

## ***Sanding Tool Templates for the Breath Flute Project***

This document has templates that you can print and use to cut out patches of sandpaper that can be glued to the Sanding Tools used to finish a Breath Flute. It also has templates for paper that can be used to adjust the diameter of the Sanding Dowels.

You can print this document on U.S. Letter size paper (8½"×11") or A4 paper (210×297 mm). Each page has a ¼" margin (in red) that should accommodate all the content. When you print:

1. Turn off all scaling options and print in landscape orientation at the original document size.
2. Measure your printout (with a ruler) to ensure the printed red border measures exactly 8"×10.5" (203.2×266.7 mm).

The sandpaper shapes needed are either rectangles or frustums – the truncated cone shapes of Sanding Wedges that finish bevels on the Breath Flute. You can temporarily fix the printed template to the back of a sheet of sandpaper – I use binder clips – and cut along the solid lines of the template. Alternately, since there is a 4 mm space between the templates, you can cut between them and trim each one individually.

The dashed purple lines are fold lines – the approximate location you will be folding that template after you cut it out.

If you fabricate Sanding Tools that are scaled to a different size – some of the Sanding Dowels support the **XYExpand** parameter for scaling the size of the dowel – these templates will no longer fit. You may be able to scale your printout to make these templates work. I have not worked out how the scale factors for the **XYExpand** parameter relate to scale factors for printing this document.

This document also contains a page of templates that can be printed on plain paper and cut out to produce spacers for the Sanding Dowels. You can place one or more of these spacers between the two halves of a Sanding Dowel to make it slightly larger and increase the sanding pressure on the bore you are sanding.

Finally, there are several pages at the end that have the calculations and development of the flat arcs that create the frustum shapes.

The calculations for frustum shapes are from code were provided by David Reed Smith ([David@DavidReedSmith.com](mailto:David@DavidReedSmith.com)), from an article and spreadsheet retrieved on 6/9/2018 from:  
[www.DavidReedSmith.com/Articles/FoamConeSander/FoamConeSander.htm](http://www.DavidReedSmith.com/Articles/FoamConeSander/FoamConeSander.htm)

**Note:** You need to use the version of the template that corresponds to the version of the Sanding Tools that you fabricated! Sizes and shapes do change from version to version, and these templates are updated to track those changes.

— Clint Goss [[clint@goss.com](mailto:clint@goss.com)]

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**SY:SandY - Mortice Sanding Dowel**  
170 × 40 mm

A strip designed to have one end (40 mm long) clamped between two SandY sanding dowel halves and then wrap the rest of the strip completely around the two dowel halves. This strip is about 50% wider than needed for the Mortice, to allow holding and grabbing the sandpaper as needed.

**SandY**

**SS:SandS - Sound Chamber Sanding Dowel**  
133 × 40 mm

A strip designed to have one end (30 mm long) clamped between two SandS sanding dowel halves and then wrap the rest of the strip completely around the two dowel halves. This strip should cover the width of the sanding dowel, from the bottom up until the bevel.

**SandS**

**SB:SandB - Bird Sanding Block**  
76 × 20 mm

Designed for the smaller, angled area of this sanding block.

**SandB**

**SF:SandF - Flue Sanding Block**  
76 × 84 mm

To drape over this sanding block for sanding the underside of the Bird.

**SandF**

**SB:SandB - Bird Sanding Block**  
76 × 43 mm

Designed for the larger flat area of this sanding block. It is a good idea not to glue the sandpaper all the way into the interior angle. It is easy to get a "bump" in the corner from the two pieces of sandpaper colliding, which could round over the inflection point on the Bird. For that reason, this template is slightly narrower than the width of this area.

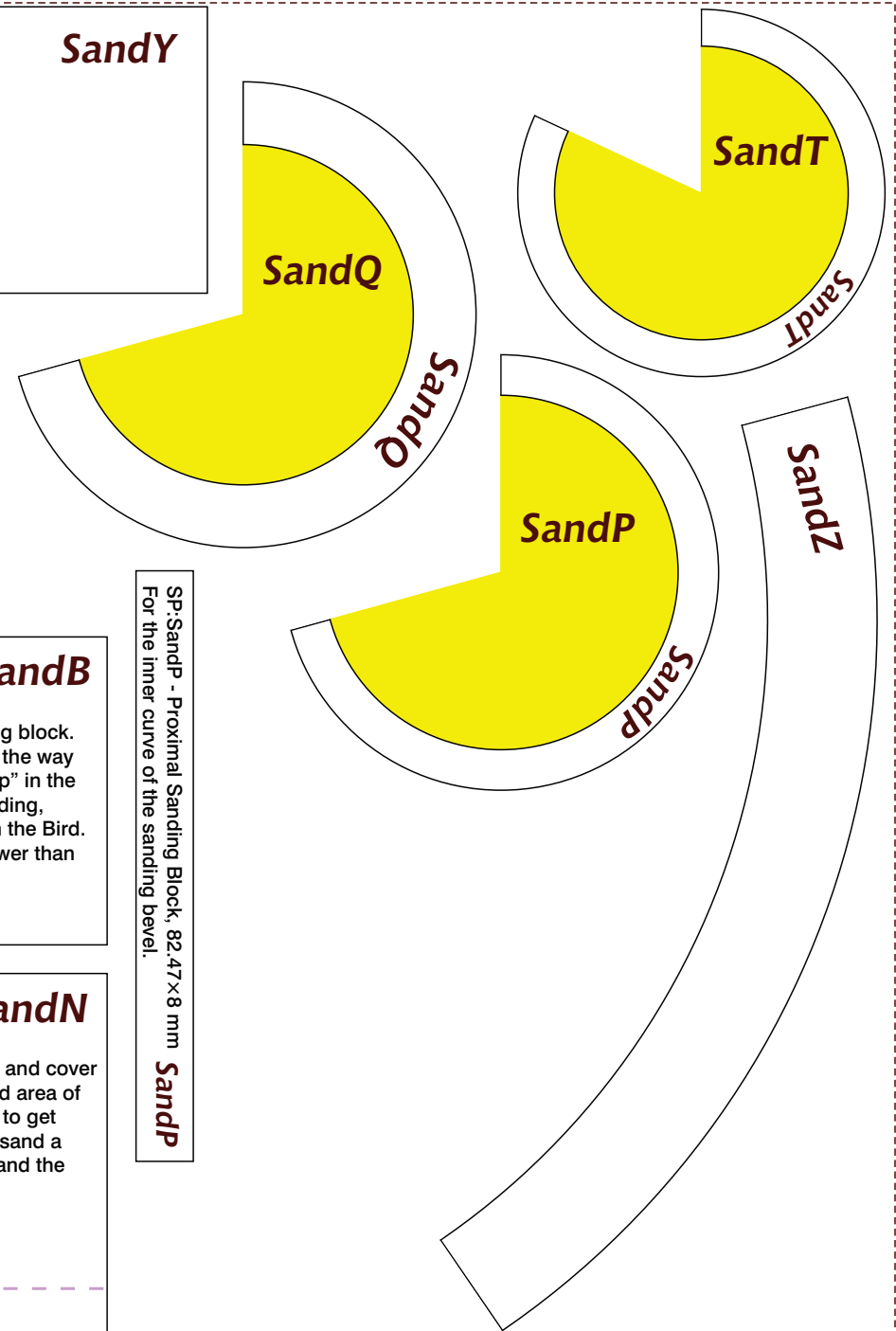
**SandB**

**SN:SandN - Nest Sanding Block**  
76 × 65 mm

Designed to be folded over the sanding block and cover both the larger flat area and the smaller angled area of this sanding block. If you use glue, be careful to get the corner glued down flat so that you do not sand a "bump" into the corner of the nest and over-sand the corner on the Nest..

**SandN**

SP:SandP - Proximal Sanding Block, 82.47×8 mm  
For the inner curve of the sanding bevel. **SandP**



**Sandpaper 1**  
**Print this page and use the outlines to cut out patches of sandpaper for the Breath Flute Sanding Tools.**

**SY:SandY - Mortice Sanding Dowel**  
170 × 40 mm

A strip designed to have one end (40 mm long) clamped between two SandY sanding dowel halves and then wrap the rest of the strip completely around the two dowel halves. This strip is about 50% wider than needed for the Mortice, to allow holding and grabbing the sandpaper as needed.

**SandY**

**SS:SandS - Sound Chamber Sanding Dowel**  
133 × 40 mm

A strip designed to have one end (30 mm long) clamped between two SandS sanding dowel halves and then wrap the rest of the strip completely around the two dowel halves. This strip should cover the width of the sanding dowel, from the bottom up until the bevel.

**SandS**

**SB:SandB - Bird Sanding Block**  
76 × 20 mm

**SandB**

Designed for the smaller, angled area of this sanding block.

**SF:SandF - Flue Sanding Block**  
76 × 84 mm

**SandF**

To drape over this sanding block for sanding the underside of the Bird.

**SB:SandB - Bird Sanding Block**  
76 × 43 mm

**SandB**

Designed for the larger flat area of this sanding block. It is a good idea not to glue the sandpaper all the way into the interior angle. It is easy to get a "bump" in the corner from the two pieces of sandpaper colliding, which could round over the inflection point on the Bird. For that reason, this template is slightly narrower than the width of this area.

**SN:SandN - Nest Sanding Block**  
76 × 65 mm

**SandN**

Designed to be folded over the sanding block and cover both the larger flat area and the smaller angled area of this sanding block. If you use glue, be careful to get the corner glued down flat so that you do not sand a "bump" into the corner of the nest and over-sand the corner on the Nest..

**SandV**

Since the SandV wedge uses an inside bevel, the sandpaper template based on straight calculations gives an outline that has an overlap. To avoid that overlap, cut on the dashed red line, which uses an angle of 155° rather than 161°.

**Sandy**

Spacer for:  
 SY:SandY - Mortice Sanding Dowel  
 75 × 35 mm

Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**Sandy**

Spacer for:  
 SY:SandY - Mortice Sanding Dowel  
 75 × 35 mm

Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**SandS**

Spacer for:  
 SS:SandS - Sound Chamber Sanding Dowel  
 78 × 27 mm  
 Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**SandS**

Spacer for:  
 SS:SandS - Sound Chamber Sanding Dowel  
 78 × 27 mm  
 Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**SandS**

Spacer for:  
 SS:SandS - Sound Chamber Sanding Dowel  
 78 × 27 mm  
 Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**SandS**

Spacer for:  
 SS:SandS - Sound Chamber Sanding Dowel  
 78 × 27 mm  
 Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

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**SandS**

Spacer for:  
 SS:SandS - Sound Chamber Sanding Dowel  
 78 × 27 mm  
 Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**Sandy**

Spacer for:  
 SY:SandY - Mortice Sanding Dowel  
 75 × 35 mm

Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**Sandy**

Spacer for:  
 SY:SandY - Mortice Sanding Dowel  
 75 × 35 mm

Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

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**Sandy**

Spacer for:  
 SY:SandY - Mortice Sanding Dowel  
 75 × 35 mm

Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

Spacer for:  
 SS:SandS - Sound Chamber Sanding Dowel  
 78 × 27 mm  
 Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**SandS**

Spacer for:  
 SS:SandS - Sound Chamber Sanding Dowel  
 78 × 27 mm  
 Designed for a plain-paper spacer between halves of the SandY Mortice Sanding Dowel.

**SandS****Spacer 1**

*Print this page on plain paper and cut out the patches to use as spacers in the Sanding Dowels.*

## Development of Sandpaper Templates for Sanding Wedges

The various wedges that sand bevels and flares on the Breath Flute components are all truncated sections of cones. They are constructed from OpenSCAD cylinder() primitives with two different diameters.

These “frustum” shapes can be covered by curved shapes cut from flat sandpaper sheets. This page develops those shapes, which are copied onto earlier pages for the actual template.

These calculations are from code provided by David Reed Smith, from an article and spreadsheet retrieved on 6/9/2018 from <http://www.DavidReedSmith.com/Articles/FoamConeSander/FoamConeSander.htm>

DiamWide = the diameter of the wider end of the wedge

DiamNarrow = the diameter of the smaller end of the wedge

Chord = the length between the ends of the wedge, along the wedge.

RadiusOuter = Radius of the outer curve  
=  $(\text{DiamWide} \times \text{Chord}) / (\text{DiamWide} - \text{DiamNarrow})$

RadiusInner = Radius of the inner curve  
= RadiusOuter - Chord

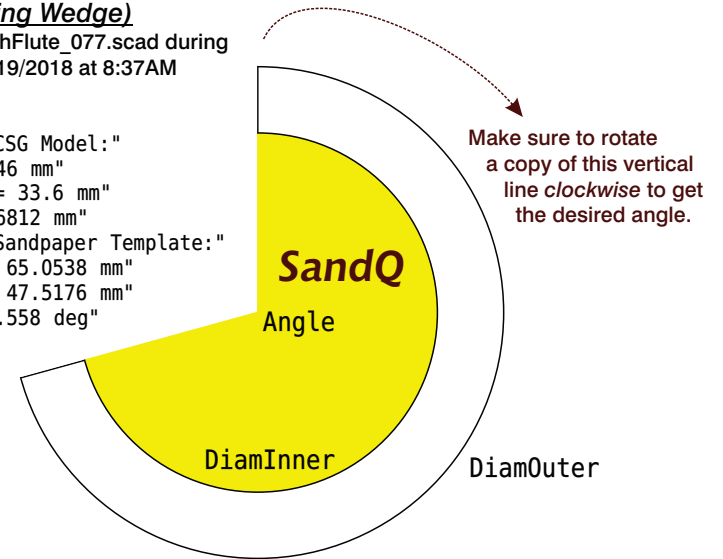
Angle = Angle of the arc to completely cover the wedge.  
=  $(\text{DiamWide} \times 180) / \text{RadiusOuter}$

The OpenSCAD model calculates these values and provides them in ECHO output when that component is rendered.

### SandQ (Distal Sanding Wedge)

Values reported by BreathFlute\_077.scad during OpenSCAD render on 6/19/2018 at 8:37AM with XYExpand=0:

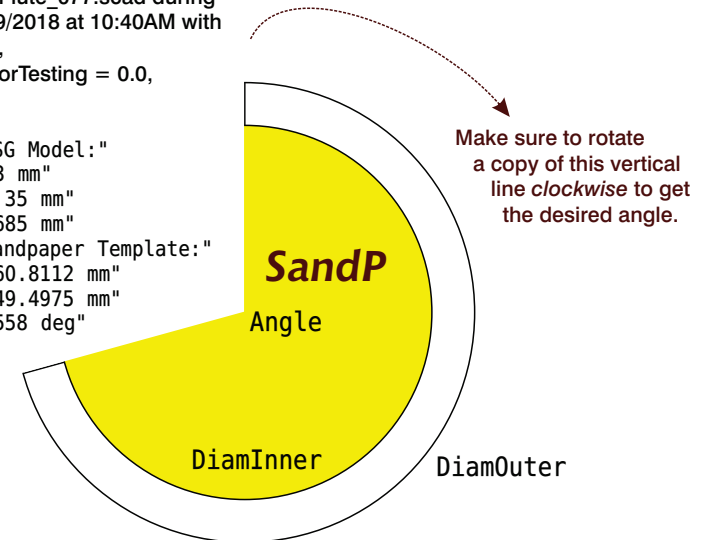
```
ECHO: " Inputs from CSG Model:"  
ECHO: "  DiamWide = 46 mm"  
ECHO: "  DiamNarrow = 33.6 mm"  
ECHO: "  Chord = 8.76812 mm"  
ECHO: " Outputs for Sandpaper Template:"  
ECHO: "  DiamOuter = 65.0538 mm"  
ECHO: "  DiamInner = 47.5176 mm"  
ECHO: "  Angle = 254.558 deg"
```



### SandP (Proximal Sanding Block)

Values reported by BreathFlute\_077.scad during OpenSCAD render on 6/19/2018 at 10:40AM with SandP\_OldRadius = false, SandP\_AdditionalRadiusForTesting = 0.0, XYExpand=0:

```
ECHO: " Inputs from CSG Model:"  
ECHO: "  DiamWide = 43 mm"  
ECHO: "  DiamNarrow = 35 mm"  
ECHO: "  Chord = 5.65685 mm"  
ECHO: " Outputs for Sandpaper Template:"  
ECHO: "  DiamOuter = 60.8112 mm"  
ECHO: "  DiamInner = 49.4975 mm"  
ECHO: "  Angle = 254.558 deg"
```



## Devel 1

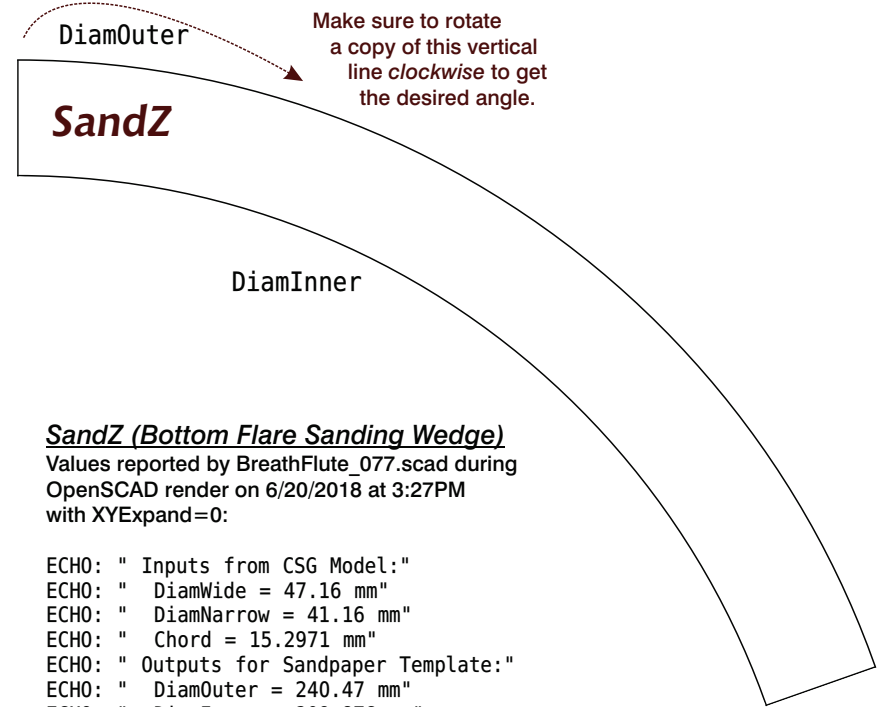
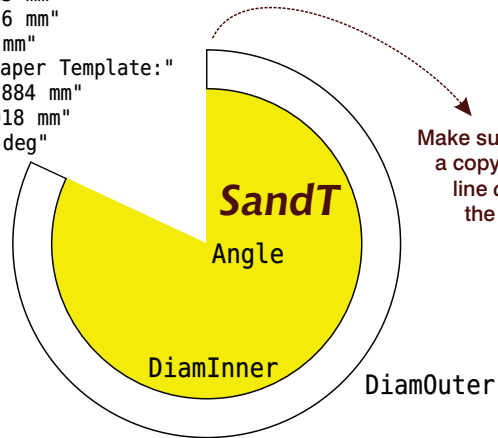
**This page is only for development and documentation, and does not need to be printed.**

## Development of Sandpaper Templates for Sanding Wedges

### SandT (Transition Sanding Wedge)

Values reported by BreathFlute\_077.scad during OpenSCAD render on 6/19/2018 at 10:49AM with XYExpand=0:

```
ECHO: " Inputs from CSG Model:"  
ECHO: "   DiamWide = 42.013 mm"  
ECHO: "   DiamNarrow = 33.6 mm"  
ECHO: "   Chord = 5.13516 mm"  
ECHO: " Outputs for Sandpaper Template:"  
ECHO: "   DiamOuter = 51.2884 mm"  
ECHO: "   DiamInner = 41.018 mm"  
ECHO: "   Angle = 294.895 deg"
```



### SandZ (Bottom Flare Sanding Wedge)

Values reported by BreathFlute\_077.scad during OpenSCAD render on 6/20/2018 at 3:27PM with XYExpand=0:

```
ECHO: " Inputs from CSG Model:"  
ECHO: "   DiamWide = 47.16 mm"  
ECHO: "   DiamNarrow = 41.16 mm"  
ECHO: "   Chord = 15.2971 mm"  
ECHO: " Outputs for Sandpaper Template:"  
ECHO: "   DiamOuter = 240.47 mm"  
ECHO: "   DiamInner = 209.876 mm"  
ECHO: "   Angle = 70.6018 deg"
```

## Devel 2

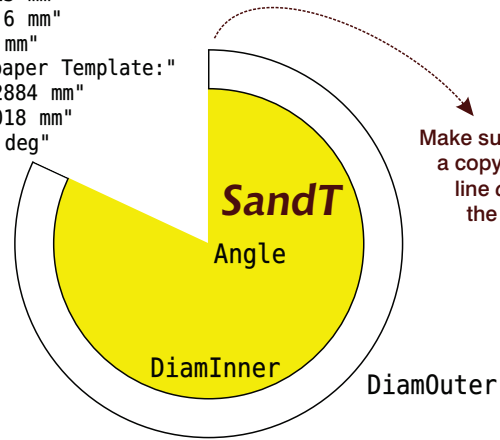
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## Development of Sandpaper Templates for Sanding Wedges

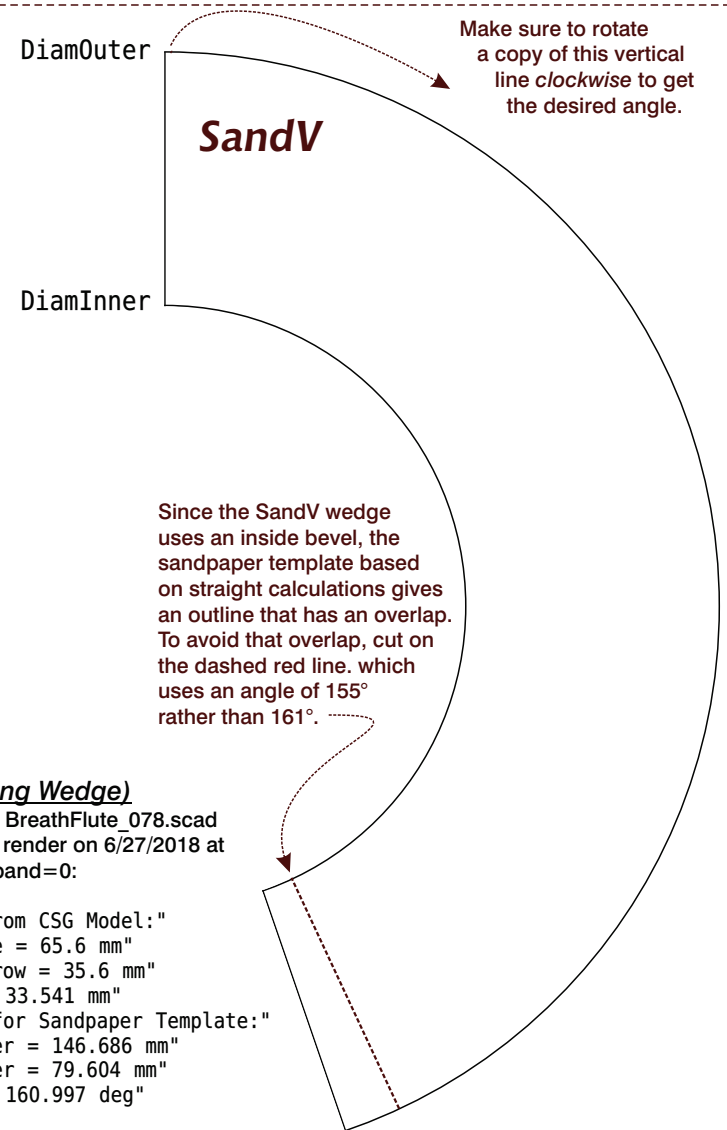
### SandT (Transition Sanding Wedge)

Values reported by BreathFlute\_077.scad during OpenSCAD render on 6/19/2018 at 10:49AM with XYExpand=0:

```
ECHO: " Inputs from CSG Model:"  
ECHO: "   DiamWide = 42.013 mm"  
ECHO: "   DiamNarrow = 33.6 mm"  
ECHO: "   Chord = 5.13516 mm"  
ECHO: " Outputs for Sandpaper Template:"  
ECHO: "   DiamOuter = 51.2884 mm"  
ECHO: "   DiamInner = 41.018 mm"  
ECHO: "   Angle = 294.895 deg"
```



Make sure to rotate  
a copy of this vertical  
line *clockwise* to get  
the desired angle.



Make sure to rotate  
a copy of this vertical  
line *clockwise* to get  
the desired angle.

Since the SandV wedge  
uses an inside bevel, the  
sandpaper template based  
on straight calculations gives  
an outline that has an overlap.  
To avoid that overlap, cut on  
the dashed red line, which  
uses an angle of 155°  
rather than 161°.

### SandV (V Sanding Wedge)

Values reported by BreathFlute\_078.scad during OpenSCAD render on 6/27/2018 at 5:28AM with XYExpand=0:

```
ECHO: "Inputs from CSG Model:"  
ECHO: "   DiamWide = 65.6 mm"  
ECHO: "   DiamNarrow = 35.6 mm"  
ECHO: "   Chord = 33.541 mm"  
ECHO: "Outputs for Sandpaper Template:"  
ECHO: "   DiamOuter = 146.686 mm"  
ECHO: "   DiamInner = 79.604 mm"  
ECHO: "   Angle = 160.997 deg"
```

## Devel 3

*This page is only for development and documentation,  
and does not need to be printed.*