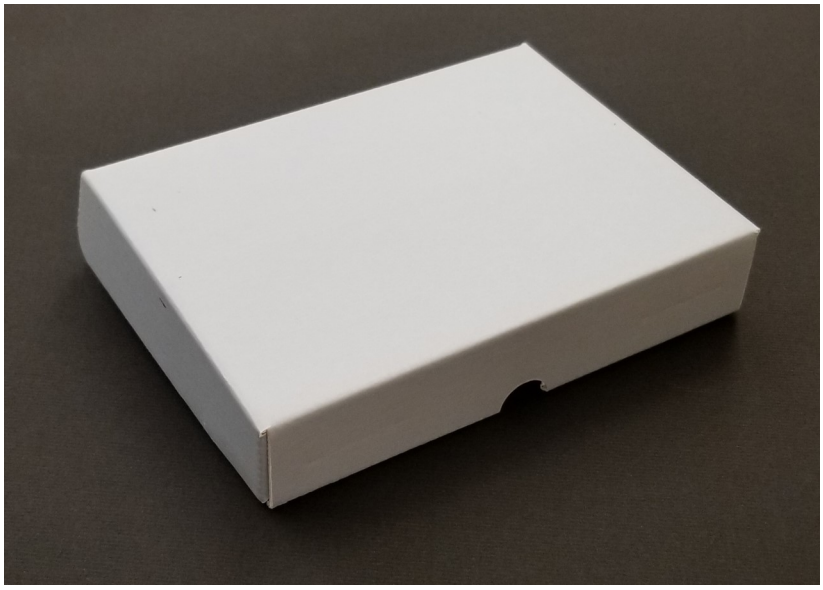
Custom E-Flute Clamshell Box

Materials:

- 1/16” E-Flute Heritage© Archival Corrugated Board
- PVA

Tools:

- Ruler
- Board shear
- Scalpel/utility knife
- Cutting mat
- Bone folder
- Binder clips



Before beginning to make the box, we have to take some measurements and do some math.

Use your ruler to measure the length, width, and depth of the book. (You can also use a MeasurepHase device if you have one in your library, though this tutorial is designed for the US system of measurement rather than metric. If using metric measurements, the board thickness (BT) of the e-flute corrugated board is 1.6 mm.)

Use your ruler to measure the **length**, **width**, and **depth** of the book.

> Note: This clamshell box is generally made for worn and deteriorating books. Because the spines are often skewed and/or the covers are bowed, it is recommended that you take two to three measurements at different points along the length, width, and depth of the book. Use the largest measurement of the set for your final dimension. If it’s close, round up 1/16”.

Note the **length**, **width** and **depth** measurements in the **Book Dimensions** space on the **E-Flute Clamshell Box Worksheet**. The **Board Thickness** (**BT**) is 1/16”.

> It is helpful to convert each fractional measurement to n/16. For example: 5 1/4 = 5 4/16.

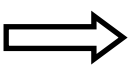
We will use these measurements and the following calculations to define the overall size of the board needed to make the box.

The **Length Calculator** will determine the overall length (top to bottom) of the board. Use your measurements (**L**, **D**, and **BT**) for the equations in each cell of the table.

> For example:
>
> L = 9 4/16” W = 7 4/16” D = 1 7/16” BT = 1/16”

Length Calculator

1.	D + 2 BT	
2.	L + 4 BT	
3.	D + 2 BT	
	(add all measurements) **Total Length**	



1.	1 7/16” + 2/16”	1 9/16”
2.	9 4/16” + 4/16”	9 8/16”
3.	1 7/16” + 2/16”	1 9/16”
	(add all measurements) **Total Length**	12 10/16” or **12 5/8”**

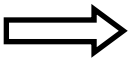
The same method is used to figure out the overall width of the board.

The **Width Calculator** will determine the overall width (left to right) of the board. Use your measurements (**W**, **D**, and **BT**) in the equations in each cell of the table. Note that there are two cells that show the measurement of two board thicknesses, or 2/16". This will account for the thickness of the board when folding the edge flaps, as will be shown later on.

The following example uses the same measurements as the above example.

Width Calculator

1.	D + 3 BT	
2.	2 BT	2/16"
3.	D + 3 BT	
4.	W + 6 BT	
5.	D + 3 BT	
6.	W + 3 BT	
7.	D + 2 BT	
8.	2 BT	2/16"
9.	D + 2 BT	
	(add all measurements) **Total Width**	



1.	1 7/16 " + 3/16"	1 10/16"
2.	2/16"	2/16"
3.	1 7/16" + 3/16"	1 10/16"
4.	7 4/16" + 6/16"	7 10/16"
5.	1 7/16" + 3/16"	1 10/16"
6.	7 4/16" + 3/16"	7 7/16"
7.	1 7/16 + 2/16"	1 9/16"
8.	2/16"	2/16"
9.	1 7/16" + 2/16"	1 9/16"
	(add all measurements) **Total Width**	**23 5/16"**

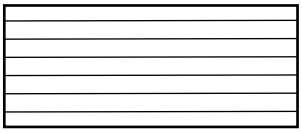
We now have the overall dimensions of the board. In this example, the board will be 10 7/8" by 15 3/8".

Start with a sheet of e-flute large enough to be able to cut to your total measurements. Make sure it is square on all sides. This is easy to do using a board sheer, squaring each side using the gauges or guides. Alternatively, you can use a T-square and scalpel/utility knife.

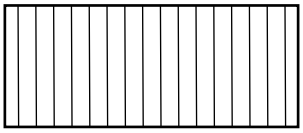
Once the board is square, mark the length and width from the **Total Length** and **Total Width** calculations, making sure that the grain is long (see below), and cut the board to the correct size.

A note on grain direction:

I have seen custom boxes from commercial sources that have the grain running either long (the fluting, or corrugations, running parallel with the long edge of the board) or short (the fluting running parallel with the short edge of the board). I cut my boards with the grain running long. I find this gives the box more strength to hold up against crushing forces (for example, being buried under a stack of heavy books, or from shoving it into a packed library shelf). With the grain short, it may be easier to fold the box, but the strength of the walls suffer. In addition, accuracy may be compromised, as the folds will follow the path of least resistance along the fluting and may bend out of line with the measurements.



Grain Long—Yes



Grain Short—No

Now that the board is the correct size, we will start to mark out the folding lines that will become the structure of the box. Use the **Worksheet** as a guide to correctly mark your board. If you are using e-flute with a colored side and a white side, mark your measurements on the white side.

We will first measure out our guidelines for the **Width** of the box. Placing your ruler parallel to the top (long) edge of the board, measure from the left edge of the board the length from box **1.** of the **Width Calculator** (in our example, 1 10/16”), and make a mark.

From the mark you just made, measure the length from box **2.** of the **Width Calculator** (2/16”) and make a mark.

From this mark, measure the length from box **3.** of the **Width Calculator** (1 10/16”) and make a mark.

Continue making marks in this manner using the measurements from boxes **4.** through **9.** of the **Width Calculator**. This should take you all the way to the right edge of the board.

Repeat this mark-making process at the bottom of the board, placing your ruler parallel with the bottom edge and using the measurements from the **Width Calculator**.

> Note: When measuring the marks on the bottom edge, avoid turning the board around 180°. If your board width happens to be a bit short (which sometimes happens when using a board shear), turning it around will skew the measurements, resulting in a skewed box.

You now have a set of marks at the top and the bottom edges of the board. Use your ruler to line up the marks from the top edge to the bottom edge and draw a line from edge to edge as in the illustration below.

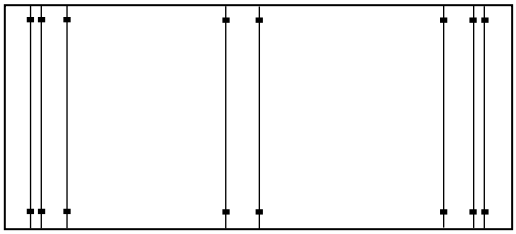


Fig. 1

We will use this same process to mark and draw the horizontal folding lines.

Placing your ruler parallel to the right (short) edge of the board, measure from the left edge of the board the length from box **1.** of the **Length Calculator** (in our example, 1 9/16”), and make a mark.

From the mark you just made, measure the length from box **2.** of the **Length Calculator** (9 8/16”) and make a mark.

If you measured and cut your board accurately, the measurement in box **3.** from the **Length Calculator** (1 9/16”) should take you exactly to the bottom edge of the board.

Repeat this mark-making process on the left side of the board, placing your ruler parallel with the left edge and using the measurements from the **Length Calculator**. Again, avoid rotating the board 180°.

You now have a set of marks at the right and left edges of the board. Use your ruler to line up the marks from the left edge to the right edge and draw a line from edge to edge as in the illustration below.

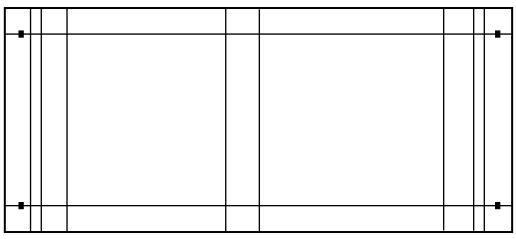


Fig. 2

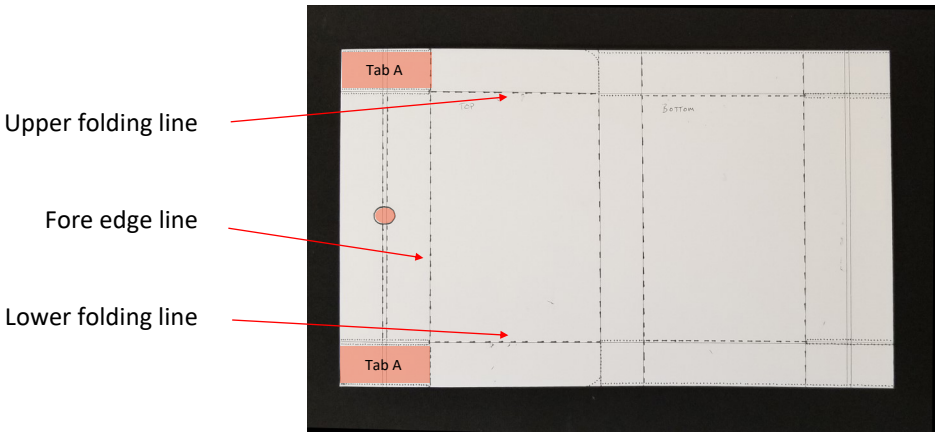


Fig. 3

Next we need to measure, mark, and cut the locations of the tabs that will fold under the edge flaps of the box. Use the **Cutting and Folding Guide** for reference.

To create **Tab A** at the upper left corner of the board, measure one board thickness (1BT) down from the top edge and make a mark in two places between the fore edge line and the left edge of the board. Draw a line through these points.

Measure one board thickness (1 BT) above the upper folding line. Make a mark in two places between the fore edge line and the left edge of the board. Draw a horizontal line through these points from the fore edge line to the left edge of the board.

Measure one board thickness (1 BT) below the upper folding line. Make a mark in two places between the fore edge line and the left edge of the board. Draw a horizontal line through these points from the fore edge line to the left edge of the board

To create **Tab A** at the lower left corner of the board, measure one board thickness (1BT) up from the bottom and make a mark in two places between the fore edge line and the left edge of the board. Draw a line through these points.

Measure one board thickness (1 BT) above the lower folding line. Make a mark in two places between the fore edge line and the left edge of the board. Draw a horizontal line through these points from the fore edge line to the left edge of the board.

Measure one board thickness (1 BT) below the lower folding line. Make a mark in two places between the fore edge line and the left edge of the board. Draw a horizontal line through these points from the fore edge line to the left edge of the board

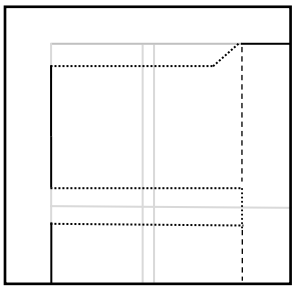


Fig. 4a

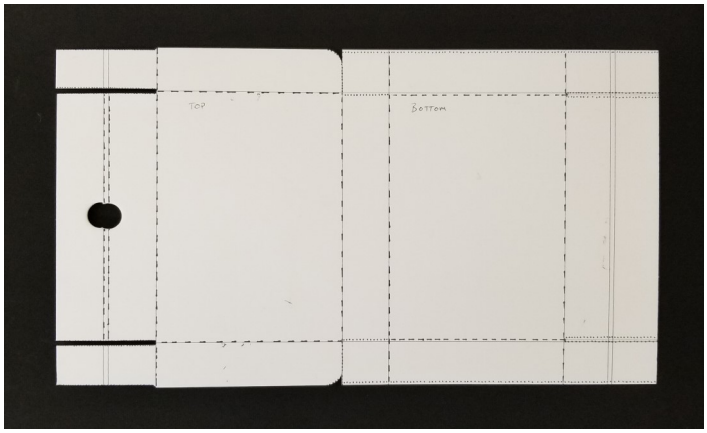
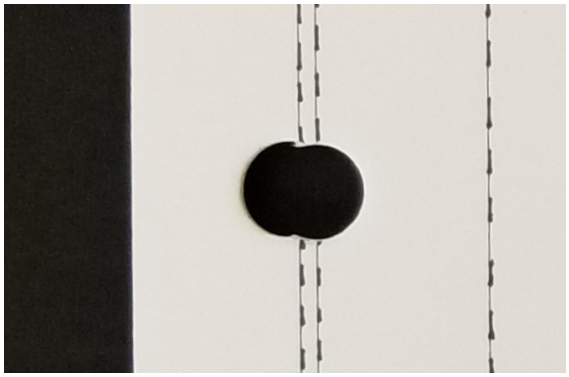


Fig. 4

Using your scalpel or utility knife, cut along the lines you just made from the fore edge line to the left edge of the board. Make a small angular cut where the fore edge line meets the top edge of the board, as shown above. Cut a small vertical line at the fore edge line connecting the two cuts at the upper folding line. Figure 4a shows a simplified diagram of where to cut the lines for the tab. Cut along the dotted lines. Repeat this for Tab A at the bottom.



To make the notch in the middle of the fore edge flap, which will help to open the box, measure exactly halfway between the top and bottom edge of the board. Draw an oval over the two vertical lines, as shown above.

Cut out the oval with your scalpel or utility knife. You can also use a 3/4" punch to create a clean, round notch. However you will have to offset the punch on either side of the line and make two strikes in order to achieve the oval shape. A punch was used in the example picture above.

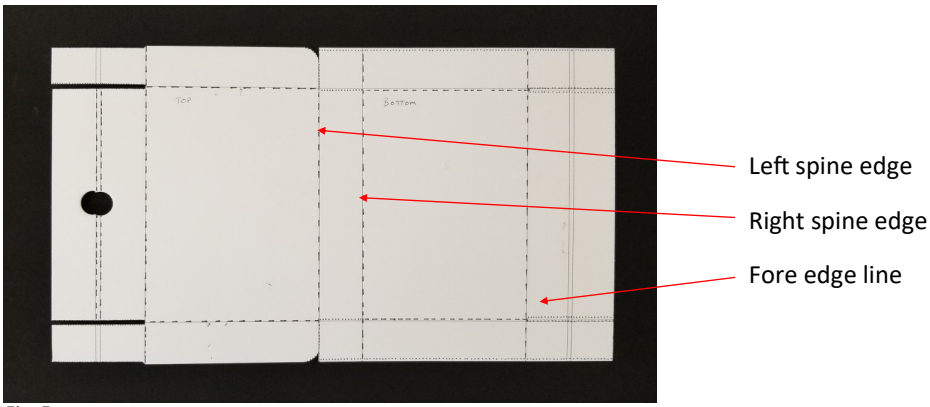


Fig. 5

Next, we will work on the right side of the board (the bottom of the box).

We first have to shrink the right half of the board so that , when folded, it will fit inside the left, or top, side of the box. Use the **Cutting and Folding Guide** for reference for the following instructions.

Measure down one board thickness (1 BT) from the top edge and make a mark in two places. Draw a line through these marks from the left spine edge to the right edge of the board.

Next measure down one board thickness (1 BT) from the upper folding line and make a mark in two places. Draw a line through these marks from the left center line to the right edge of the board. This line will be referred to as the *adjusted* upper folding line.

Measure up one board thickness (1 BT) from the bottom edge and make a mark in two places. Draw a line through these marks from the left spine edge to the right edge of the board.

Finally, measure up one board thickness (1 BT) from the lower folding line and make a mark in two places. Draw a line through these marks from the left center line to the right edge of the board. This line will be referred to as the *adjusted* lower folding line.

These new lines now define the smaller, inset area of the box.

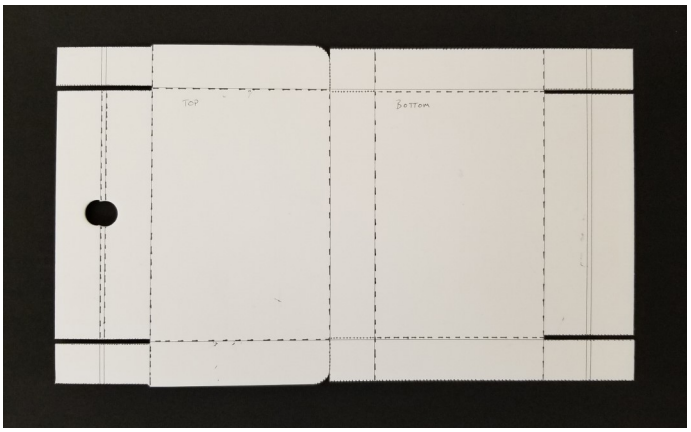


Fig. 6

Before we make **Tab B**, we have to trim down the outside edges of the right side of the board.

Cut along the horizontal line you just drew, one board thickness below the top edge, from the left spine edge to the right edge of the board.

Do the same at the bottom. Cut along the horizontal line, one board thickness above the bottom edge, from the left spine edge to the right edge of the board..

Next we will measure, mark, and cut the lines for **Tab B** in the same way we did for **Tab A**.

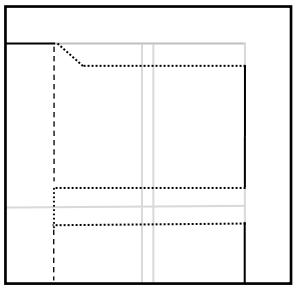


Fig. 7a

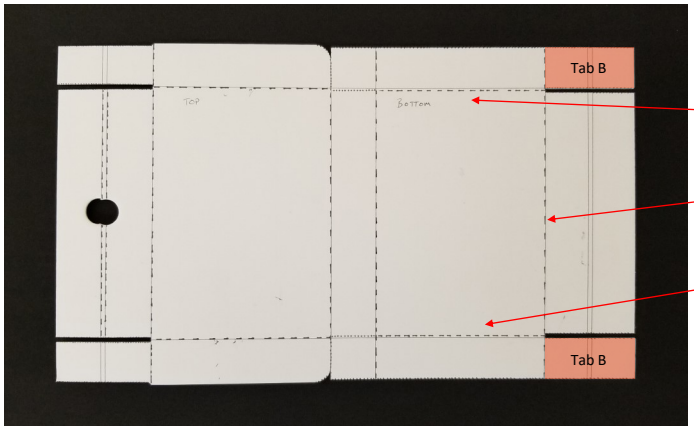


Fig. 7

To create **Tab B** at the upper right corner of the board, measure one board thickness (1BT) down from the top edge and make a mark in two places between the fore edge line and the right edge of the board. Draw a line through these points.

Measure one board thickness (1 BT) above the adjusted upper folding line. Make a mark in two places between the fore edge line and the right edge of the board. Draw a horizontal line through these points from the fore edge line to the right edge of the board.

Measure one board thickness (1 BT) below the adjusted upper folding line. Make a mark in two places between the fore edge line and the right edge of the board. Draw a horizontal line through these points from the fore edge line to the right edge of the board

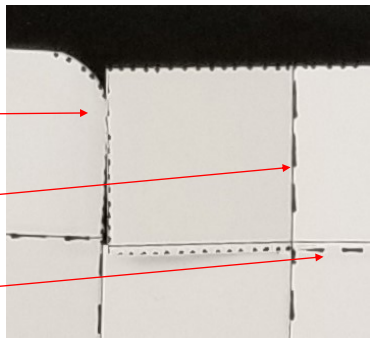
To create **Tab B** at the lower right corner of the board, measure one board thickness (1BT) up from the bottom and make a mark in two places between the fore edge line and the left edge of the board. Draw a line through these points.

Measure one board thickness (1 BT) above the adjusted lower folding line. Make a mark in two places between the fore edge line and the right edge of the board. Draw a horizontal line through these points from the fore edge line to the right edge of the board.

Measure one board thickness (1 BT) below the adjusted lower folding line. Make a mark in two places between the fore edge line and the right edge of the board. Draw a horizontal line through these points from the fore edge line to the right edge of the board

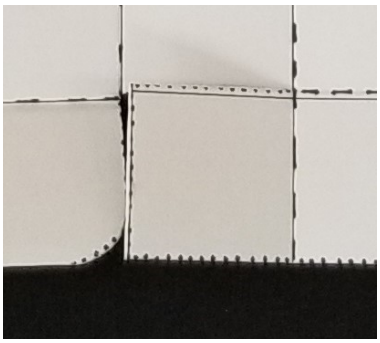
Using your scalpel or utility knife, cut along the lines you just made from the fore edge line to the right edge of the board. Make a small angular cut where the fore edge line meets the top edge of the board, as shown above. Cut a small vertical line at the fore edge line connecting the two cuts at the adjusted upper folding line. Figure 7a shows a simplified diagram of where to cut the lines for the tab. Cut along the dotted lines. Repeat this for Tab B at the bottom.

Fig. 8a



Top Spine Tab

Fig. 8b



Bottom Spine Tab

The next cut to make is for the **Spine Tab**. Use the **Cutting and Folding Guide** and Figs. 8a/b above for reference.

Using your scalpel or utility knife, make a vertical cut along the left spine edge from the top edge down to the adjusted upper folding line (one board thickness below the original upper folding line). Make a horizontal cut along the adjusted upper folding line from the left spine edge to the right spine edge.

Repeat this for the bottom **Spine Tab**. Make a vertical cut along the left spine edge from the bottom edge up to the adjusted lower folding line (one board thickness above the original lower folding line). Make a horizontal cut along the adjusted lower folding line from the left spine edge to the right spine edge.

Finally, trim the corner of the top edge flap near the left spine edge by make a rounded cut about 1/2" in size (see Fig. 8a). Repeat this for the tail edge flap. Using a small pair of scissors makes easy work of this. This creates a nice rounded corner on the top cover of the box.

At this point, all of the cuts have been made and we can now start assembling the box.

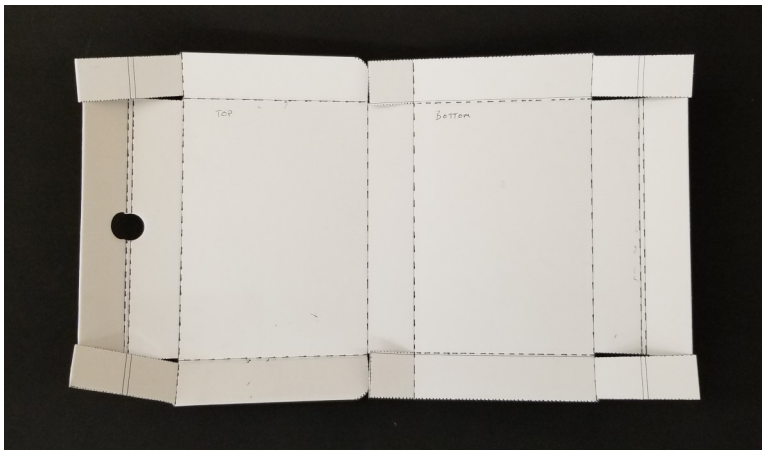


Fig. 9

Using the **Cutting and Folding Guide** as reference, place a ruler along each dashed line. Run the edge of your bone folder over each line a few times to make a crease. Be careful not to press too hard while creasing the lines that run with the grain (horizontal lines) as you might end up piercing the paper.

Next, fold each creased line up and over, using your ruler as a straight edge to fold over. It is helpful to push the folds as flat as you can. You could also run a bone folder over the outside of each fold to make a more crisp line. This helps prevent the box from opening up on its own. Each fold will be made in the same direction - towards the inside of the box.

The box should now look like the one pictured in Fig. 9

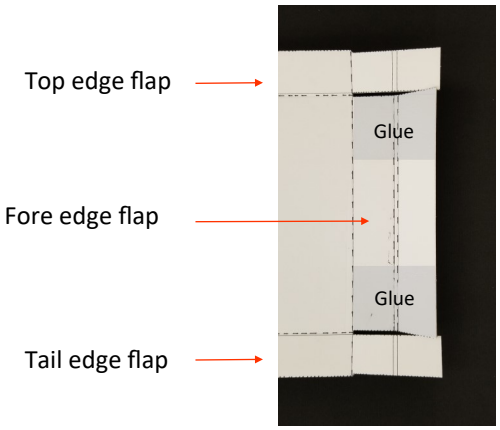


Fig. 10a

Fig. 10b

On the right (or bottom) side of the box, apply PVA to the inside of the Fore Edge Flap as notated by the shaded areas in Fig. 10a. You can use straight or diluted PVA for this step, but straight PVA is preferred. You won't need that long to maneuver the tabs into place and it will set-up within a few minutes.

Next, fold the **Top edge flap** and the **Tail edge flap** towards the inside while simultaneously folding both top and bottom **Tab B** towards the inside. Hold these folds in place while folding the **Fore edge Flap** over **Tab B** and back in on itself, sandwiching the tabs under the flap.

Pinch and smooth along the folded fore edge flap for a few seconds to make sure the glue has adhered to the tabs. Affix small binder clips to hold the flap closed over the tabs.

Your box should now look like Fig. 10b.

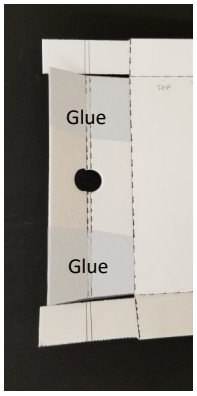


Fig. 11a

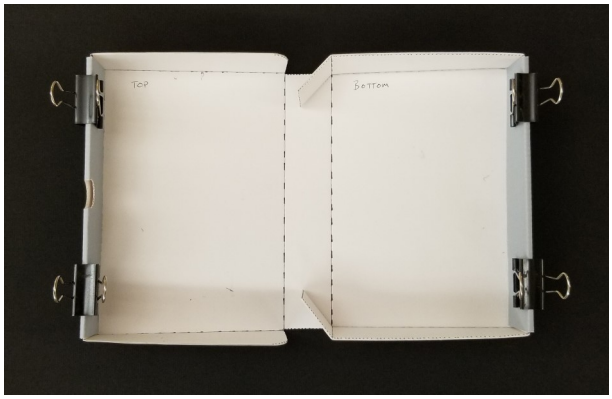


Fig. 11b

Repeat this process for the left (or top) side of the box.

Apply PVA to the inside of the Fore Edge Flap as notate by the shaded areas in Fig. 11a.

Next, fold the **Top edge flap** and the **Tail edge flap** towards the inside while simultaneously folding both top and bottom **Tab A** towards the inside. Hold these folds in place while folding the **Fore edge Flap** over **Tab A** and back in on itself, sandwiching the tabs under the flap.

Pinch and smooth along the folded fore edge flap for a few seconds to make sure the glue has adhered to the tabs. Affix small binder clips to hold the flap closed over the tabs.

Your box should now look like Fig. 11b.

Let the box sit with the binder clips in place for awhile to let the glue dry. Generally, the box should be ready to handle in around ten minutes, though the glue will take a bit longer to set up completely.

When the glue has set up, remove the clips and place your book inside your custom E-Flute Clamshell Box.

E-Flute Clamshell Box Worksheet

Book Dimensions

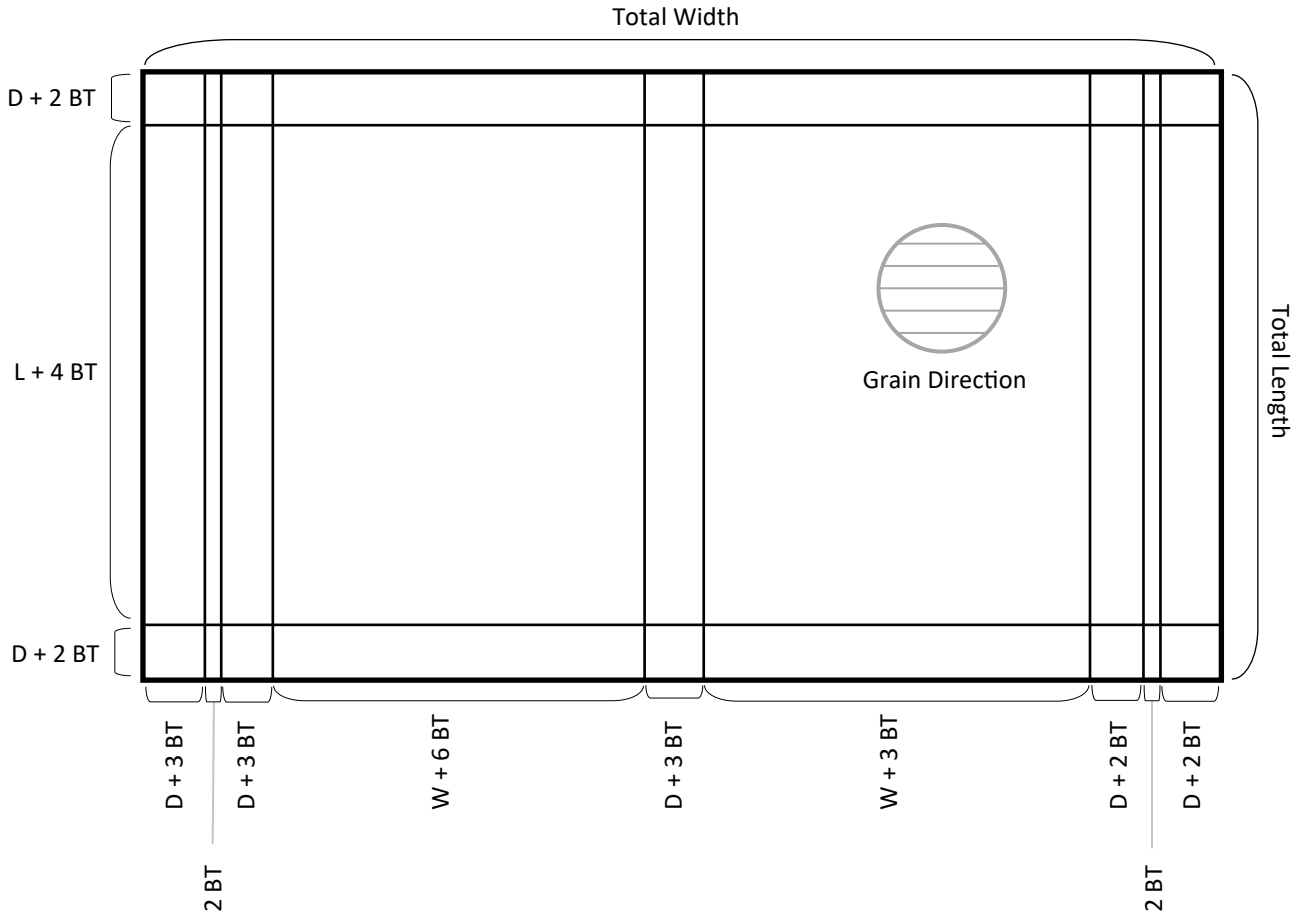
Length (L): _____ Width (W): _____ Depth (D): _____ *Board Thickness (BT): _____

Length Calculator

1.	D + 2 BT	
2.	L + 4 BT	
3	D + 2 BT	
	(add all measurements)	

Width Calculator

1.	D + 3 BT	
2.	2 BT	2/16”
3	D + 3 BT	
4.	W + 6 BT	
5.	D + 3 BT	
6.	W + 3 BT	
7.	D + 2 BT	
8.	2 BT	2/16”
9.	D + 2 BT	
	(add all measurements)	



E-Flute Clamshell Box Cutting and Folding Guide