7$ sides, with each side tilted 83 degrees from horizontal (7 degrees from vertical).

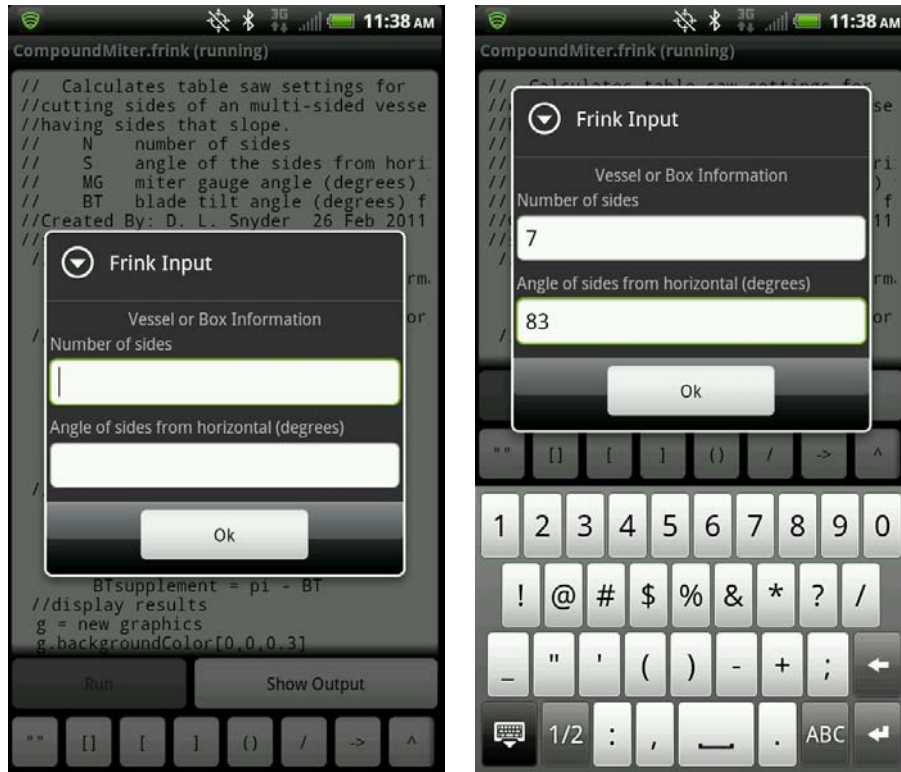


Figure 1. Input Screen Without (left) and With (right) User Input Values

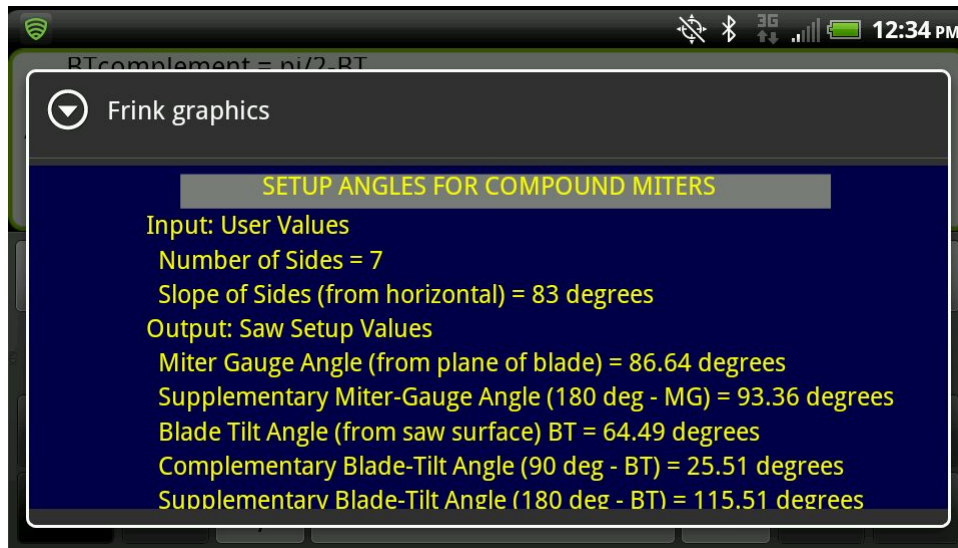


Figure 2. Output Screen