



NESTKING
EMPOWER YOUR WORK

User Guide V2

NestKing Version B8Rxx

Release Date: April 4, 2024



The intention of NestKing is to...

- ✓ ... make cutting generation and modifications of cuts intuitive, simple and efficient by using material databases, mirror and labeling functions etc.
- ✓ ... make not just your life easier, but also the work of the employees at the cutter and in the clean room and minimize the risk of failure (collection of small cuts in subnests, printing additional information on cuts ...).
- ✓ ... provide the user with a universal tool for creating cuts and production documentation.

If you have any questions or suggestions for improving NestKing, just let me know:
office@nestking.at

Many thanks,
Daniel



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A. Introduction

The graphic below illustrates NestKing’s intended role in the cut making process.

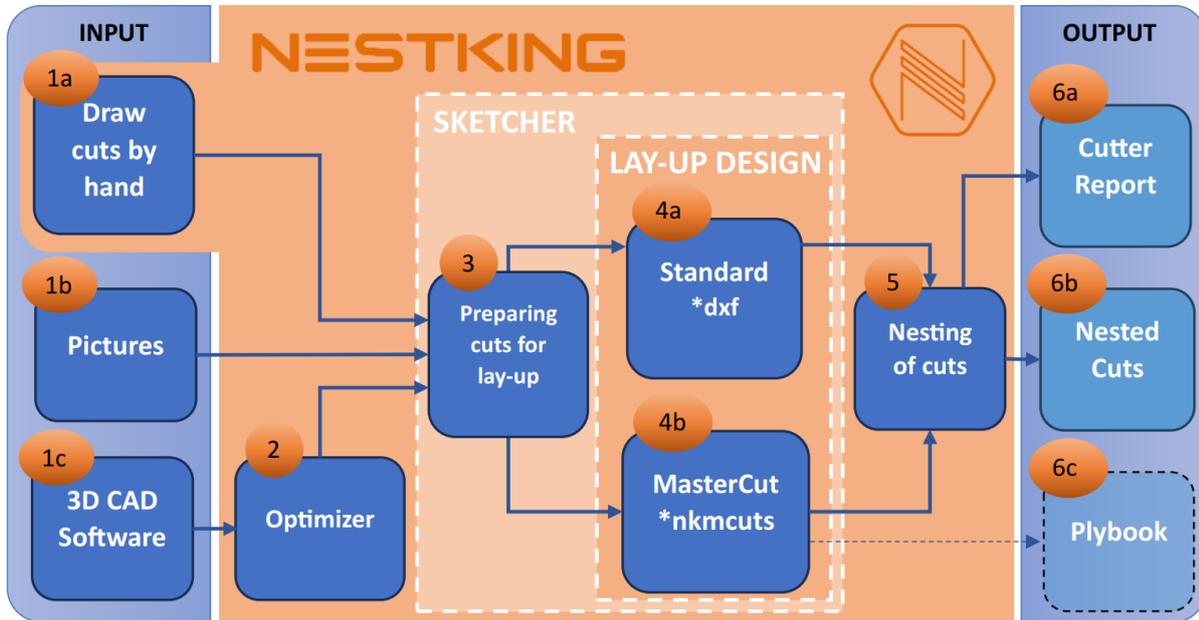


Figure 1

INPUT

As you can see, data for NestKing can be provided in three different ways:

- 1a) Draw cuts by hand:** Cuts can be drawn directly in NestKing by using the sketcher tools.
- 1b) Pictures:** Cut data is derived from pictures.
- 1c) 3D CAD Software:** A 3D-CAD-Software provides the flattened two-dimensional cut data.

NESTKING

2) Optimizer: NestKing includes an optimizer tool used to simplify and optimize input data from the 3D-Software.

SKETCHER: NestKing has a complete 2D drawing environment, hereinafter referred to as sketcher. It provides all the necessary tools to create and modify cuts quickly and efficiently.

3) Preparing cuts for lay-up: Here the cuts are prepared for the subsequent design of the lay-up.

LAY-UP DESIGN: For designing the lay-up NestKing offers two ways:

4a) Standard: Standard is used for working with files in dxf format. The complete lay-up is designed by hand. NestKing commands help you to make work easier (e.g. labeling, multiplying and mirroring).

4b) MasterCut: The heart of NestKing is formed by the mastercut tool using the nkmcuts file format. The mastercut tool includes many useful features and a powerful cut generator assisting the user to make the cut making process intuitive and efficient.

5) Nesting of cuts: A nesting tool completes the NestKing software. Here you can nest your generated cuts with advanced nesting algorithms reducing the material waste to a minimum.



OUTPUT

NestKing provides following output data:

6a) Cutter report: The cutter report includes all relevant nest data, like overall cutting time, material consumptions as well as the weight of the cuts.

6b) Nested cuts: The nested cuts can be exported in different file formats suitable for your cutter like *.dxf, *.gtk and *.zcc.

6c) Plybook: The plybook contains all relevant data for the cleaning room. The plybook feature is not implemented yet but will be integrated in NestKing in the near future.



Input Data

There are three different ways to get your cut data.

1a) Draw Cuts by Hand

NestKing offers all necessary 2D drawing tools to design your cuts directly in NestKing.

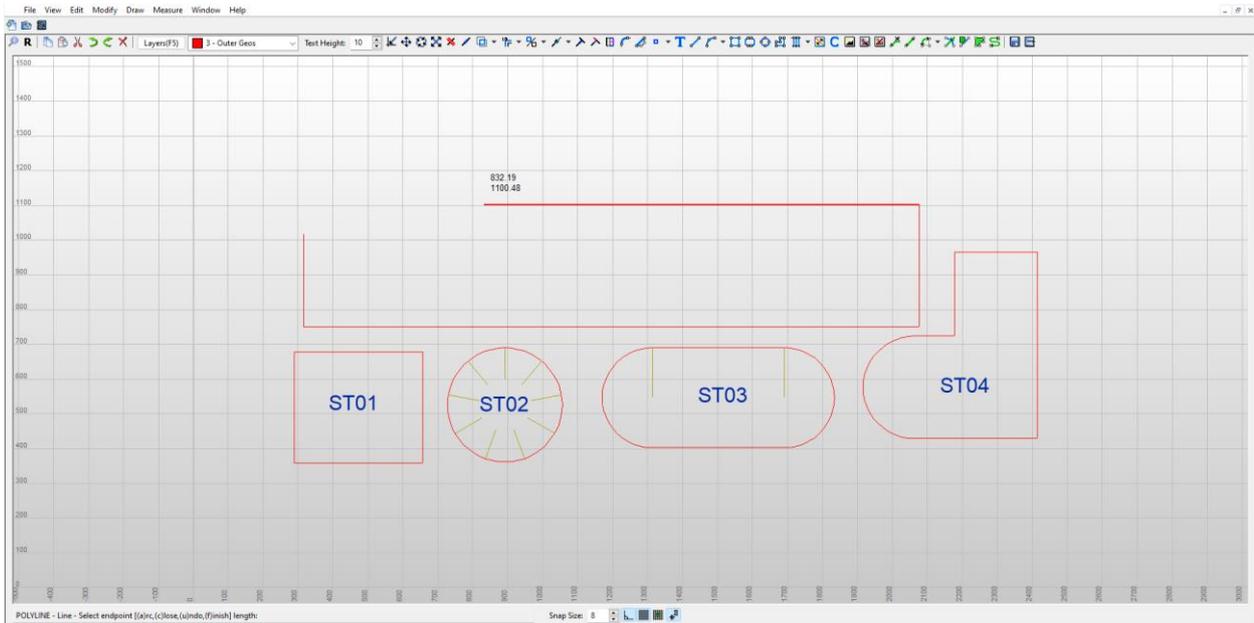


Figure 2

1b) Using Pictures

Further it is also possible to derive cut geometries from pictures. Supported formats are *.jpg, *.png and *.bmp. Nestking's integrated image processing tool automatically recognizes the cutting contours. For more detailed information go to chapter *F* starting from page 159.

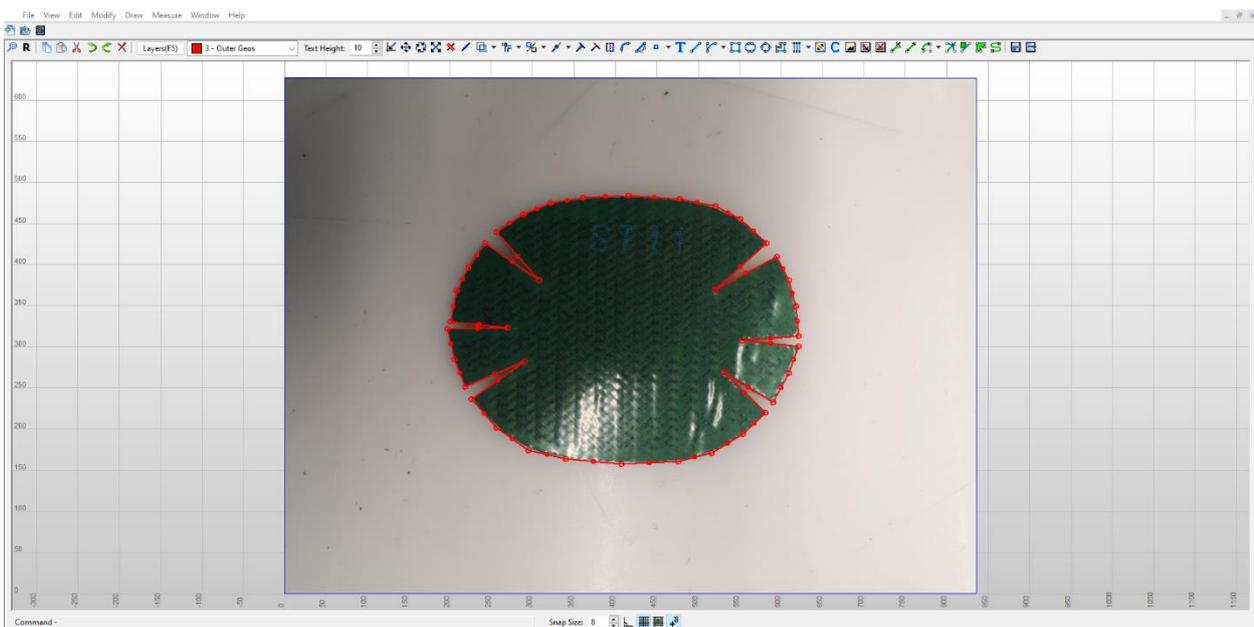


Figure 3



1c) 3D CAD Software

3D-CAD-Software provides the flattened two-dimensional cut data. A 3D-Software, such as Solid Works or CATIA, derives the cuts of the first layer from the lamination surface (Figure 4). This layer is divided into smaller pieces that can be flattened into two-dimensional shapes (Figure 5). For data exchange between your 3D-Software and NestKing the widespread DXF file format can be used.

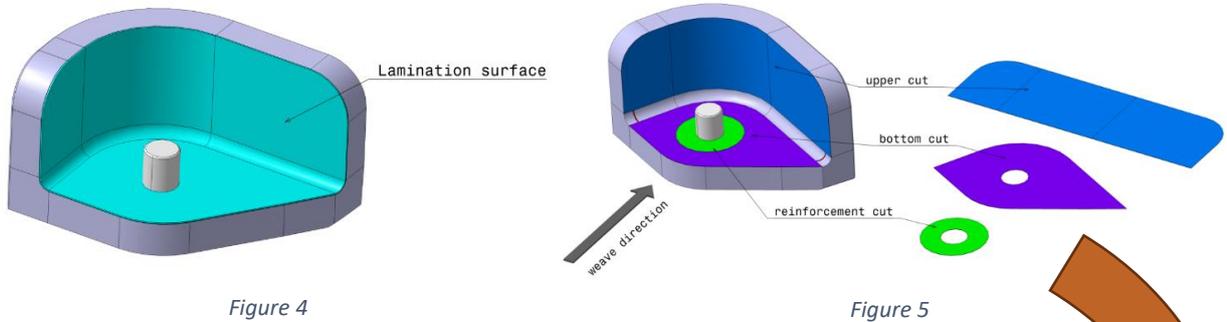


Figure 4

Figure 5

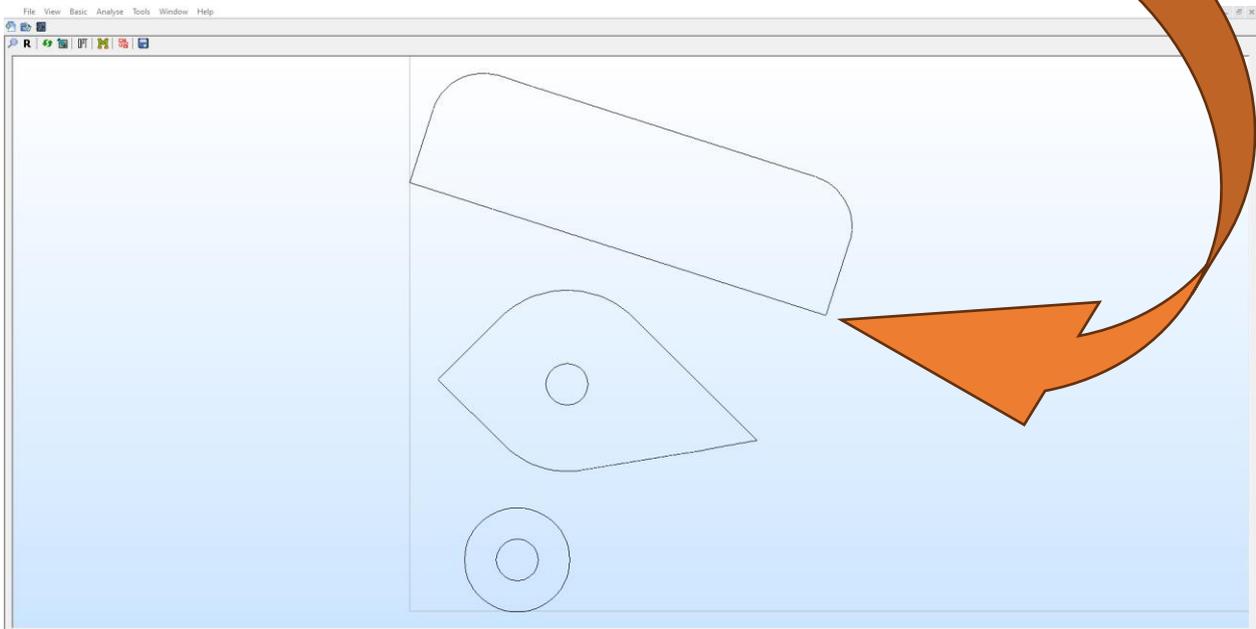


Figure 6



2) Optimization of imported cuts

Typically, the geometries of the imported cuts from the 3D software consist of many small elements that are usually impractical for further processing. For that reason, NestKing offers an optimization tool. This tool reduces the number of elements by simplifying the geometries. In addition, overlaps are removed automatically, and geometries are connected and closed. Furthermore, correct layers are assigned to these geometries according to Table 1.

Layer	Name	Default Color	Purpose	Applied cutter tool
0	Design layer	Black	Used for geometries and text not considered for nesting and cutter operations.	Ignored
1	Text layer	Blue	Text layer is used for labeling. Label position on the cut and label size are flexible. NestKing can resize the labels on Level 1 and reposition them to fit the cuts properly. If you want to fix position and size of labels use layer 4.	Ink Jet (Printing head)
2	Inner layer	Yellow	Layer 2 is used for holes and slices inside cuts.	Cutter knife
3	Outer layer	Red	Layer 3 is used for the outline of cuts.	Cutter knife
4	Plot layer	Purple	Geometries on layer 4 can be used to print additional information on the cut. In comparison to layer 1 labels on layer 4 are not resized and repositioned by NestKing. They are printed as indicated in NestKing.	Ink Jet (Printing head)

Table 1

Figure 7 presents a cut example using all five layers mentioned in Table 1.

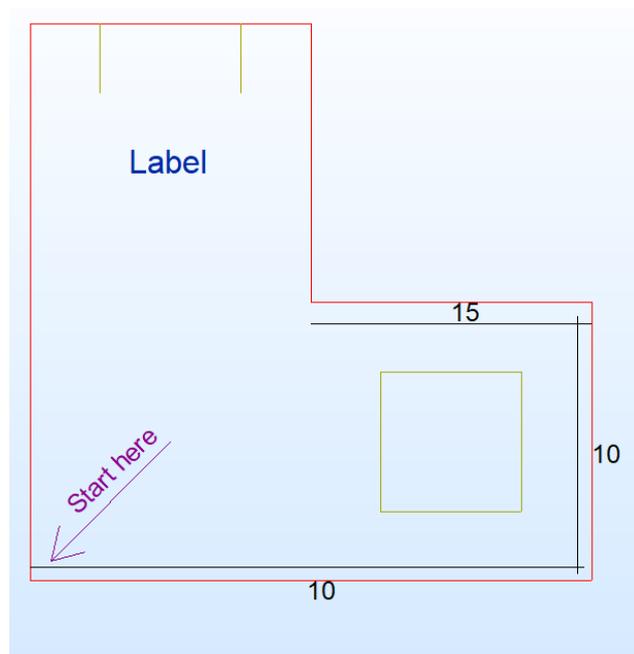


Figure 7



3) Preparation of imported cuts for lay-up design

Preparation is to modify imported data to convert it into cuts that can be used for lay-up design. Examples for such changes are:

- Adding additional material to cover fillets (Figure 8),
- Compensation of excessive material distortion caused by the 3D flattening process.

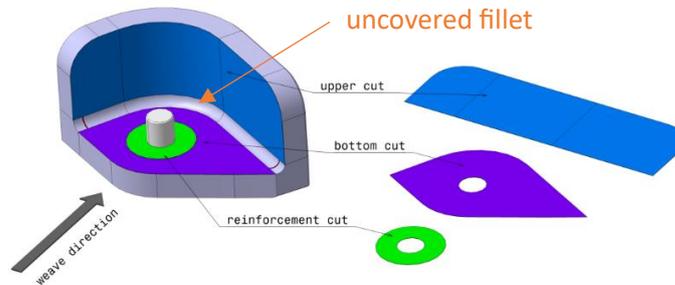


Figure 8

The resulting cuts are the base for the upcoming lay-up design process.

4) Lay-up design

The goal of this step is to create the complete lay-up. Therefore we need to copy our prepared cuts multiple times, depending on the number of layers the composite part exists of. Next, to avoid weak spots in the laminate part, we need to offset touching segments.

This process is easiest to explain using our example. Figure 9 shows the touching segments of our example part.

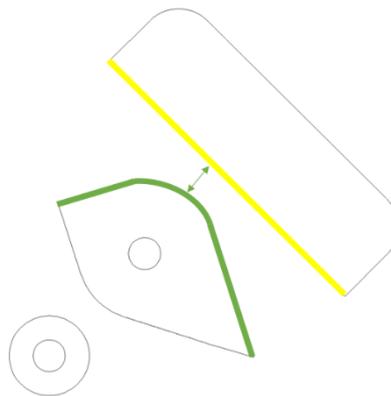


Figure 9



COPYING LAYER: Assuming our example part exists of five layers the prepared cuts need to be copied four times. If we would just take these cuts and put them on the tool, we would get following lay-up:

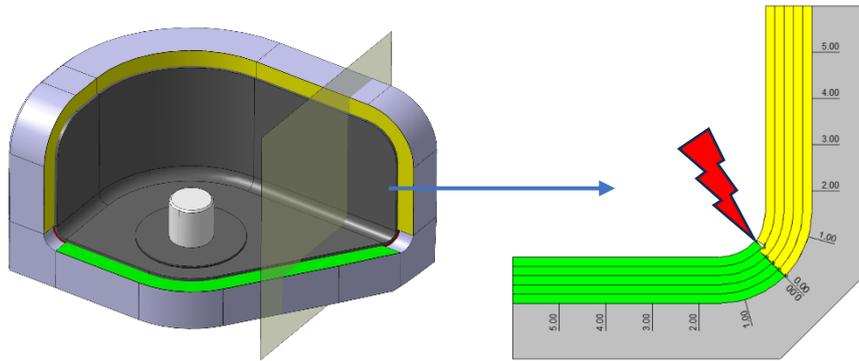


Figure 10

OFFSETTING SEGMENTS: Bottom cuts are indicated in green and upper cuts are represented in yellow. There are no cuts covering the rounded edge, so the component is only held together at this point by the significantly less resilient resin. To avoid weak spots in the final composite part, we need to offset touching segments of our cuts to create staggered offset joints (Figure 11).

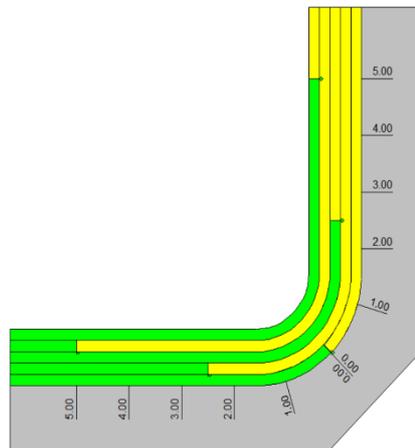


Figure 11

ROTATING LAYERS: In addition, varying the layer angles also contributes to higher damage tolerance of the composite part and component deformations caused by thermal stresses are reduced. Therefore, if using fabric material each odd layer is usually rotated by +45°.

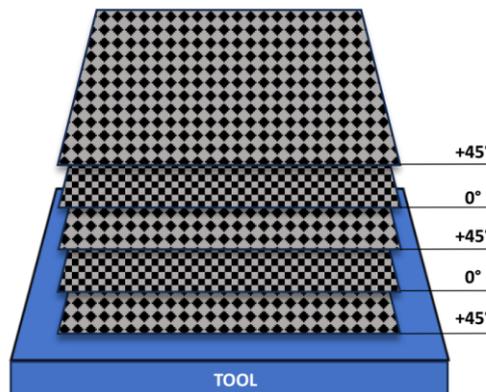


Figure 12

LABELING: Lay-up design also includes labeling of all cuts to ensure clear identification.



NestKing provides two workspaces for the designing lay-ups:

4a) Standard workspace

The Standard workspace is the basic workspace of NestKing. Copying, offsetting, rotating and labeling has to be done manually. A tool-set for text and geometry manipulation helps to set up the whole lay-up. Further, pictures can be added and used to generate cuts (see chapter *F*). The Standard workspace can handle DXF, ZCC and GTK files.

4b) MasterCut workspace

Since generating lay-up is usually the most time-consuming part of all, NestKing developed the MasterCut workspace. In this workspace copying, offsetting, rotating and labeling is done automatically. After creating the links between the touching segments (Figure 9), a table-based control mechanism generates the lay-up. This further increases the degree of automation, reduces the risk of error, and makes the whole process more intuitive. How segments can be linked is explained in more detail in chapter *D*. In addition, the MasterCut workspace also contains all tools of the Standard workspace. To save the additional information the DXF-file is no longer sufficient, thus the NKMCUTS file is applied.

The output of the Standard and MasterCut workspace are the finished cuts that form the entire lay-up of our composite part.

5) Nesting cuts

Nesting is the process of arranging cuts in the given nesting area on the material in such a way that as little material waste as possible is created. In other words, it's about optimizing the position of the cuts on the material so that they take up as little space as possible. Therefore NestKing is equipped with several different nesting algorithms, which can be either explicitly selected by the user or by the software. In the "auto mode", NestKing automatically selects the correct algorithm depending on the shape, number of cuts and whether rotation of cuts is allowed or not.



6) Output Data

6a) Cutter Report

Further it is also possible to generate a cutter report containing all relevant information like the estimated cutting time, material consumption and weight of the cuts for estimating the weight of the part (see chapter 5.5. *Cutter Report*).

6b) Nested Cuts

Finally, the nest results can be exported in different file formats like GTK, ZCC or DXF. In addition, NestKing also offers a cutter simulation tool used for simulating the cutting process (see chapter 5.4. *Cutter Simulation*).

The exported nest files are ready for upload into the cutter control software and usually cut without any further modifications.

Prominent examples of cutter software are Wingman from ISODev GmbH and Zünd Cut Center from Zünd GmbH.

6c) Plybook

The plybook feature is not implemented yet but will be integrated in NestKing soon.



B. Sketcher Features

This chapter introduces the main Sketcher features provided by NestKing. First, chapter *B1* will give you an overview over the User Interface of the sketcher area. Upcoming chapters *B2* and *B3* gives you an overview of all tools offered by the sketcher. Chapter *B4* is about how to use the Command Prompt box. How to select single and multiple objects at once is described in chapter *B5*.

Open the sketcher by clicking on the pencil button in the *Main Toolbar* .

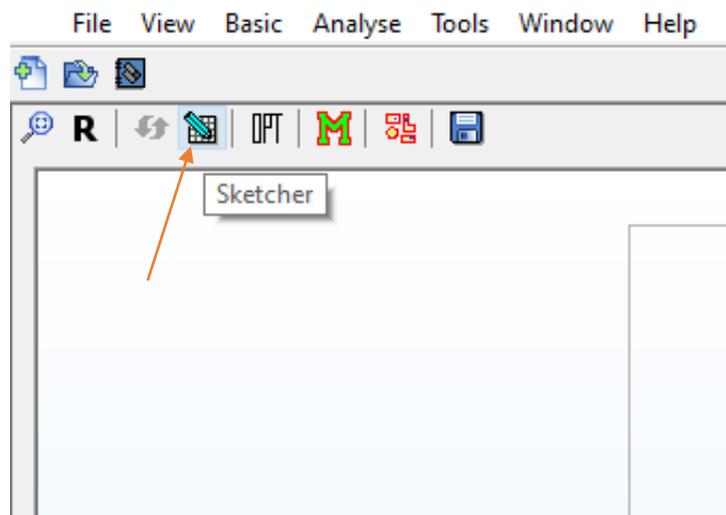


Figure 13



B1. User Interface

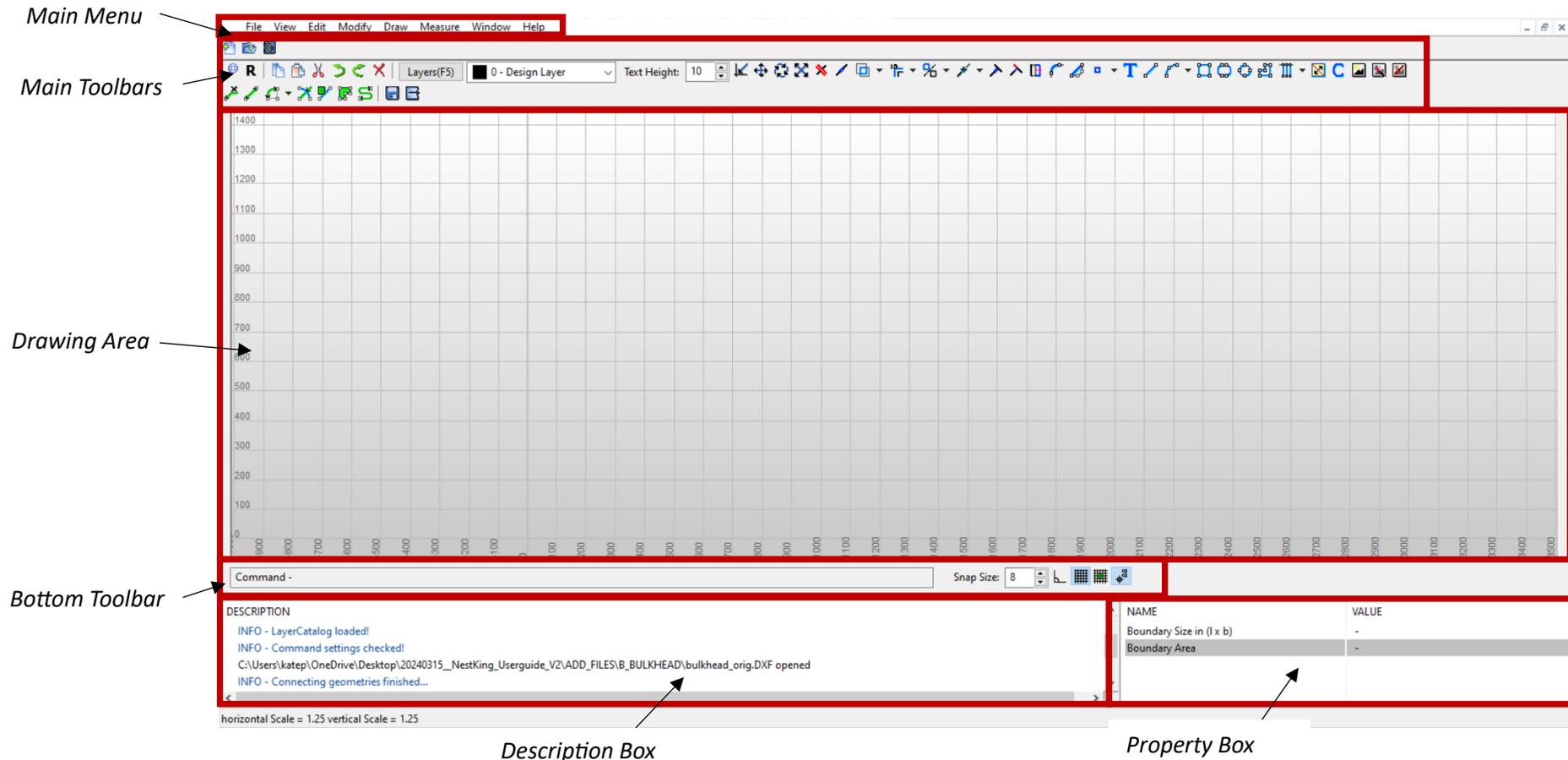


Figure 14



B2. Main Toolbar

The *Main Toolbar* is located at the top of the Sketcher Window as highlighted in Figure 15.

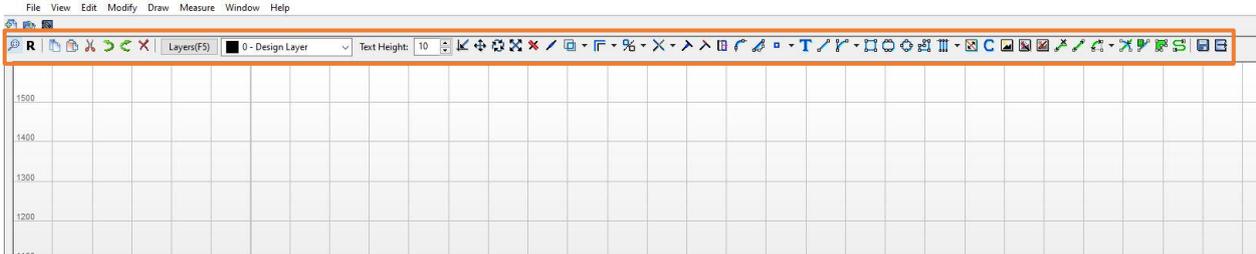


Figure 15

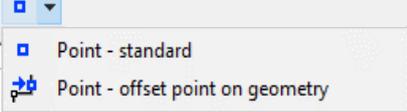
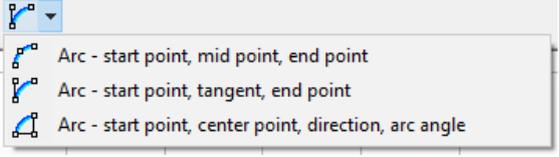
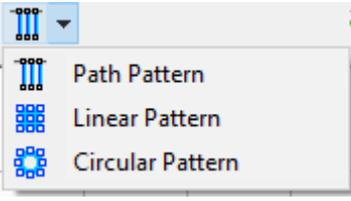
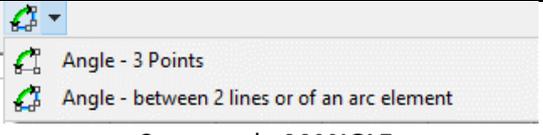
Table 2 describes all tools of the *Main Toolbar* in more detail.

	Fit to Window – Click to fit all objects inside our visible window area.
	Reset – Clears all indication objects used for emphasizing errors and other important information. See also page 72 for more details.
Shortcut: -CTRL- + -C-	To copy all selected objects.
Shortcut: -CTRL- + -V-	To paste copied objects.
Shortcut: -CTRL- + -X-	To cut all selected objects.
Shortcut: -CTRL- + -Z-	To undo last action.
Shortcut: -CTRL- + -Y-	To redo last action.
Shortcut: -DEL-	To delete all selected objects.
	Opens our Layer Dialog with a list of all layers as displayed in Figure 16. If required, you can use the Layer Dialog to show and hide objects of a specific layer. <div data-bbox="1098 1301 1378 1581" style="float: right; border: 1px solid gray; padding: 5px;"> </div> <p style="text-align: right; margin-right: 100px;">Figure 16</p>
	Change layer – Can be used to change the layer of the currently selected objects. <p>Note: You can also change the layer of currently selected objects by clicking the appropriate layer number on the keyboard:</p> <ul style="list-style-type: none"> Key -0- for design layer Key -1- for text layer Key -2- for inner geometries Key -3- for outer geometries Key -4- for plot geometries and text Key -9- for command geometries and text



<p>Text Height: 4</p>	<p>Change the text height of currently selected text objects.</p>
	<p>Shift to origin - Shifts all objects to the x- and y- axes.</p>
<p>Command: -SHIFT-</p>	<p>To shift all selected objects.</p>
<p>Command: -ROTATE-</p>	<p>To rotate all selected objects.</p>
<p>Command: -SCALE-</p>	<p>To scale all selected objects.</p>
<p>Command: -BREAK-</p>	<p>To split a geometry into two parts.</p>
<p>Command: -CONNECT-</p>	<p>To merge multiple selected geometries within an adjustable gap tolerance.</p>
<p>Command: -AND-, -OR-, -MINUS-</p>	<p>Boolean geometry manipulation – Can be used to</p> <ol style="list-style-type: none"> 1. get the overlapping geometry of two intersecting geometries (-AND-), 2. get the outer geometry of two intersecting geometries (-OR-), 3. get the resulting geometry of the first selected geometry minus the second selected geometry (-MINUS-).
<p>Command: -OFFSET-</p>	<p>We have five options for offsetting:</p> <ol style="list-style-type: none"> 1. Offset with straight edges . 2. Offset with straight edges and the offset value added as text object . 3. Offset with round edges . 4. Offset with round edges and the offset value added as text object . 5. Offset by using the Offset Dialog .
<p>Command: -MIRROR-</p>	<p>Mirrors all selected objects around a defined axis. The original objects can be either kept or removed .</p>
<p>Command: -TRIM-</p>	<p>Trims a selected geometry by</p> <ol style="list-style-type: none"> 1. a point on the geometry , or by 2. a limit geometry intersecting the selected geometry .
<p>Command: -EXTEND-</p>	<p>Extends the selected geometry up to a limit geometry or by a defined extension length.</p>
<p>Command: -JOIN-</p>	<p>Join – Combines three tools in one: Trim, extend and connect. This tool connects the ends of two geometries by trimming and extending as needed. Merging the resulting geometries to one geometry is optional and can be enabled or disabled.</p>
<p>Command: -STRETCH-</p>	<p>Stretch – This tool can be used to stretch geometries. In contrary to the shift tool with stretch you can also shift just certain points of a geometry.</p>
<p>Command: -FILLET-</p>	<p>Fillet – Rounds an edge of a geometry with an adjustable radius.</p>



 <p>Command: -SIMPLIFY-</p>	<p>Simplify – Reduces the number of elements (arcs and lines) that make up a geometry. The degree of simplification depends on the chosen deviation. Default value of 0.1mm is usually fine.</p>
 <p>Command: -POINT-</p>	<p>Adds a new point...</p> <ol style="list-style-type: none"> anywhere in the Drawing Area , or as an offset from a selected point on a geometry .
 <p>Command: -TEXT-</p>	<p>Adds a new text.</p>
 <p>Command: -LINE-</p>	<p>Adds a new line geometry (geometry consisting of one line element).</p>
 <p>Command: -ARC-</p>	<p>Adds a new arc geometry (geometry consisting of one arc element). There are three options available:</p> <ol style="list-style-type: none"> Add arc defined by start, mid and end point . Add arc defined by start, tangent and end point . Add arc defined by start and center point, direction, and the angle of the arc .
 <p>Command: -RECTANGLE-</p>	<p>Adds a new rectangle geometry.</p>
 <p>Command: -SLOT-</p>	<p>Adds a new slot geometry.</p>
 <p>Command: -CIRCLE-</p>	<p>Adds a new circle geometry.</p>
 <p>Command: -POLYLINE-</p>	<p>Adds a new polyline geometry.</p>
 <p>Command: -PATHPATTERN-, -LINEARPATTERN-, -CIRCULARPATTERN-</p>	<p>Adds new pattern geometries. There are 3 different types of pattern available:</p> <ol style="list-style-type: none"> Path Pattern: Creates a pattern along an userdefined path. Linear Pattern: Creates a pattern that is aligned to a linear grid in x and y direction. Circular Pattern: Creates a pattern that aligns with a circle grid in angular and radial direction.
 <p>Command: -SPLITCUT-</p>	<p>Splits one geometry into two geometries using a split geometry.</p>
 <p>Command: -COMMAND-</p>	<p>Adds a new NestKing command. For further information see page 37.</p>
	<p>Load picture from directory (see chapter F).</p>
	<p>Process Picture – Processes all selected pictures with same settings, definable via an appearing Picture Process Setting Dialog (see chapter F).</p>
	<p>Get geo from Picture – Extracts the outline of mapped objects on selected pictures for further modification.</p>
 <p>Command: -MABS-</p>	<p>Measure Point absolute – Displays the x- and y-values of a point.</p>
 <p>Command: -MP2P-</p>	<p>Measure Point to Point – Shows the distance between two points.</p>
 <p>Command: -MANGLE-</p>	<p>Measure Angle – Measures the angle between</p> <ol style="list-style-type: none"> three points , two lines , or the angle of an arc element .



	Command: -MRADIUS-	Measure Radius – Displays the radius of an arc element or circle.
	Command: -MELEMENT-	Measure Element - Displays all relevant data of an arc or line element.
	Command: -MAREA-	Measure Area – Returns the area of a closed geometry.
	Command: -MGEOLEN	Geometry Length – Returns the length of a geometry.
		Save – Saves all changes to the file.
		Exit – Click to leave the sketcher.

Table 2

B3. Bottom Toolbar

This chapter is about the *Bottom Toolbar* and its functionalities.



Figure 17

	Command Prompt – Used to trigger tools by keyboard commands or change tool settings (see <i>section B4. Command Prompt</i>).
	For changing the snapping size of the cursor inside the Drawing Area.
Shortcut: -F8-	For activating and deactivating orthogonality.
Shortcut: -F9-	Show/hide the grid in the background of the Drawing Area.
Shortcut: -F10-	Activate and deactivate snapping the cursor on the grid.
Shortcut: -F11-	Show/hide the absolute mouse position in the Drawing Area measured from origin point.

Table 3



B4. Command Prompt

The Command Prompt can be used to trigger most tools on the Main Toolbar via shortcuts. In addition, the Command Prompt also guides you through the steps required to successfully apply the functionality of the selected tool. To cancel the process at any time press the **-ESC-** key.

How to use the Command Prompt:

First, make sure that the Command Prompt only states “Command – “ . If that is not the case, click the escape key **-ESC-** on the top left of your keyboard.

Next press the **-S-** key, however capital letters don’t matter. Now the Command Prompt shows all tools starting with letter “S”:

With clicking the **-SPACE-** or **-ENTER-** on your keyboard we confirm the first suggestion in the count. In this case it would be the shift tool. If we want to scale objects we have to press the **-C-** key as well and just all tools starting with “SC” are displayed:

Click **-SPACE-** or **-ENTER-** to confirm. Now NestKing activates the scale tool.

Note: You can put the software in the same state simply by clicking the scale button  on the Main Toolbar.

Each tool has its own workflow, and the Command Prompt gives you the instructions needed to properly run the selected tool functionality. In our case an object to be scaled is required next. Therefore simply select the object to be scaled.

Note: If you want to scale several objects at the same time, you must first select these objects and then activate the scale tool. The same procedure also applies to shifting, rotating, connecting and mirroring.

After selecting the object to be scaled, the scaling function needs a center scaling point.

Pick a center scaling point somewhere in the Drawing Area. Now you have two options for defining the scaling factor.

(1) On the one hand you can enter the scaling factor using the Command Prompt. To do so, type “5” on your keyboard to scale the selected geometry by factor 5.

Finally, we confirm with **-SPACE-** or **-ENTER-**.

(2) On the other hand you can also scale our geometry by selecting a scaling fix point anywhere in your Drawing Area.



B5. How to select objects

For selecting objects, we have two opportunities.

(1) Select by mouse click

If no tool is activated (the Command Prompt only states “Command – “). You can select any object by picking it with the left mouse button. For multiple object selection we need to hold the **CTRL** key on your keyboard down to keep previous selected objects. If we click on an already selected object again, we can deselect it.

(2) Select by using the Selection Box

First ensure that no tool is activated (the Command Prompt only states “Command – “). We can select one or multiple objects by drawing a selection box containing all required objects as indicated in green in Figure 18. To do this, simply select the first corner and stretch the rectangle by holding down the left mouse button and moving the mouse at the same time until all objects are inside the box.

If you span your selection box from left to right all objects completely inside the selection box are selected. If you span the selection box from right to left also objects just intersecting our selection box are selected as well.

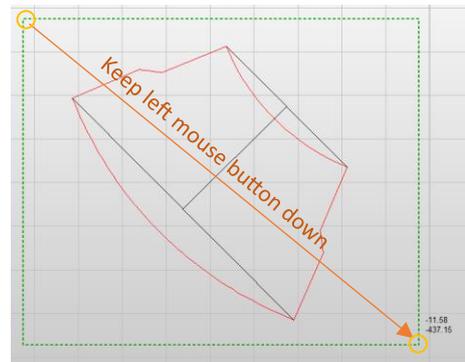


Figure 18



C. Example Bulkhead – Generating cuts from start to finish

This chapter explains all the steps from opening the dxf file (containing our cuts from our 3D-Software) to exporting the final nest files for our cutting machine.

2) Optimization of imported cuts from 3D

1. Click in the *Main Toolbar* on the button **Open File** and open the dxf file **bulkhead_orig.DXF**, which is part of the download ZIP file USER GUIDE (Figure 19). It is the contour of a bulkhead from a 3D-Software.

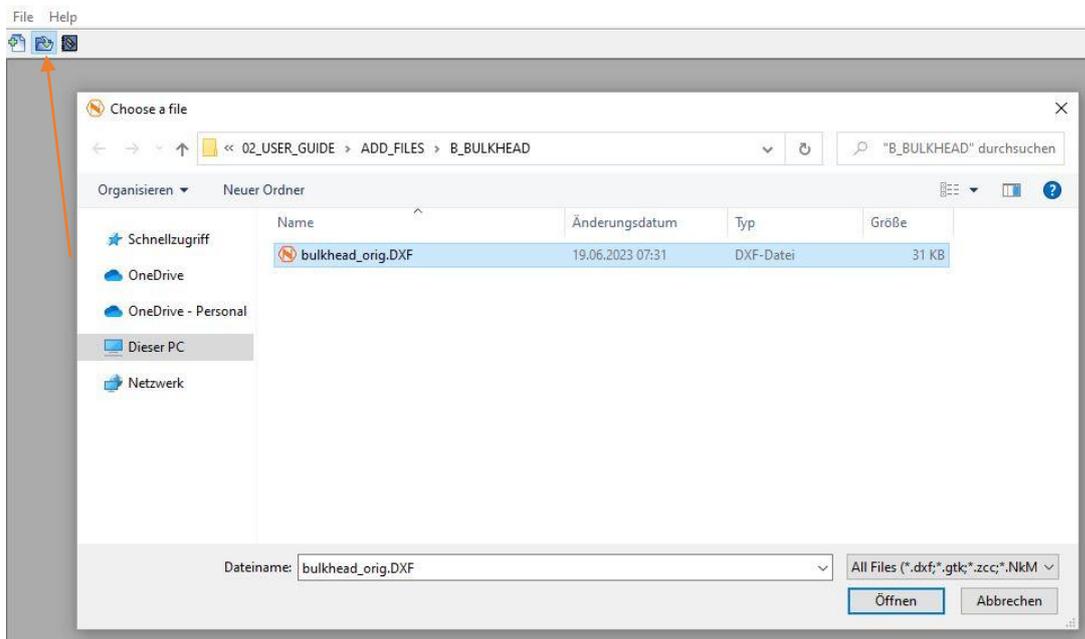
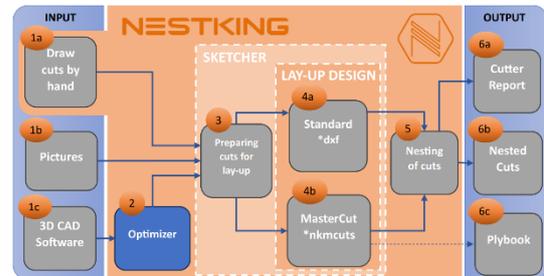


Figure 19



Figure 20

Note: *Zooming* is done by **turning the mouse wheel**. The **zoom point** is the **current position of your cursor** on the Drawing Area.

Scrolling left, right, up and down is done by **pressing down the mouse wheel and moving the mouse** at the same time.

Click on the imported contour. In the **Property Box** you can see that the geometry has **Layer 0** (see Table 1 on page 9). This means that the geometries are not considered in nesting and cutting operations at the moment.



Figure 21



2. Press button **View** in the Main Menu. Activate [**Show Element-Position-Numbers**] and [**Show Geometry-Numbers**] (Figure 22).

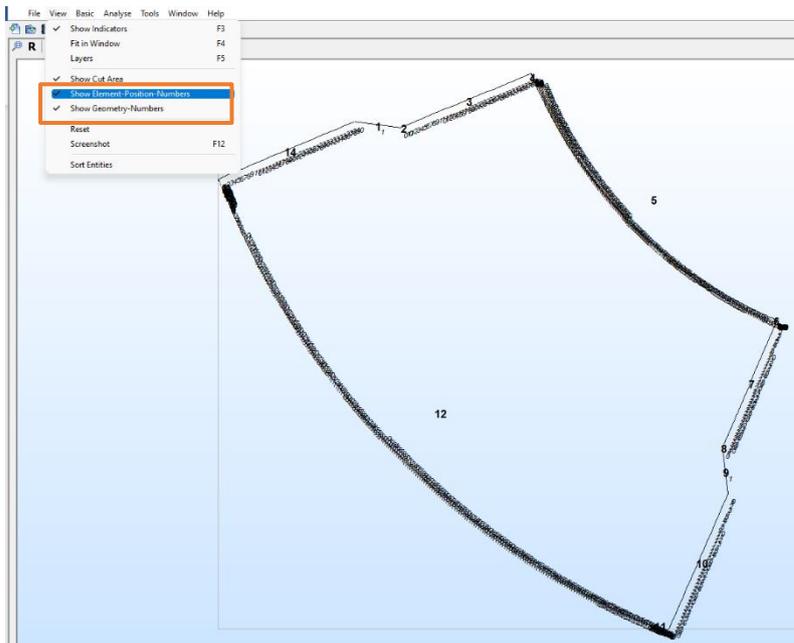


Figure 22

Note: The exported contour from the 3D-Software consists of 14 geometries each of these geometries exists of many elements. This can be either arc element or line element. The aim of our optimization tool is to reduce the number of these elements by substituting and merging geometries within a certain tolerance. Further, the optimization tool assigns the right layers to these geometries according to Table 1 on page 9.

3. Click on  **Optimize Geometries** in the *Main Toolbar* (Figure 23) to start the optimization process.

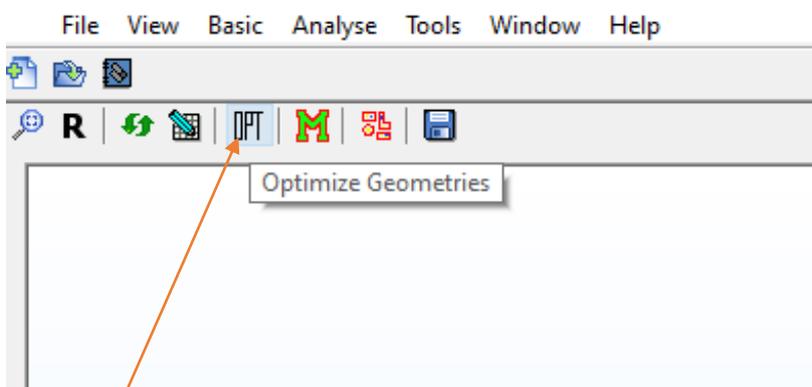


Figure 23



- Next the Optimizer asks for an **optimization tolerance** (Figure 24).

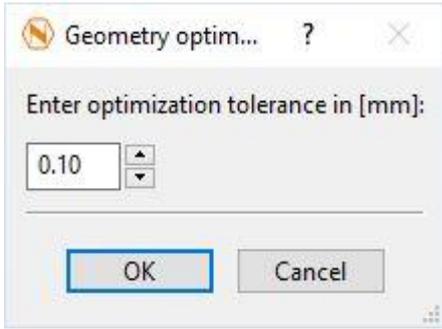


Figure 24

Note: This tolerance defines the width of the tolerance band around the original geometry. A high tolerance results in a large reduction of the elements that make up the simplified geometry, but also results in a larger deviation between the original and simplified geometry. In addition, if the distance between endpoints of two geometries is less than the defined tolerance, both geometries will be merged into one.

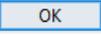
The default tolerance value of 0.1 mm is fine, **click OK**  to confirm.

Figure 25 illustrates the difference between original and optimized data.

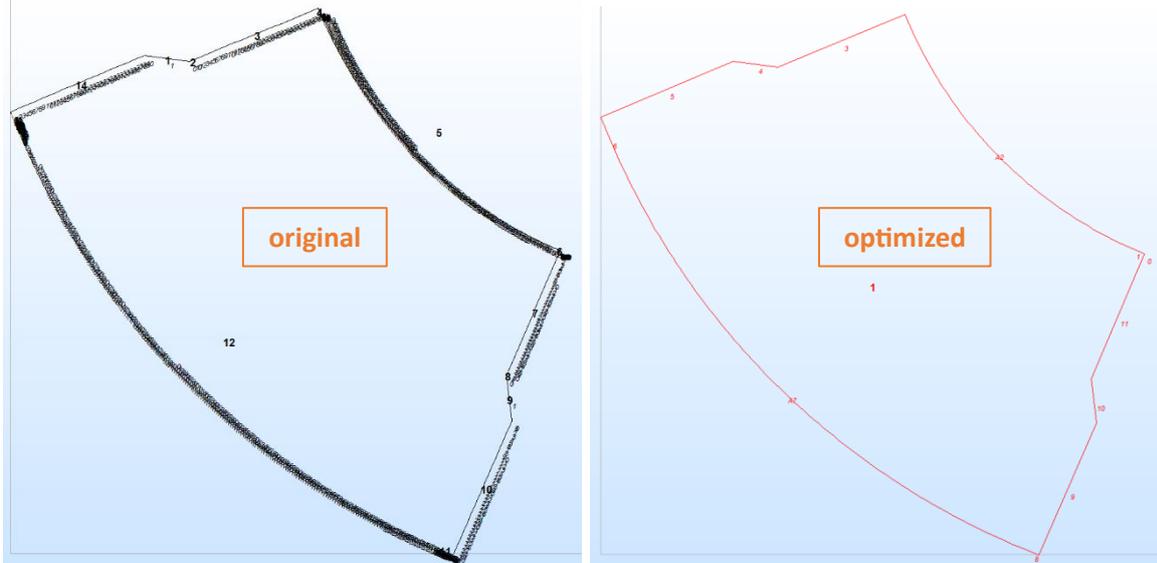


Figure 25

- Press button **View** in the *Main Menu* to deactivate [**Show Element-Position-Numbers**] and [**Show Geometry-Numbers**] (Figure 26).

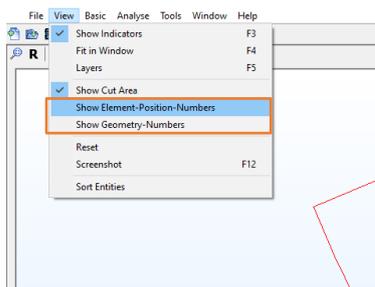


Figure 26



6. Click on the geometry, you can see in the **Property Box** that now the geometry has **layer 3**.

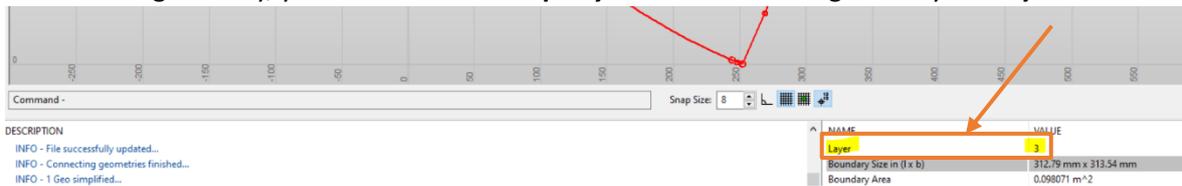


Figure 27

The Button  Optimize Geometries assigned the right layer. Layer 3 means that the red line is the outline of the cut (see Table 1 on page 9).

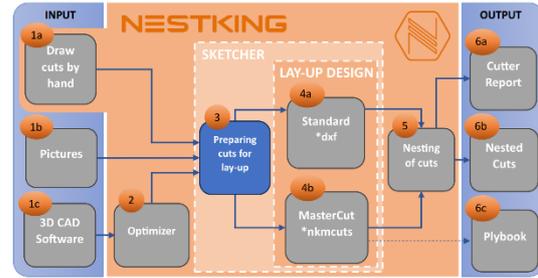
Summary: Step 2) Optimization of imported cuts contains:

1. Reducing the number of elements of the original geometry.
2. Merging geometries when the gap between the endpoints is smaller than the optimization tolerance value.
3. Assignment of the correct layers (Table 1 page 9).



3) Preparation of cuts for lay-up

For our Bulkhead example the preparation of cuts includes removing the distortions of the imported cuts caused by the flattening process in the 3D-Software. To clarify, the following steps show that the distortions and asymmetries are actually very low. Thus, STEP 3 can also be considered as optional for our Bulkhead. Still, this is also a good opportunity to present you some of the sketcher main tools and how they work. For more detailed information regarding the Standard Sketcher check chapter [Sketcher Features](#) at page 14.



1. Click on **SKETCHER**  in the Main *Toolbar* (Figure 28) or use **shortcut key** **[S]**.



Figure 28

2. **LINE:** Let's draw three support lines.

There are two options to activate the line tool:

- Option 1:** Click **LINE**  on the *Main Toolbar* (Figure 29).

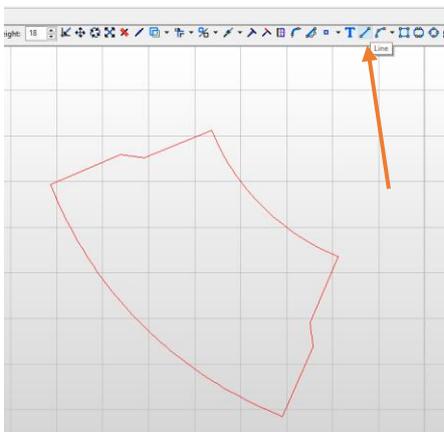


Figure 29



Figure 30

Line 1 starts with **SP1** and ends with **EP1** (Figure 30).



If the starting or end point is not exactly on the right point, you can use the Bottom **STRETCH**  in *Main Toolbar*. Follow the instructions of the *Command Prompt* to change the line.

Option 2: Use the *Command Prompt* positioned on the left bottom (Figure 31)

First, make sure **NestKing** is the currently **active** software (click anywhere in the NestKing window) and then click **[L]** on the keyboard:



Press **[SPACE]** or **[ENTER]** on your keyboard to confirm the Line tool.



Figure 31

Next, the command prompt asks for the starting point of our line.



Line 2 starts with **SP2** and ends with **EP2**. Select the points in the drawing area.

For drawing a third line, you don't have to select the line tool again. The *Command Prompt* indicates that you can select the start point of our next line immediately.



Figure 32

Line 3 starts from the **midpoint** of **Line 1** and ends at the **midpoint** of **Line 2** (Figure 33).

By moving over line 1 and 2 a triangle appears, when you reaches the midpoint of the line.

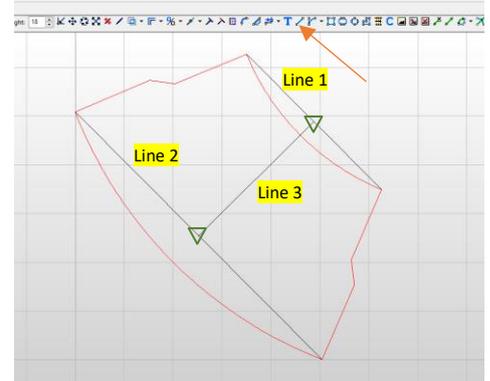


Figure 33

Note: If you have troubles with capturing the points, check if **[ORTHO]** (**ORTHO=Orthogonality**) on the *Bottom Toolbar* is activated (Figure 34). When orthogonality is active, only horizontal and vertical lines can be drawn.



Figure 34



3. **SELECT:** For selecting all geometries ensure that no tool is active and the Command Prompt just states “Command - ” . If any command is selected click **-ESC-** on your keyboard.

Click in the **top left corner** and stretch the rectangle by **holding down the left mouse button** and **moving** it at the same time until all objects are inside your selection box (Figure 35).

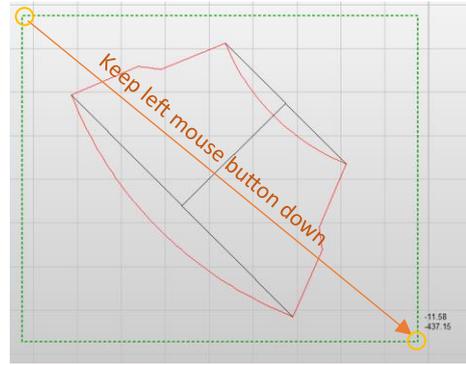


Figure 35

*Note: If you **span** the selection box **from left to right** the objects are **selected only** if they are **completely inside** the selection box. If you **span** the selection box **from right to left** also objects just **intersecting** the selection box **are selected**.*

4. **ROTATE:** To rotate the geometry click  **Rotate** on the *Main Toolbar* (Figure 36) or click **-R-** to activate the rotation tool by using the *Command Prompt* and press **-SPACE-** or **-ENTER-** to confirm the suggestion in the *Command Prompt* (in this case **ROTATE**).

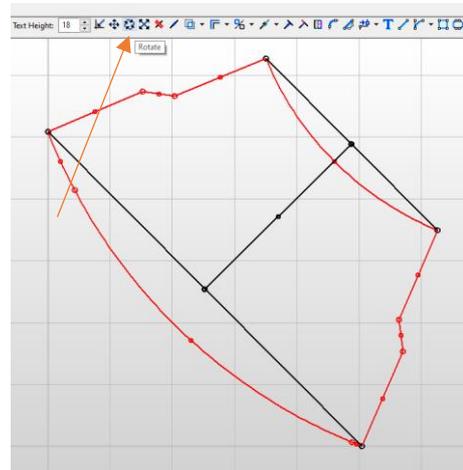


Figure 36

Next follow the **commands in the Command Prompt:**

(a) **Select the rotation center point of the objects.**

Select the **end point of Line 3** (Figure 37).



Figure 37

(b) **Select the rotation fix point:**

Select the **start point of Line 3** (Figure 38).



Figure 38



(c) For selecting the rotation angle point move the mouse or enter a number on the keyboard(=rotation angel) and press **-SPACE-** or **-ENTER-**. In our case we want our **Line 3** to be horizontal. The easiest way to align geometries to 0° is to activate the orthogonality mode **ORTHO** on the *Bottom Toolbar*. The result is displayed in Figure 39. If something went wrong press **-ESC-** and click **Undo** and repeat the upper steps.

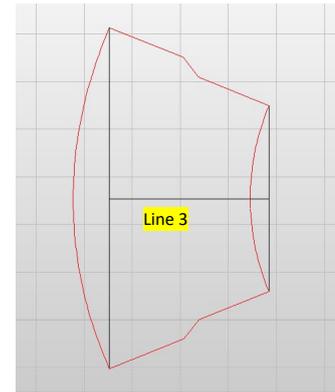


Figure 39

5. **MEASURE:** To measure the radii of both arcs select the radius measurement tool **RADIUS** on the *Main Toolbar* and click on the arc elements to display the radii (Figure 40).
 Radius 1 = 254.2476 mm, Radius 2 = 443.1537 mm

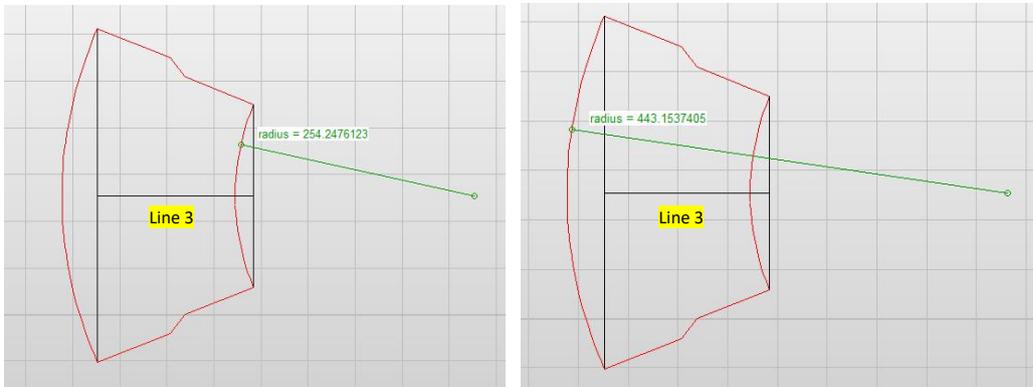


Figure 40

6. **EXTEND:** To extend a line click on **Extend** or press **E** on your keyboard to use the **-EXTEND-** Command for the *Command Prompt*.

Next follow the commands in the *Command Prompt*:

(a) Select **Line 3**

EXTEND - Select extend geometry...

By clicking anywhere on the right half of **Line 3** tells NestKing to extend the right end of the geometry (Figure 41).

Now enter “500” on the keyboard and confirm with **-SPACE-** or **-ENTER-** that the line should be extend by 500mm.

EXTEND - Select limit geometry or extend length: 500

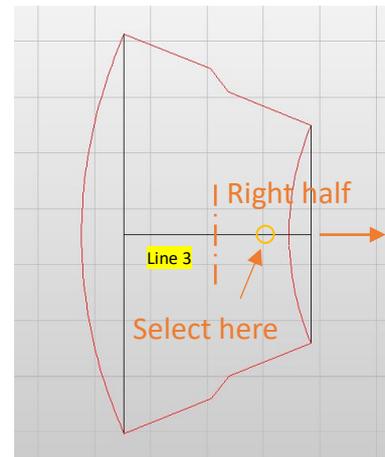


Figure 41



Further, extend **Line 3** to the left by 300mm (Figure 42).

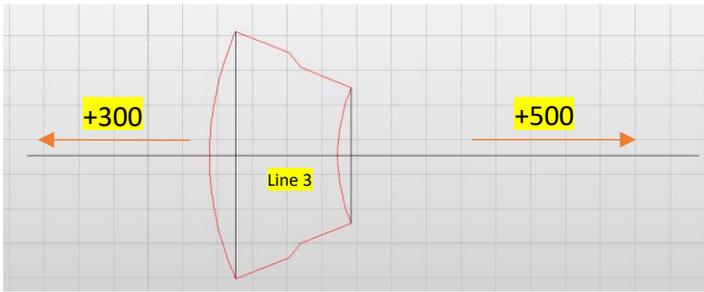


Figure 42

7. **BREAK:** The Bulkhead cut should be divided into four segments (Figure 43): One outer arc segment on the left **A1**, another inner arc segment on the right **A2**, and the two symmetrical interface segments, one at the top **I3** and one at the bottom **I4**.

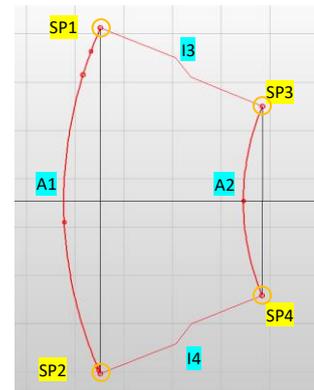


Figure 43

- a. Click on  (**Break**) on the *Main Toolbar* or press **B** to use the-
BREAK- Command
 - b. Select the geometry and position the first split point **SP1** on the top left (Figure 43).
 - c. Place the second split point **SP2** on the bottom left (Figure 43).
 - d. Now the geometry is divided into two independent geometries.
 - e. Repeat these steps for the top **SP3** and bottom right **SP4** split points to get all four independent segments.
- The breaking tool is activated as long as you do not press **[ESC]**.

8. **CIRCLE:** Substitute the outer **A1** and the inner **A2** arc by the corrected arcs with the defined radii of radius 1 = 255mm and radius 2 = 450mm. To ensure that the center points of these new arcs are perfectly aligned with the symmetry line use circles. The center points of these circles coincide and lie on the line of symmetry. Finally, trim them properly to form together with the interface segments **I3** and **I4** a closed Bulkhead cut again.

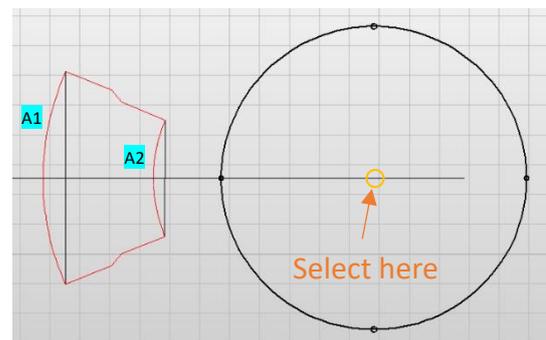


Figure 44

Click  (**Circle**) on the *Main Toolbar* or use the **-CIRCLE-** Command.

Follow the commands in the Command Prompt:

- (a) **Select a center point:** Click anywhere on the symmetrical line to the right to define the



center point (Figure 44).

CIRCLE - Select outer point of circle or enter radius:

(b) Define the circle size by selecting another point anywhere in the Drawing Area or by entering the radius. In our case enter "255" (radius 1 = 255mm) and confirm with the **-SPACE-** or

-ENTER-. CIRCLE - Select outer point of circle or enter radius: 255

- 9. **SHIFT:** Shift the circle to its final position, touching the current inner arc **A2** at the symmetrical line (Figure 45).

Press **-ESC-** to leave the circle tool and click  (Shift) or use the **-SHIFT-** command and confirm with the **-SPACE-** or **-ENTER-** key to activate the shift tool. SHIFT - Select objects to be shifted...

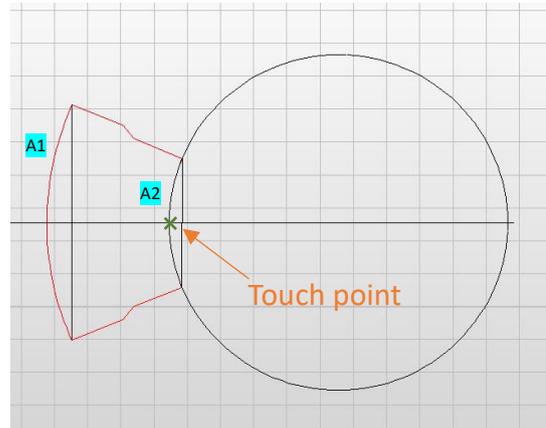


Figure 45

Follow the commands in the **Command Prompt:**

(a) **Select objects to be shifted:** Click on the object you want to shift. Click on the circle.

SHIFT - Select objects to be shifted...

(b) **Select shift point of objects:** Click on the point of the object you want to place on a specific position. For the shift point select the **leftmost point on the circle** at the 9 o'clock position. It should be placed on the "Touch point" shown in .Figure 45.

SHIFT - Select shift point of objects...

(b) **Select insertion point for selected objects or distance:** Move the shift point to the final position.

SHIFT - Select insertion point for selected objects or distance:

Move the shift point of the circle to the leftmost point of the Bulkhead and press **-SPACE-** or **-ENTER-**.

Now create a circle with a radius of 450 mm. The point of contact of the second circle and the bulkhead is the leftmost point of the bulkhead (see Figure 47). Therefore, repeat the steps from chapter circle.



10. **DELETE:** The original inner and outer arcs (A1 and A2) are no longer needed and can be deleted.

Click on the arc and delete it with  (**Delete**) on the *Main Toolbar* or press **-DEL-** on your keyboard.

Note: To select multiple objects hold down the **-CTRL-** key then left click on each object you wish to select.

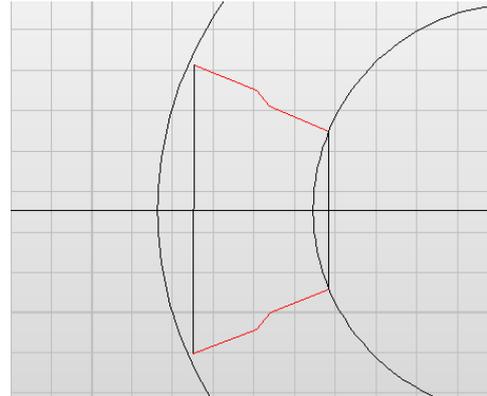


Figure 47

11. **MIRROR:** To ensure that the top and bottom interface segments I3 and I4 are symmetrical, use the mirror tool .

- a. **Change layer:** Before mirroring I3, change the layer of I4 temporarily to layer 1, so that we can later differ between the original and the mirrored segment. Make sure that currently no command is selected. If that is not the case press **-ESC-** until the Command Prompt just states "Command -" . Next pick I4 and select layer 1 in the layer drop down menu on the *Main Toolbar* or simply click key **-1-** on your keyboard. Now I4 should show up as blue (Figure 48). Finally press **-ESC-** to deselect I4.

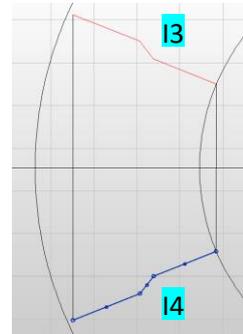
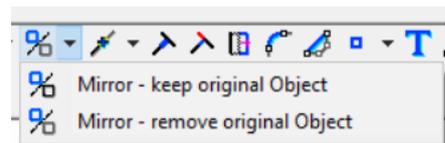


Figure 48

- b. Press the **mirror**  button in the *Main Toolbar* or use the **-MIRROR-** Command.

There are two different ways to use the Mirror Command:

- Mirror – keep original object
- Mirror – remove original object



In our case, we want to **keep the original object**

Note: As you can see in the Command Prompt, it is still possible to switch into the [(r)remove mirrored objects] mode:

Therefore press key **-R-** (that's why the letter is framed by two parentheses) and the mode will change:

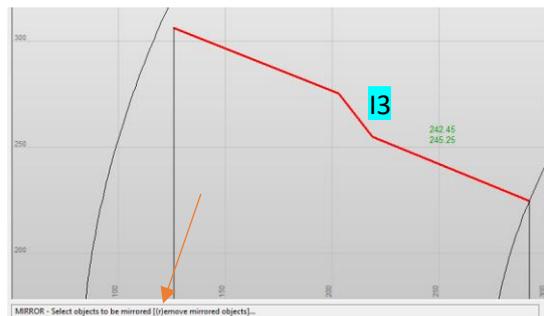


Figure 49



MIRROR - Select objects to be mirrored [(k)keep mirrored objects]...

Press **-K-** for [(k)keep mirrored objects] to get back into the keep mode again:

MIRROR - Select objects to be mirrored [(r)emove mirrored objects]...

c. Select the **upper interface segment I3** as our object to mirror.

d. Select **start** and **end point** of the mirror axes.

MIRROR - Select start point of mirror axis [(r)emove mirrored objects]...

As shown in Figure 50, we can use our line of symmetry and position our two mirror points **MP1** and **MP2** on it. The resulting symmetrical geometry has the same layer as the original geometry. In our case layer 3.

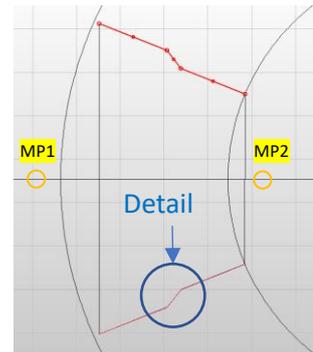


Figure 50

e. If you take a closer look and compare the currently created **I4** on layer 3 in red and the older **I4** on layer 1 in blue, you see that they differ slightly by approximately 0.4mm (Figure 51).

To measure this gap, select the **POINT TO POINT**  measuring tool or use the **-MP2P-** Command. This tool measures the distance between any points on the Drawing Area.

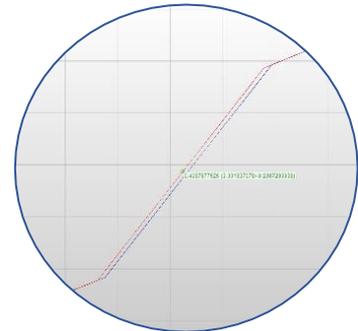


Figure 51

The original segment **I4** on layer 1 (blue) is no longer needed. Pick the original **I4** and click  (**Delete**) or press the **-DEL-** key on the keyboard.

The two vertical support **Line 1** and **Line 2** can be deleted as well (Figure 52).

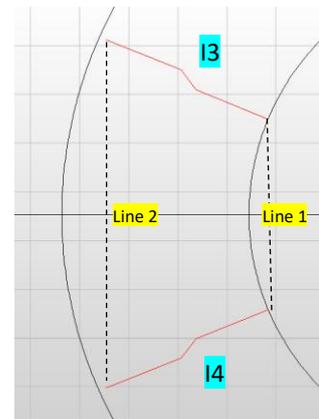


Figure 52



12. **JOIN:** To get a closed Bulkhead, cut and extend all four segments with the join tool.

Activate the **Join** tool  on the *Main Toolbar* or use the **-JOIN-** Command. Now you can choose if we want to apply autoconnect or not.

JOIN - Select first geometry or (d) for disable autoconnect ...

If you use **autoconnect**, you finally get **one single closed geometry**. If you use **disable autoconnect** you keep the four segments **A1**, **A2**, **I3** and **I4**. We chose disable autoconnect. Therefore, deactivate automatic connection by clicking the **-D-** key on the keyboard or using the right mouse button to change the tool mode.

JOIN - Select first geometry or (e) for enable autoconnect ...

Follow the commands in the **Command Prompt:**

- **Select first geometry.**
Click on the part of the first geometry you want to keep. Set the selection points as shown in Figure 53 to join **A1** and **I3**.
- **Select second geometry:**
Click on the part of the second geometry you want to keep.

Repeat the process until the desired geometry remains.

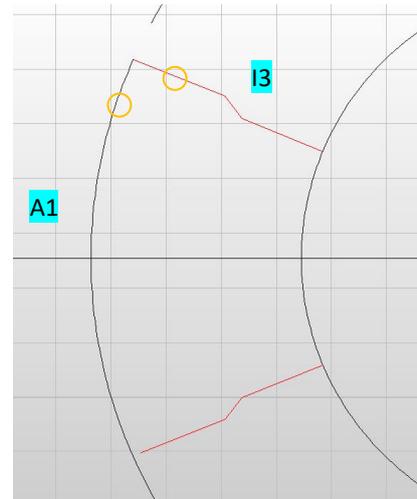


Figure 53

13. **Change the layers** of **A1** and **A2** from layer 0 (design layer) to **layer 3** (outer layer).

Select **A1** and **A2** and choose layer 3 in the layer drop down menu on the *Main Toolbar* (Figure 54) or simply press **-3-** on our keyboard.

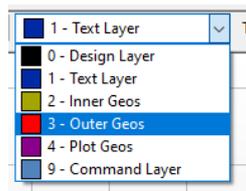


Figure 54

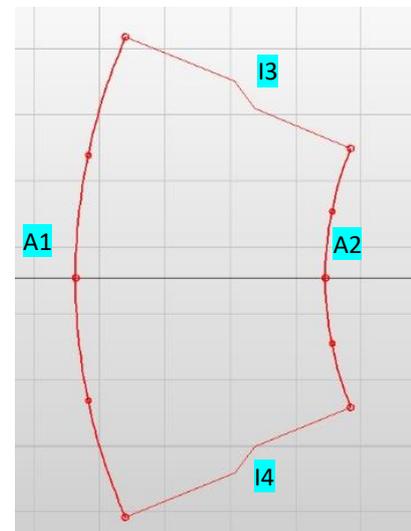


Figure 55

14. **TRIM:** Finally trim the line of symmetry (support line 3) to get a more compact appearance. The selection point marks the remaining part of the geometry.

- There are two options for trimming:
- (1) **[Trim - by point]** requires a point as trim element and
 - (2) **[Trim - by limit geometry]** requires a limit geometry as trim element.

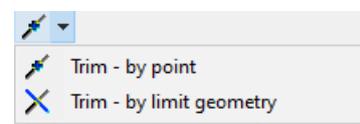


Figure 56

In our case we will use the first option **[Trim - by point]**.



Select  (Trim Geometry) or apply the **-TRIM-** Command.

Follow the commands in the **Command Prompt**:

- Select geometry:**

Select the geometry somewhere near selection point **SP** in the middle of the cut (Figure 57). This part of the symmetry line should remain.
- Ensure that **[Trim - by point]** is activated:

If that is not the case

→ click **-P-** to activate **[Trim - by point]** as stated in the Command Prompt or use the right mouse click to select the right mode via the pop-up menu.
- Select trim point:**

As trim point 1 select **TP1** to trim the left part of the symmetry line (Figure 57).
- Select geometry:**

Select the symmetry line again somewhere near point **SP**.
- Select trim point:**

As second trim point select **TP2**, to trim the right part of the symmetry line.

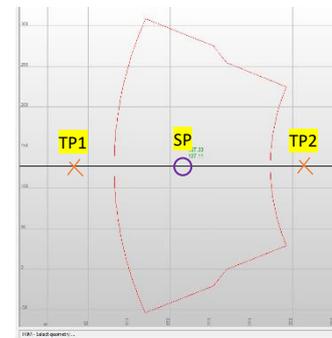


Figure 57

15.**SAVE**: Click  (**Save**) on the *Main Toolbar* or use the **-CTRL-** + **-S-** shortcut.

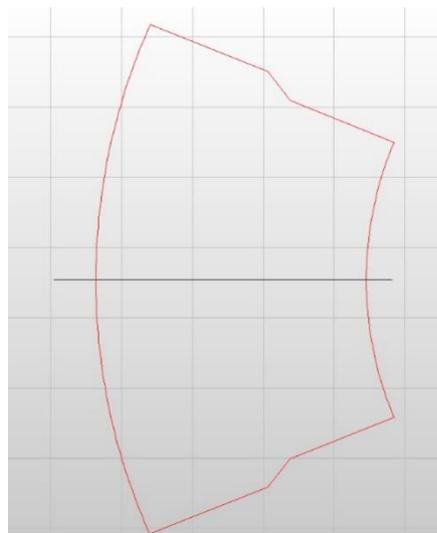


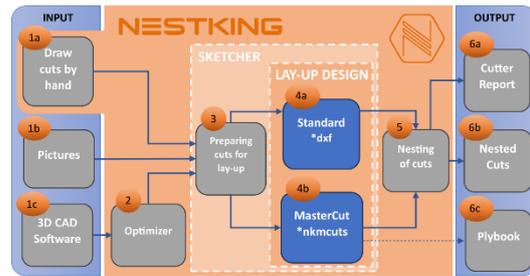
Figure 58

Perfect! Bulkhead cut is modified, now continue with step 4.



4) Generate Lay-up

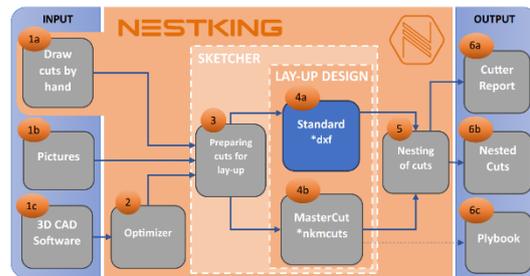
To generate our Bulkhead compound lay-up, we can choose between two approaches. First, as already used for STEP 3, we can use the Standard workspace. The Standard workspace can handle DXF, ZCC and GTK files.



The second approach uses the MasterCut workspace. Beside our standard tools the MasterCut workspace incorporates a lot more functionalities and information compared to the Standard workspace. MasterCut files are saved in the NkMCut (NestKing MasterCut) data format.

Chapter 4a describes how the Standard workspace can be used to derive the Bulkhead lay-up and the subsequent chapter 4b explains lay-up generation using the second approach including the MasterCut workspace.

4a) Standard workspace



1. First enter the Standard workspace sketcher  (Figure 59).

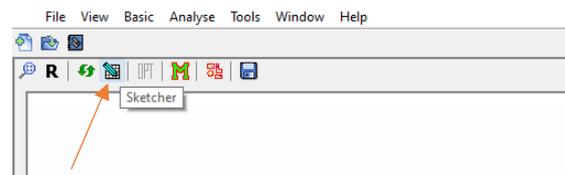


Figure 59

2. **NESTKING COMMAND:** NestKing Commands are used to add all relevant nest information. They can be applied with the command button  in the Main Toolbar or by using the **-COMMAND-** command.

Next the Command Dialog will appear (Figure 60). The Material (mat) Command is selected by default. This command can be used to assign materials. You can find a description of each command in the Description Box (Figure 60).

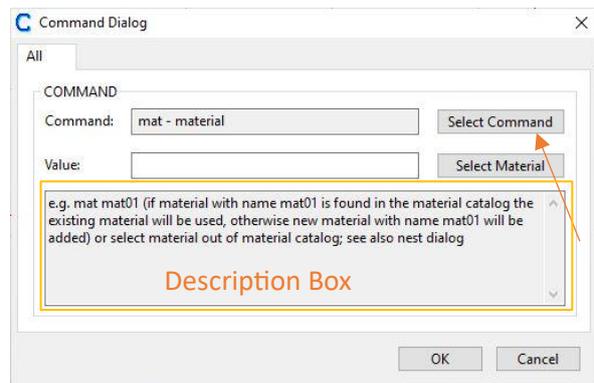


Figure 60



COMMAND – MULTIPLIER:

a. The Bulkhead cut covers 45° of a complete Bulkhead layer. Thus, we need this cut eight times to get the complete 360°. Either we can copy it eight times or we can also use the NestKing Multiplier Command. Therefore click on **Select Command** in the Command Dialog (Figure 60) to enter the Command Selection Dialog (Figure 61).

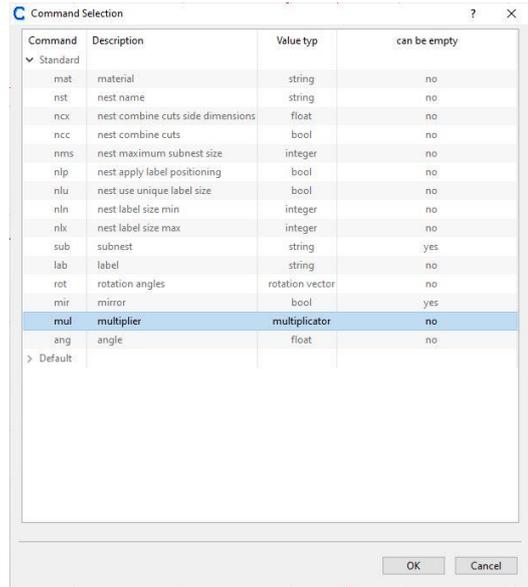


Figure 61

b. There you will find the Multiplier Command -mul- in the second last position of the standard list. Select this command with a double-click or just mark it and confirming with **OK**.

c. Back in the Command Dialog enter the multiplier value of “8” in the value entry (Figure 62). Click **OK** to confirm.

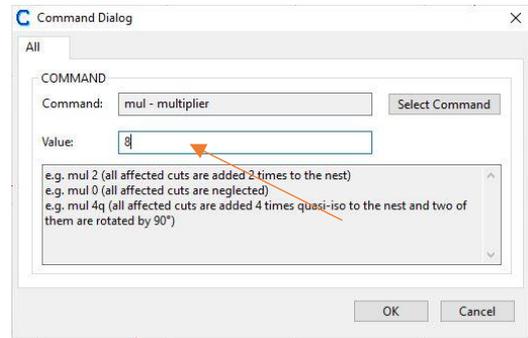


Figure 62

d. Next position the generated “mul 8” text somewhere next to our Bulkhead cut geometries (Figure 63 left)

Note: It is also possible to write “8x” instead of “mul 8” and to place the command directly inside a cut if just one cut needs to be multiplied (Figure 63 right). In the second case a command frame, which will be added in the next step, is not required. Consider that this is just possible for the Multiplier and Mirror Commands!

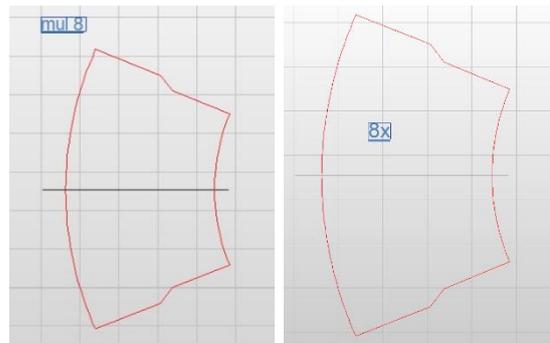


Figure 63

3. **COMMAND BOX:** To tell NestKing which geometries are affected by the Multiplier Command it is necessary to define the scope of the command. Therefore add a rectangle, which needs to be on layer 9. This command rectangle should cover the Bulkhead geometries and the mul-Command as well (Figure 64). Now NestKing knows that all cuts inside the command rectangle need to be copied eight times before nesting.

- a. Click on (Rectangle) on the Main Toolbar or use the -**RECTANGLE**- Command.
- b. Draw a rectangle by selecting the start point **P1** at the top left and select the second point **P2** at the bottom right.

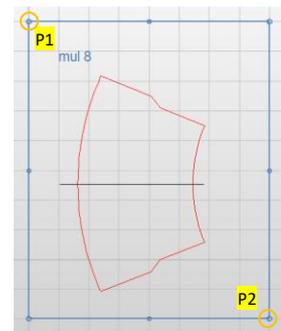


Figure 64



- c. Change the layer of the geometry to layer 9 by selecting the rectangle and click key **[9]** on the keyboard or use the layer selection box 9 - Command Layer on the Main Toolbar.
4. **LABEL:** To label our Bulkhead cut we have two opportunities:

(1) Add labels using the text tool:

- a. Click on **T** (Text) on the Main Toolbar or use **-TEXT-** Command.
- b. Enter the label text “STP01” in the text entry of the appearing Text Dialog (Figure 65).
- c. Choose the right layer:

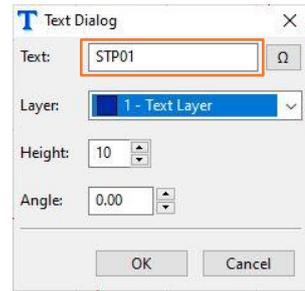


Figure 65

Layer 1 (Text Layer): Labels on layer 1 can be shifted by the automated label positioning function of NestKing. If the position of the label on the cut and its text height is not important, layer 1 is the one to prefer.

Layer 4 (Plot Layer): Labels on layer 4 are plotted with the same size and at the same position as displayed.

Thus, position and size of the label are not important, let’s pick layer 1.



Figure 66

- d. Click OK to confirm.
- e. Position the label anywhere inside of our Bulkhead cut geometry as (Figure 66).

(2) Add labels using the NestKing command tool:

- a. Click on **C** (Command) on the Main Toolbar or use the **-COMMAND-** command.
- b. Click on the Select Command (Figure 67).
- c. Select the Label (lab) Command (double-click or mark + OK button) (Figure 68).
- d. Enter “STP01” into the value entry box (Figure 69).
- e. Click OK to confirm.
- f. Position the command text somewhere inside the command rectangle (Figure 70).

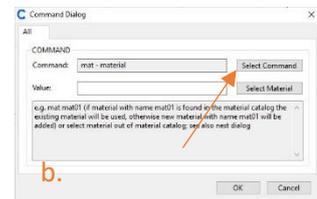


Figure 67



Figure 68

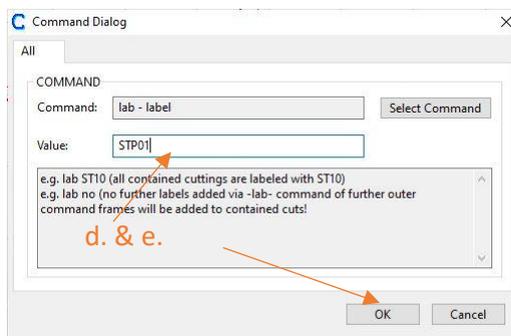


Figure 69



Figure 70

Note: Option 2 is more practicable if there are more than one cut inside the command rectangle, so we don’t have to label each cut individually.



5. **COPY:** Now we have set up our base compound layer geometries, which we can use to generate all further compound layers. Usually, a Bulkhead exists of far more compound layers, but for exercise purposes four compound layers are sufficient.

- a. First shift our current objects to the origin position by clicking  (Shift to origin) on the Main Toolbar.
- b. Further select the command frame with all its geometries and text four times. Proceed as follows:
Ensure that no tool is selected. If so, just click the **[ESC]** key till our Command Prompt just states "Command - " .
Select all objects by dragging a selection box over all objects.
- c. Next click on  (Copy) on the Main Toolbar or use the **[CTRL] + [C]** shortcut instead.
- d. Now click on  (Paste) on the Main Toolbar or use the **[CTRL] + [V]** shortcut instead.
- e. The copied objects appear a second time in your Drawing Area. Now move these copies and position them next to the original objects (Figure 71).
- f. Repeat the last two steps two more times to get all cuts for all four compound layers (Figure 71).

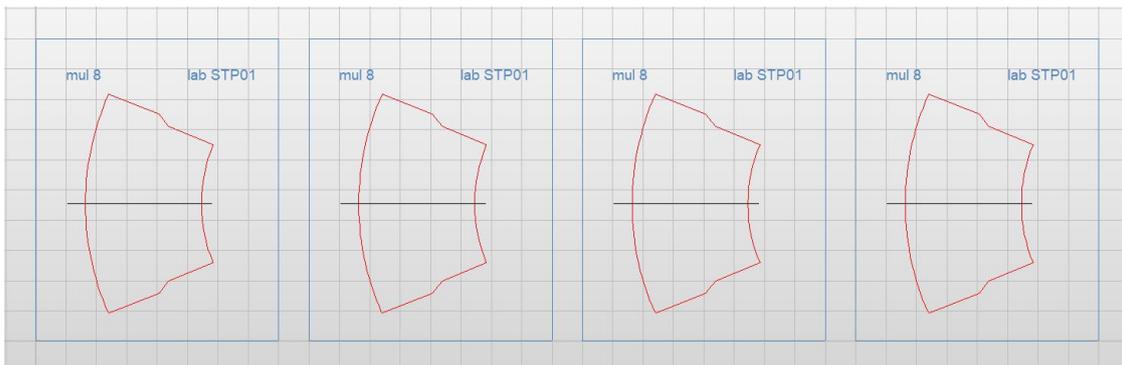


Figure 71

6. **Modifying Text:** Assume the first compound layer is applied within STP01, the second compound layer within STP02 and so on. Therefore change the labels of our copies from ST01 to STP02, STP03 and STP04:

- a. To change the command text in the second command frame, double-click it to open the Text Dialog.
- b. In the Text Dialog simply rewrite "STP01" to "STP02" (Figure 72).
- c. Confirm with .

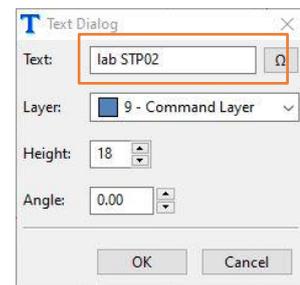


Figure 72



d. Repeat these steps with STP03 and STP04 (Figure 73).

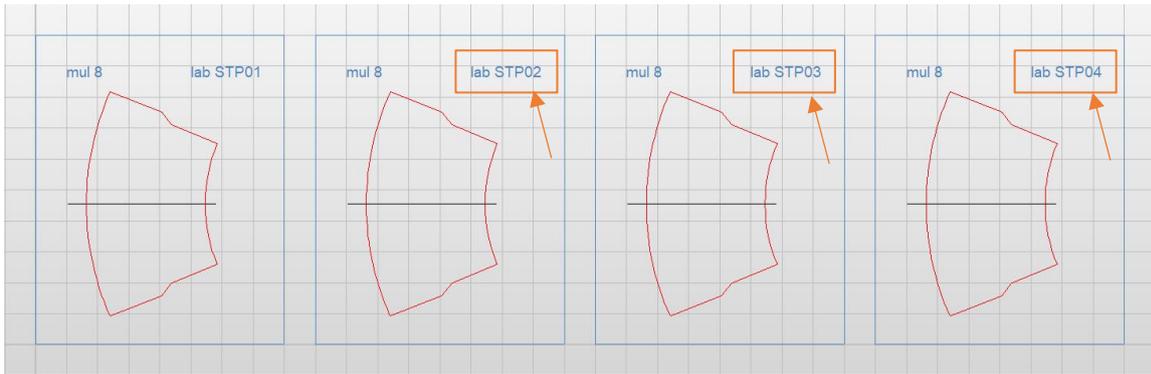


Figure 73

Note: Modification by double-clicking also works for line , arc , rectangle , slot  and circle  geometries.

7. **OFFSET:** Next offset all four segments **A1**, **A2**, **I3** and **I4** for all four compound layers individually. For test purposes assume we want to have following offsets in [mm]:

	A1	A2	I3	I4
STP01	0	0	0	0
STP02	+5	0	+1	+1
STP03	-5	0	+2	+2
STP04	+10	0	+3	+3

Table 4

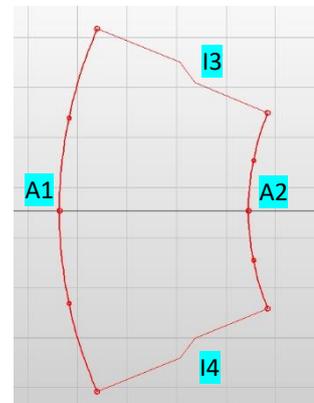


Figure 74

a. First activate the **[Offset – round edges, offset value]** tool  (Figure 75).

You can either select this option by clicking on the tool button  on the Main Toolbar or using the **-OFFSET-** Command.

Note: If we use the **-OFFSET-** Command we need to ensure, that the right settings are activated. Therefore let's check the Command Prompt:

OFFSET - Straight edges - Select offset geometry [(a)dd offset value, (r)round edges].....

In this case the Command Prompt states that no offset value is added. To change this setting press the **-A-** key or use the right-click pop-up menu (Figure 76). Further the Command Prompt states that straight edges are used. Change this setting to round edges by pressing the **-R-** key or by using the right-click pop-up menu again (Figure 77).



Figure 76

Figure 77

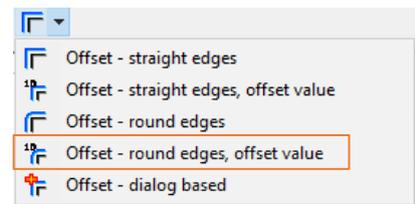


Figure 75

Now the Command Prompt should look like this:

OFFSET - Round edges - Select offset geometry [(n)o offset value, (s)traight edges]...



b. **Select offset geometry:** Start with our first offset according to Table 4. Therefore select **A1** (Figure 78).

c. Next the Command Prompt asks for an offset length. The current selected offset length is 10mm as stated between the two square brackets [10]:

```
OFFSET - Round edges - Select offset direction [(n)o offset value, (s)traight edges] or enter length [10]
```

Change this value to 5mm by typing **-5-** on the keyboard:

```
OFFSET - Round edges - Select offset direction [(n)o offset value, (s)traight edges] or enter length [10]:5
```

d. Next press the **-SPACE-** or **-ENTER-** to confirm. Now the offset length is set to 5mm:

```
OFFSET - Round edges - Select offset direction [(n)o offset value, (s)traight edges] or enter length [5]
```

e. **Select offset direction:** Next the Command Prompt asks for an offset direction to know on which side the offset geometry of **A1** should be placed.

```
OFFSET - Round edges - Select offset direction [(n)o offset value, (s)traight edges] or enter length [5]:
```

Note: +5mm usually means we want to extend our cut edge by 5mm, so our offset direction would be to the left. -5mm would usually mean we want to trim our cut edge by 5mm so our offset direction would be to the right. We can tell NestKing the offset direction by clicking on the left or on the right side of **A1**.

In our case we want to extend by +5mm so click anywhere on the left side of **A1**.

f. **Select layer:** In my case the current selected layer was layer 0 so my resulting offset geometry is also on layer 0:

```
(F5) [0 - Design Layer] Text
```

Before changing the layer to layer 3 we need to ensure that our offset geometry is selected. Next choose layer 3 in the layer combo box on the Main Toolbar or simply click key **-3-** on your keyboard.

g. Further change the layer of the original **A1** from layer 3 to layer 0 (Figure 80).

To reduce the amount of work we can set layer 3 on the Main Toolbar **[3 - Outer Geos]** as our active layer for the following offset activities.

h. Now offset all remaining cut segments as well. Therefore activate the offset tool again by clicking the appropriate Main Toolbar button  or using the **-OFFSET-** Command. All previous offset settings are saved and do not have to be set again.

i. Next offset all other segments according to our offset Table 4 on page 41.

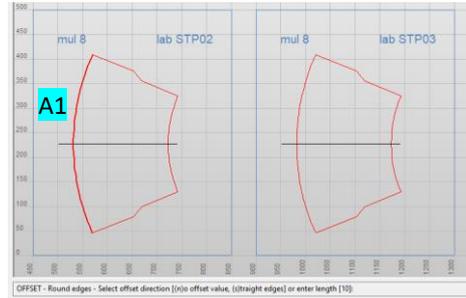


Figure 78

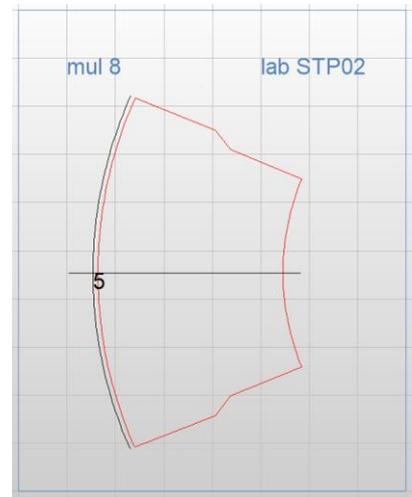


Figure 79

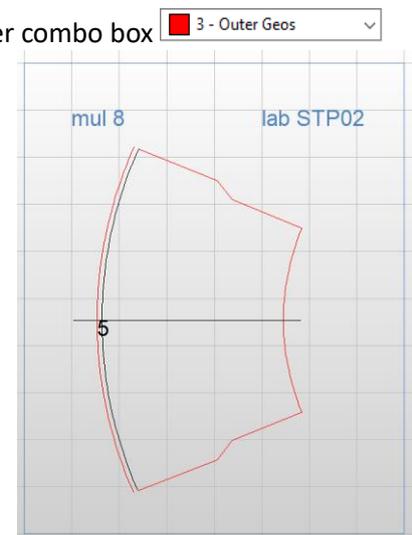


Figure 80



Note: If you enter an offset value of -5mm, NestKing will offset to the opposite direction. Thus, for A1 in STP03 (Figure 81) enter +5mm and choosing the right side of **A1** for the offset direction to trim the cut by -5mm.

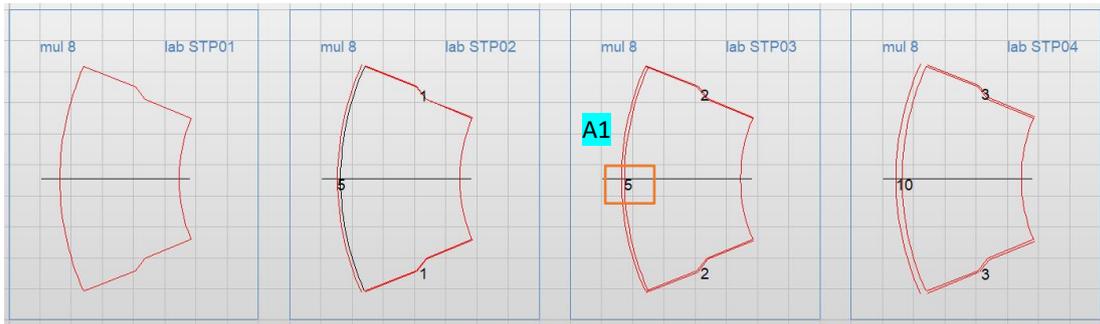


Figure 81

Change the layers of the original geometries to layer 0 (Design Layer). Therefore select them all by clicking on them one by one while pressing the **CTRL** key and finally press **0** on our keyboard to assign layer 0.

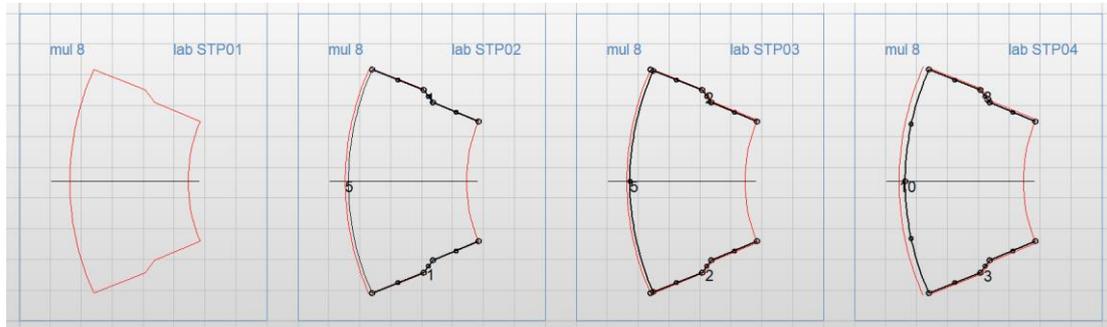


Figure 82

8. **JOIN** : Perfect, we have just finished our offset activities and need to reconnect the outer geometries again to get closed cuts. Therefore use  (Join) one more time. Please check step 11.e on page 34 again if you need more detailed information. Whether the autoconnect setting is enabled or disabled no longer matters, because NestKing automatically merges them to a closed geometry in the scope of the prenesting process. Figure 83 shows the result after joining all segments.

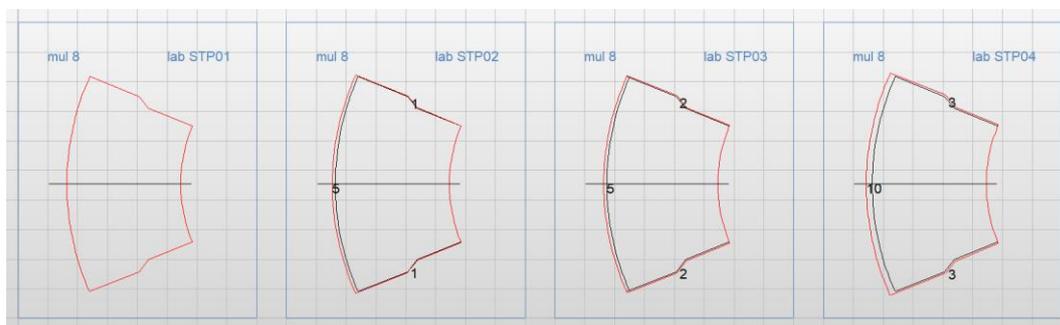


Figure 83



9. **COMMAND C - ANGLE:** Finally, before we can nest our cuts, I want to show you one last helpful command. This command automatically rotates all cuts inside the affected command frame by 45°:

- a. Let's click on the command button **C** or use the **-COMMAND-** Command.
- b. Click **Select Command** (Figure 84).
- c. Select the last command in the standard list called angle (ang).
- d. Enter "45" and confirm with **OK** (Figure 84).
- e. Now we can add this command to our STP02 command frame (Figure 85).
- f. Since, we want to rotate all cuts of STP04 as well we can simply copy our -ang 45- command text (**-CTRL-** + **-C-** or copy button ) and paste it to the STP04 command rectangle (**-CTRL-** + **-V-** or paste button ) (Figure 85).

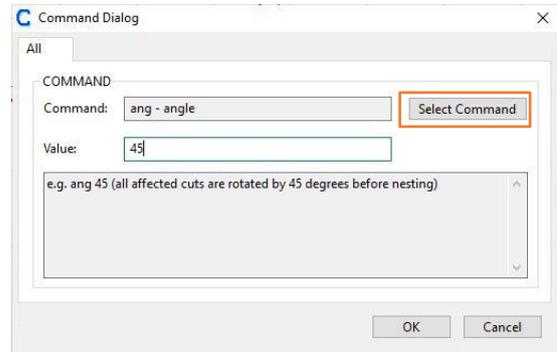


Figure 84

*Note: You can also use the text tool **T** for adding commands. Just type in "ang 45", set the layer to 9 and add it wherever required.*

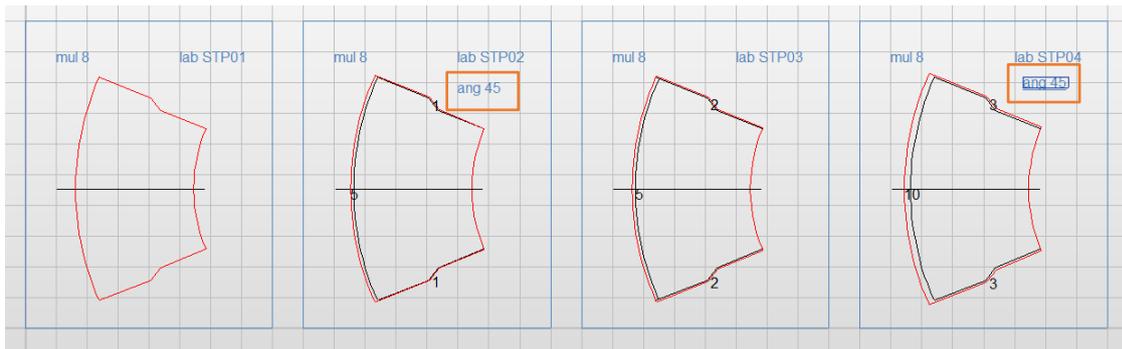


Figure 85

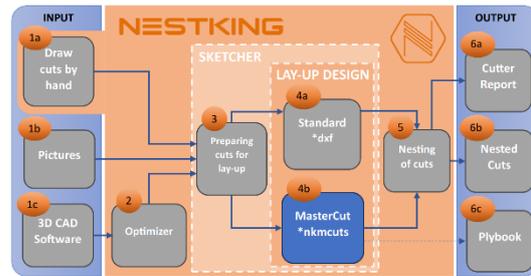
Save: To save our data press  on the Main Toolbar or use the **-CTRL-** + **-S-** shortcut.

10. **Exit Sketcher:** Congratulations! You have just finished the cut generation using the Standard workspace approach. Now we can leave the sketcher via the exit button  and check out the second approach using the MasterCut workspace for cut generation as described in the next chapter 4b) *MasterCut workspace*.



4b) MasterCut workspace

The generation of the offset geometries as described in the previous section for only one cut per compound layer and for a total of four compound layers is not complex. But if you think of ten or more different cuts per compound layer and several more compound layers the amount of work for generating the offset geometries increases drastically. Thus, NestKing’s MasterCut workspace offers, beside our already known sketcher tools, some additional tools to make offset generation less labor intensive and less prone to error.



First, let’s change our file back to the prepared cut of step 3, so we have the same initial situation as at the beginning of 4.a.

1. Start with the already generated file from 4.a..

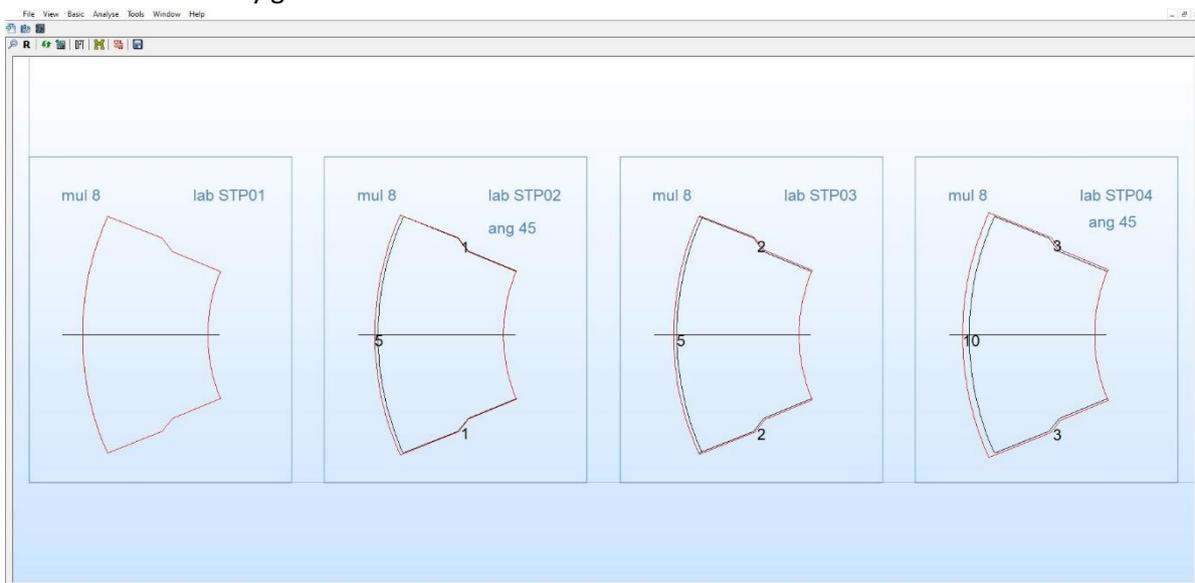


Figure 86

2. **Save as:** Before making any changes save the file with a new name. Therefore click on **[Save as...]** in the File tab (Figure 87 left). Extend the name with “_mastercut” (Figure 87 right) and click on the save button **Speichern**.

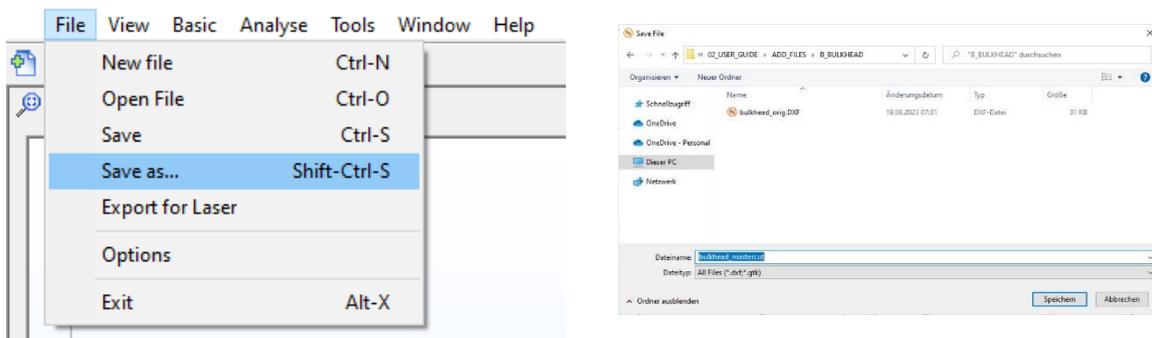


Figure 87

3. **SKETCHER:** Next, bring up the Standard Sketcher by clicking  on the Main Toolbar or using the **[S]** keyboard shortcut.



- DELETE:** Now select all objects except of our base geometries (Figure 88) and delete  (shortcut **-DEL-**) them.

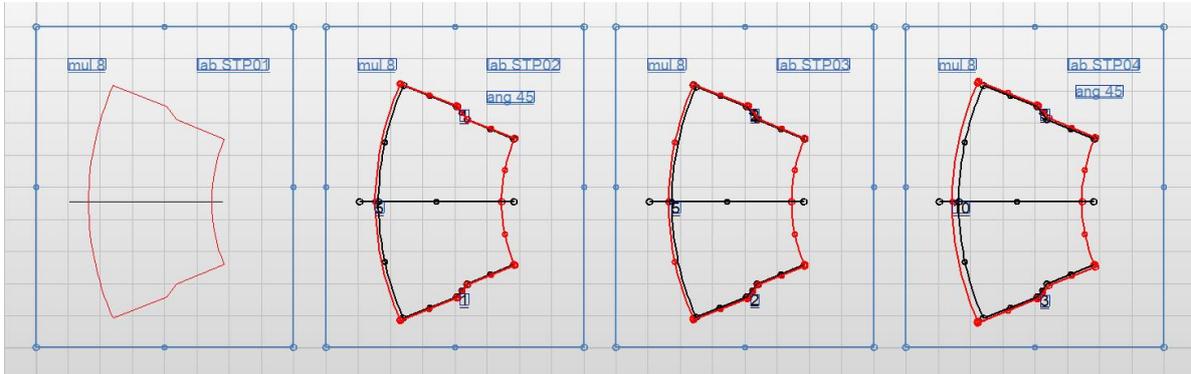


Figure 88

We just need our modified outer shape and the centerline as shown in Figure 89.



Figure 89

- SAVE:** Click the save button  to save all the changes to our new file.
- EXIT:** Exit the sketcher with .



Perfect, now we can start the real work:

1. To generate mastercuts and switch to the MasterCut workspace click on the MasterCut button  on the Main Toolbar (Figure 90).

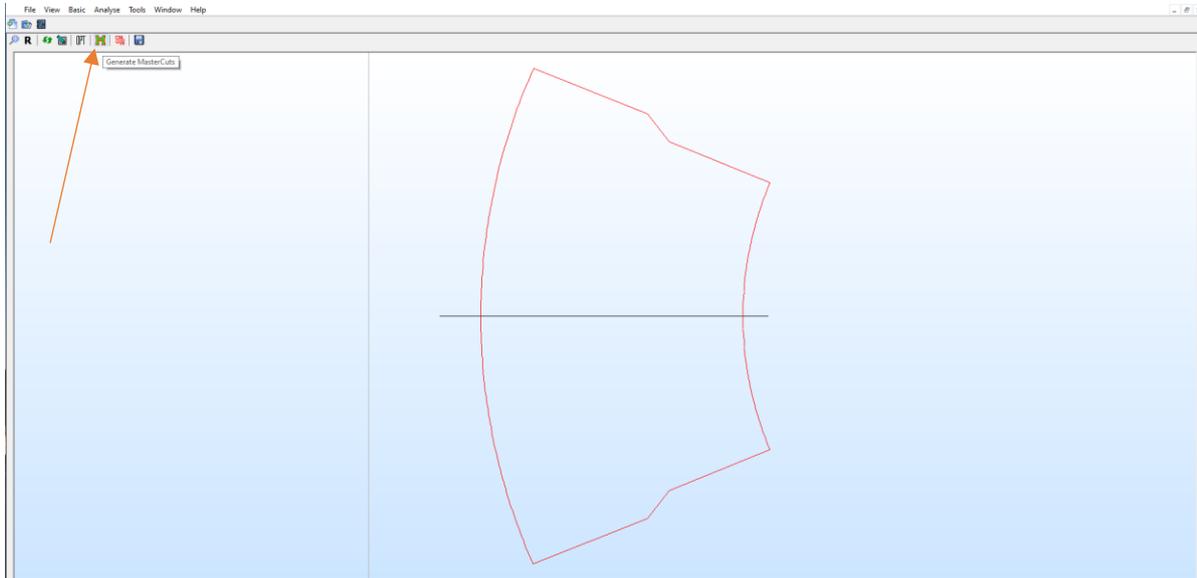


Figure 90

2. Next, NestKing asks if you want to optimize our geometries (same as hitting the  button) (Figure 91).

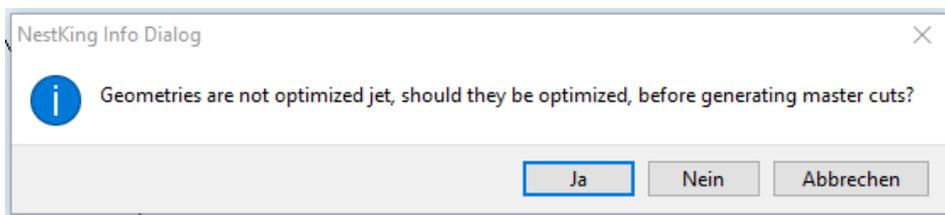


Figure 91

Note: To obtain a closed outer contour, which is a prerequisite for generating mastercuts, optimization is necessary.

Click the yes button .

3. As shown in Figure 92 the default value of 0.1mm for the optimization tolerance is fine.

Click .

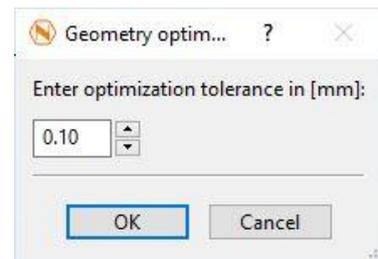


Figure 92



- When our mastercut has been created successfully, a new MasterCut Window will be opened. Welcome to the MasterCut workspace.

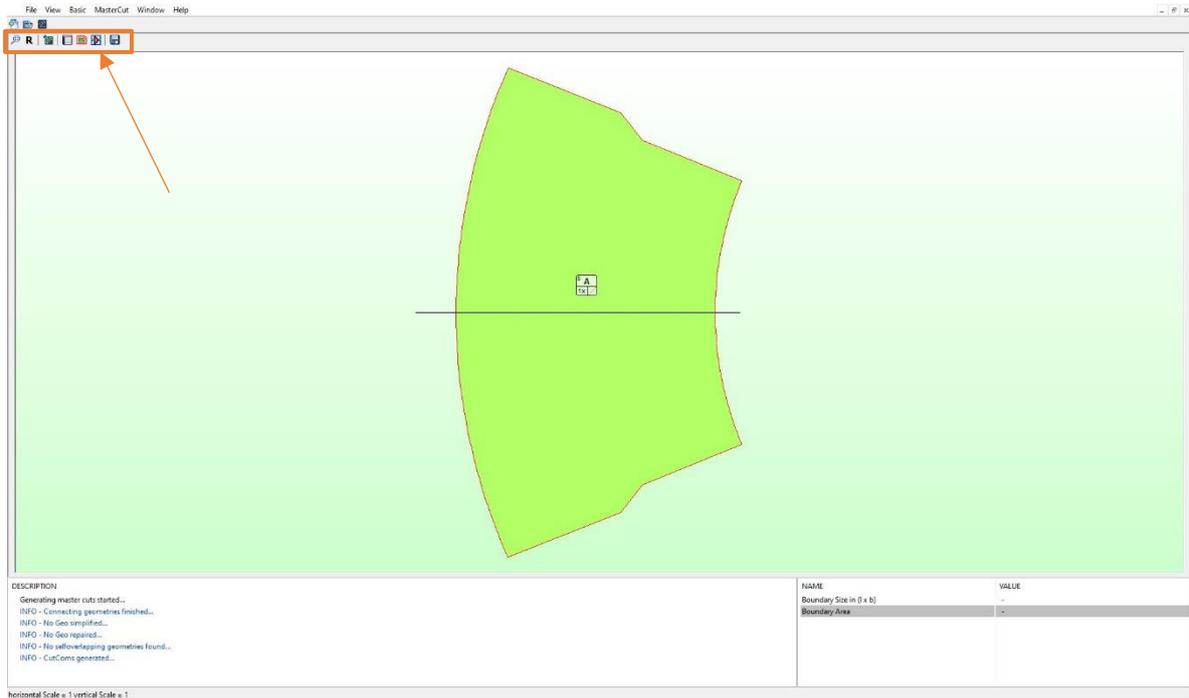


Figure 93

As highlighted in Figure 93, the Main Toolbar also changes and offers some new features, which will be explained in the next steps.

- First click on  (Open MasterTable) in the Main Toolbar (Figure 94).

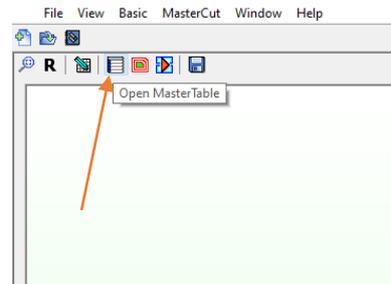


Figure 94

- The appearing Step Table Dialog lists all steps used for generating the lay-up of our composite part. In our case we want to add four compound layers. Each layer is applied by one single step. For more complex parts, it is also possible to split layers into multiple steps if required. The first step is already added by default, so three more steps are needed. Therefore click (Figure 95).

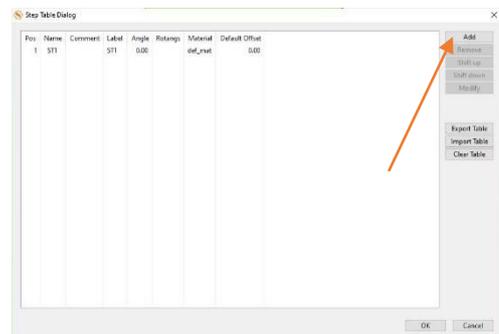


Figure 95



7. The appearing Step Dialog provides several step settings.

Name	Description
Pos	Position of the step inside the step table.
Quantity	Number of steps to be generated
Name	For naming the step autotexting is also possible. So “%stpos” will automatically be replaced by the current position of the step. This is very helpful if you add additional steps to the step table. With autotext you don’t have to rename all following steps again. “%cutpos” will add the position number just considering cutsteps, so non cutsteps will be neglected in the count.
Comment	Any additional information.
Cutstep	If checked, the current step is a cutstep. This makes it possible to assign cuts to this step. If not checked no cuts can be assigned. Non cutsteps can be used to add “Debulk” or “Curing” processes, etc.
Add Step name to Label	If checked, all cuts of this step are labeled with the step name by default.
Labels	Here you can add additional labels for all cuts of this step.
Angle	If a value is set, all cuts of this step are rotated by the stated value.
Rotation Angles	If applied, cuts are allowed to be rotated by the defined angles during the nesting process to reduce material consumption. For example, “d90” will mean that plies are allowed to be rotated by 0°, 90°, 180° and 270°.
Material	This button opens the material catalog and we can change the material for all cuts assigned to this step.
Default offset	Here we can set the default offset of our cut segments.

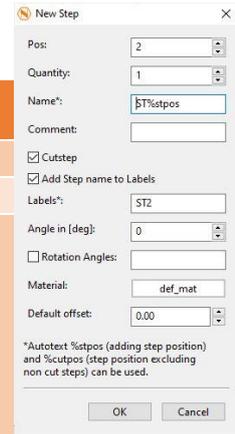
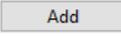


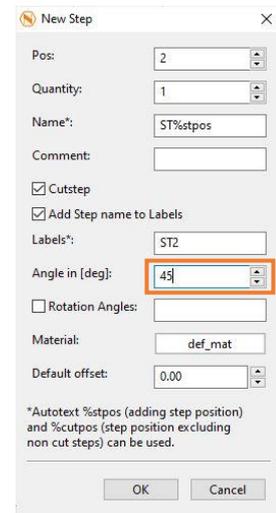
Table 5

8. For our Bulkhead we previously rotated the cut of step 2 by 45° using the “ang 45” NestKing Command. To achieve the same result in the MasterCut workspace change the angle value from 0° to 45° (Figure 96)

9. Now we are done with step 2. Proceed with .

10. For step 3 just click  again. The required angle of 0° is already set by default. Confirm with .

11. Cuts of step 4 are rotated by 45° again. Change the angle to “45” (Figure 96).



Now we have added all four steps and our step table should look like this:

Pos	Name	Comment	Label	Angle	Rotangs	Material	Default Offset
1	ST1		ST1	0.00		def_mat	0.00
2	ST2		ST2	45.00		def_mat	0.00
3	ST3		ST3	0.00		def_mat	0.00
4	ST4		ST4	45.00		def_mat	0.00

Figure 97



12. Close the Step Table with .
13. Next enter the MasterCut sketcher area by clicking on the sketcher pencil button  (Figure 98) or using shortcut **S** on the keyboard.

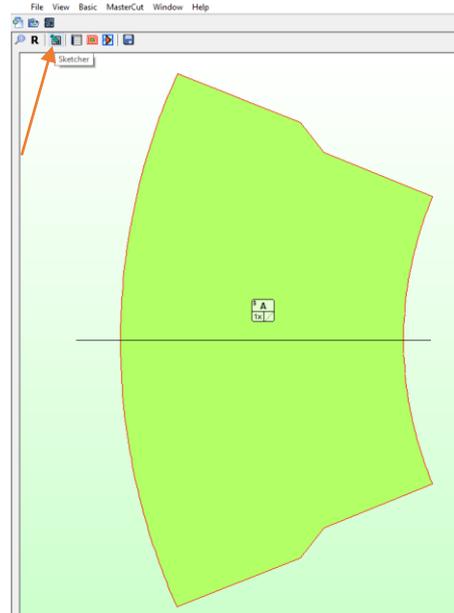


Figure 98

Note: At the first glance, the MasterCut Sketcher looks like our already known Standard Sketcher, but if you take a closer look on the Main Toolbar, you will recognize four additional buttons:

	
	Generate MasterCut – You can add cut geometries and labels directly to the sketcher area. If you want to convert them into mastercuts, just select them and click this button.
	Link MasterCut segments – Mastercut geometries can be split into several segments (see upcoming steps). These segments can then be linked to one another for adding and managing offsets in a more efficient way. Due to the fact, that our Bulkhead cut is just one single cut the linking tool is not required in this case. But since linking mastercut segments is very powerful, easy to use and can save you a lot of time chapter <i>D Example Bracket – Using MasterCut Links</i> starting on page 67 has been added to this user guide.
	Equalizer – Segments that should have the same offsets can be linked with each other using the equalizer. Changes to the offset table are then made in the master segment from which the slave segments are adjusted accordingly.
	Generate RawCuts – Generates and displays all cuts in the Drawing Area.

Table 6



Each MasterCut is identified by its own ID box (Figure 99). This ID box can be shown and hidden either via the View tab **[Show MasterCut IDs]** (Figure 100) or via **[F6]**.

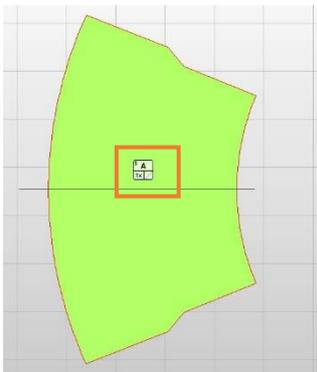


Figure 99

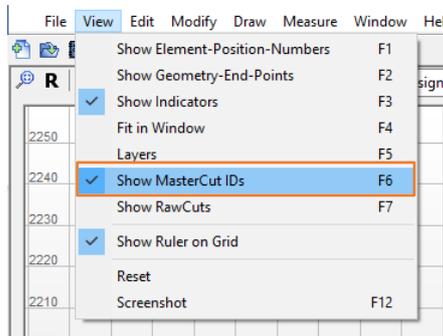


Figure 100

The MasterCut ID Box contains following MasterCut information:

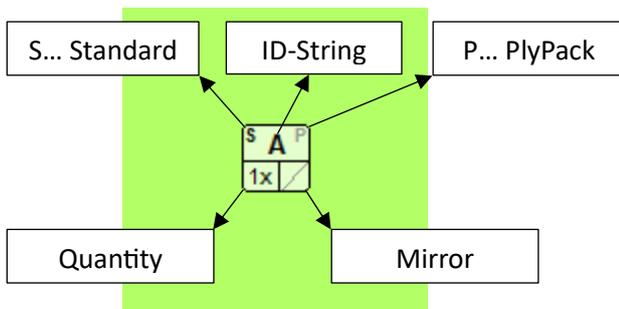


Figure 101

If you double-click the MasterCut geometry, you can also find the information in the MasterCut Edit Dialog:

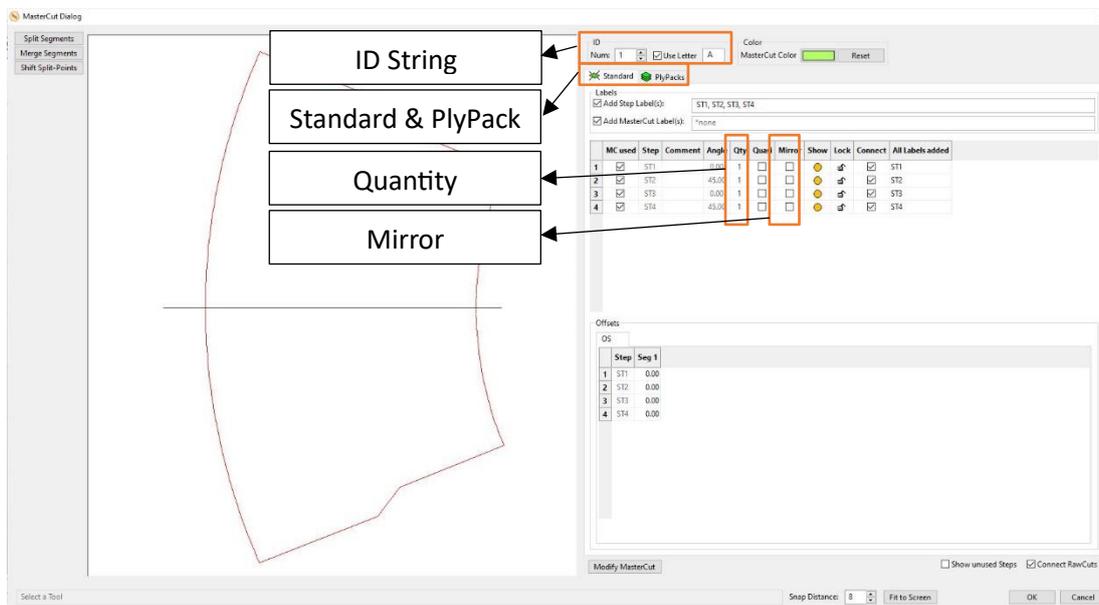


Figure 102



Name	Description
------	-------------

ID String	<p>The ID string of the MasterCut shows the currently assigned ID. It can be either shown as an integer number from 1 to 999 or as the corresponding letter combination starting with A (=1) to ALK (=999).</p> <div style="border: 1px solid #ccc; padding: 5px; margin: 10px 0;"> <p>ID</p> <p>Num: <input type="text" value="1"/> <input type="checkbox"/> Use Letter <input type="text" value="A"/></p> </div> <p style="text-align: center; font-size: small; color: #808080;">Figure 103</p> <p>Note: The ID of a MasterCut does not have to be unique. You can therefore have several MasterCuts with the same ID if desired.</p>
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Standard & PlyPack	<p>We can use MasterCuts in two different, independent ways. The first is Standard which we already know from the previous chapters. Here we can assign our steps, which we have defined in our step table. Links to other MasterCuts only affect the Standard.</p> <p>The second way to use MasterCuts is as a PlyPack (or patch). In contrast to the standard, no links to other MasterCuts are possible here. You can find a more detailed description in D3. Introducing MasterCut PlyPacks (Patches) on page 84.</p> <p>As soon as standard is used, i.e. MasterCut is activated for at least one step in the step table, the S in the ID box is always shown in black, and the following multiplier and mirror information refer to the standard. However, if no step from the step table is activated and the MasterCut is only used purely as a PlyPack, the P for PlyPack is displayed in black and the two following pieces of information in the MasterCut ID box regarding multiplier and mirror refer to the PlyPack.</p>
--------------------	--

Quantity	<p>The quantity value shows the value from the quantity column. If these values are not all equal for all used steps the Multiplier value shows “-x”.</p> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 45%;"> <table border="1" style="font-size: x-small; border-collapse: collapse;"> <thead> <tr> <th>MC used</th> <th>Step</th> <th>Comment</th> <th>Angle</th> <th>Qty</th> <th>Quasi</th> <th>Mirror</th> <th>Show</th> <th>Lock</th> <th>Connect</th> <th>All Labels added</th> </tr> </thead> <tbody> <tr> <td>1</td> <td><input checked="" type="checkbox"/></td> <td>ST1</td> <td>0.00</td> <td>3</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>●</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>ST1</td> </tr> <tr> <td>2</td> <td><input checked="" type="checkbox"/></td> <td>ST2</td> <td>45.00</td> <td>1</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>●</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>ST2</td> </tr> <tr> <td>3</td> <td><input checked="" type="checkbox"/></td> <td>ST3</td> <td>0.00</td> <td>3</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>●</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>ST3</td> </tr> <tr> <td>4</td> <td><input checked="" type="checkbox"/></td> <td>ST4</td> <td>45.00</td> <td>3</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>●</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>ST4</td> </tr> </tbody> </table> <p style="text-align: center; font-size: x-small; color: #808080;">Figure 104</p> </div> <div style="width: 45%; text-align: center;">  <p style="font-size: x-small; color: #808080;">Figure 105</p> </div> </div> <p>The Quantity column can be used to tell NestKing how often the generated Cuts of the appropriate step should be added to the nest.</p>	MC used	Step	Comment	Angle	Qty	Quasi	Mirror	Show	Lock	Connect	All Labels added	1	<input checked="" type="checkbox"/>	ST1	0.00	3	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST1	2	<input checked="" type="checkbox"/>	ST2	45.00	1	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST2	3	<input checked="" type="checkbox"/>	ST3	0.00	3	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST3	4	<input checked="" type="checkbox"/>	ST4	45.00	3	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST4
MC used	Step	Comment	Angle	Qty	Quasi	Mirror	Show	Lock	Connect	All Labels added																																														
1	<input checked="" type="checkbox"/>	ST1	0.00	3	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST1																																														
2	<input checked="" type="checkbox"/>	ST2	45.00	1	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST2																																														
3	<input checked="" type="checkbox"/>	ST3	0.00	3	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST3																																														
4	<input checked="" type="checkbox"/>	ST4	45.00	3	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST4																																														

Mirror	<p>The mirror sign shows if mirrored cuts for the selected steps should be added to the nest as well. If not all mirror checkboxes are either checked or unchecked, so if they are in different states, the mirror symbol is displayed grayed out:</p> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 45%;"> <table border="1" style="font-size: x-small; border-collapse: collapse;"> <thead> <tr> <th>MC used</th> <th>Step</th> <th>Comment</th> <th>Angle</th> <th>Qty</th> <th>Quasi</th> <th>Mirror</th> <th>Show</th> <th>Lock</th> <th>Connect</th> <th>All Labels added</th> </tr> </thead> <tbody> <tr> <td>1</td> <td><input checked="" type="checkbox"/></td> <td>ST1</td> <td>0.00</td> <td>3</td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>●</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>ST1</td> </tr> <tr> <td>2</td> <td><input checked="" type="checkbox"/></td> <td>ST2</td> <td>45.00</td> <td>3</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>●</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>ST2</td> </tr> <tr> <td>3</td> <td><input checked="" type="checkbox"/></td> <td>ST3</td> <td>0.00</td> <td>3</td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>●</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>ST3</td> </tr> <tr> <td>4</td> <td><input checked="" type="checkbox"/></td> <td>ST4</td> <td>45.00</td> <td>3</td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>●</td> <td><input checked="" type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td>ST4</td> </tr> </tbody> </table> <p style="text-align: center; font-size: x-small; color: #808080;">Figure 106</p> </div> <div style="width: 45%; text-align: center;">  <p style="font-size: x-small; color: #808080;">Figure 107</p> </div> </div>	MC used	Step	Comment	Angle	Qty	Quasi	Mirror	Show	Lock	Connect	All Labels added	1	<input checked="" type="checkbox"/>	ST1	0.00	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST1	2	<input checked="" type="checkbox"/>	ST2	45.00	3	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST2	3	<input checked="" type="checkbox"/>	ST3	0.00	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST3	4	<input checked="" type="checkbox"/>	ST4	45.00	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST4
MC used	Step	Comment	Angle	Qty	Quasi	Mirror	Show	Lock	Connect	All Labels added																																														
1	<input checked="" type="checkbox"/>	ST1	0.00	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST1																																														
2	<input checked="" type="checkbox"/>	ST2	45.00	3	<input type="checkbox"/>	<input type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST2																																														
3	<input checked="" type="checkbox"/>	ST3	0.00	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST3																																														
4	<input checked="" type="checkbox"/>	ST4	45.00	3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	●	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST4																																														

Table 7



14. Double-click the bulkhead mastercut (Figure 108).

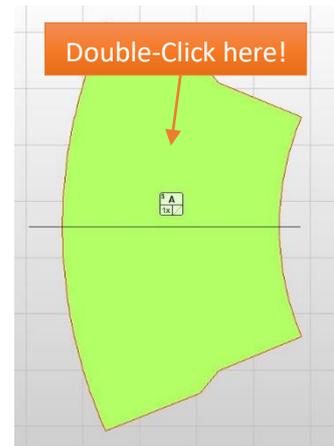


Figure 108

15. Next, split the outline of our mastercut into our four segments **A1**, **A2**, **I3**, **I4** (Figure 109). Therefore select **Split Segments** in the upper left corner of the MasterCut Dialog.

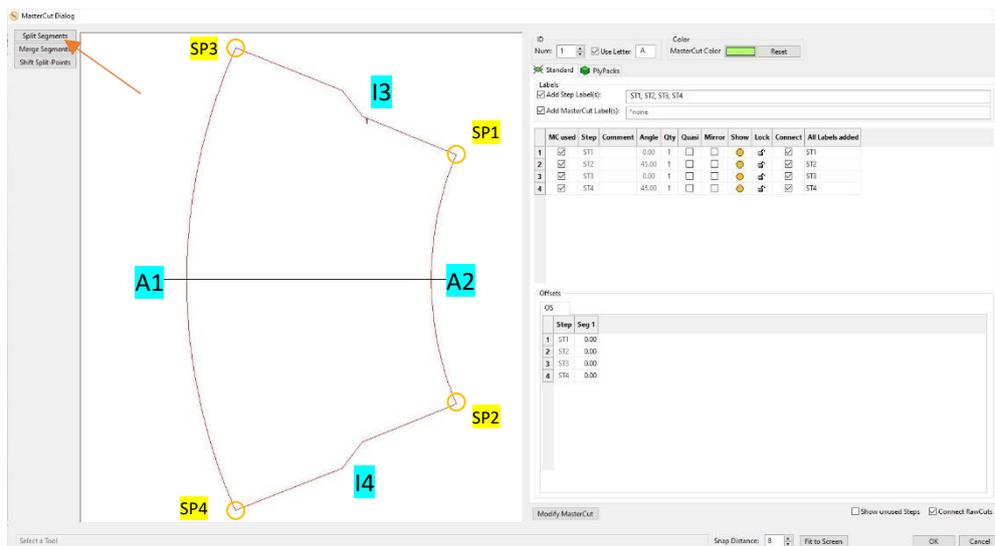


Figure 109



- Next select split points **SP1**, **SP2**, **SP3** and **SP4** one after each other to receive four segments. Try to follow the order given here so that your numbering of the segments in the further steps also corresponds to that in this User Guide (Figure 110).

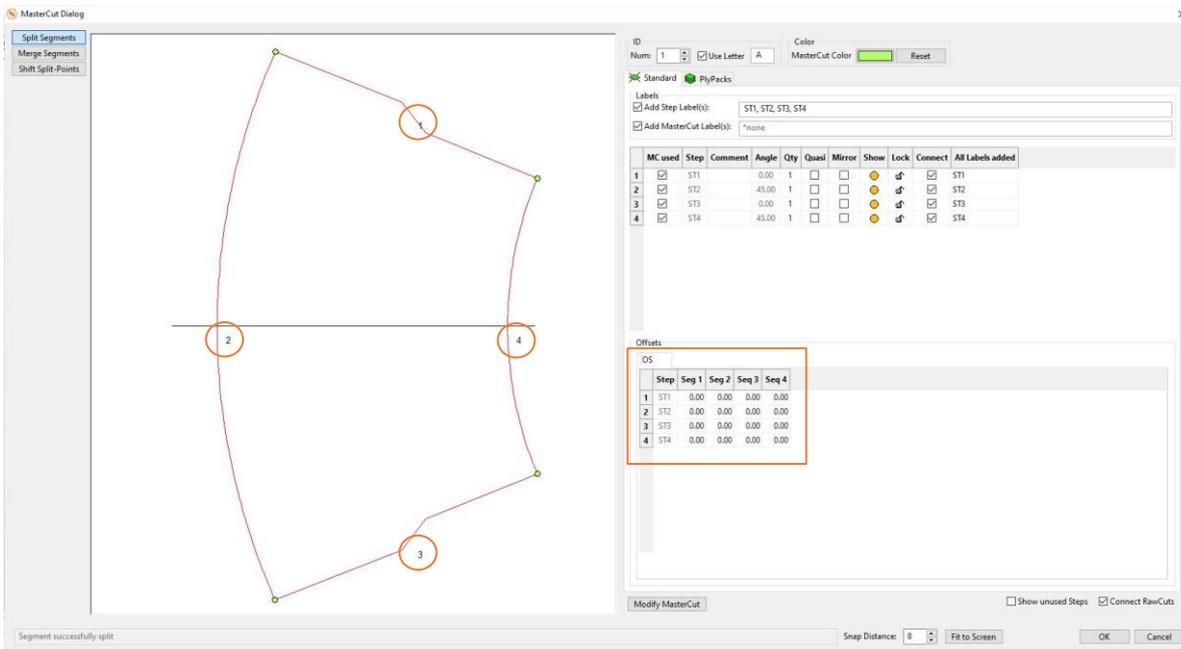


Figure 110

- Deactivate the splitting tool by press **ESC**.
- Considering the offset table already used previously, expanded by the segment numbers in the second line, we can now transfer the offset values from Table 6 into the offset table of the MasterCut Dialog (Figure 111).

	A1	A2	I3	I4
Segment	2	4	1	3
STP01	0	0	0	0
STP02	+5	0	+1	+1
STP03	-5	0	+2	+2
STP04	+10	0	+3	+3

Table 8

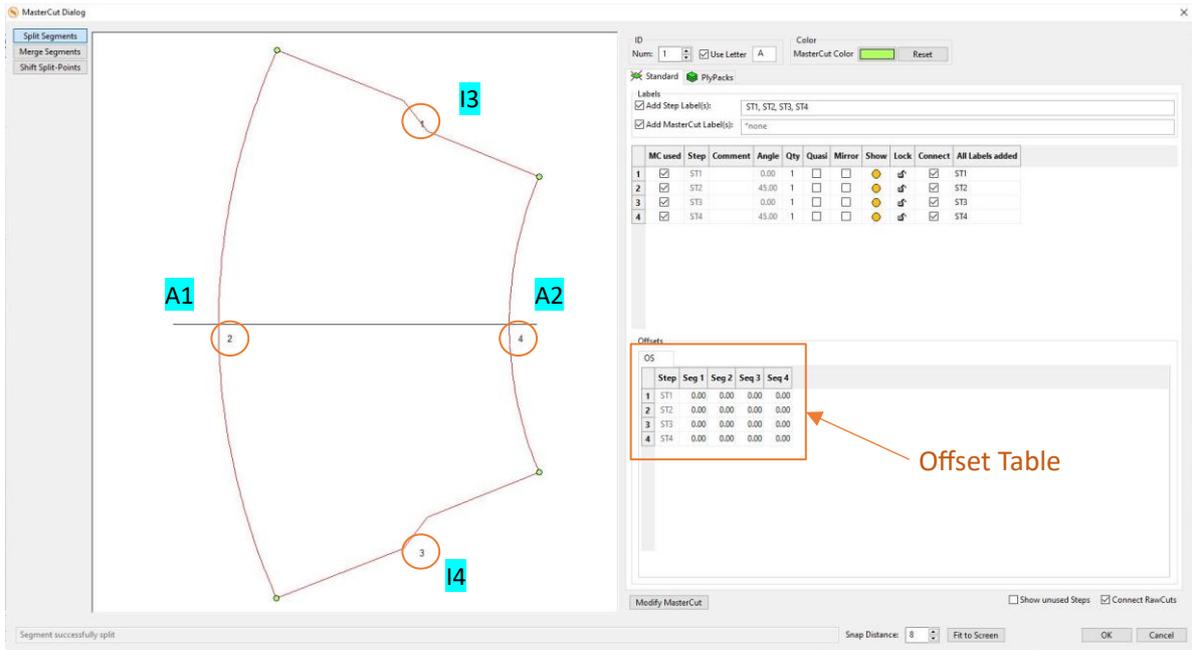


Figure 111

As emphasized by Figure 112 NestKing does all the offset and joining work for us.

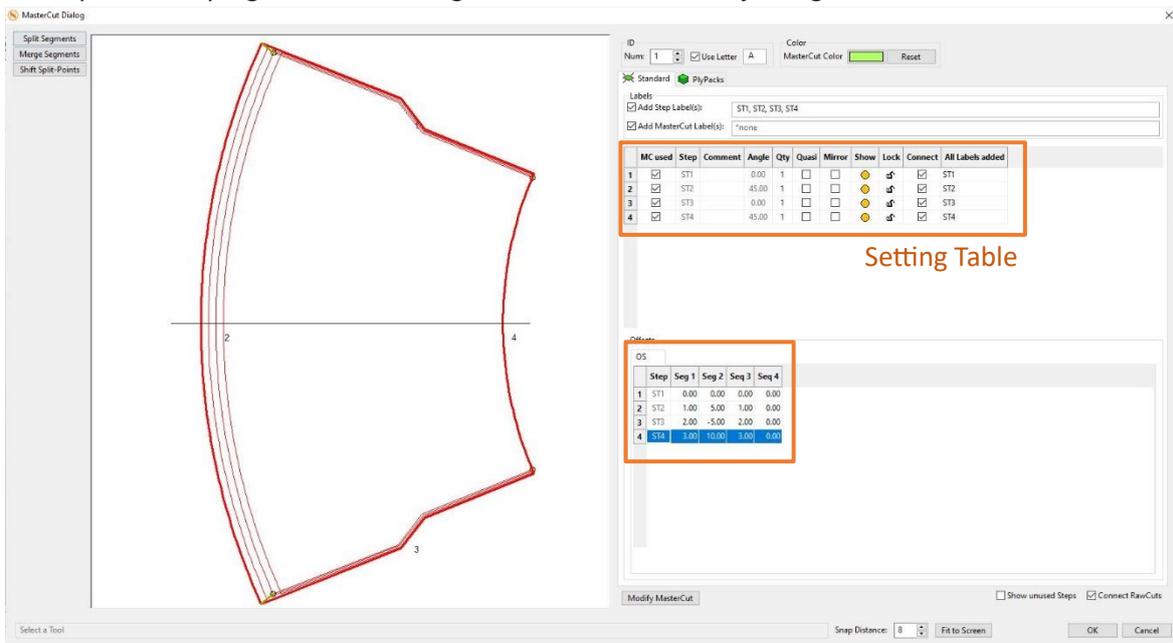


Figure 112

- Furthermore, for each step we need eight pieces of each cut to form a fully closed composite layer (as we have done previously with the “mul 8” NestKing Command). This setting can be changed within the Mastercut Setting Table by setting the quantity from 1 to 8 (Figure 113).

MC used	Step	Comment	Angle	Qty	Quasi	Mirror	Show	Lock	Connect	All Labels added
<input checked="" type="checkbox"/>	1	ST1	0.00	8	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST1
<input checked="" type="checkbox"/>	2	ST2	45.00	8	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST2
<input checked="" type="checkbox"/>	3	ST3	0.00	8	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST3
<input checked="" type="checkbox"/>	4	ST4	45.00	8	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ST4

Figure 113



20. Next confirm and leave the MasterCut Dialog with .

21. If you want to show the RawCuts in the sketcher Drawing Area as well, just click the -Generate RawCuts- button  (Figure 114).

22. The appearing NestKing Info Dialog can be confirmed with yes .

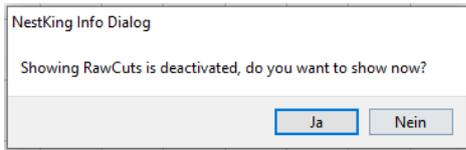


Figure 115

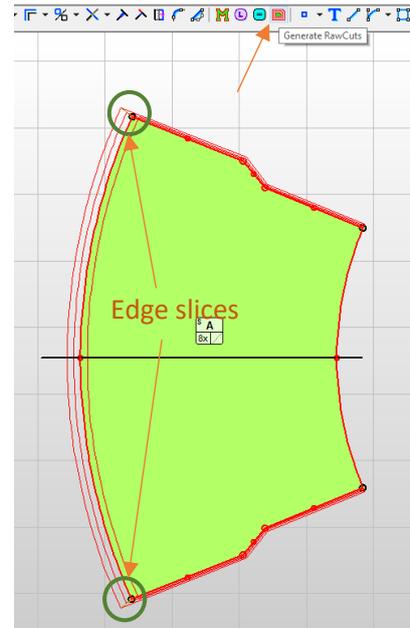


Figure 114

23. As indicated in Figure 114, NestKing adds some edge slices at the top and bottom edges. In this case we don't really need them. To remove these slices double-click the first connection point (green circle) at the top and remove the checkmarks of the **[ConSlices]** checkboxes for all four steps (Figure 116).

Note: We can track our changes live in the sketcher Drawing Area on the mastercut and see the effect of each action immediately.

24. Confirm and save the changes with (Figure 116).

25. Remove the edge slices for the second connection point at the bottom as well by repeating the previous two steps.

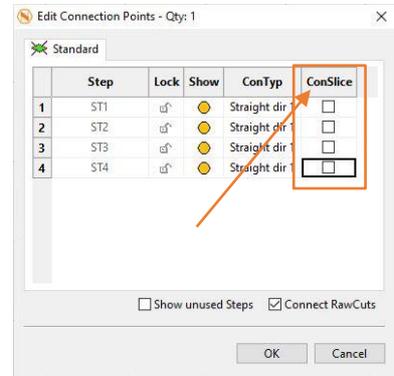


Figure 116



26. To save our changes click  on the Main Toolbar.

Note: Mastercuts require a new file format called NkMCuts to save all necessary information. You can either change the default file name or just leave it as is.

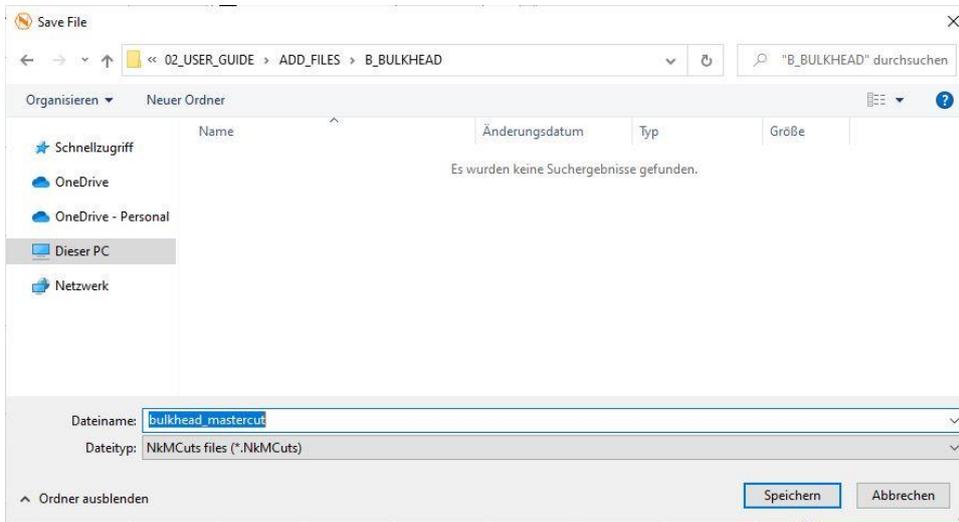
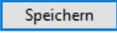


Figure 117

27. Click save  (Figure 117).

28. Leave the sketcher by clicking the -Exit Sketcher- button  on the Main Toolbar.

29. Back in the MasterCut workspace click the -Generate MasterCut output- button  (Figure 118).



Figure 118



30. Now NestKing generates all cuts and further adds all NestKing Commands as displayed in Figure 119. So basically, everything we had to do by hand as presented in chapter 4a) *Standard workspace*, is now generated automatically.



Figure 119

Nice! We have just finished the lay-up generation. Now you know how to generate cuts by using the Standard workspace and the MasterCut workspace as well.

For the Bulkhead cut design, existing solely of four compound layers and one cut per compound layer, both ways are fine. But for composite parts with more compound layers and more cuts per layer the advantage of the additional tools offered by the MasterCut workspace quickly outweighs the Standard workspace approach and is the recommended way.

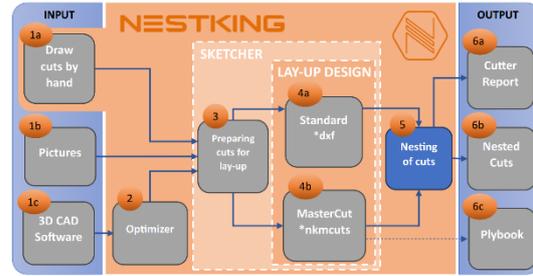
Next, we can proceed with nesting our output data, which is part of the next chapter 5) *Nesting*.



5) Nesting

All cuts of our composite Bulkhead are generated and additional information is also added by using NestKing Commands.

Now we are ready for nesting and this chapter will show how to do it.



Depending on the workspace used for previous Step 4, you will find the -Nest- button  on different spots:

- Using the Standard workspace (4a) Standard workspace):

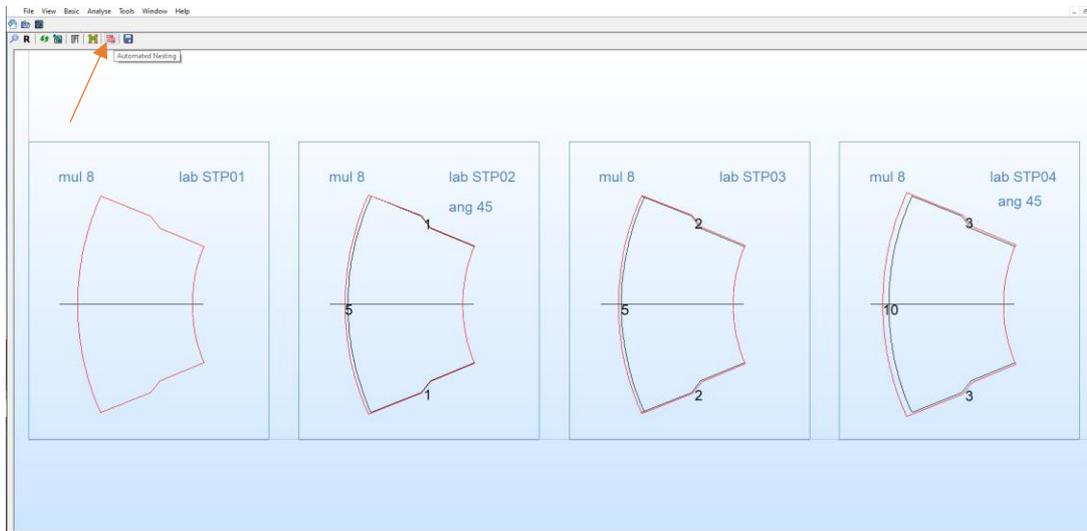


Figure 120

- Using the MasterCut workspace (4b) MasterCut workspace) after generating the MasterCut output:



Figure 121



5.1. PreNest Settings

After clicking the nesting button  the PreNest Settings Dialog will appear.

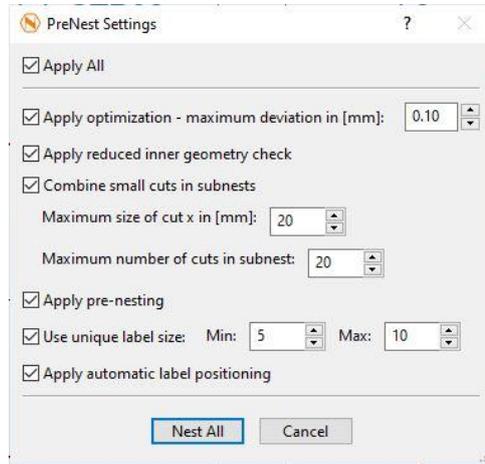


Figure 122

For more detailed information regarding the prenest settings see also chapter *H1. PreNest Settings* starting on page 171.

- For our Bulkhead cuts the standard values are fine (everything is checked as indicated in Figure 122). Proceed with Nest All.

Now there are two possibilities:

- If the cut generation process is successful and all NestKing Commands are set without any discrepancies the Nest Dialog, as described in following chapter 5.2. Nest Dialog, will appear. Perfect! Just proceed with the next chapter 5.2. Nest Dialog on page 61.
- If our dxf file contains any unassignable geometries or label objects, or if there are any unknown NestKing Commands on layer 9 an error message will be displayed in the Description Box (Figure 123). In this case we need to proceed with section 5.6. Error Handling on 67 first.

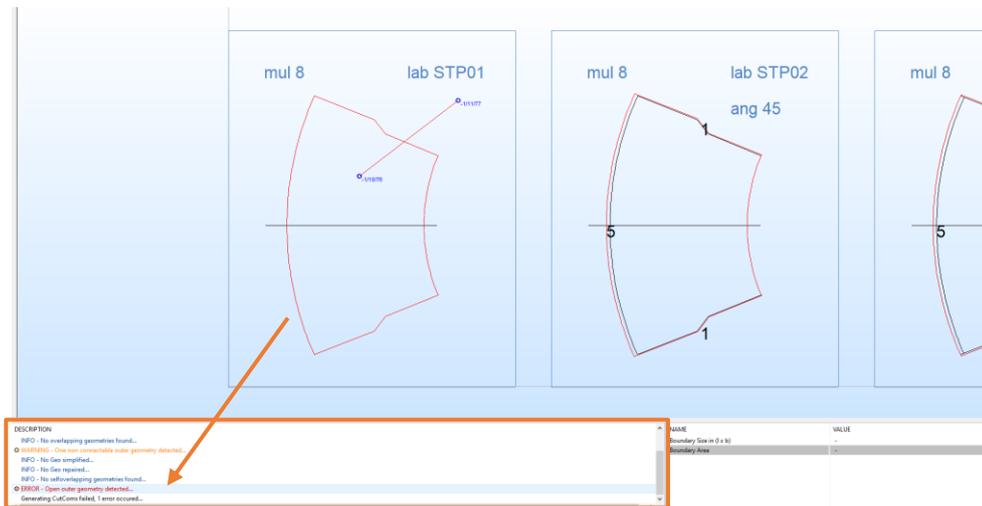


Figure 123



5.2. Nest Dialog

If cut generation and NestKing Command interpretation was successful, the Nest Dialog pops up. As highlighted in Figure 124 this Nest Dialog can be split into three levels:

- 1. Material level:** For our Bulkhead cuts we have no material assigned so the default material is used (def_mat) (Figure 124).
- 2. Nest level:** Further, we have not divided our cuts into separate nests. Thus, there is also just one default nest tab (def_nest) containing all our cuts.
- 3. Container level:** Cuts of the same nest will be automatically subdivided into separate containers as soon as the nest exceeds the predefined nest length during nesting.

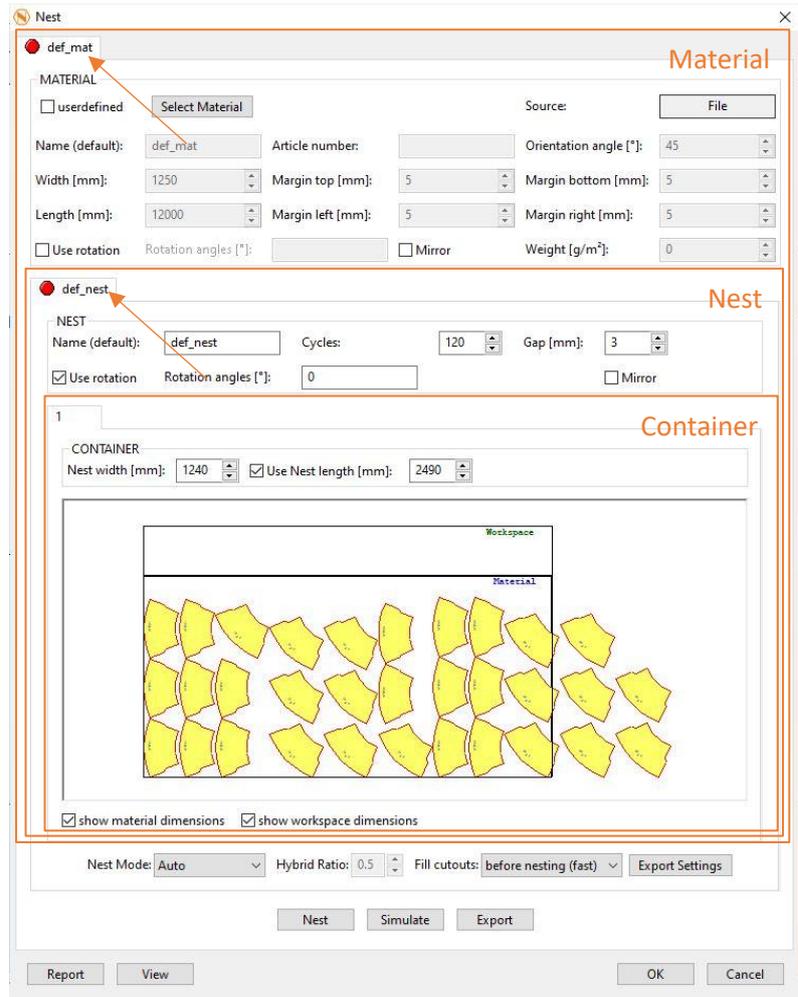


Figure 124

For more detailed information see chapter *H2. Nest Dialog* starting on page 171.

3. For nesting our Bulkhead cuts the default settings are fine. In some cases we just need to adapt the nest width (Figure 125).

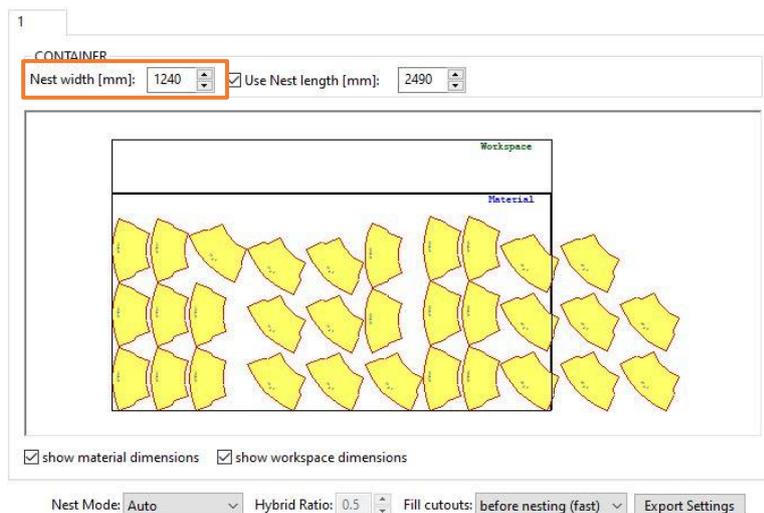


Figure 125



- Click and the Nest Window will show up:

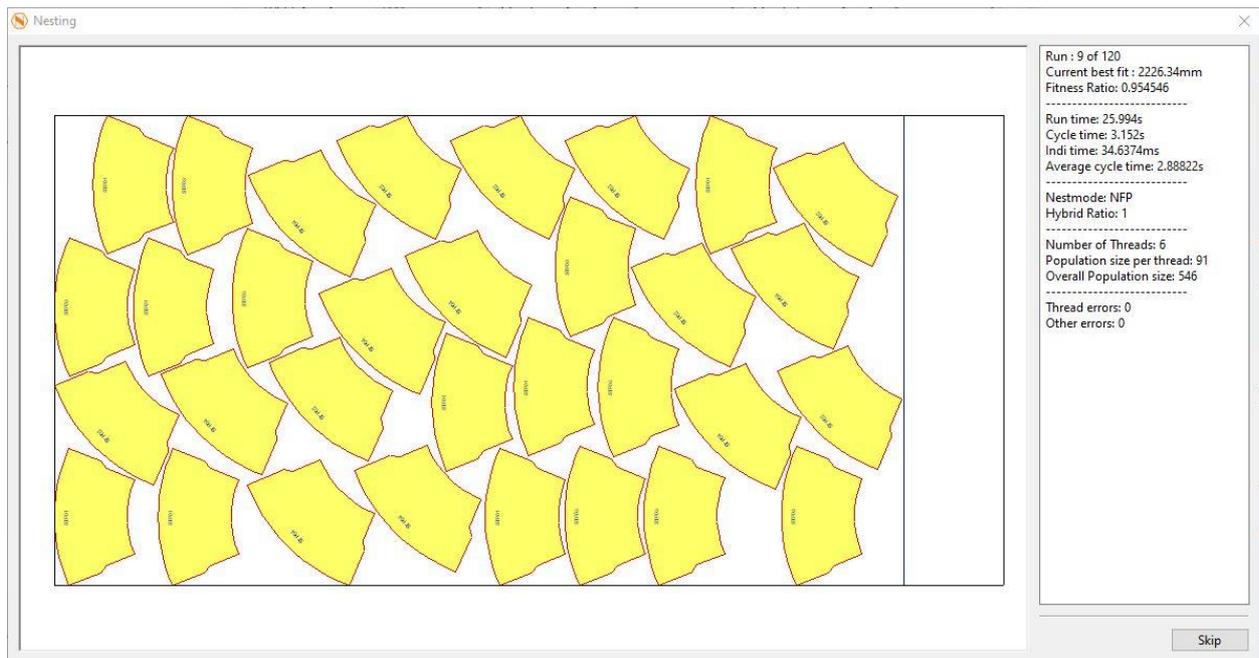


Figure 126

On the right you can see the current nest status. In this case due the small number of cuts and no rotation constraint, the NFP nesting mode was selected automatically. More information regarding nest algorithms can be found in chapter *H2.4 Nesting Modes* starting on page 177.

- We can run all 120 cycles, or we can also abort the nesting process by clicking as soon as we are happy with the nest result.

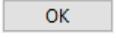


ATTENTION: The following steps are only required if you are using Wingman to control your cutter! If you are not using Wingman jump to step 11 on page 64.

5.3. Export for Wingman

Wingman is a software used for controlling the cutter. It is offered by ISODev GmbH based southern Germany.

Before we can export the nest result for Wingman we need to ensure that our dxf export settings are set properly.

6. Therefor close the Nest Dialog by clicking .
7. Open the Options Dialog (Figure 127).
8. Go to the Nestdialog tab and scroll down to set following export settings:

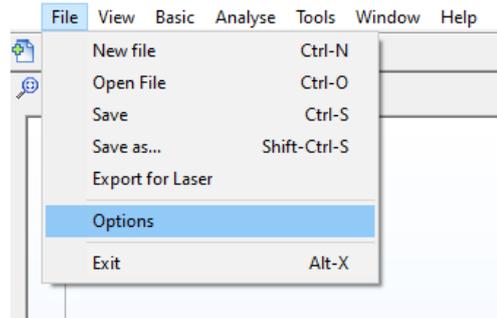


Figure 127

- a. Set **[Default export file format:]** to **[*.dxf]**.

Note: With this setting you don't have to change the file format to DXF everytime you export a nested file.

- b. Disable **[For DXF Export - to save cuts of subnests into a separate block (block in block)]**.

Note: Wingman is not capable of block in block. Update June 6, 2023: Mr. Alfons Wess confirmed that Wingman is also capable of block in block but I have not tried it yet, so you can also enable block in block and try it on your cutter as soon as you are using subnests (see also chapter *H1.1 Subcuts*).

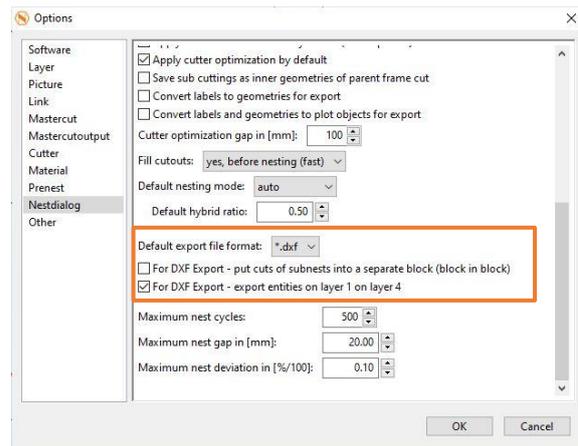


Figure 128

- c. Enable **[For DXF Export – export objects on layer 1 on layer 4]** (Figure 128).

Note: Older Wingman Version ignores text on layer 1 (text is neglected and not visible in Wingman). Activate this checkbox to export text and geometries on layer 1 (text layer) on layer 4 (plot Layer) instead.

9. Now close the Option Dialog with  and reopen the Nest Dialog by clicking on the nest button  again.
10. Confirm the PreNest Settings Dialog with .



5.4. Cutter Simulation

NestKing also offers an additional feature called cutter simulation. To open the Cutter Simulation Window click **Simulate** (Figure 131).

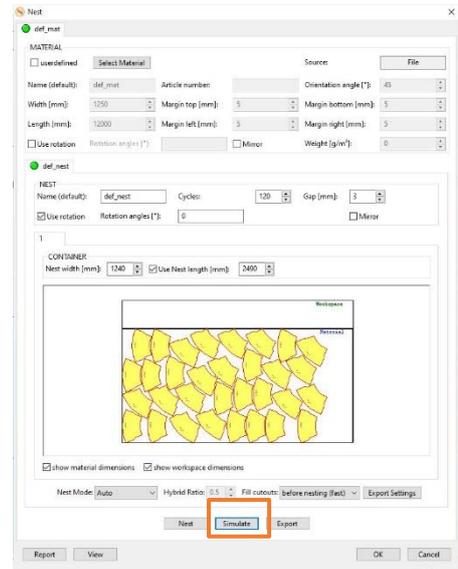


Figure 131

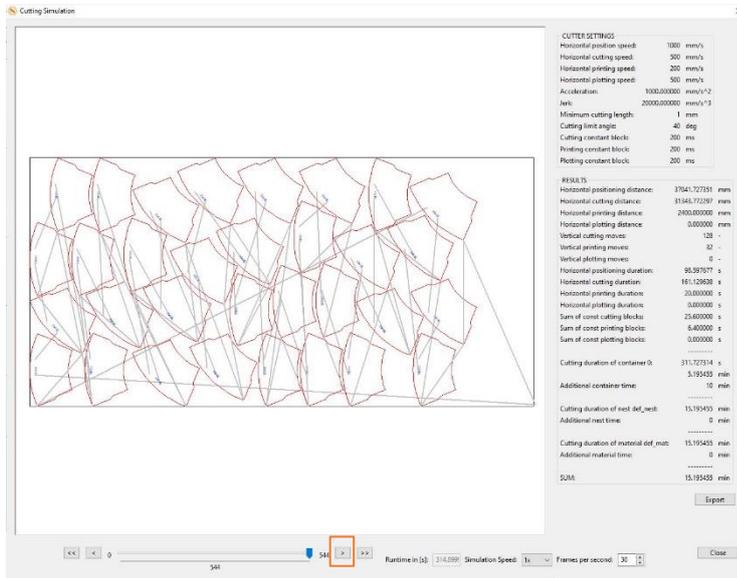


Figure 132

To start simulation, click the **>>** button (Figure 132). If you click the same button again you can pause the simulation. With **<<** you can play the simulation backwards. With **<** you can go one step back and in contrary with **>** you can go one step forward. Further you can also change the simulation speed **Simulation Speed: 1x** and the frame rate **Frames per second: 30**.

In the right column you will find an estimate of the overall cutter time.

All settings underlying these calculations can be changed in the Options Dialog in the Cutter tab.

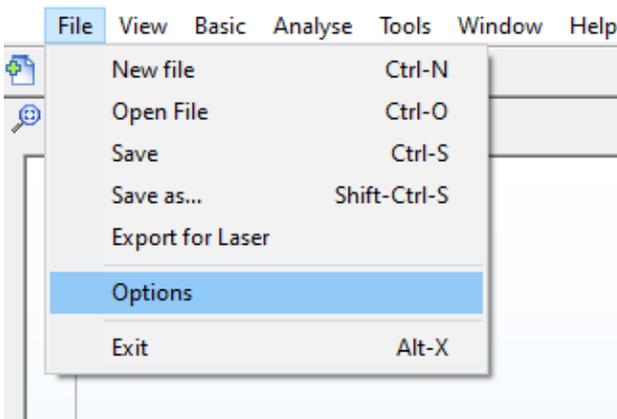


Figure 133

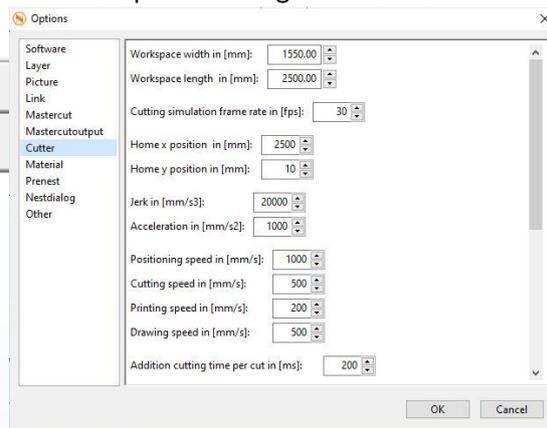


Figure 134



5.5. Cutter Report

You will find the report button **Report** on the left bottom of the Nest Dialog (Figure 135). This report contains all relevant data of all materials and nests of the current file. Relevant data are the overall cutting time, the material consumptions as well as the overall cut area with the weight of the cuts (Figure 136).

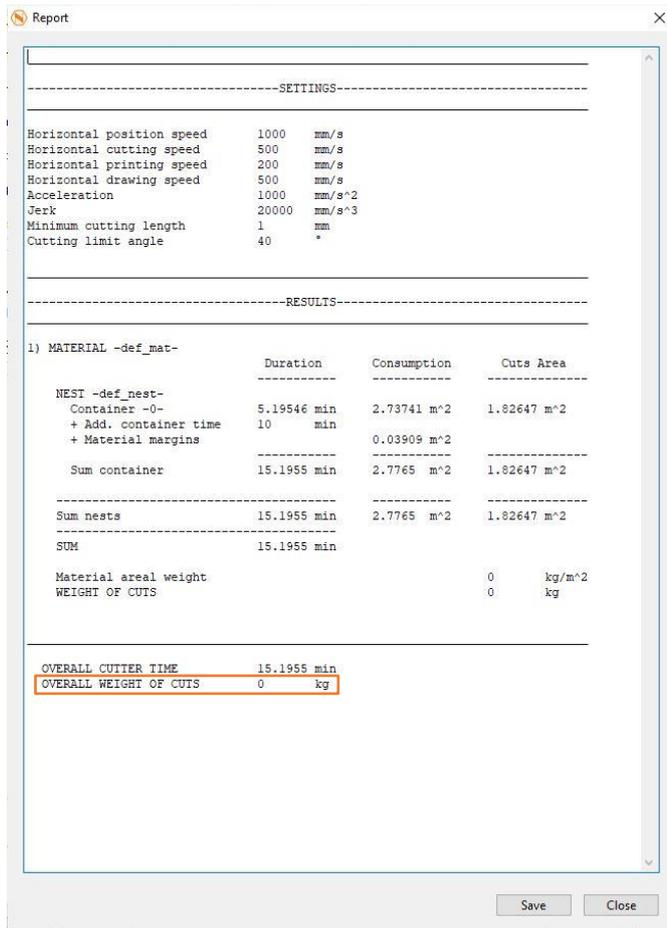


Figure 136

If you click on the **Report** button again the calculations show that the overall weight of our cuts is about 0.36529 kg (Figure 138).

1) MATERIAL -def_mat-1-	Duration	Consumption	Cuts Area
NEST -def_nest-			
Container -0-	5.15691 min	3.5729 m ²	1.82647 m ²
+ Add. container time	10 min		
+ Material margins		0.46396 m ²	
Sum container	15.1569 min	4.03686 m ²	1.82647 m ²
Sum nests	15.1569 min	4.03686 m ²	1.82647 m ²
SUM	15.1569 min		
Material areal weight		0.2	kg/m ²
WEIGHT OF CUTS		0.36529	kg

At the bottom, the overall values are summarized:

- OVERALL CUTTER TIME: 15.1569 min
- OVERALL WEIGHT OF CUTS: 0.36529 kg

Figure 138

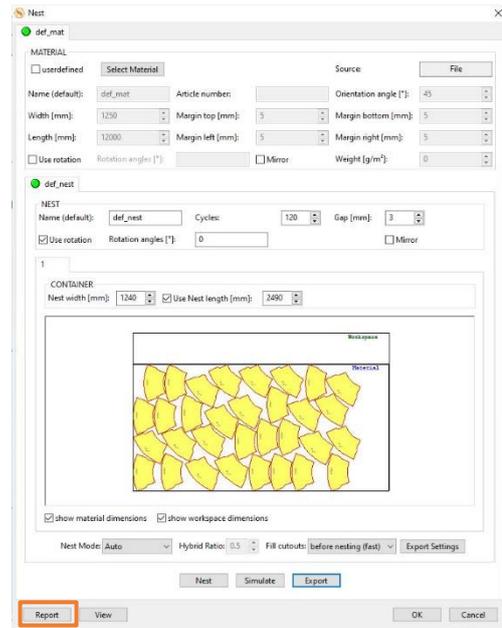


Figure 135

If the file contains all cuts of the composite part and the material weight of all used materials is set correctly, the calculated weight of the cuts is also a good estimation for the final weight of the part itself.

In our case the material weight is zero by default. Thus, the overall weight of cuts is also zero. But we can easily change this if we close the Report Dialog and set the material to user defined and the weight to 200 g/m² (Figure 137).

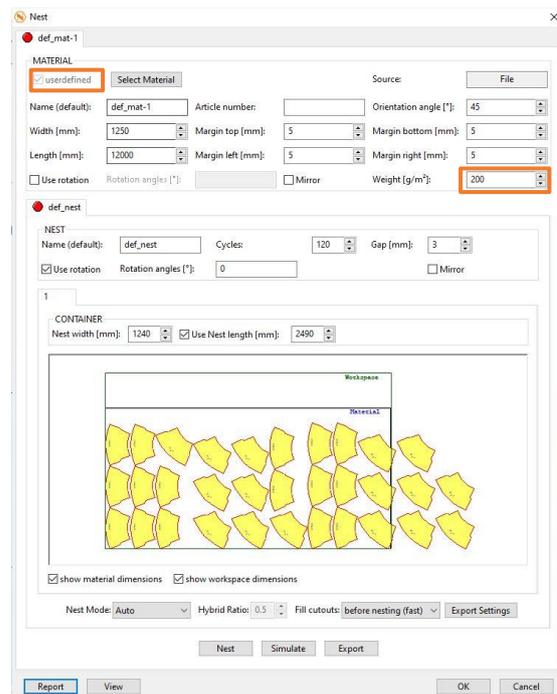


Figure 137



5.6. Error Handling

This chapter is intended to give you a brief introduction to how to deal with errors and warnings. These messages mainly appear during the cut generation process initiated by clicking on the **Nest All** of the PreNestSettings Dialog (Figure 139). NestKing automatically tries to generate cuts based on our input geometries and texts. Further NestKing also tries to interpret all NestKing Commands and tries to assign this additional information to our cuts.

When these input geometries and texts are causing discrepancies and cut generation or NestKing Command interpretation fails NestKing returns error and warning messages. These messages are added to the Description Box at the bottom left of the Standard View Window (Figure 140).

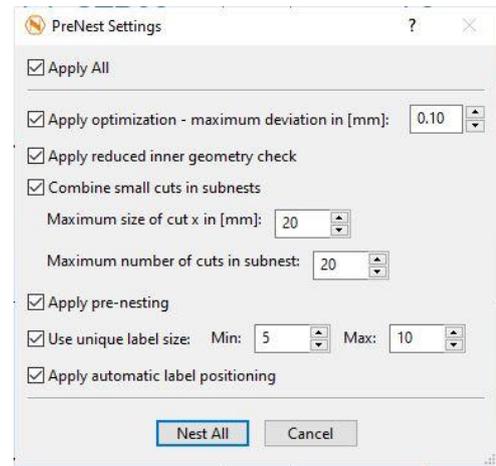


Figure 139

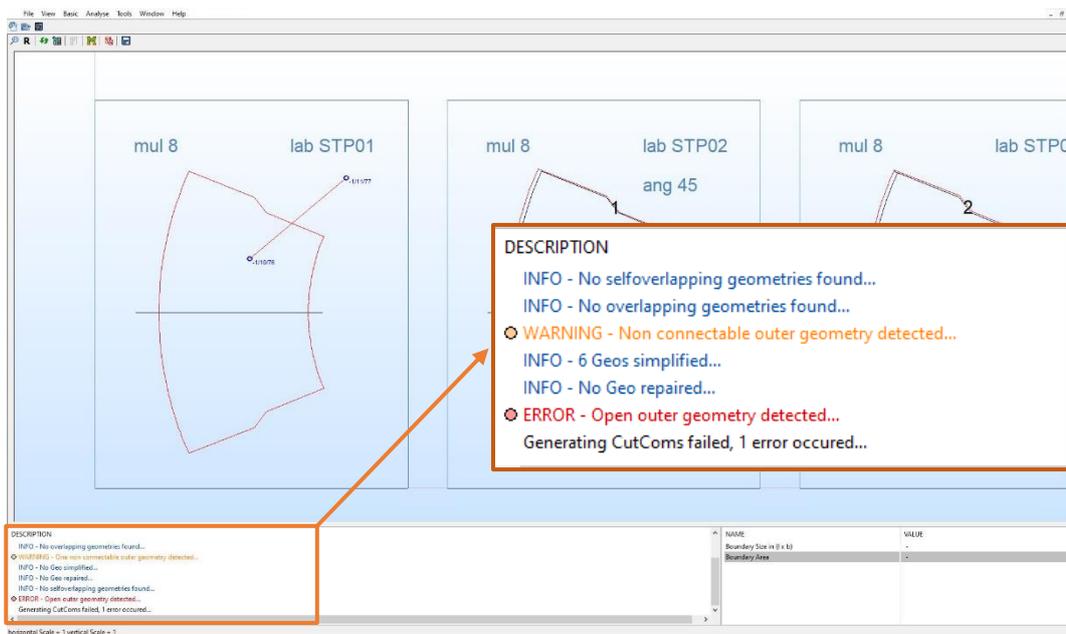


Figure 140

As indicated in red the error message states that an open outer geometry was detected. In addition, also a warning message is listed in orange.

Note: You can click on messages marked with colored circles to highlight the objects causing the message.



Following steps are intended to give you an example how errors and warnings can be handled and solved.

1. Open the Bulkhead example file resulting from Step 4.a., containing all Bulkhead cuts ready for nesting: bulkhead_orig.DXF.

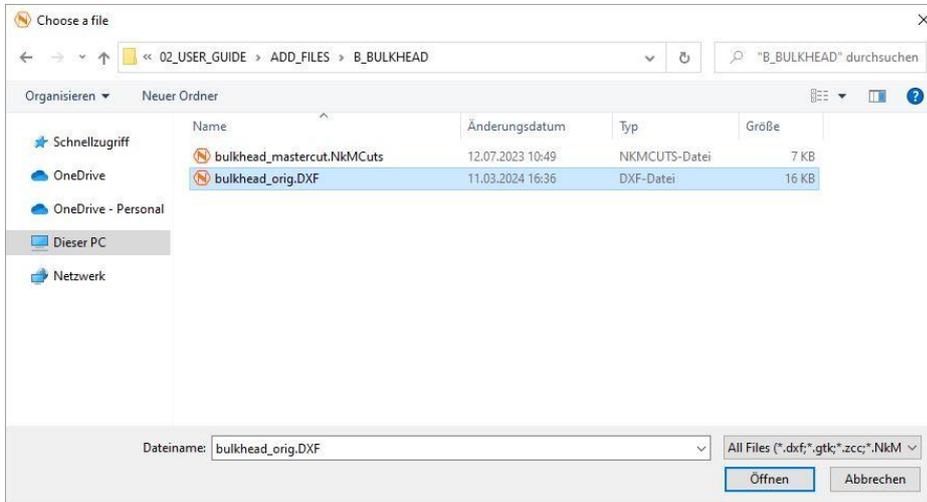


Figure 141

2. Next, bring up the Standard Sketcher by clicking  on the Main Toolbar or using the **S** keyboard shortcut.

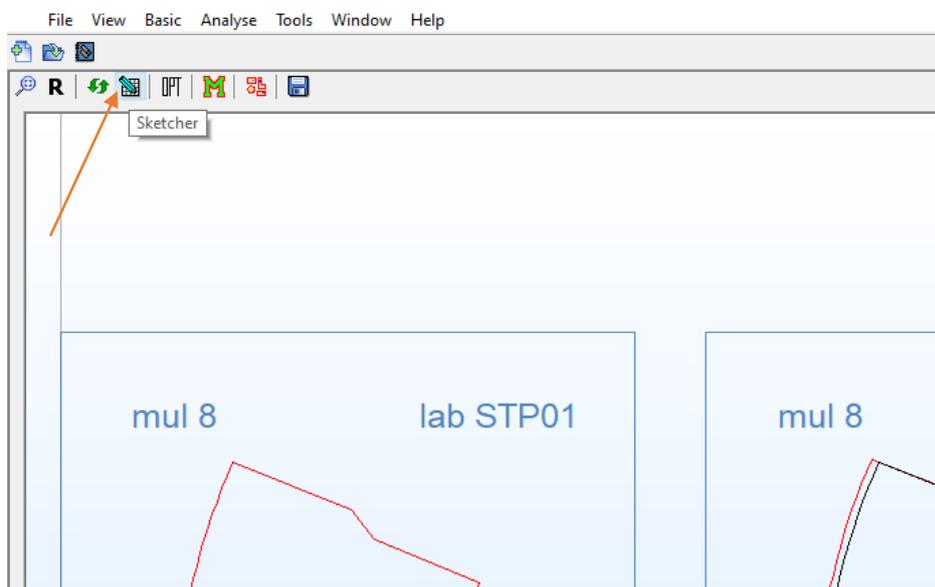


Figure 142



- Line:** Activate the line tool by clicking  or using the **-LINE-** Command as (Figure 143).

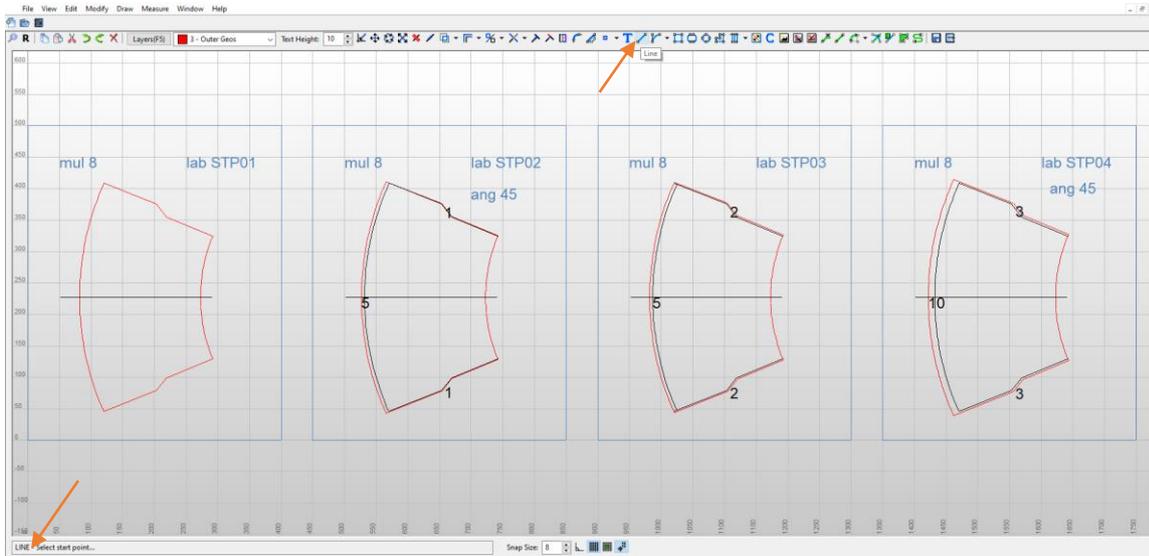
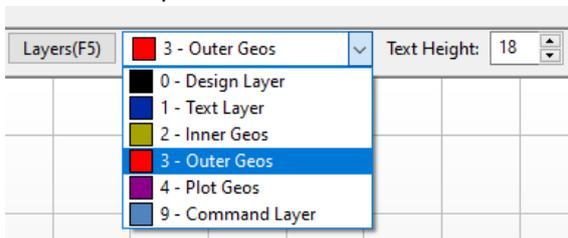


Figure 143

- Draw a line inside the command box of STEP01 as indicated in Figure 144.
- Ensure that our generated line is assigned to layer 3. If that is not the case pick the line and select layer 3 in the layer selection drop down menu in the Main Toolbar



or click on key **-3-** on the keyboard.

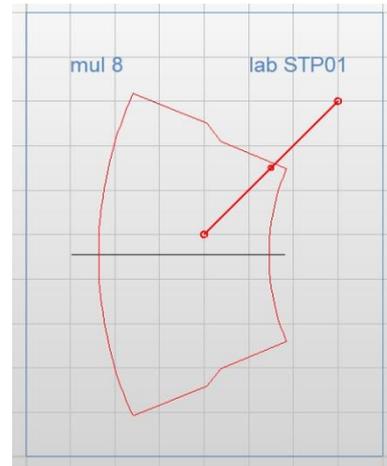


Figure 144

- Command Error:** Further we also intentionally want to produce an unknown NestKing Command error. Therefore double-click on our **"mul 8"**- Text object of STEP01 and change the text to **"mult 8"** in the appearing Text Dialog (Figure 145).

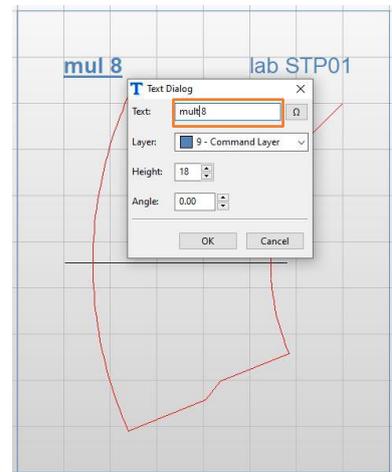


Figure 145

- Leave the sketcher by clicking the exit sketcher button  on the Main Toolbar.



6. Back in the Standard Viewer click  (Figure 146).

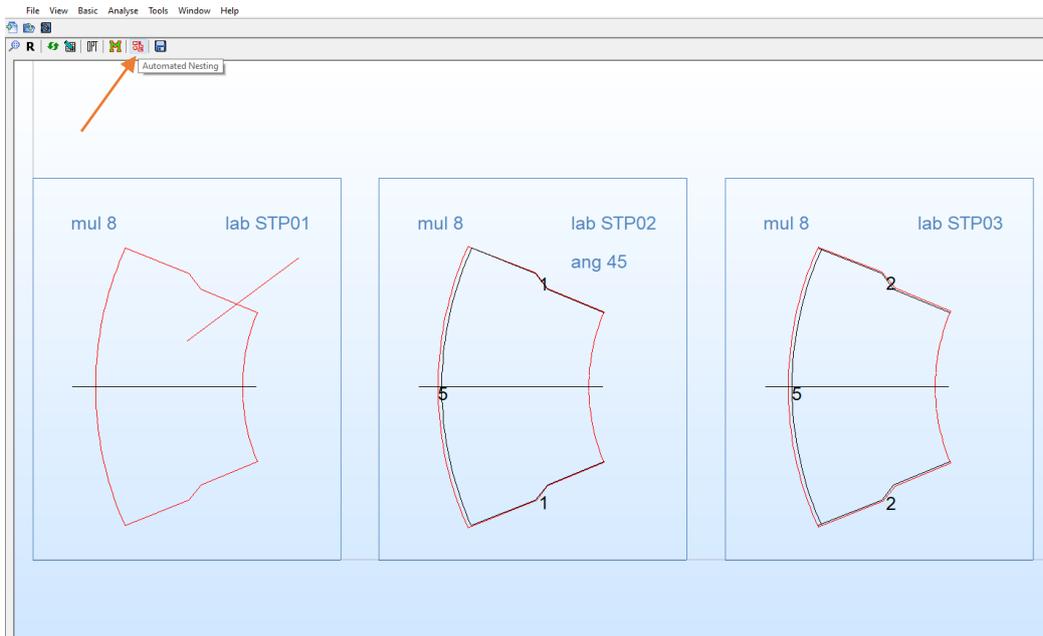


Figure 146

7. The appearing PreNest Settings Dialog can be confirmed without any further changes with (Figure 147).

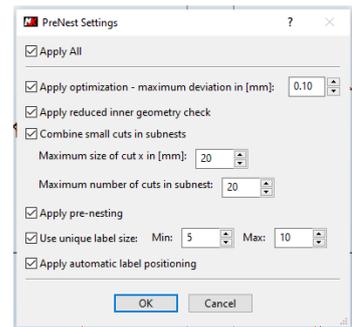
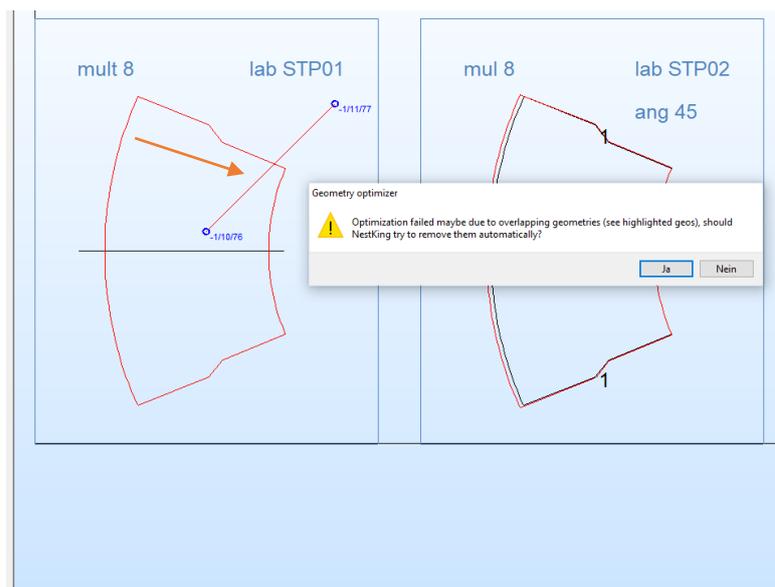


Figure 147

8. Now a warning Dialog appears, stating the optimization maybe failed due to overlapping geometries and it asks if NestKing should try to remove these overlaps automatically.

Note: NestKing also already highlights our line geometry (Figure 148).

Confirm the warning message with .



DESCRIPTION
 Autonest started...
 INFO - No neglectable entities found...
 ⚠ WARNING - Non connectable outer geometry detected...

Figure 148



9. Now the Description Box states that three errors occurred.

Note: The previously added red line as well as our manipulated “mult 8” command is clearly highlighted.

If you click on the error messages in the Description Box you can zip through all errors and warnings (Figure 149).

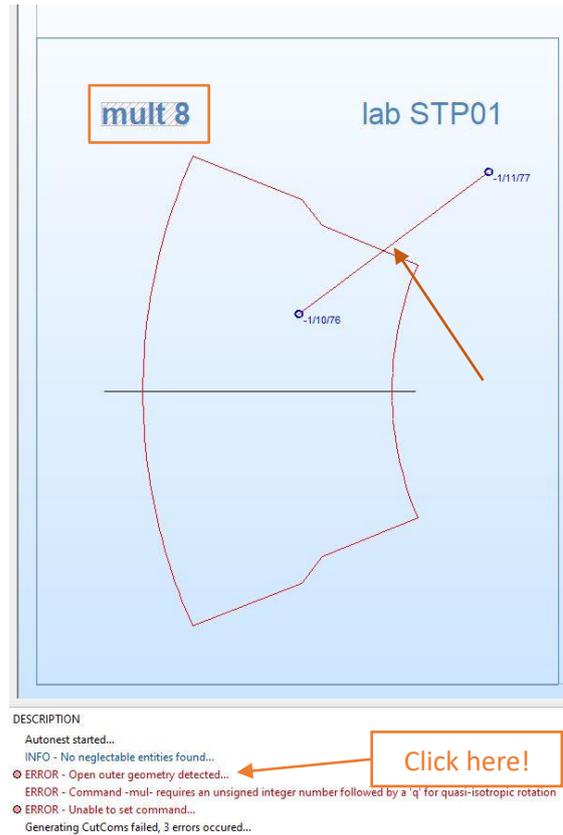


Figure 149

10. To resolve these errors, switch back into the Standard Sketcher with  or using shortcut **-S-** (Figure 150).

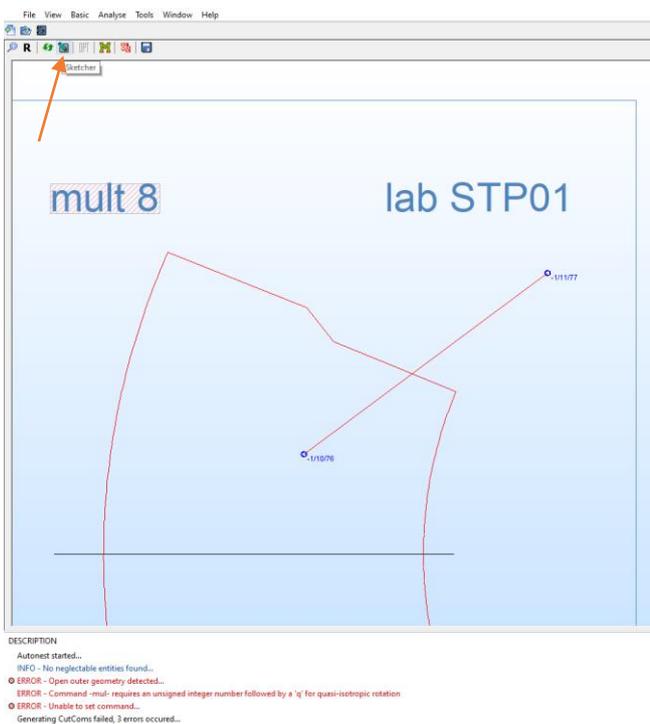


Figure 150



- Delete:** Back in the sketcher area select the line causing the error and click  in the Main Toolbar (Figure 151) or press **-DEL** on our keyboard.
- Reset:** Now you may recognize that a grey line with two markings at its ends remains. They can be neither picked nor deleted. These NestKing indication objects can either be left or removed by clicking on the reset button **R** on the Main Toolbar (Figure 152).

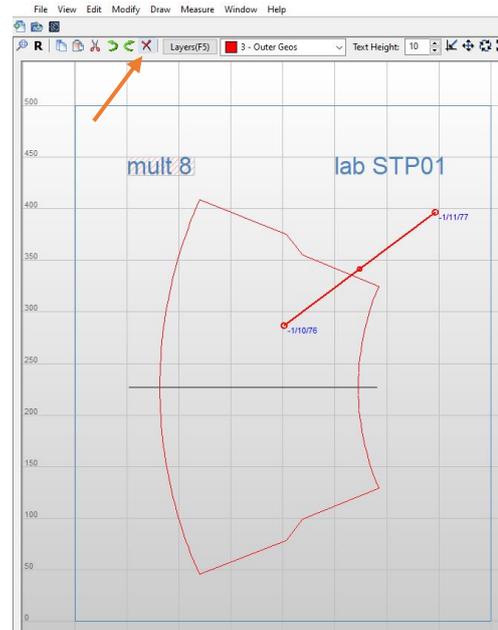


Figure 151

Note: Clicking the reset button also clears the Description Box and the error marking at our manipulated “mult 8” Command also disappears (Figure 153). So, if there are several more errors it is recommended to reset at the end, after all errors have been fixed. Consider, you do not even need to reset, as error messages and objects are automatically removed when you start the nesting process again.

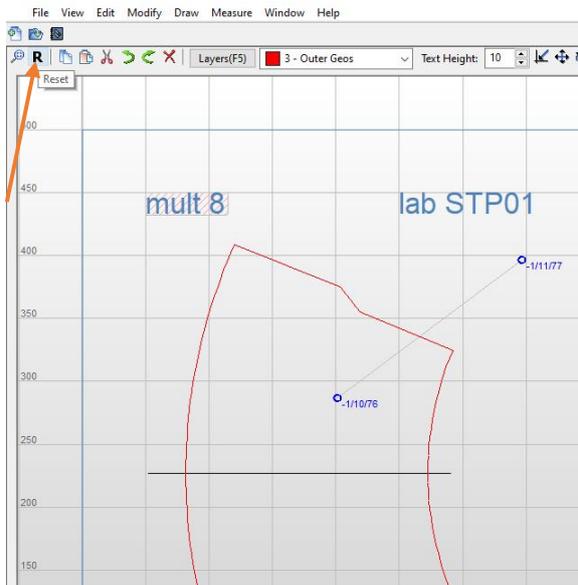


Figure 152

- Text:** Finally remove the added letter “t” from our “mult 8” text to get the correct “mul 8” NestKing Command. Therefore just double-click on the “mult 8”-text object and remove the “t” in the text entry (Figure 154).

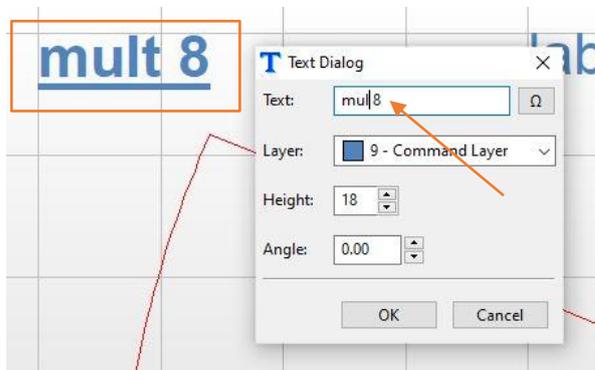


Figure 154

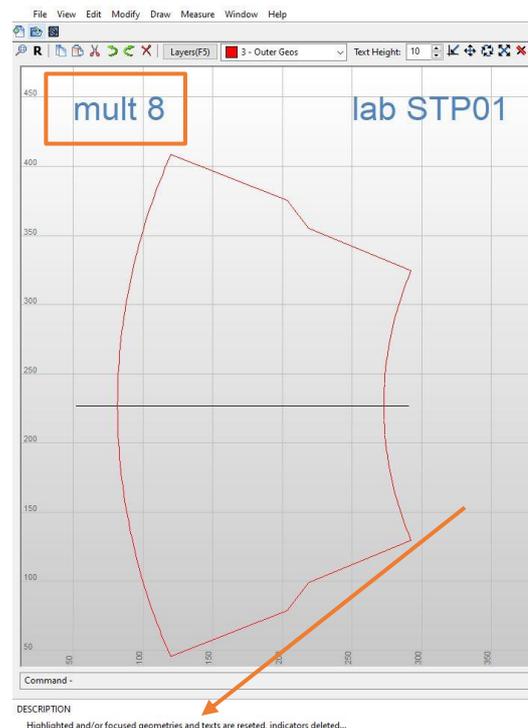


Figure 153



11. **Save:** To save all bug fixes just press  on the Main Toolbar or use shortcut **-CTRL- + -S-**.
12. **Exit Sketcher:** Leave the sketcher by clicking the exit button  on the Main Toolbar.
13. **Automated Nesting:** Back in the Standard Viewer try nesting our corrected file again. Therefore let's click on the nest button  in the Main Toolbar (Figure 155).

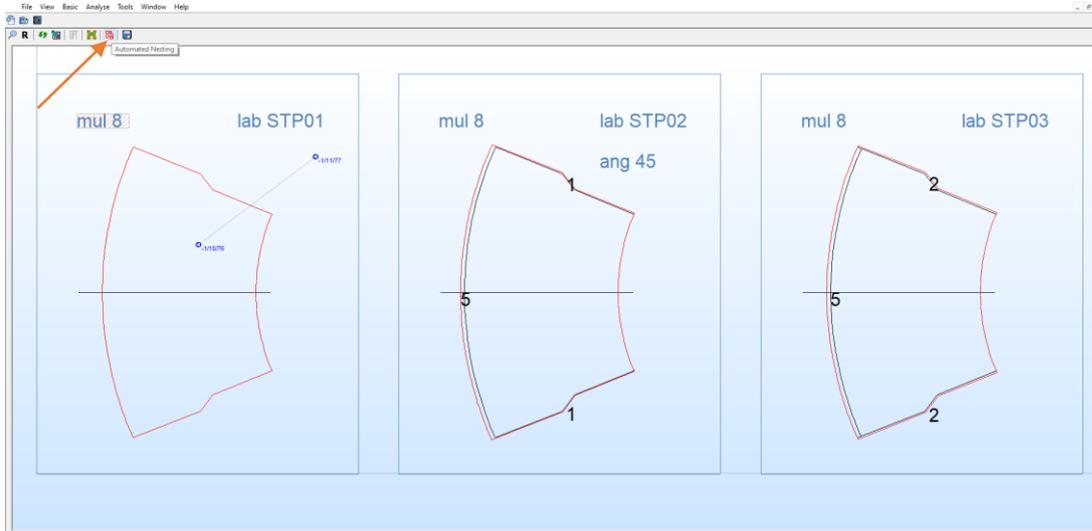


Figure 155

14. The appearing PreNest Settings Dialog can be confirmed with  without any further changes.

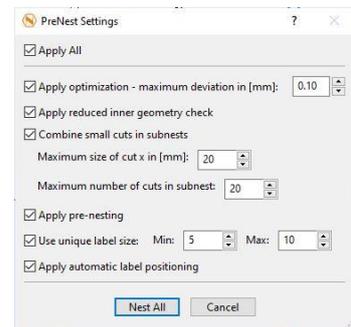


Figure 156

If all data is set correctly the cut generation and NestKing Command interpretation completes successfully. The Nest Dialog should appear on our screen. Here you can just proceed as described in chapter 5.2. *Nest Dialog* on page 61.

That's basically the way how errors can be handled and eliminated. If you still have any troubles, just let me know (office@nestking.at)!

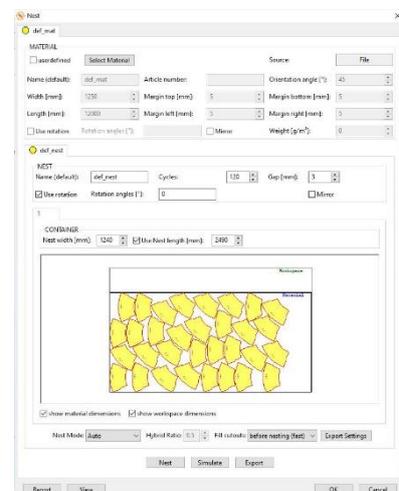


Figure 157



D. Example Bracket – Using MasterCut Links

D1. Introduction

This chapter explains how links can be used to make cut generation faster and easier. As in chapter A, the bracket is also used here as an example (Figure 158).

To repeat, the bracket is an asymmetrical composite part with a hole at the bottom. It exists of five compound layers with three additional reinforcement layers around the hole.

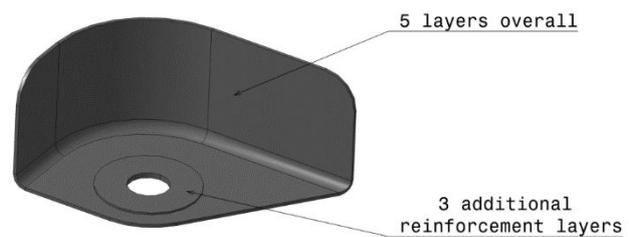


Figure 158

Figure 159 shows the tool used for lamination and Figure 160 shows the tool together with the already finished part.

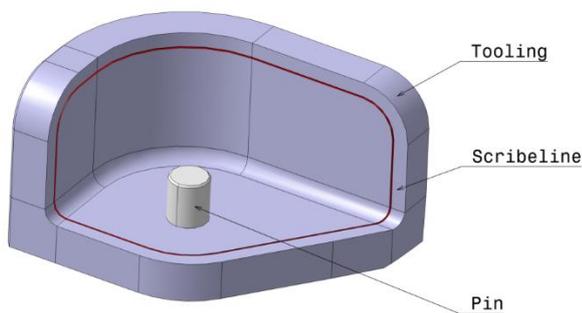


Figure 159

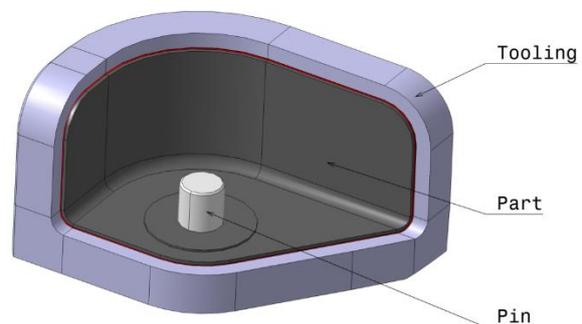


Figure 160

All cuts are derived in a 3D CAD software (Solid Works, CATIA V5, Solid Edge, ...) and saved as flattened 2D geometries in an DXF-File (Figure 161).

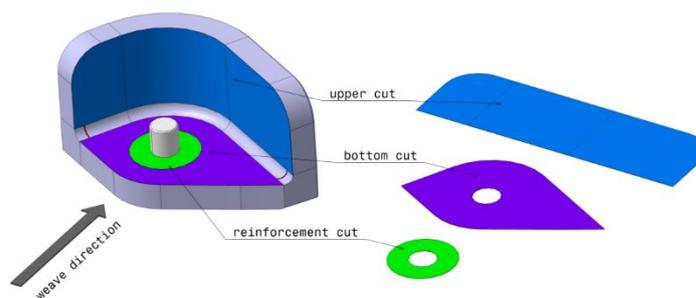


Figure 161



D2. Workflow

1. First open  the bracket example file (bracket_cuttings_CATIA_export.dxf):



Figure 162

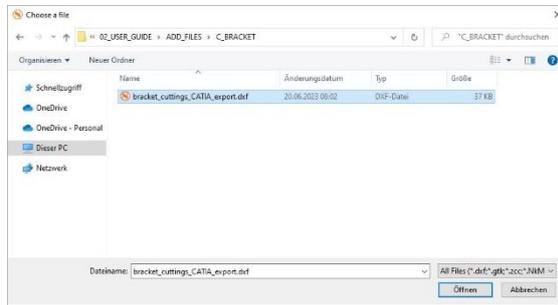


Figure 163

2. In order not to overwrite the original file save the opened file with **[Save as...]** (Figure 164) to a new file "bracket_cuttings_01.dxf" (Figure 165).

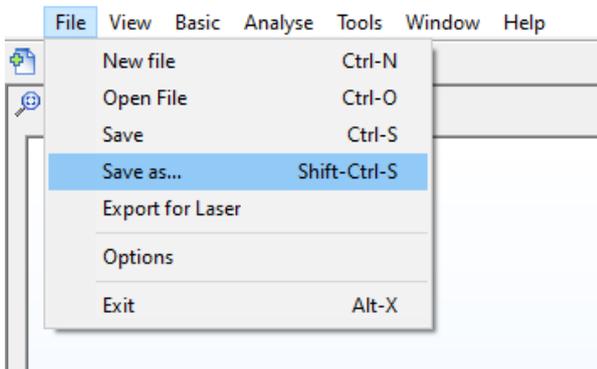


Figure 164

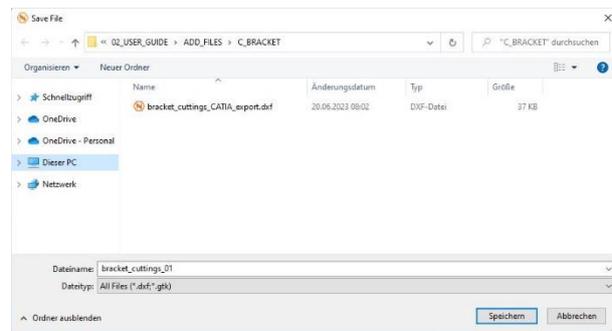


Figure 165

3. Next click the -Generate MasterCut- button .
4. Our geometries are not optimized yet. So, confirm to optimize them now by clicking the yes button .

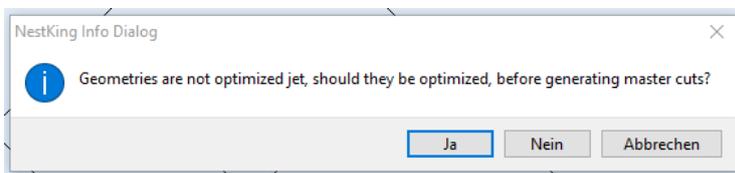


Figure 166

5. Maximum gap between geometries of 0.1 mm is fine → Confirm with .

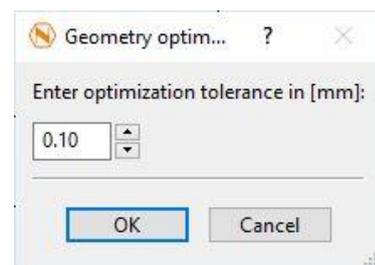


Figure 167



6. Now that you are in the Mastercut workspace. Start by setting up our master table  (Figure 168).
7. As stated in the Bracket example description we need five compound layers over the complete lamination surface and three additional reinforcement layers around the pin hole. Regarding reinforcement cuts we have two options to add them:
 - (1) Add reinforcement cuts via a MasterCut in combination with an additional step in the master table.
 - (2) Add reinforcement cuts using standard geometries and use NestKing Commands for assigning labels, multiplicator and material. Basically, this is the same procedure as shown in chapter 4a) *Standard workspace*.

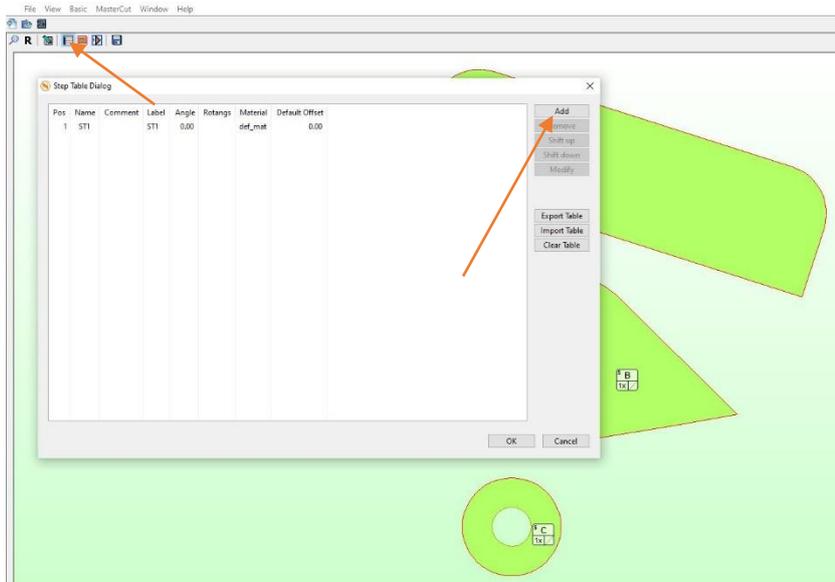


Figure 168

In this case I want to show you how to add reinforcement cuts with option 1, using an additional master step. Therefore we add altogether six steps to our master step table. ST2, representing compound layer 2, and STP4 (Figure 169 center), representing compound layer 4 (Figure 170 left), are rotated by 45°. Additionally as indicated in Figure 170 on the right step 6 is renamed to “REINF” to emphasize that this step will be used for the reinforcements cuts.

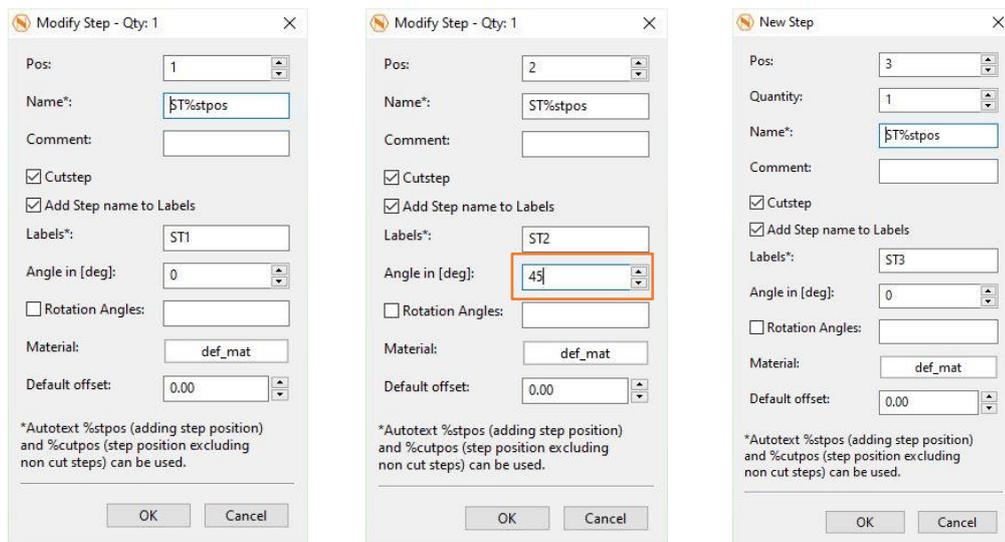


Figure 169

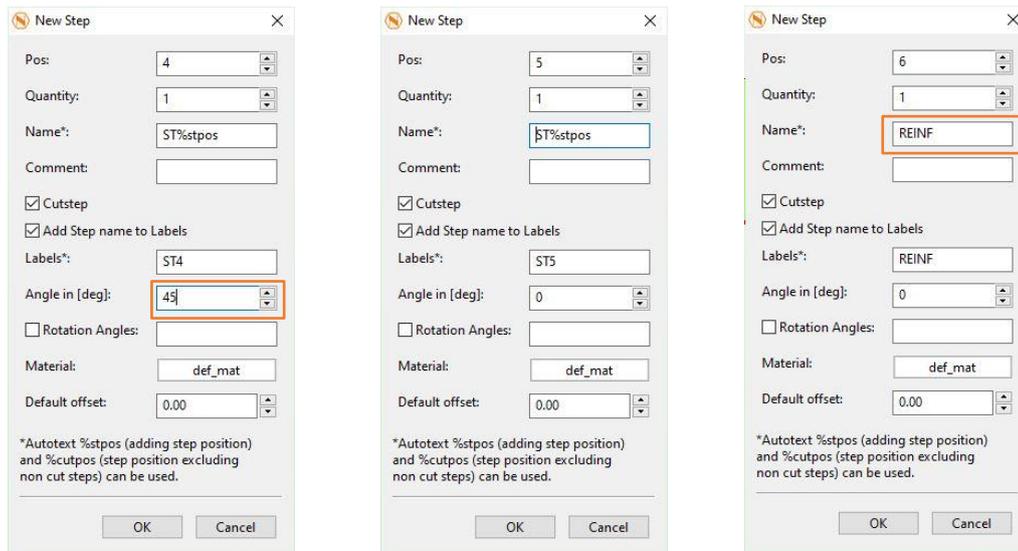


Figure 170

8. Finally, confirm and leave the master table with .

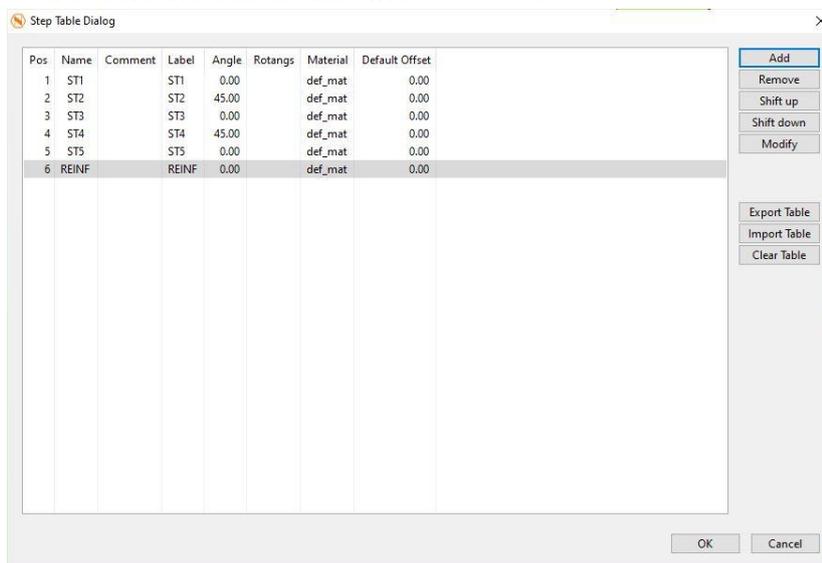


Figure 171

9. Next click the  button. Due to the fact that we haven't saved our mastercut file yet the Save File Dialog will pop up. The default name "bracket_cuttings_01" is fine. Click .

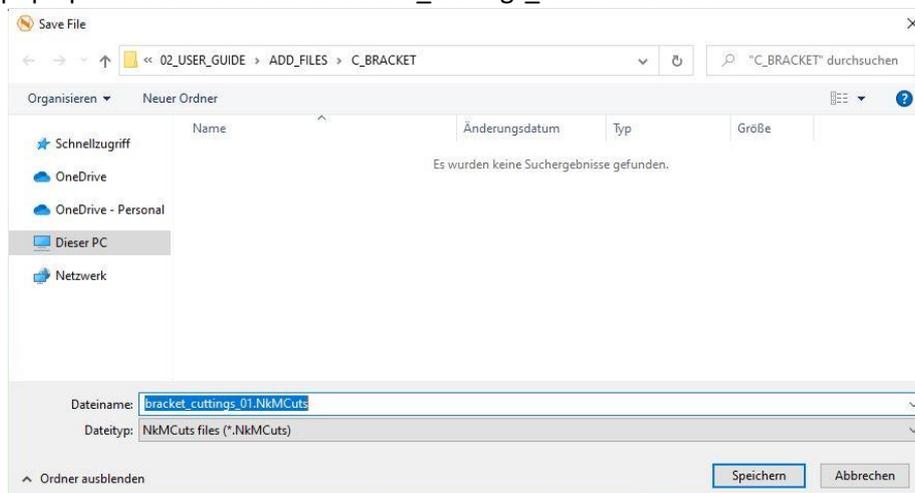


Figure 172



10. Next, enter the MasterCut Sketcher with  (Figure 173) or using the **-S-** shortcut on the keyboard.

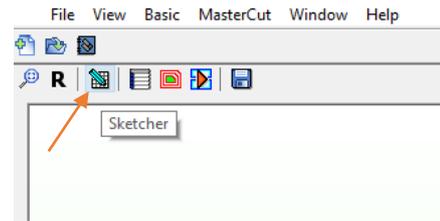


Figure 173

Our goal now is to link the segments indicated in yellow and green with each other (Figure 174).

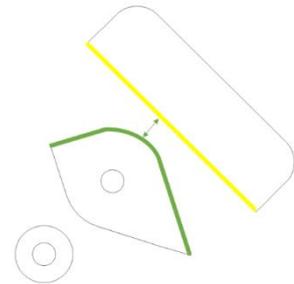


Figure 174

To do this, we first need to split your mastercut contours into segments.

11. Therefore double-click on the first mastercut above to open its MasterCut Dialog (Figure 175).

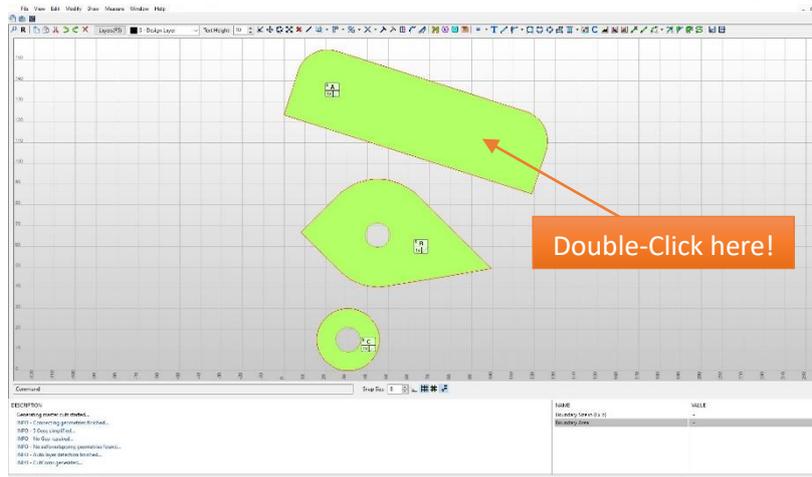


Figure 175

12. **SPLIT SEGMENTS:** Here use the **Split Segments** tool and pick both lower edge points **SP1** and **SP2** to split the outer geometry into two segments (Figure 176).

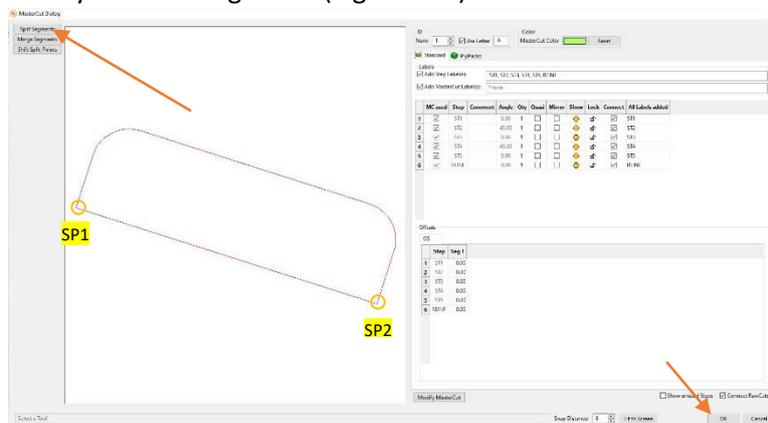


Figure 176

13. Confirm with **OK**.



14. Let's do the same for the middle mastercut as well:
 - a. Double-click on the mastercut itself.
 - b. Click **Split Segments**.
 - c. Pick split points **SP1**, **SP2** (Figure 177).

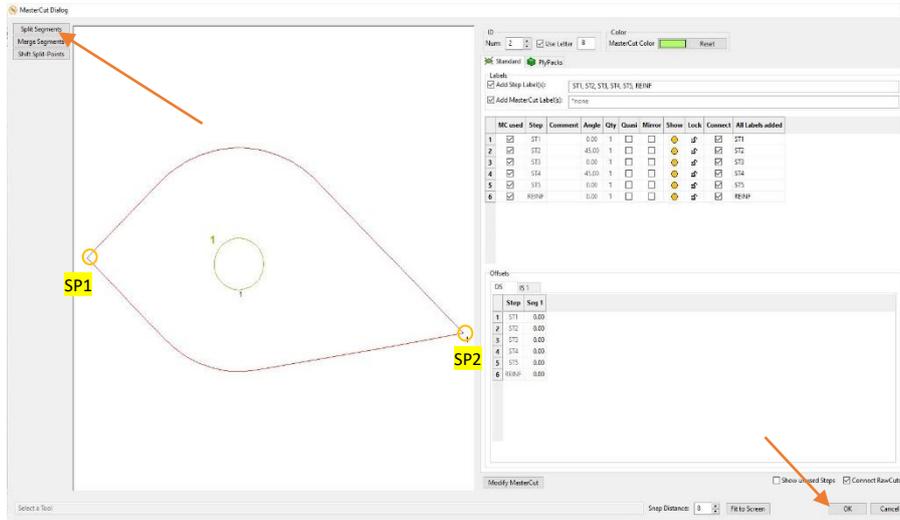


Figure 177

- d. Click **OK** to confirm.
15. After splitting our mastercuts into segments we can link them with the link tool button **L** on the Main Toolbar (Figure 178) or using the **-LINK-** Command.
16. Next the Command Prompt states to select a master segment (Figure 178).

Note: Actually, it doesn't matter which of the two segments we select first as the master segment and which as the slave segment.

17. Select the slave segment.
18. Deactivate the Linking tool by pressing the **-ESC-** key.
19. Double-click the link and see what the Edit Links Dialog offers.

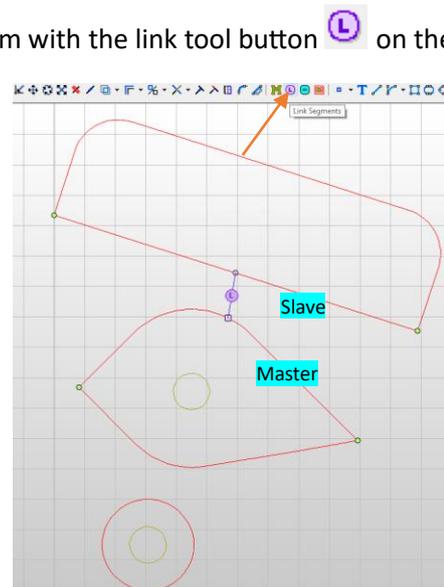


Figure 178

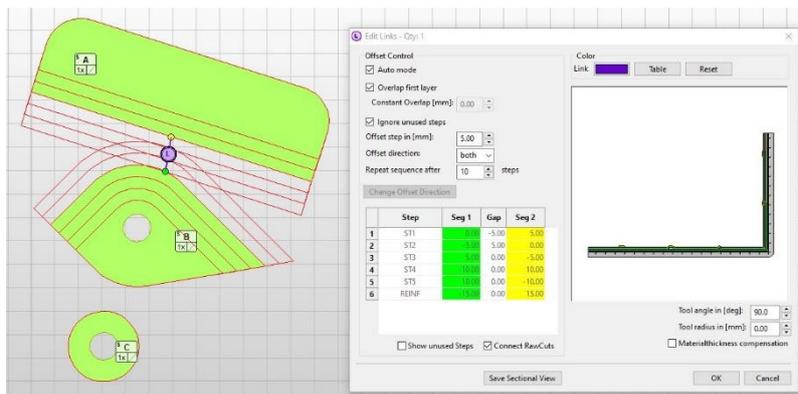


Figure 179



Edit Link Dialog: The following Table 9 shows the different settings of the Edit Link Dialog. The effect of each change can be directly seen in the Sectional View (Figure 180). Further also the raw cuts in the Sketcher Area adapt accordingly. Feel free to play around.

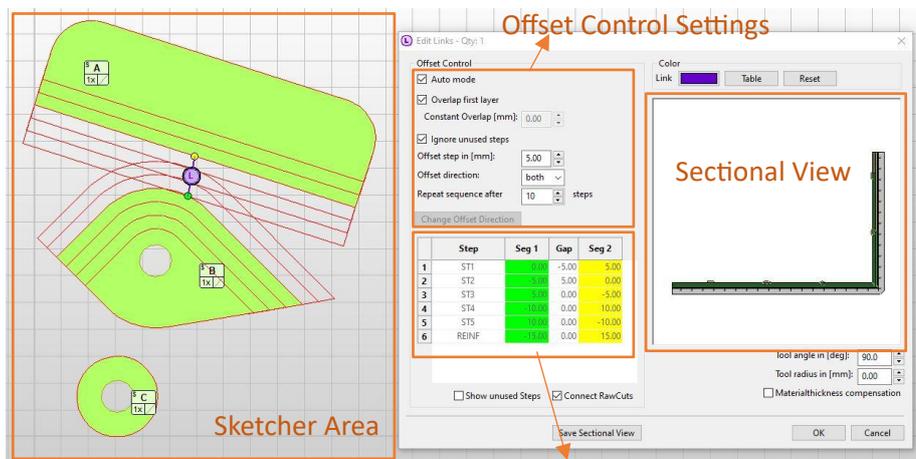


Figure 180 Offset Table

Name	Description
Auto mode	Activate/deactivate automatic offset control. If active, the offset values in your Offset Table are automatically set depending on your Offset Control Settings (Figure 180). If deactivated, you can change the offset values in the Offset Table by hand.
Overlap first layer	If checked, the first layer will overlap. This is very useful to prevent visible gaps on the visible outer part surface. The additional material thickening caused by the overlap is compensated automatically by the second compound layer.
Ignore unused steps	If active, unused cut steps are ignored during calculation of the offset values.
Offset step in [mm]	Offset step value.
Offset direction	Offset direction can be both directions, or just in the direction of the master segment or direction of the slave segment.
Repeat sequence after ... steps	The sequence will start again with offset of 0mm after the defined steps.
Show unused Steps	Shows/hides unused steps inside the Offset Table.
Connect RawCuts	If checked, raw cuts are connected automatically.
Tool angle in [deg]	This setting changes the angle of the tool.
Tool radius in [mm]	Here you can add a radius to the tool edge if required.
Materialthickness compensation	Activates/deactivates tool angle compensation. This is especially important for thicker laminates, because through the thickening of the material overlappings between the cuts will increase.

Table 9



20. Activate **[Materialthickness compensation]** (Figure 181).

Note: Currently our two upper mastercuts are also used for our reinforcement “REINF” step 6 (Figure 181). Disable this step for both mastercuts by applying following actions:

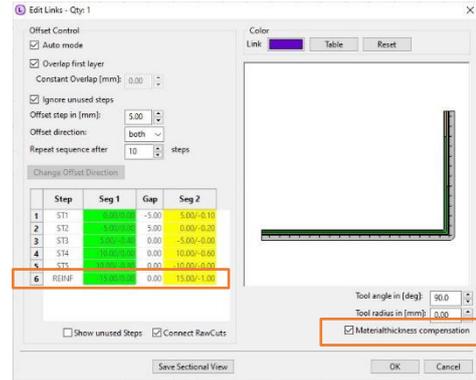


Figure 181

21. First close the Edit Link Dialog with **OK**.

22. There are two options to remove the top two mastercuts from the reinforcement step:

- (1) Open the MasterCut Dialog by double-clicking on the mastercut and uncheck the **[MC used]** checkbox for the “REINF” step as emphasized by Figure 182.

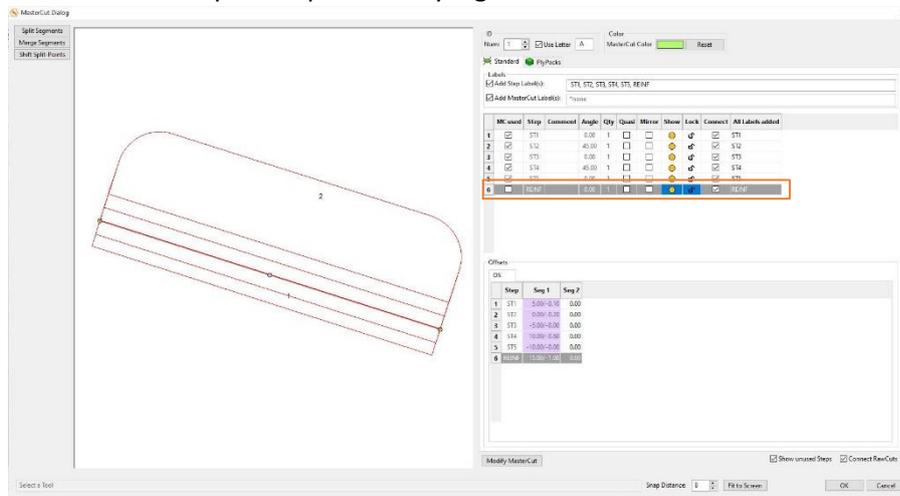


Figure 182

- (2) The second option is to select both mastercuts, click the right mouse button and pick **[Edit MasterCuts]** (Figure 183). Now disable the **[Used]** checkbox for the “REINF” step and confirm with **OK**.

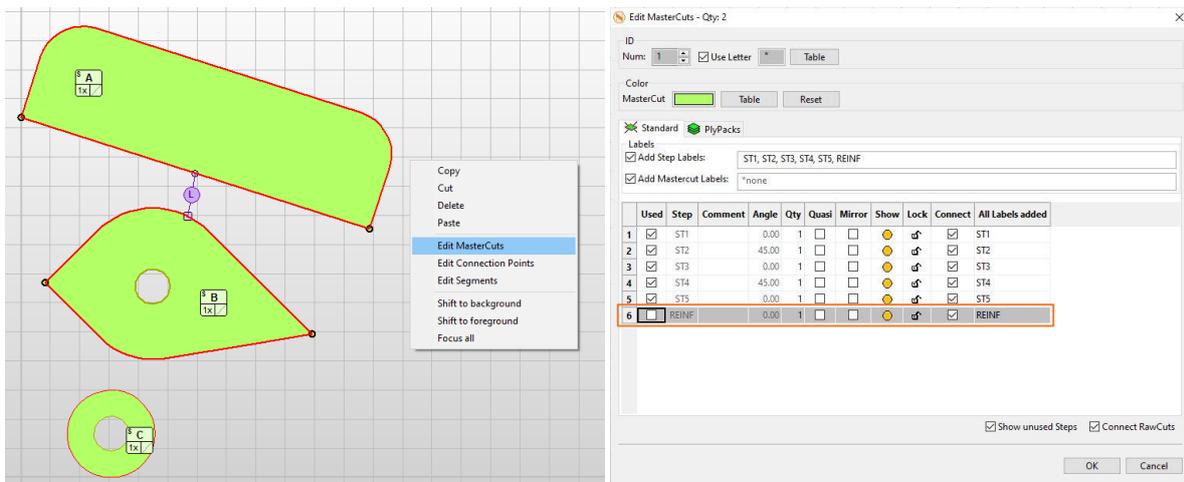


Figure 183



23. If we reopen the Edit Link Dialog again by double-clicking on the link, we will see that our “REINF” step is now grayed out and is no longer considered for the affected top mastercuts (Figure 184).

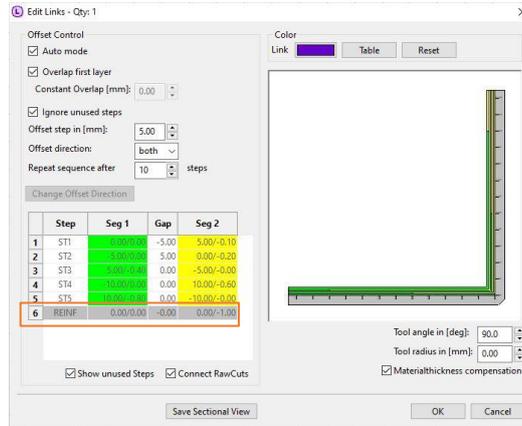


Figure 184

24. Close the Edit Link Dialog with .

25. The top two mastercuts are already finished. Now we need to adjust the settings for the reinforcement cut at the bottom. Therefore double-click the reinforcement cut to open its MasterCut Dialog.

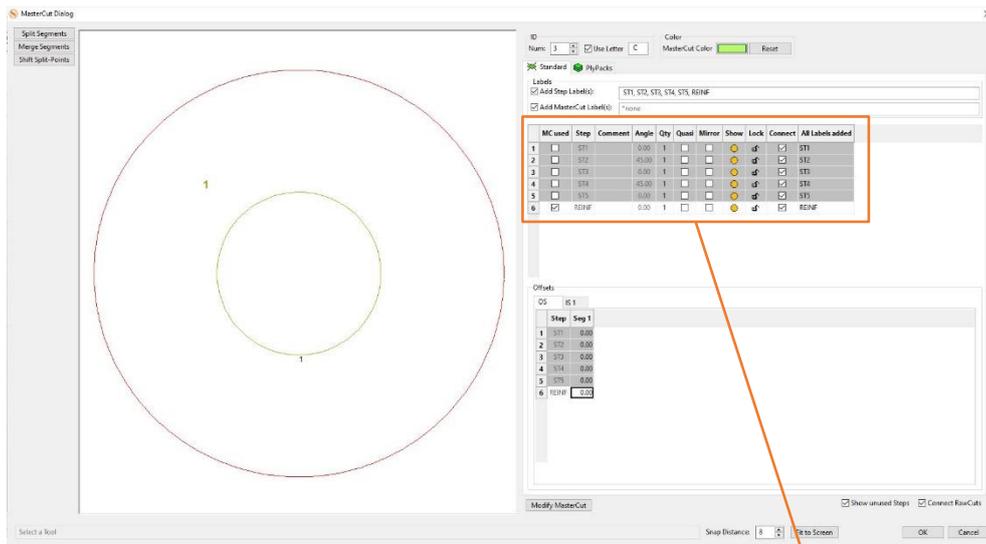


Figure 185

The only settings we need to change is to deactivate steps 1, 2, 3, 4, 5 and set the quantity for the REINF step to 3 (Figure 186).

MC used	Step	Comment	Angle	Qty	Quasi	Mirror
<input type="checkbox"/>	1	ST1	0.00	1	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	2	ST2	45.00	1	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	3	ST3	0.00	1	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	4	ST4	45.00	1	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	5	ST5	0.00	1	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	6	REINF	0.00	3	<input type="checkbox"/>	<input type="checkbox"/>

Figure 186

26. Click the to save the changes to the mastercut file.

27. Leave the sketcher with .



28. The main part is already done. Generate the MasterCut output by with  (Figure 187).

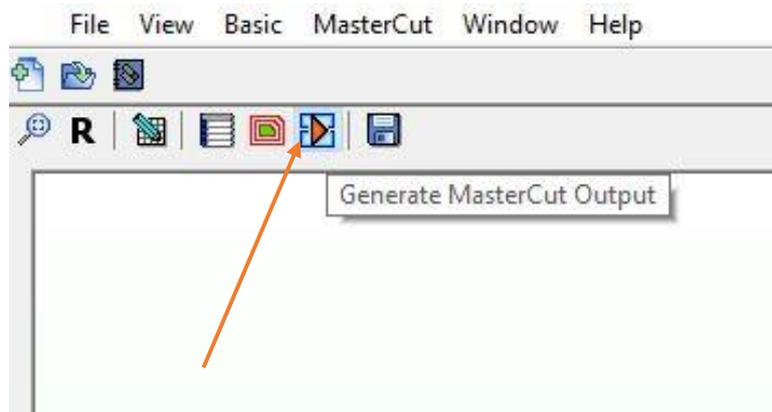


Figure 187

Figure 188 shows the appearing MasterCut Output Window which can be used for nesting. If you want to nest just proceed with 5) Nesting on page 59.

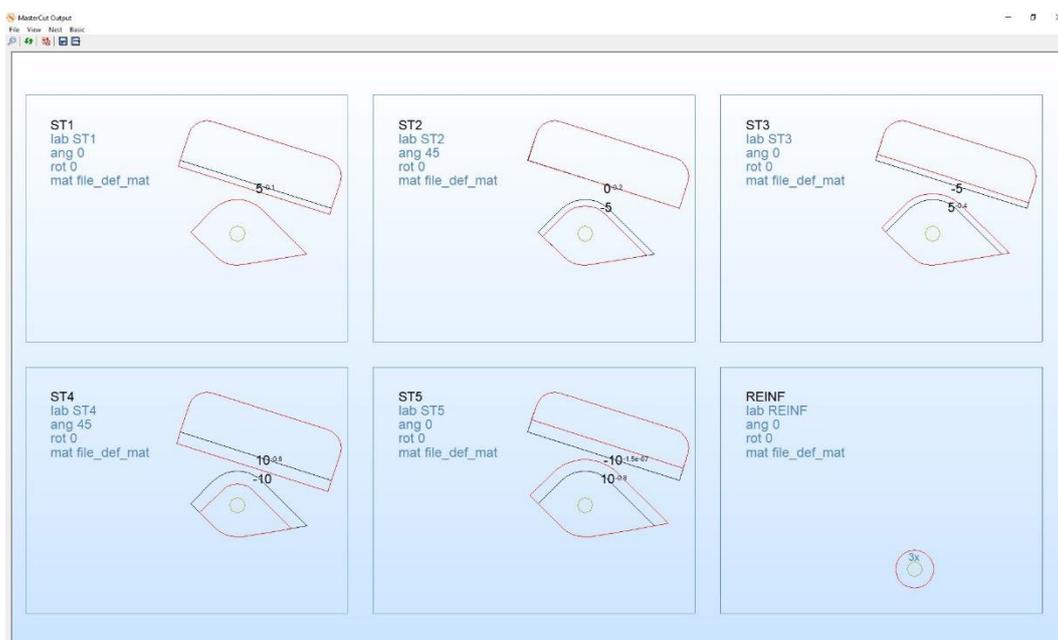


Figure 188

As shown in this chapter linking segments makes cut generation further intuitive. Offsetting segments usually follows the same schemes, which can be easily adapted with the Offset Controls of the Edit Links Dialog. If you need a special offset pattern you can also adjust the Offset Table manually or use the Autofiller Tool, as presented in the next chapter *D3. Introducing MasterCut PlyPacks (Patches)* on page 87.



D3. Introducing MasterCut PlyPacks (Patches)

This chapter is added to show you the MasterCut PlyPack tool and its functionalities.

Assuming the REINF step at position 6 should not just exist of 3 equal ring shaped cuts any more, but the outer diameter of these cuts should get smaller to get a cone shaped reinforcement around the pin. The MasterCut PlyPack is perfectly suited for this purpose.

1. So back in the MasterCut workspace enter to the sketcher workspace by clicking the Sketcher button  (Figure 189) or using shortcut **-S-**.

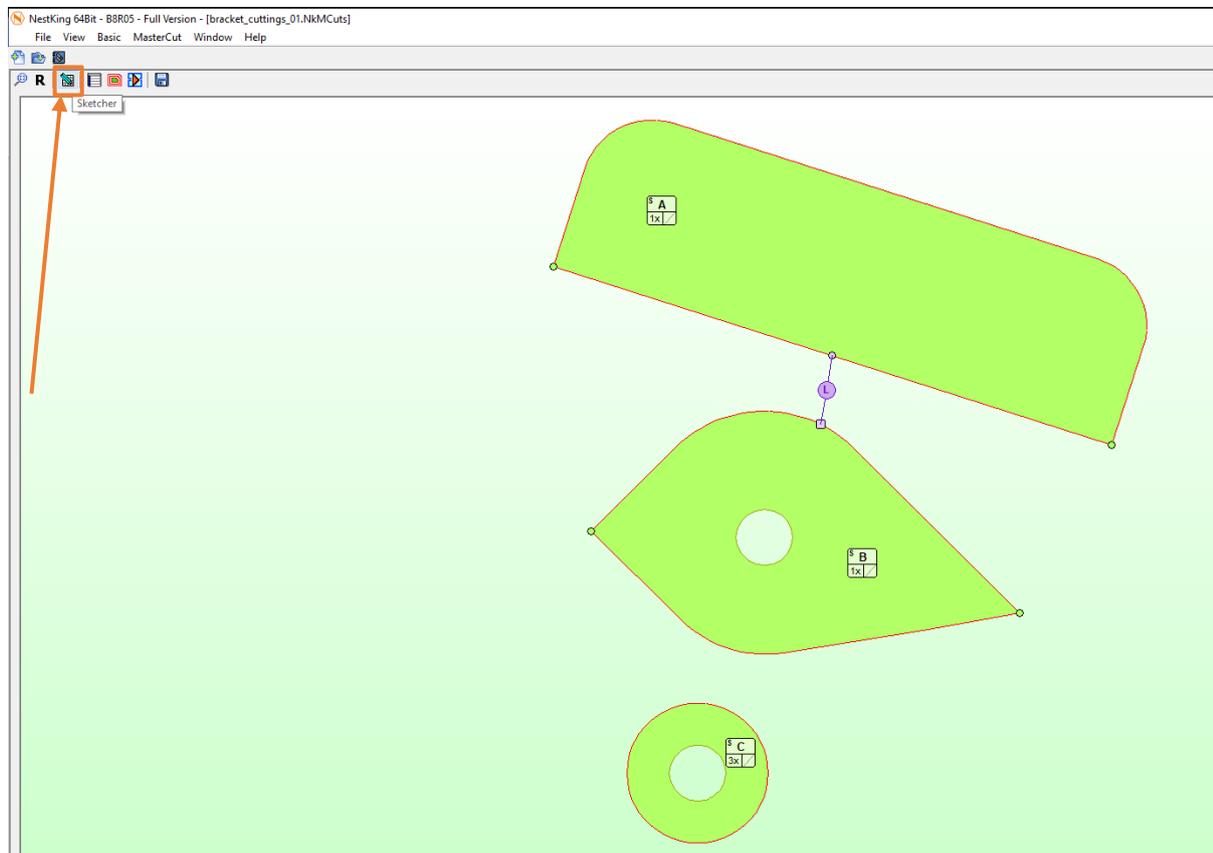


Figure 189



- In the Sketcher double click on the ring shaped MasterCut C to open the MasterCut Dialog.

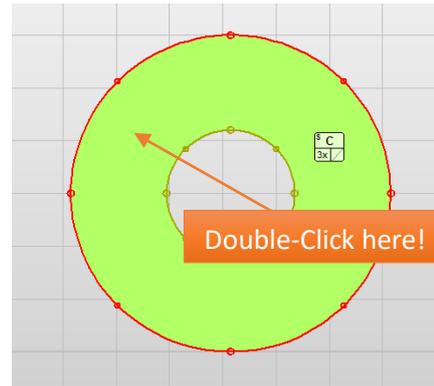


Figure 190

- Inside the MasterCut dialog you can switch between the Standard and the PlyPacks Tab. Previously, we used the Standard Tab when linking segments to each other. The PlyPacks Tab can be considered completely independent. Enter the PlyPacks Tab  PlyPacks and click Select Steps (Figure 191).

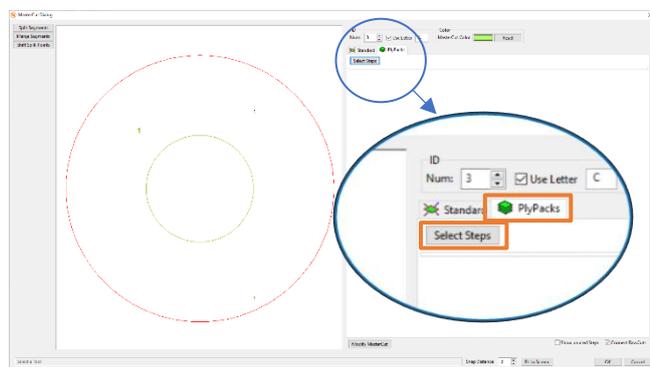


Figure 191

- Inside the Step Selection Dialog select the REINF step at position 6 (Figure 192).
- Click OK to confirm.

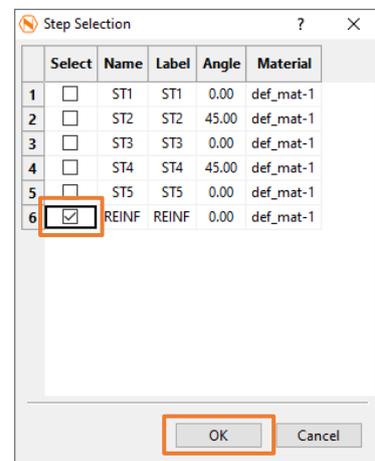


Figure 192



- Now a new TAB is generated named after the selected step (in this case REINF). To get a better impression of what we can do with the PlyPack tab let's assume we want to add 8 tapered ring cuts instead of three. Therefore set the Size from one to 8 (Figure 193).

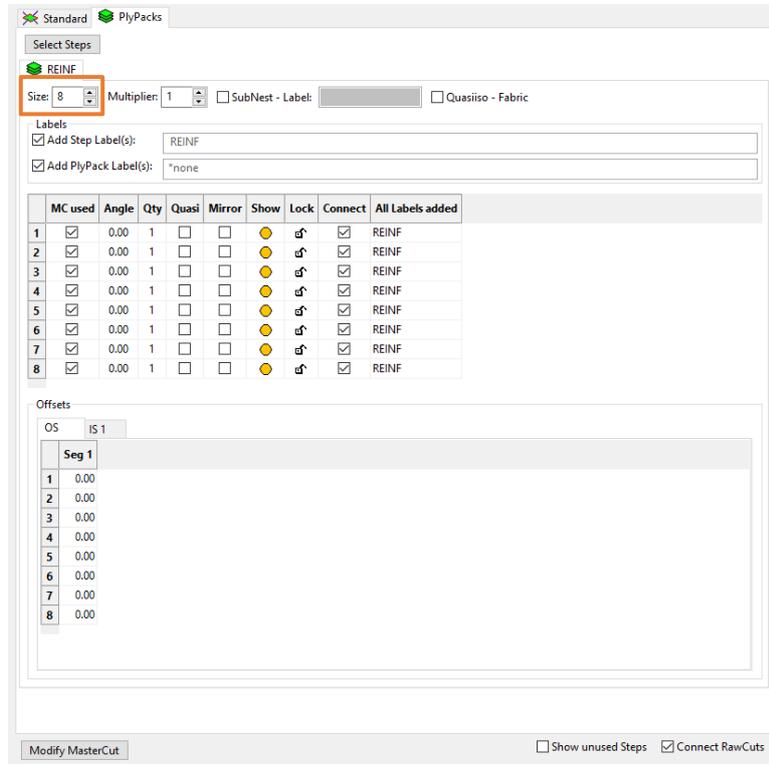


Figure 193

NestKing automatically extends the number of steps to the defined size, each representing its own RawCut. Just like the Standard tab, we have many options to modify these RawCuts to our liking. We can add labels, change the rotation angle of each RawCut, change the quantity, mirror certain cuts and so on.

Additionally, we can also combine them into a subnest by activating the **[SubNest]** checkbox and adding a SubNest label if required. Further we can also tell NestKing that it should rotate all generated cuts of this plypack to get a quasiisotropic layup (Figure 194).

- Activate the **[SubNest]** checkbox and enter "REINF ST" (Figure 194). Regarding SubNest see also chapter *H1.1 Subcuts and Subnests* on page 171.
- Since we already label the subnest patch, we do not have to label the cuts and can deactivate Step and PlyPack labels (Figure 194).



Figure 194

As shown in the following steps, we can also systematically change the shape of the cuts by changing the offset values of each MasterCut segment.



- We can change the outer segment offset values manually or we can also use the autofiller tool. To do this, right-click on the Seg1 label and select the **[AutoFiller]** (Figure 195).

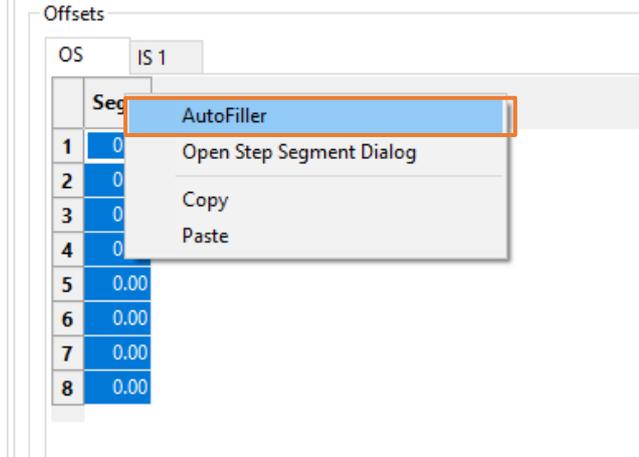


Figure 195

- Next we want the outer diameter to get smaller by e.g. 0.5 mm for each step.

Set the delta value to 2 and change the direction from **[Positive (+)]** to **[Negative (-)]** (Figure 196).

Click **OK** to confirm.

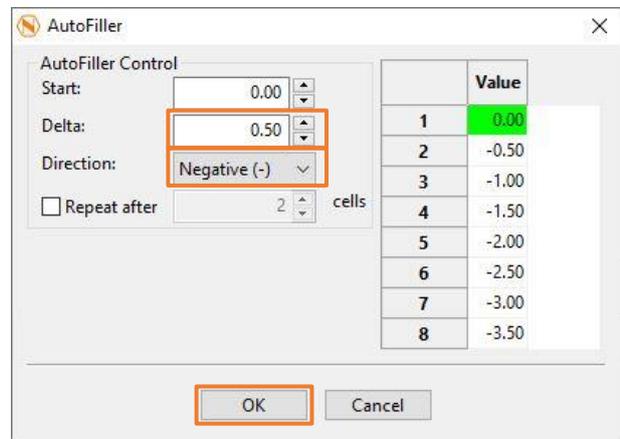


Figure 196

- Figure 197 shows the resulting cuts. With this tool you can very easily generate PlyPacks. Click **OK** to confirm.

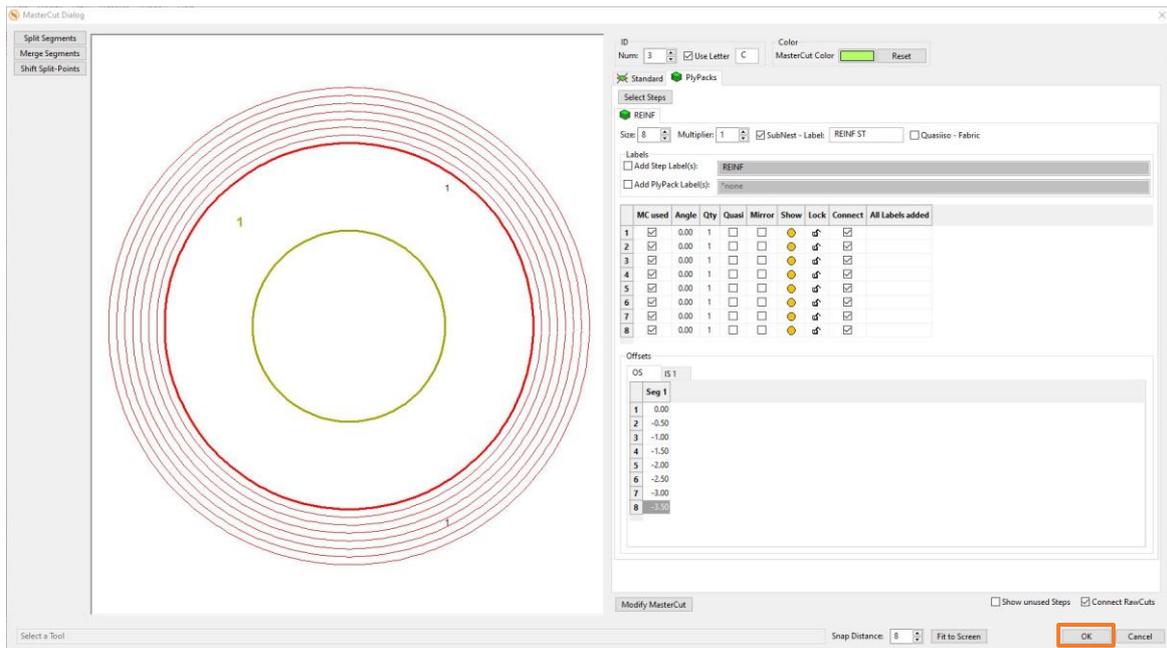


Figure 197



Note: You can also apply the PlyPack tool for MasterCuts with multiple segments. Figure 198 shows the behaviour of the angles if the Quasiiso checkbox is activated. Here the angles are set automatically depending on the PlyPack size and the used material. For PlyPacks made from fabric materials the angles are different compared to PlyPacks made from UD materials.

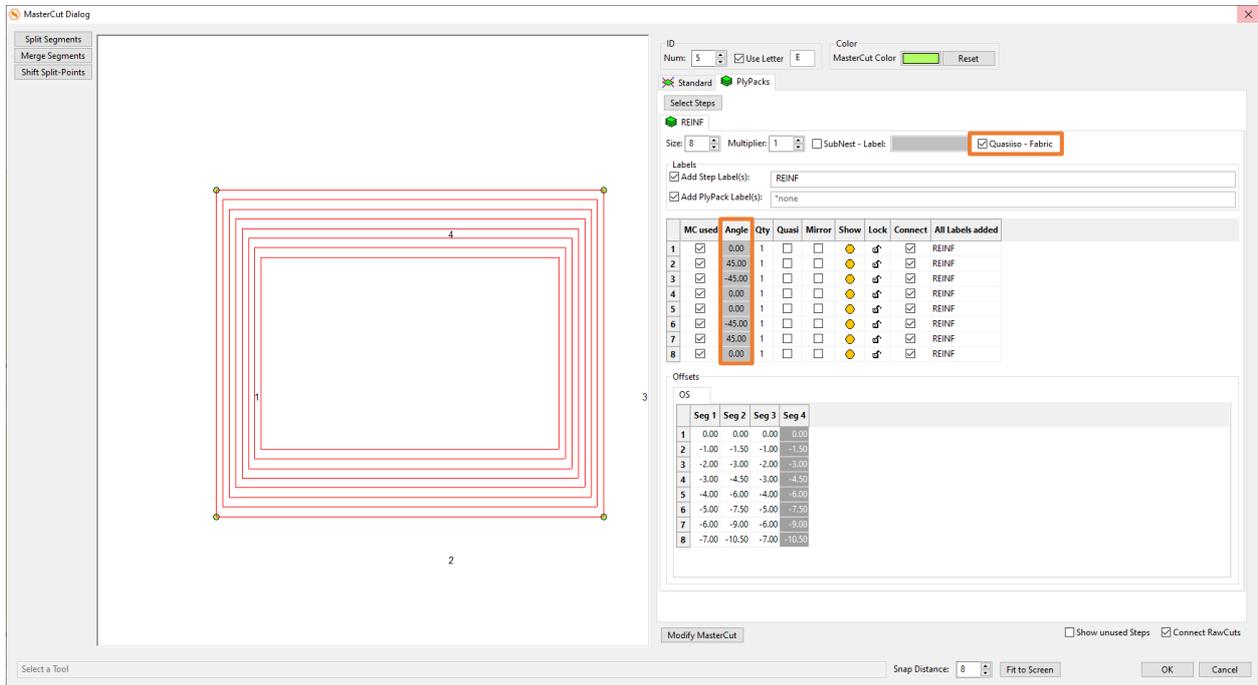


Figure 198

12. Next click on save and exit the Sketcher area.



Figure 199

13. To see how PlyPacks are treated in the MasterCut Output file click (Figure 200).

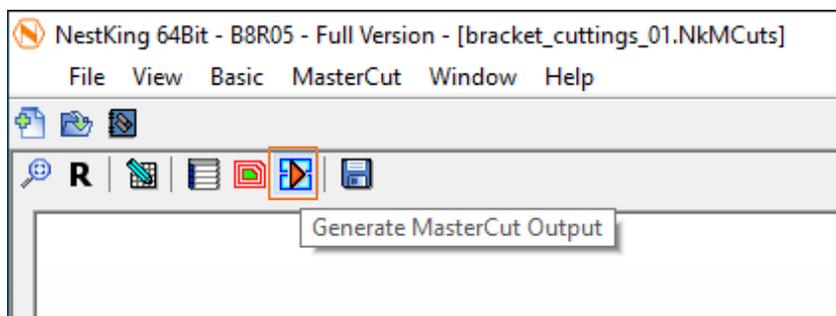


Figure 200



14. PlyPacks (or Patches) are added after the Standard MasterCut RawCuts (Figure 201).

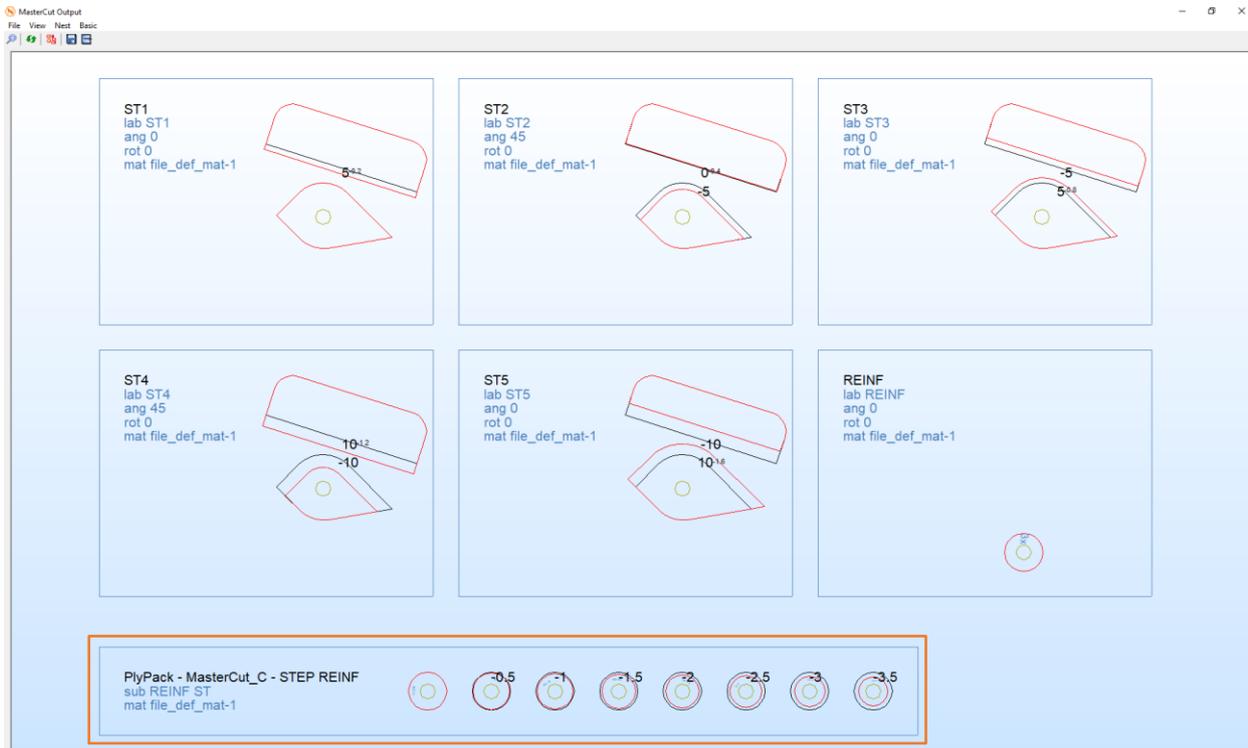


Figure 201

If you want to nest just proceed with 5) Nesting on page 59.



E. Example Rear Wing – Using MasterCut, Links and Equalizer

E1. Introduction

This chapter explains the complete process of creating CFRP and adhesive plies for a rear wing of a sports car (Figure 202). Therefor we use the MasterCut Working Space with special focus on the standard Links we already know from the previous chapter. Further this chapter will introduce Equalizer Links reducing the number of required elements and minimizing the complexity of the cutting generation process.



Figure 202

The wing consists of the following components:

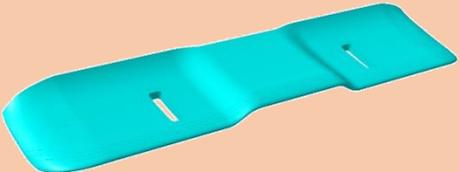
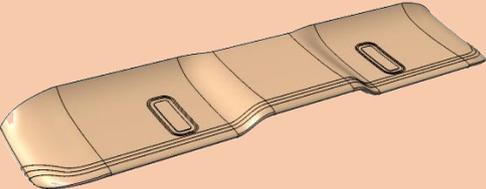
Name	Description
	Rohacell Core filling the empty space inside the wing
	2x CFRP Inserts for the mounting points
	Adhesive Film: <ul style="list-style-type: none"> - covering the Rohacell Core - and the CFRP Inserts
	CFRP Layers: <ul style="list-style-type: none"> - 6 Layers forming the outer shell of the wing - 6 Reinforcement layers on the leading edge - 6 Reinforcement layers to integrate the inserts neatly into the structure

Table 10



This wing is just used as an example in this User Guide and has not been tested for its actual mechanical properties.

The tool for the rear wing mainly exists of four parts as emphasized by following Figure 203.

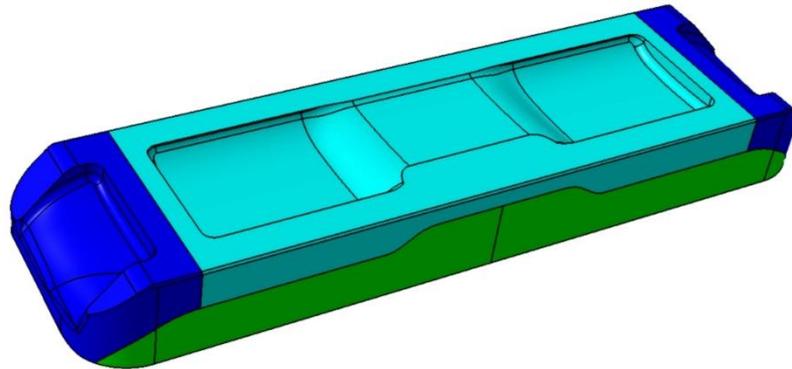


Figure 203

For the lamination process, however, the three upper tool parts, formed by the two blue tool parts on the left and on the right and the cyan colored center part can already be screwed together (Figure 204). Why three parts? This is necessary to be able to deform the wing from the tool due to tool undercuts after it has cured in the autoclave.

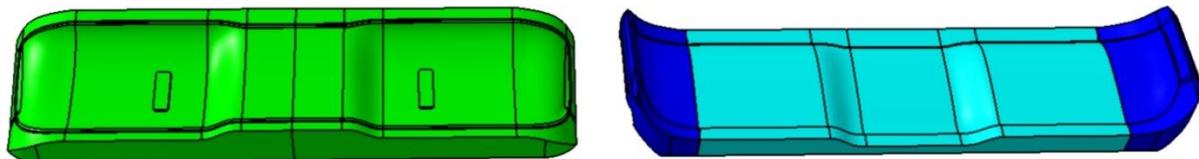


Figure 204



E2. Lay-up Sequence

Based on Table 10 the upcoming section shortly describes the intended layup sequence.

E2.1 Step 1-6: Outer Shell formed by 6 overall layers

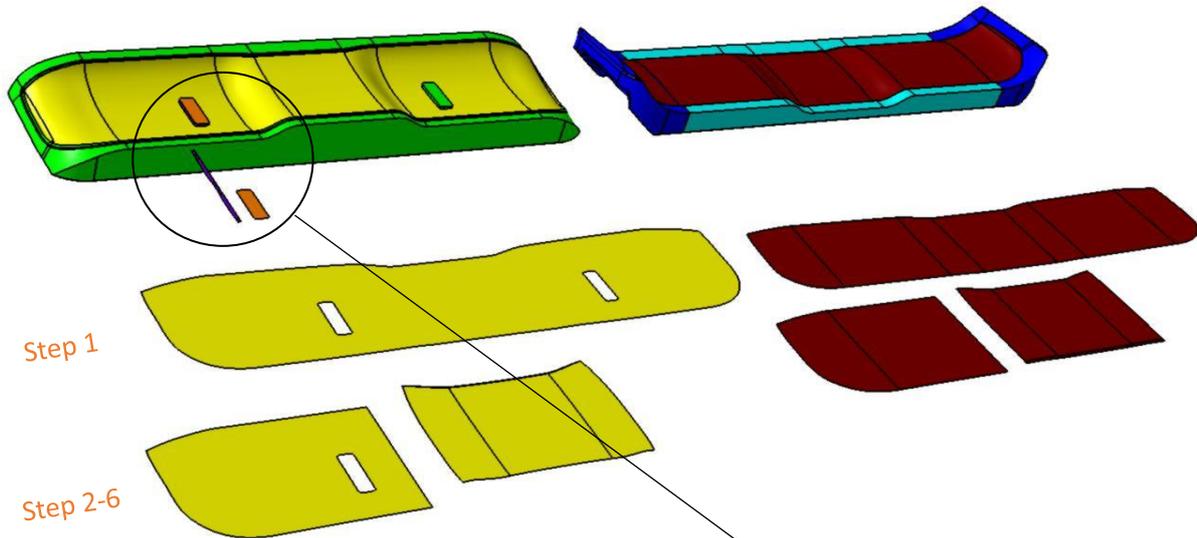


Figure 205

First, we need six overall layers forming the outer shell of the rear wing. As indicated in Figure 205 the lamination surfaces of the lower tool on the left and the upper tools on the right are completely covered with plies. To generate a nice fancy looking outer rear wing surface the first layer (applied by step 1) is formed by one ply. All upcoming plies are put together by 3 separate cuts, whereby mirrored cuts are generated in 2D.

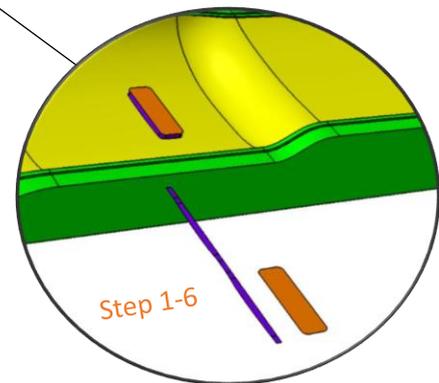


Figure 206

Figure 206 shows a detailed view of the import cuts covering the mounting pockets. In this case also just the geometries of the left pocket are derived. The mirrored cuts for the right pocket will be generated later in 2D as well.

Figure 207 shows a sectional view of the upper and bottom tool, the Rohacell core and three representative layers, represented in yellow, orange and pink, in between. So, to be able to close the tool without any problems, cuttings of ST2-ST6 of the bottom tool are extended and the cuttings of the top tool are trimmed accordingly.

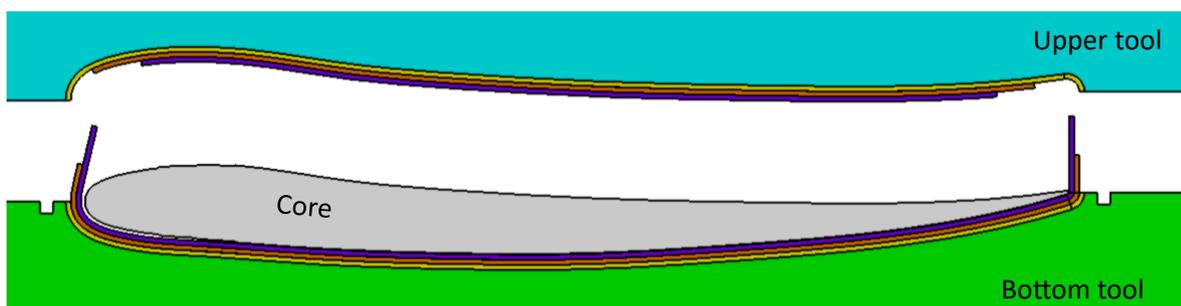
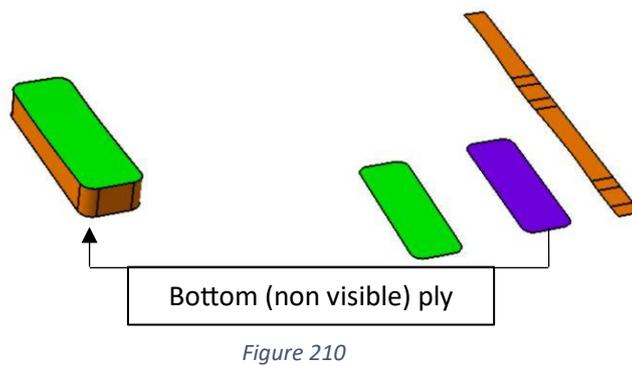
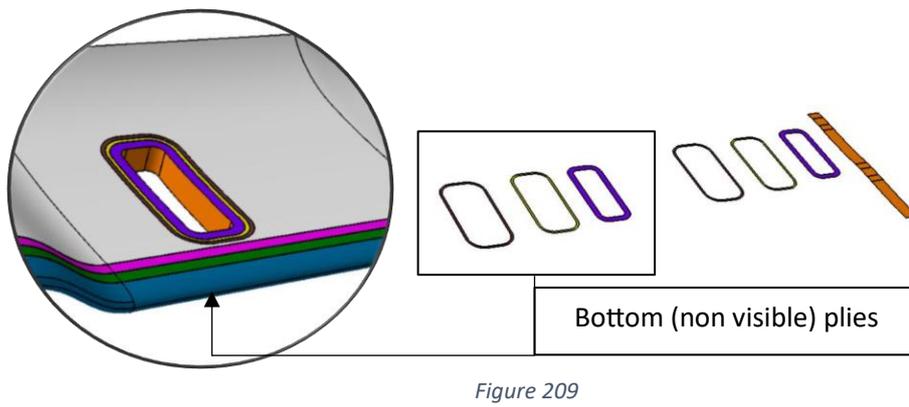
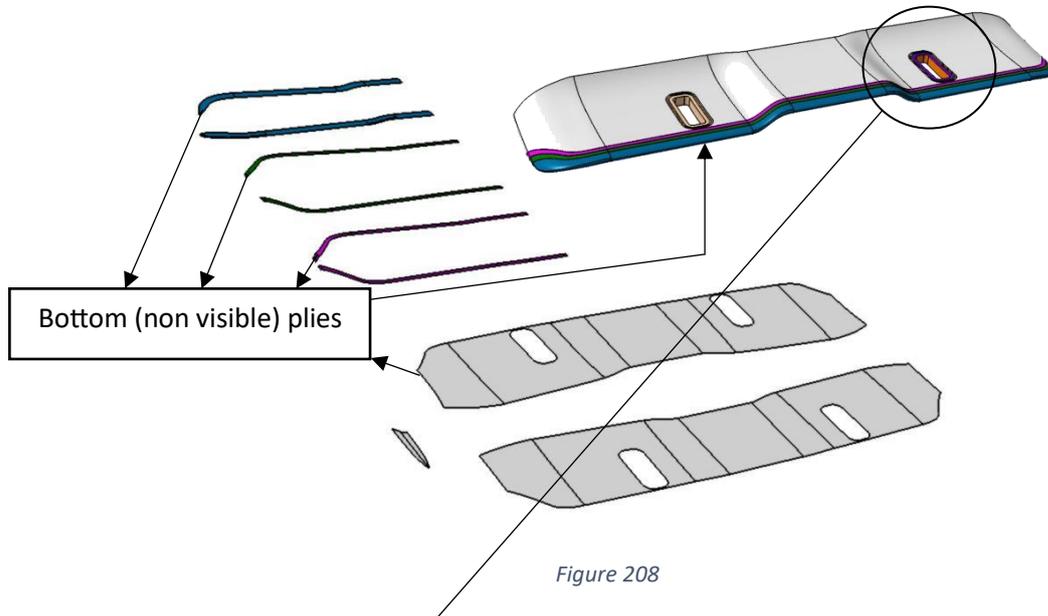


Figure 207



E2.2 Step 7: Adhesive Film

As part of step 7, we cover the Rohacell core (Figure 209 and Figure 208) and both mounting inserts (Figure 210) with adhesive film. Here, too, layers mirrored are created later in 2D.





E2.3 Step 8-13: Leading Edge Reinforcement Plies

Next, we can place the six leading edge reinforcement layers on the Rohacell core.

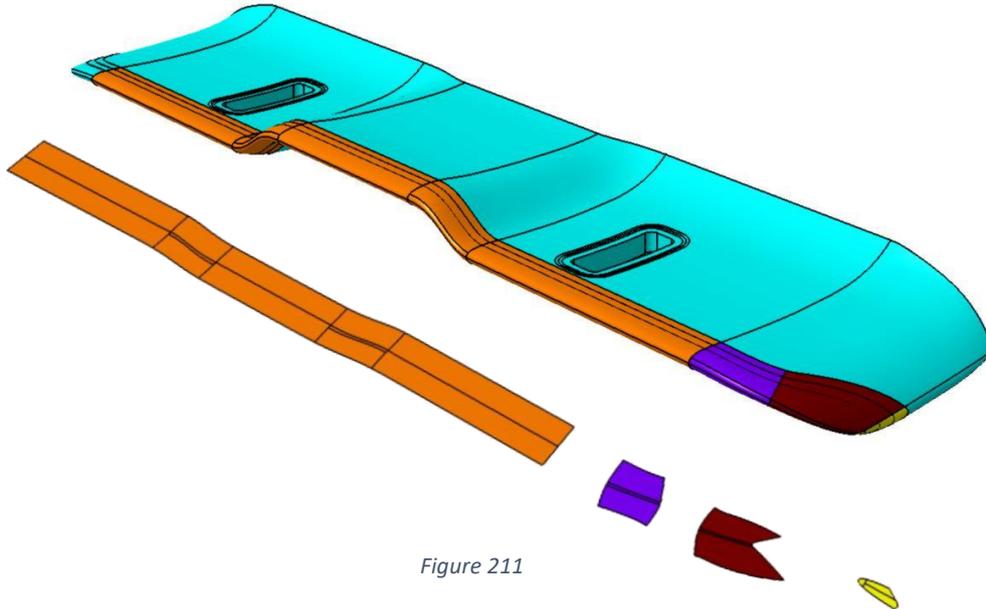


Figure 211

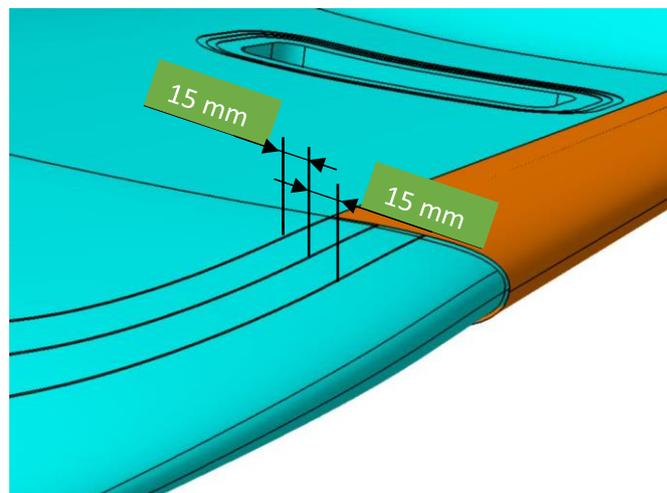


Figure 212

The Rohacell core is designed with three gradations at the leading edge, each stepped back by 15 mm. Each gradation covers two plies resulting in six leading edge reinforcements plies in total. The derived geometries, as indicated in orange, already covers all 3 gradations (Figure 212).

Because we place the layers directly on the Rohacell core the innermost layer 8 and layer 9 correspond to the derived layer minus 30 mm, layer 10 and 11 minus 15 mm and the final two reinforcement layers 12 and 13 will remain unchanged.



E2.4 Step 14-19: Insert Reinforcement Plies

Next we will place the six leading edge reinforcement layers onto the Rohacell core.

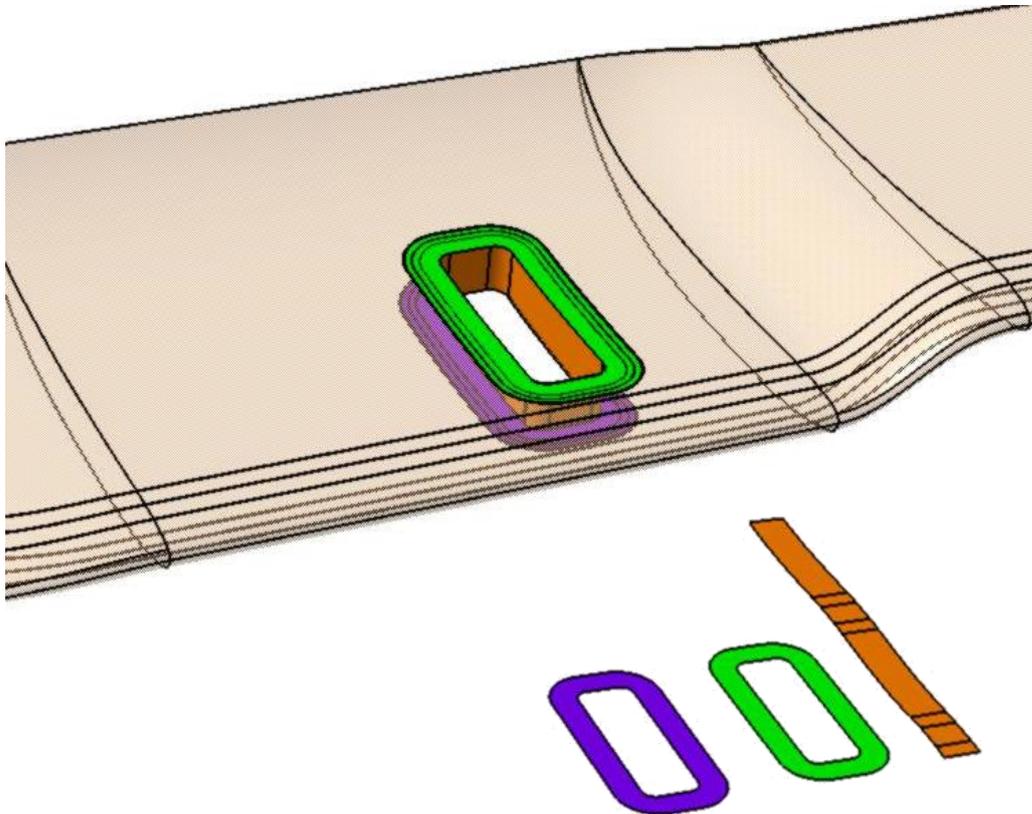


Figure 213

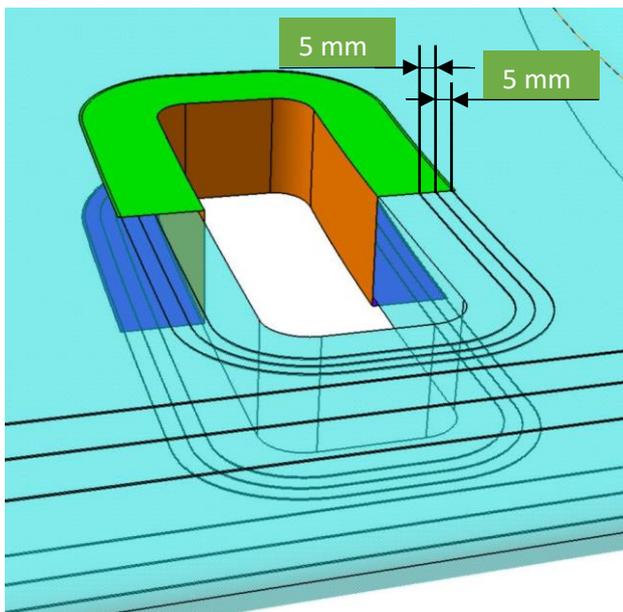


Figure 214

Also for the insert reinforcement plies the Rohacell Core contains three gradations graduated by 5mm each. Consider, the derived plies are also covering all three gradations and thus forming the outer shape of layer 18 and 19. Cuts of layers 14 and 15 correspond to the derived cuts minus 10 mm and layers 16 and 17 minus 5 mm.



E2.5 Export Data

Figure 215 shows an overview of all export geometries and the corresponding materials and steps.

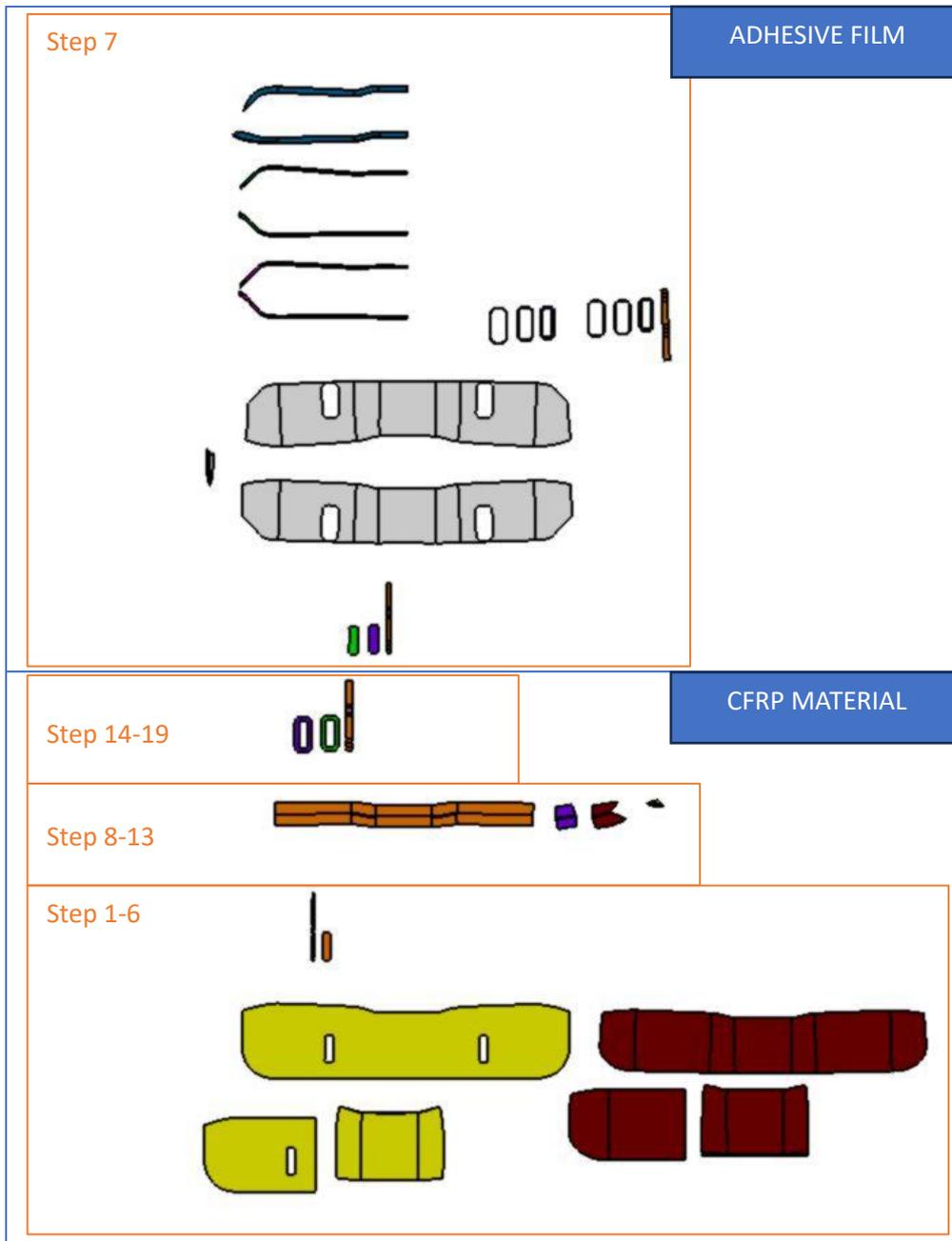


Figure 215



E3. Workflow

E3.1 Generating MasterCuts

1. First open  the rear wing example file (rear_wing_CATIA_export.dxf):

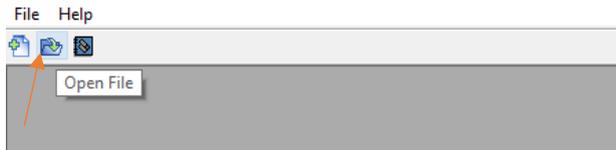


Figure 216

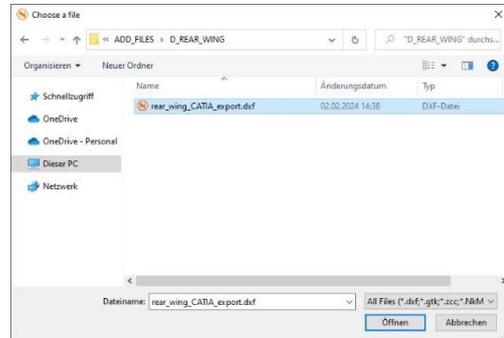


Figure 217

2. In order not to overwrite the original file save the opened file to a new file named "rear_wing_cuttings_01.dxf":

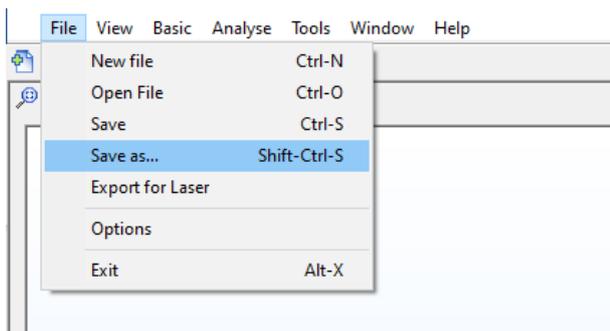


Figure 218

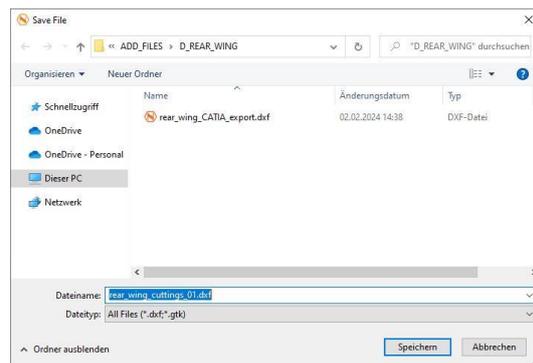


Figure 219

3. Next click  (Generate MasterCuts) in the main toolbar.
4. The geometries are not optimized yet. So, confirm to optimize them by clicking yes .

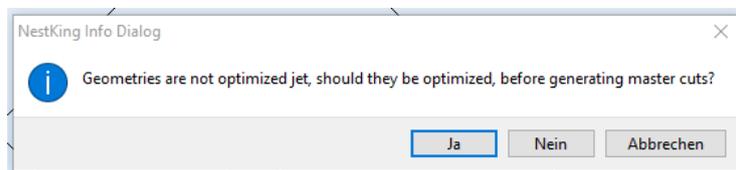
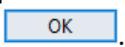


Figure 221

5. Maximum gap between geometries of 0.1 mm is fine → Confirm with .

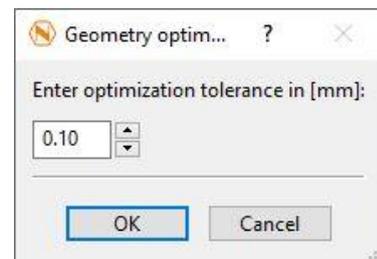


Figure 220



E3.2 Setting up the Step Table

6. Now we are in the Mastercut workspace.

Start by setting up our step table .

7. According to Chapter E2. Lay-up Sequence and as summarized by Figure 215 we need altogether 19 steps. To add these steps we simply click  on the top right (Figure 222).

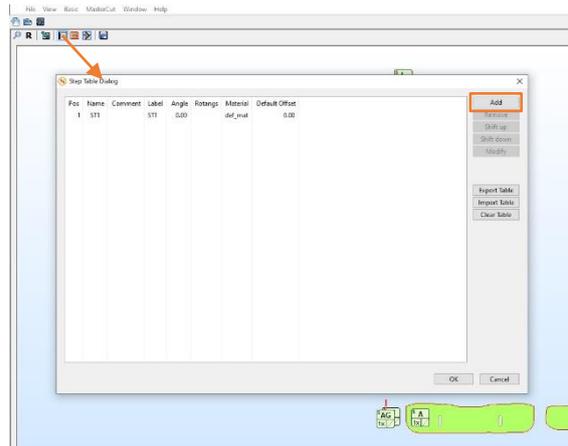
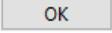


Figure 222

8. Since there is already one step in the table by default, we have to add 18 more steps. Therefore simply enter “18” into the quantity field (Figure 223) and click  to confirm.

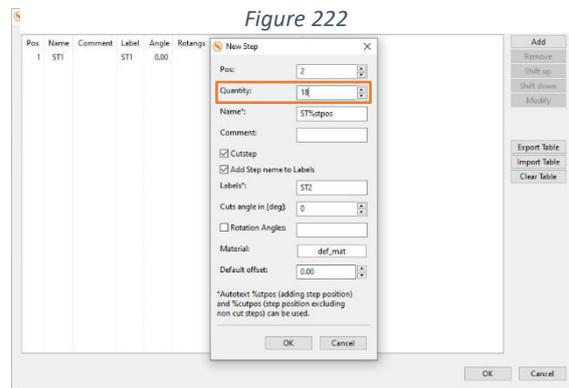


Figure 223

9. Now our Step Table includes 19 steps all looking the same. To change this, we mark the first six steps by selecting them one by one while pressing the **-CTRL-** key or by clicking on the first step and press **-SHIFT-** while clicking the sixth step. Now all steps from 1 to 6 are selected and we can click  (Figure 224) to edit them all at the same time.

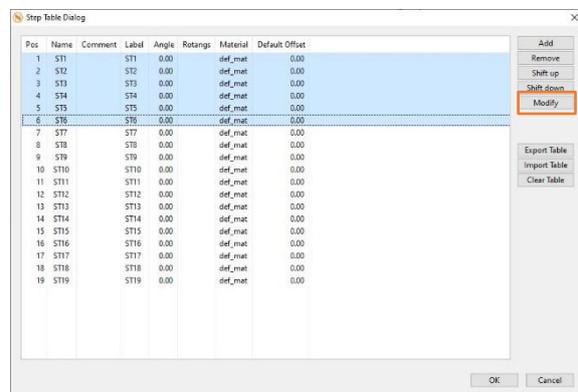


Figure 224

10. The first six steps are used for our overall layers. Write “Overall Layers” into to comment textbox (Figure 225). Further change the material for the cuts of those steps by clicking on the Material button .

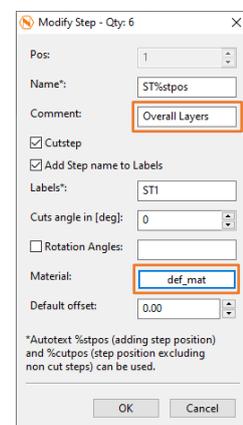


Figure 225



- Now the material dialog pops up. You can find more detailed information regarding the material catalog in the chapter *G* starting from page 167. But for the moment we want to define our own adhesive and CFRP materials.

Therefore click **Edit Local Materials** on the bottom left (Figure 226).

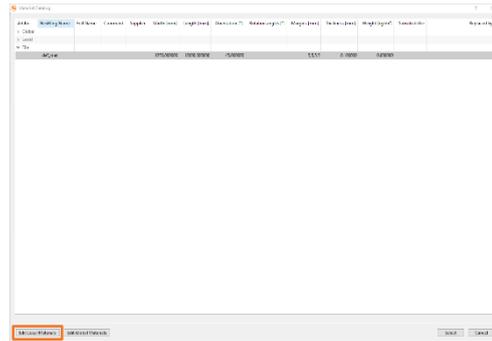


Figure 226

- Next add a new material by clicking **Add** on the top right.

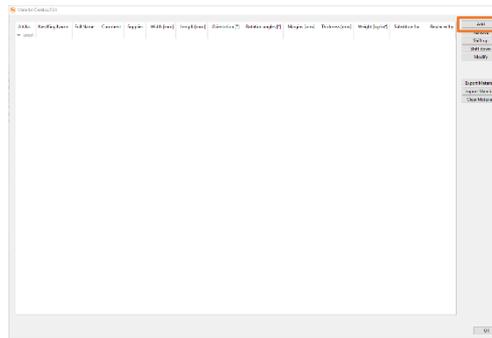


Figure 227

- Here in the Material Edit dialog we can add all relevant material data. For now, just copy the properties as shown on the right (Figure 228). To save all set material properties and click **Save**.

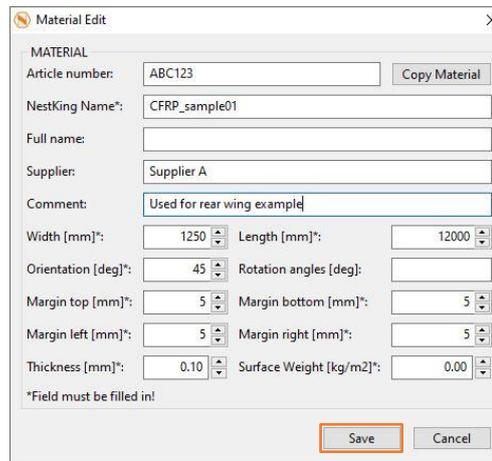


Figure 228

- To add the adhesive material as well repeat the process and copy the material properties from Figure 229 on the right. Consider that the material width is changed to 1000 mm and since adhesive material normally has no orientation 0° is selected (see also chapter *G3. Weaving Direction of Composite Fabrics*). Click **Save** to finish this step and save the adhesive material to our local material catalogue.

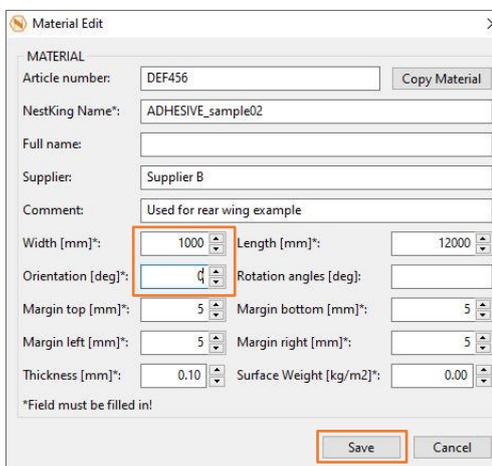


Figure 229



- Now our local material catalogue contains the CFRP material as well as the adhesive film.

Click **OK** to confirm.

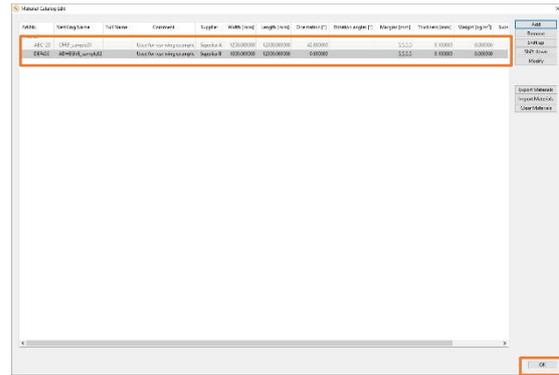


Figure 230

- Next we can select the CFRP material for our first 6 steps forming the outer shell of the rear wing. Therefore simply select the appropriate line in the material table (CFRP_sample01) and click **Select** on the bottom left or also just double-click on the CFRP_sample01 material.

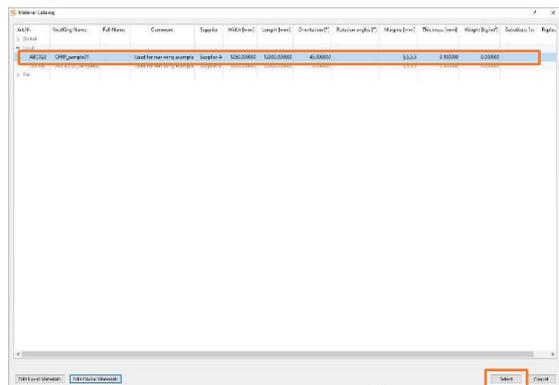


Figure 231

- Nice, now we have assigned the correct material to our first 6 steps. Confirm with **OK** (Figure 232).

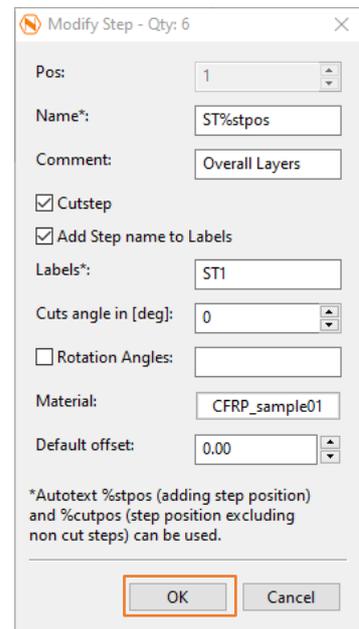


Figure 232

- Proceed with step 7 by double-clicking line 7 (Figure 233) or by selecting line 7 and click **Modify**.

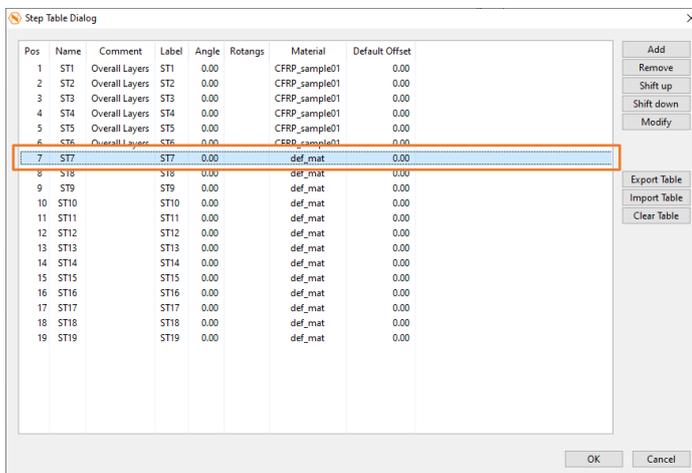


Figure 233



19. Step 7 incorporates applying adhesive film on the Rohacell and both mounting inserts.
Enter “Adhesive” into the comment text box and assign our ADHESIVE_sample02 material, we have created before (Figure 234).
Confirm our entries with .

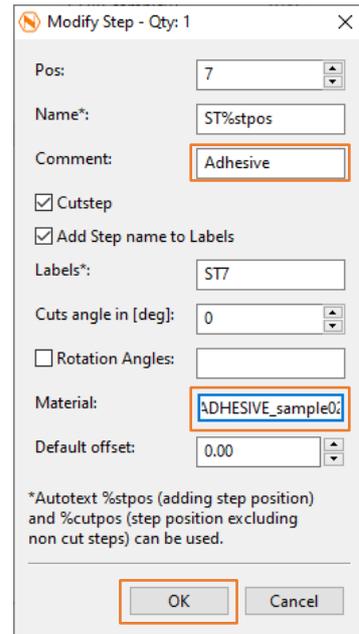


Figure 234

20. Step 8 to 13 are used for our leading-edge reinforcement plies. As mentioned in step 9, we can select them one by one while pressing the **-CTRL-** button on the keyboard or by clicking on the eighth step and press **-SHIFT-** while clicking the thirteenth step. Next click (Figure 235).

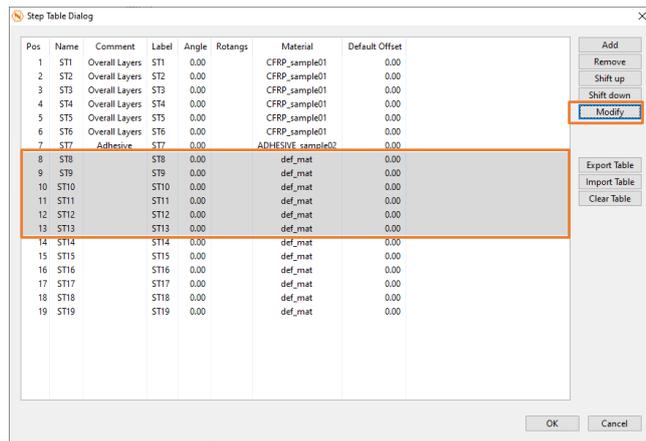


Figure 235

21. Enter “Leading Edge Reinf” to highlight the purpose of this steps and select our CFRP_sample01 material Figure 236.
22. Click .

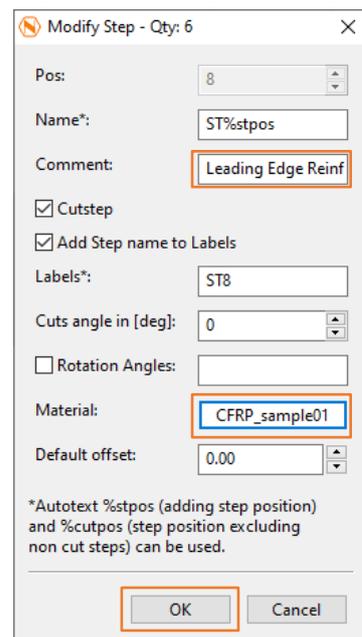


Figure 236



23. Finally, select steps 14-19, used for the insert reinforcement plies.
Click **Modify** to open the Step modification dialog (Figure 237).

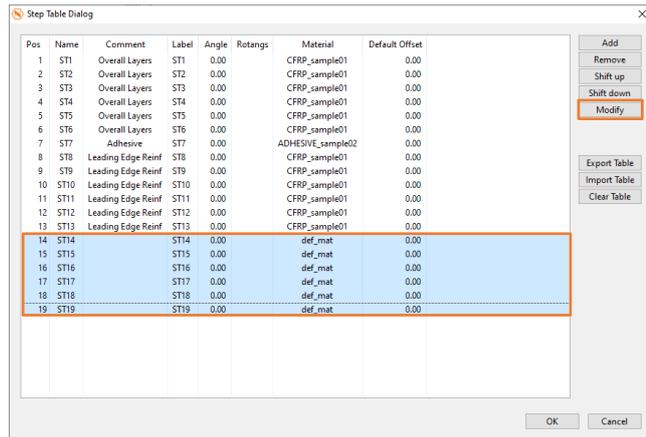


Figure 237

24. Enter “Insert Reinf” to emphasize the purpose of this steps and select our CFRP_sample01 material (Figure 238).
25. Click **OK**.

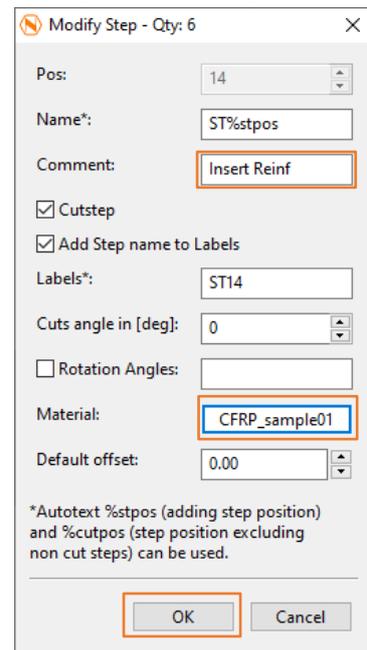


Figure 238

26. Now there is just one last thing missing before we can close the Step Table: Varying the step angle between 0° and 45°. This means the cuts of all 45° steps will be rotated by 45° before nesting. So, let’s select step 1,3,5,8,10,12,14,16 and 18 (Figure 239) and click **Modify**.

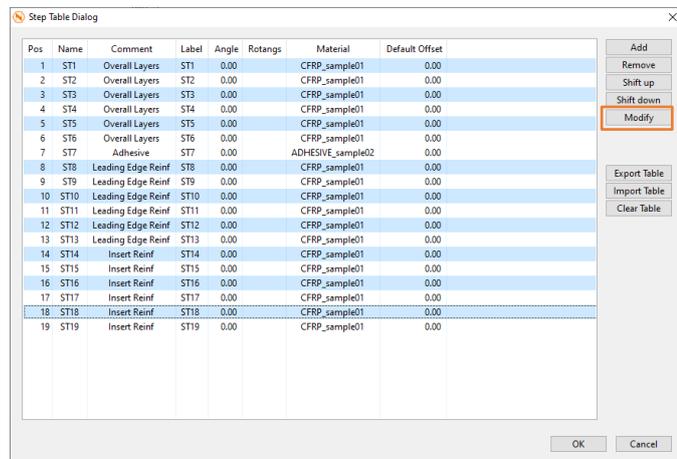
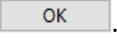


Figure 239



27. Now enter “45” into the Cuts angle entry box (Figure 240).

28. Click .

29. Now the Step Table dialog should look as shown in Figure 241.

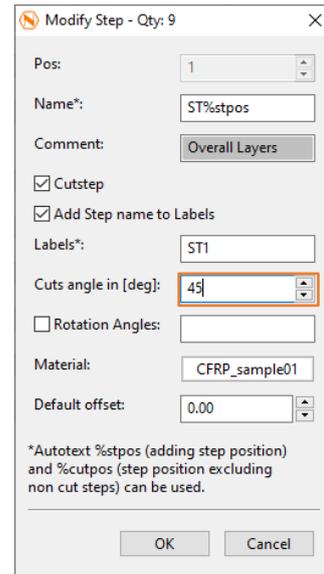


Figure 240

Pos	Name	Comment	Label	Angle	Rotangs	Material	Default Offset
1	ST1	Overall Layers	ST1	45.00		CFRP_sample01	0.00
2	ST2	Overall Layers	ST2	0.00		CFRP_sample01	0.00
3	ST3	Overall Layers	ST3	45.00		CFRP_sample01	0.00
4	ST4	Overall Layers	ST4	0.00		CFRP_sample01	0.00
5	ST5	Overall Layers	ST5	45.00		CFRP_sample01	0.00
6	ST6	Overall Layers	ST6	0.00		CFRP_sample01	0.00
7	ST7	Adhesive	ST7	0.00		ADHESIVE_sample02	0.00
8	ST8	Leading Edge Reinf	ST8	45.00		CFRP_sample01	0.00
9	ST9	Leading Edge Reinf	ST9	0.00		CFRP_sample01	0.00
10	ST10	Leading Edge Reinf	ST10	45.00		CFRP_sample01	0.00
11	ST11	Leading Edge Reinf	ST11	0.00		CFRP_sample01	0.00
12	ST12	Leading Edge Reinf	ST12	45.00		CFRP_sample01	0.00
13	ST13	Leading Edge Reinf	ST13	0.00		CFRP_sample01	0.00
14	ST14	Insert Reinf	ST14	45.00		CFRP_sample01	0.00
15	ST15	Insert Reinf	ST15	0.00		CFRP_sample01	0.00
16	ST16	Insert Reinf	ST16	45.00		CFRP_sample01	0.00
17	ST17	Insert Reinf	ST17	0.00		CFRP_sample01	0.00
18	ST18	Insert Reinf	ST18	45.00		CFRP_sample01	0.00
19	ST19	Insert Reinf	ST19	0.00		CFRP_sample01	0.00

Figure 241

We have finished our Step Table. Some people may now be wondering whether you can also add other steps such as “Debulks” or “Close Tool” etc. to really show the entire lamination process. The answer is yes. Use this procedure to add steps to the step table that do not affect the design of the cuts themselves:

30. Click  (Figure 241).

31. Define the position of the new step by setting the value in the **[Pos:]** entry box to “2” (Figure 242). This includes the new step at position 2 in our step table.

32. Name this step “Debulk”.

33. Further uncheck the **[Cutstep]** checkbox. This setting tells NestKing that it is not possible to assign any mastercuts to this step and therefore also no cuts can be generated for this step. You'll find out exactly what that means later in this chapter.

34. Finally close the Edit Dialog with .

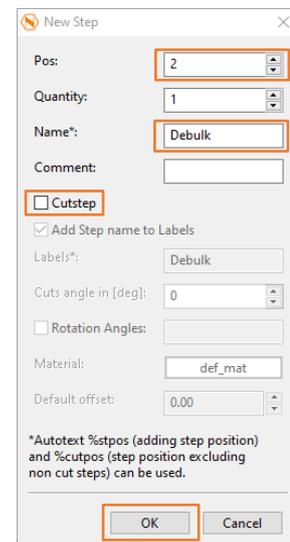


Figure 242



Now we can see in the Step Table (Figure 243) that we have added a new step on position 2 named “Debulk”.

Pos	Name	Comment	Label	Angle	Rotangs	Material	Default Offset
1	ST1	Overall Layers	ST1	45.00		CFRP_sample01	0.00
2	Debulk						
3	ST3	Overall Layers	ST3	0.00		CFRP_sample01	0.00
4	ST4	Overall Layers	ST4	45.00		CFRP_sample01	0.00
5	ST5	Overall Layers	ST5	0.00		CFRP_sample01	0.00
6	ST6	Overall Layers	ST6	45.00		CFRP_sample01	0.00
7	ST7	Overall Layers	ST7	0.00		CFRP_sample01	0.00
8	ST8	Adhesive	ST8	0.00		ADHESIVE_sample02	0.00
9	ST9	Leading Edge Reinf	ST9	45.00		CFRP_sample01	0.00
10	ST10	Leading Edge Reinf	ST10	0.00		CFRP_sample01	0.00
11	ST11	Leading Edge Reinf	ST11	45.00		CFRP_sample01	0.00
12	ST12	Leading Edge Reinf	ST12	0.00		CFRP_sample01	0.00
13	ST13	Leading Edge Reinf	ST13	45.00		CFRP_sample01	0.00
14	ST14	Leading Edge Reinf	ST14	0.00		CFRP_sample01	0.00
15	ST15	Insert Reinf	ST15	45.00		CFRP_sample01	0.00
16	ST16	Insert Reinf	ST16	0.00		CFRP_sample01	0.00
17	ST17	Insert Reinf	ST17	45.00		CFRP_sample01	0.00
18	ST18	Insert Reinf	ST18	0.00		CFRP_sample01	0.00
19	ST19	Insert Reinf	ST19	45.00		CFRP_sample01	0.00
20	ST20	Insert Reinf	ST20	0.00		CFRP_sample01	0.00

Figure 243

Some people might ask themselves whether it is possible to omit such non-cut steps when naming the following steps. In other words, our step to position 3 should automatically continue with name ST2 instead of ST3, ST4 to position 4 with ST3 etc. The answer is again yes:

35. Select all steps except our debulk step on position 2 and click .

Pos	Name	Comment	Label	Angle	Rotangs	Material	Default Offset
1	ST1	Overall Layers	ST1	45.00		CFRP_sample01	0.00
2	Debulk						
3	ST3	Overall Layers	ST3	0.00		CFRP_sample01	0.00
4	ST4	Overall Layers	ST4	45.00		CFRP_sample01	0.00
5	ST5	Overall Layers	ST5	0.00		CFRP_sample01	0.00
6	ST6	Overall Layers	ST6	45.00		CFRP_sample01	0.00
7	ST7	Overall Layers	ST7	0.00		CFRP_sample01	0.00
8	ST8	Adhesive	ST8	0.00		ADHESIVE_sample02	0.00
9	ST9	Leading Edge Reinf	ST9	45.00		CFRP_sample01	0.00
10	ST10	Leading Edge Reinf	ST10	0.00		CFRP_sample01	0.00
11	ST11	Leading Edge Reinf	ST11	45.00		CFRP_sample01	0.00
12	ST12	Leading Edge Reinf	ST12	0.00		CFRP_sample01	0.00
13	ST13	Leading Edge Reinf	ST13	45.00		CFRP_sample01	0.00
14	ST14	Leading Edge Reinf	ST14	0.00		CFRP_sample01	0.00
15	ST15	Insert Reinf	ST15	45.00		CFRP_sample01	0.00
16	ST16	Insert Reinf	ST16	0.00		CFRP_sample01	0.00
17	ST17	Insert Reinf	ST17	45.00		CFRP_sample01	0.00
18	ST18	Insert Reinf	ST18	0.00		CFRP_sample01	0.00
19	ST19	Insert Reinf	ST19	45.00		CFRP_sample01	0.00
20	ST20	Insert Reinf	ST20	0.00		CFRP_sample01	0.00

Figure 244

36. If we now take a closer look, we can recognize a *-sign in the name label (Figure 245). The corresponding description at the bottom of the dialog states that we can use Autotext functionalities for the name entry. This is what we have already done by using the default value of "ST%stpos". By adding "%cutpos" instead of "%stpos" this placeholder would automatically be filled with the step position excluding preceding non cut steps. So replace the "%stpos" part in the name entry box with "%cutpos" as shown on the left and click to see the effect in the Step Table...

Modify Step - Qty: 19

Pos: 1

Name: ST3%cutpos

Comment: Overall Layers

Cutstep

Add Step name to Labels

Labels: ST1

Cuts angle in [deg]: 45

Rotation Angles:

Material: CFRP_sample01

Default offset: 0.00

*Autotext %stpos (adding step position) and %cutpos (step position excluding non cut steps) can be used.

OK Cancel

Figure 245



Pos	Name	Comment	Label	Angle	Rotangs	Material	Default Offset
1	ST1	Overall Layers	ST1	45.00		CFRP_sample01	0.00
2	Debulk						
3	ST2	Overall Layers	ST2	0.00		CFRP_sample01	0.00
4	ST3	Overall Layers	ST3	45.00		CFRP_sample01	0.00
5	ST4	Overall Layers	ST4	0.00		CFRP_sample01	0.00
6	ST5	Overall Layers	ST5	45.00		CFRP_sample01	0.00
7	ST6	Overall Layers	ST6	0.00		CFRP_sample01	0.00
8	ST7	Adhesive	ST7	0.00		ADHESIVE_sample02	0.00
9	ST8	Leading Edge Reinf	ST8	45.00		CFRP_sample01	0.00
10	ST9	Leading Edge Reinf	ST9	0.00		CFRP_sample01	0.00
11	ST10	Leading Edge Reinf	ST10	45.00		CFRP_sample01	0.00
12	ST11	Leading Edge Reinf	ST11	0.00		CFRP_sample01	0.00
13	ST12	Leading Edge Reinf	ST12	45.00		CFRP_sample01	0.00
14	ST13	Leading Edge Reinf	ST13	0.00		CFRP_sample01	0.00
15	ST14	Insert Reinf	ST14	45.00		CFRP_sample01	0.00
16	ST15	Insert Reinf	ST15	0.00		CFRP_sample01	0.00
17	ST16	Insert Reinf	ST16	45.00		CFRP_sample01	0.00
18	ST17	Insert Reinf	ST17	0.00		CFRP_sample01	0.00
19	ST18	Insert Reinf	ST18	45.00		CFRP_sample01	0.00
20	ST19	Insert Reinf	ST19	0.00		CFRP_sample01	0.00

Figure 246

Now as we can see in Figure 246 that names and labels of steps on position 3 and subsequent are continued with ST2, ST3, ST4 and so on.

By setting rotation angles in the **[Rotangs]** column we can tell NestKing that cuts of certain steps are allowed to be rotated during the nesting process to minimize material waste.

For STP 1, representing the outer visible layer, this is not wanted. Assuming we are using a fabric material with an arrow like pattern as described in chapter G3. *Weaving Direction of Composite Fabrics*. In order to keep these arrows pointing into the driving direction, ST1 will be excepted from rotation during nesting.

But to all other steps using CFRP fabric material we can tell NestKing that rotation by 90 degree steps is allowed as it has no effect on the mechanical properties of the finished component.

The Adhesive film can even be rotated by any angle to minimize material consumption.

37. Select ST2 to ST6 and ST8 to ST19.

Pos	Name	Comment	Label	Angle	Rotangs	Material	Default Offset
1	ST1	Overall Layers	ST1	45.00		CFRP_sample01	0.00
2	Debulk						
3	ST2	Overall Layers	ST2	0.00		CFRP_sample01	0.00
4	ST3	Overall Layers	ST3	45.00		CFRP_sample01	0.00
5	ST4	Overall Layers	ST4	0.00		CFRP_sample01	0.00
6	ST5	Overall Layers	ST5	45.00		CFRP_sample01	0.00
7	ST6	Overall Layers	ST6	0.00		CFRP_sample01	0.00
8	ST7	Adhesive	ST7	0.00		ADHESIVE_sample02	0.00
9	ST8	Leading Edge Reinf	ST8	45.00		CFRP_sample01	0.00
10	ST9	Leading Edge Reinf	ST9	0.00		CFRP_sample01	0.00
11	ST10	Leading Edge Reinf	ST10	45.00		CFRP_sample01	0.00
12	ST11	Leading Edge Reinf	ST11	0.00		CFRP_sample01	0.00
13	ST12	Leading Edge Reinf	ST12	45.00		CFRP_sample01	0.00
14	ST13	Leading Edge Reinf	ST13	0.00		CFRP_sample01	0.00
15	ST14	Insert Reinf	ST14	45.00		CFRP_sample01	0.00
16	ST15	Insert Reinf	ST15	0.00		CFRP_sample01	0.00
17	ST16	Insert Reinf	ST16	45.00		CFRP_sample01	0.00
18	ST17	Insert Reinf	ST17	0.00		CFRP_sample01	0.00
19	ST18	Insert Reinf	ST18	45.00		CFRP_sample01	0.00
20	ST19	Insert Reinf	ST19	0.00		CFRP_sample01	0.00

Figure 247



38. Next click .
39. Activate the **[Rotation Angles:]** checkbox and enter “d90” (Figure 248)
40. Click to confirm and close the Modify Step Dialog.
41. Further double-click ST7 to open its Modify Step Dialog as well.
42. Activate the **[Rotation Angles:]** checkbox and enter “360” (Figure 249). This tells NestKing that ST7, using the Adhesive material, can be rotated by any angle during nesting.
43. Click to confirm and close the Modify Step Dialog.

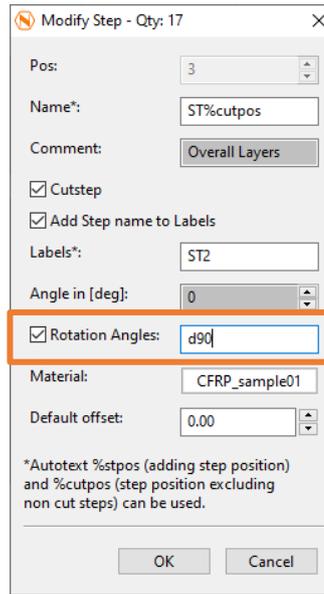


Figure 248

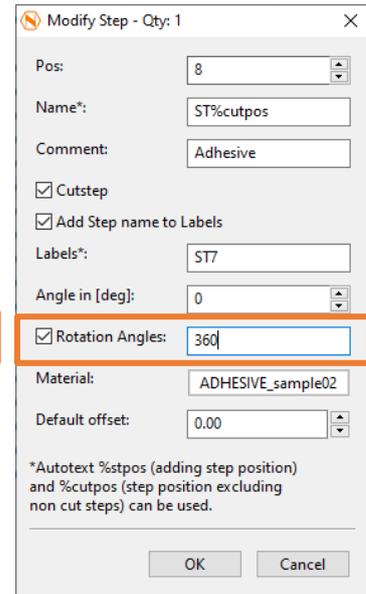


Figure 249

44. Figure 250 shows the final step table. Click to confirm and close the Step Table Dialog.

Pos	Name	Comment	Label	Angle	Rotangs	Material	Default Offset
1	ST1	Overall Layers	ST1	45.00		CFRP_sample01	0.00
2	Debulk						
3	ST2	Overall Layers	ST2	0.00	0,90,180,270	CFRP_sample01	0.00
4	ST3	Overall Layers	ST3	45.00	0,90,180,270	CFRP_sample01	0.00
5	ST4	Overall Layers	ST4	0.00	0,90,180,270	CFRP_sample01	0.00
6	ST5	Overall Layers	ST5	45.00	0,90,180,270	CFRP_sample01	0.00
7	ST6	Overall Layers	ST6	0.00	0,90,180,270	CFRP_sample01	0.00
8	ST7	Adhesive	ST7	0.00	360	ADHESIVE_sample02	0.00
9	ST8	Leading Edge Reinf	ST8	45.00	0,90,180,270	CFRP_sample01	0.00
10	ST9	Leading Edge Reinf	ST9	0.00	0,90,180,270	CFRP_sample01	0.00
11	ST10	Leading Edge Reinf	ST10	45.00	0,90,180,270	CFRP_sample01	0.00
12	ST11	Leading Edge Reinf	ST11	0.00	0,90,180,270	CFRP_sample01	0.00
13	ST12	Leading Edge Reinf	ST12	45.00	0,90,180,270	CFRP_sample01	0.00
14	ST13	Leading Edge Reinf	ST13	0.00	0,90,180,270	CFRP_sample01	0.00
15	ST14	Insert Reinf	ST14	45.00	0,90,180,270	CFRP_sample01	0.00
16	ST15	Insert Reinf	ST15	0.00	0,90,180,270	CFRP_sample01	0.00
17	ST16	Insert Reinf	ST16	45.00	0,90,180,270	CFRP_sample01	0.00
18	ST17	Insert Reinf	ST17	0.00	0,90,180,270	CFRP_sample01	0.00
19	ST18	Insert Reinf	ST18	45.00	0,90,180,270	CFRP_sample01	0.00
20	ST19	Insert Reinf	ST19	0.00	0,90,180,270	CFRP_sample01	0.00

Figure 250

45. Next click . Since we haven't saved our Mastercut file yet, the Save File dialog box will appear. The default name “rear_wing_cuttings_01” is fine. Click save to confirm.

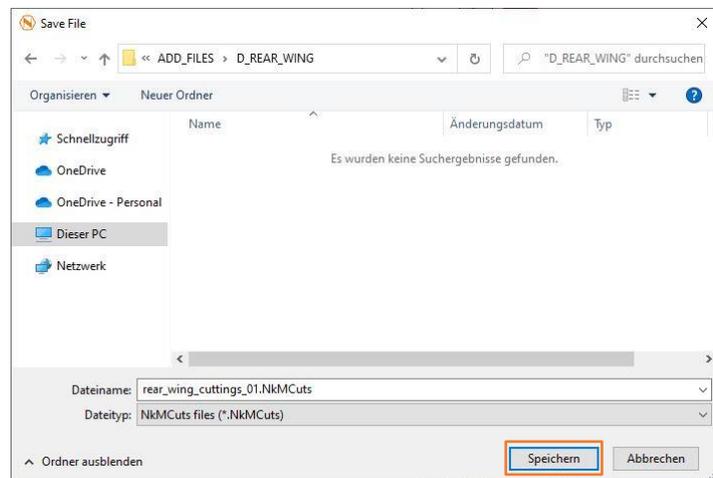


Figure 251



E3.3 Editing MasterCuts

The following Figure 253 shows how our Master Cut file looks like. According to Figure 252 (see chapter E2. Lay-up Sequence), we can assign different colors to our MasterCuts. Further, it may be helpful to add some additional information, such as which step affects which mastercuts as well as associated materials.

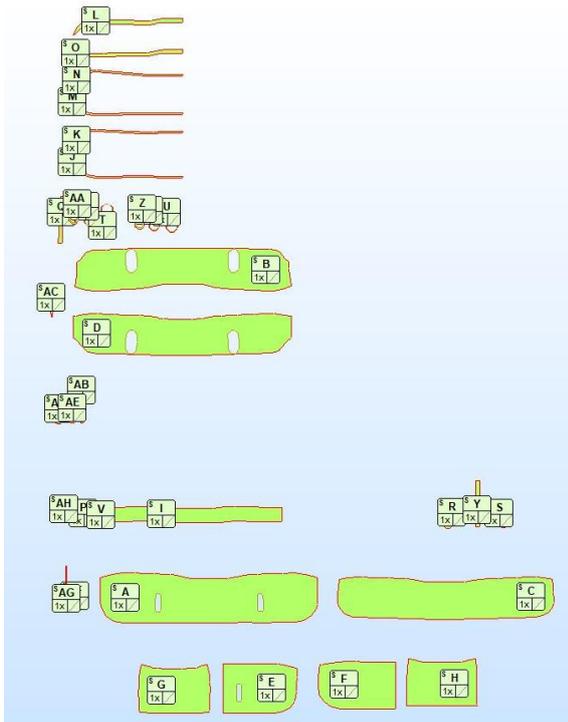


Figure 253

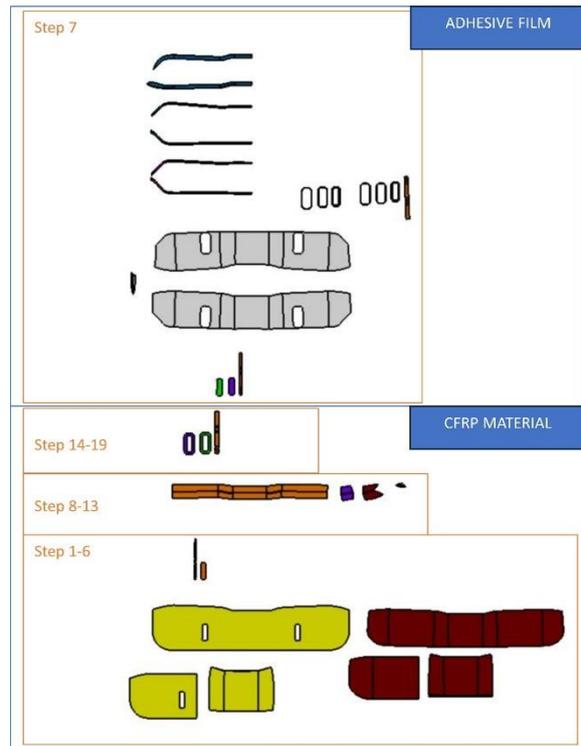


Figure 252

46. Enter the Sketcher Space by pressing shortcut **S** or clicking on the sketcher button  in our toolbar (Figure 254).



Figure 254



47. **Optional:** In this step adds the additional information to clearly show which cuts are needed for which steps and what material they are made of. Therefor draw rectangular geometries  and text  objects on design layer 0 according to Figure 255.

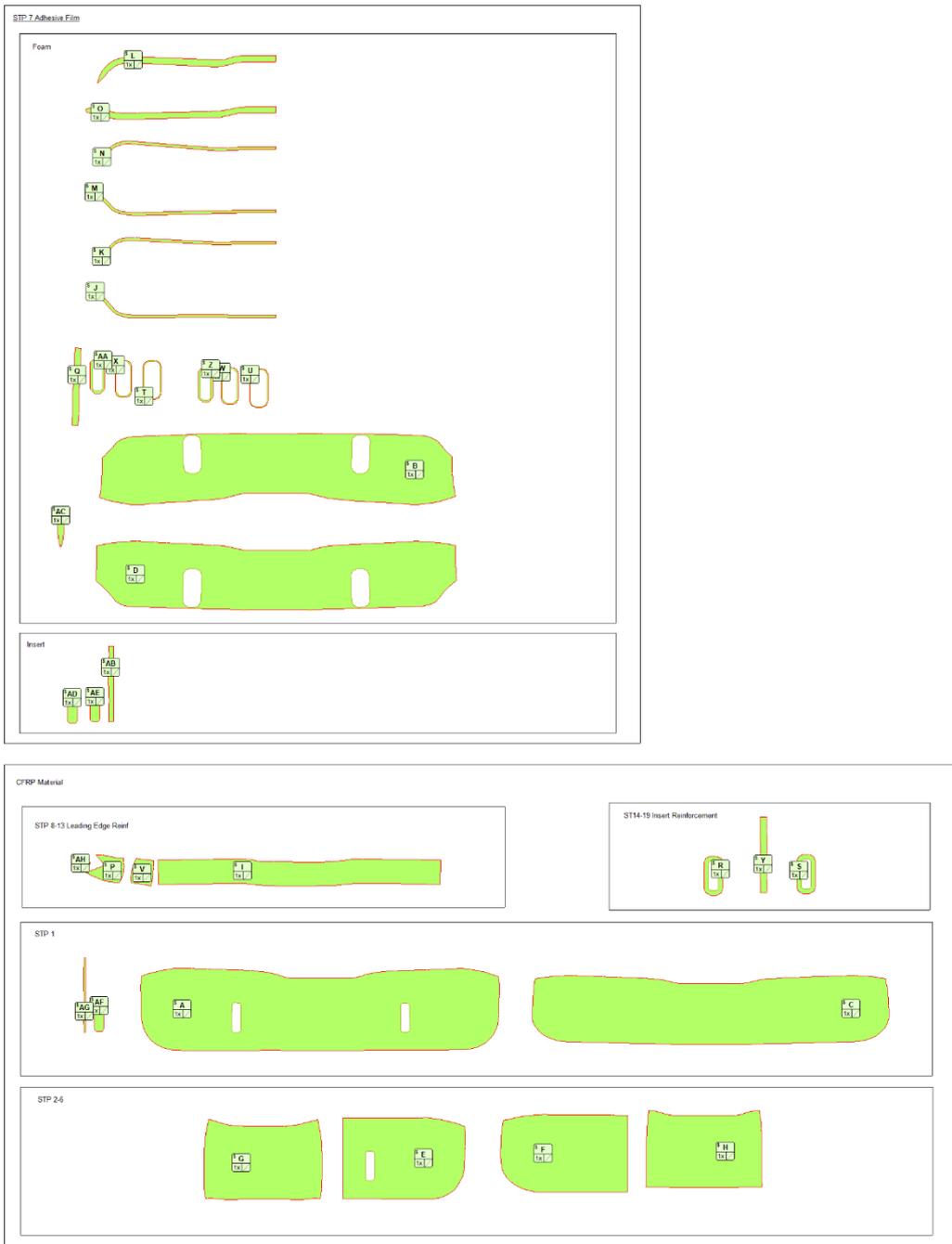


Figure 255



Changing MasterCut ID:

48. To change the IDs of all our MasterCuts at the same time select all of them with **[CTRL] + [A]**, or right click on Drawing Area and click on **[Focus all]** (Figure 256).

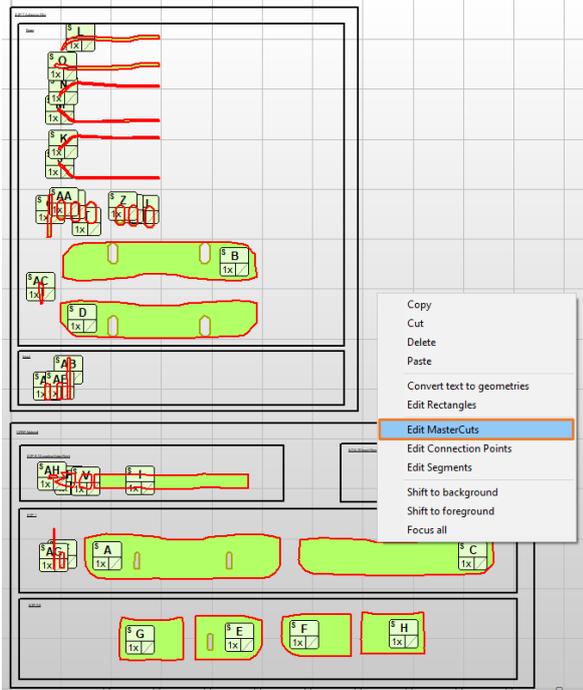


Figure 257

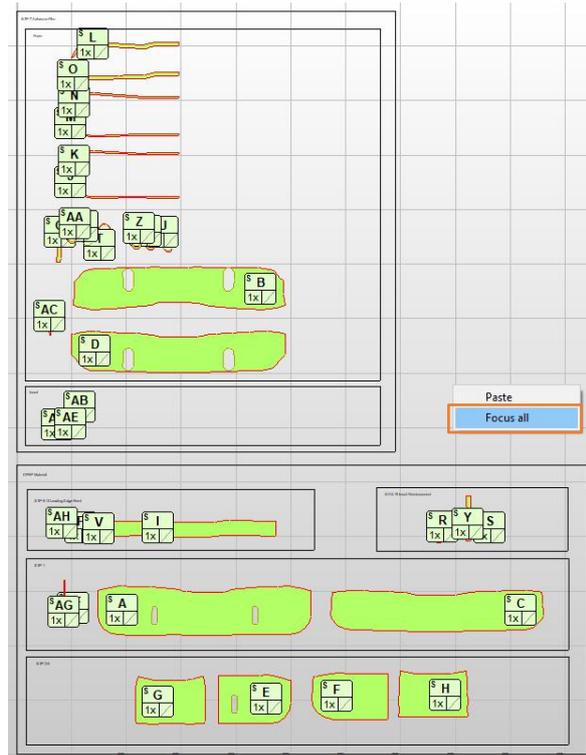


Figure 256

49. Next right-click and then select **[Edit MasterCuts]** (Figure 257).

50. Inside the Edit MasterCuts dialog we will find the ID controls. Here we can modify the IDs of all selected cuts at the same time. Therefore just change the **[Num:]** – value, whereby all marked MasterCuts are assigned the same ID number. But that's usually not what we want. Normally we want to assign the ID to our MasterCuts according to a specific pattern.

Therefore click **Table** (Figure 258) to open the MasterCut ID Table.

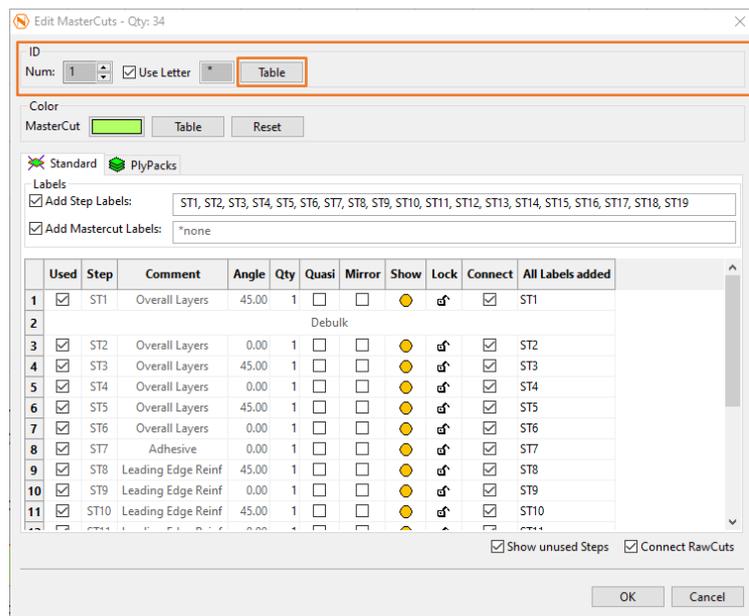


Figure 258



51. Inside the MasterCut Table we can assign certain IDs to certain MasterCuts by shifting them up or down. Further we can also assign the ID according to certain patterns. E.g. with we can assign the ID A to our largest MasterCut, B to the second largest MasterCut and so on. starts with the smallest MasterCut and finally ends with the largest MasterCut.

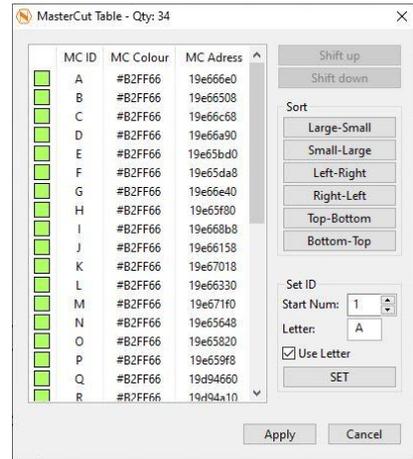


Figure 259

For now use the Top-Bottom pattern. So, the top MasterCut gets the first ID, i.e. A, and the bottom MasterCut gets the last ID, i.e. AH (Figure 260).

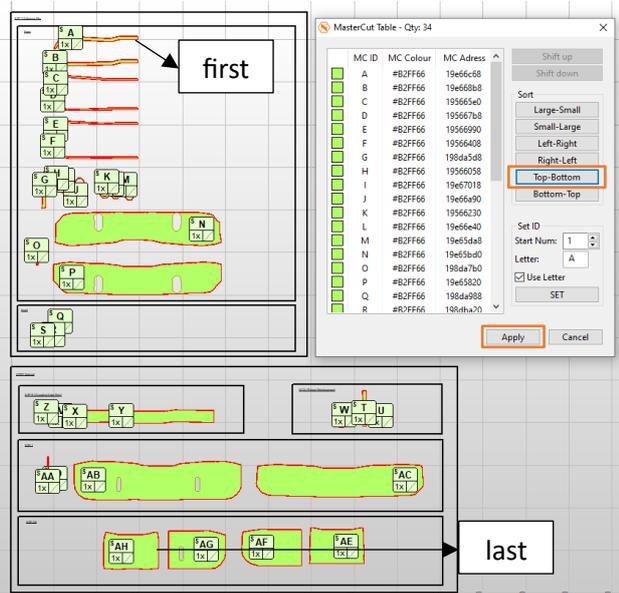


Figure 260

With the Set ID controls we can tell NestKing which ID should be the first one by changing the **[Start Num]** value, respectively we can also switch between using numbers or letters for MasterCut identification.

Leave these settings as they are and close the dialog window with .

52. Now all mastercut ID's are set. Confirm our settings in the Edit MasterCut dialog with .

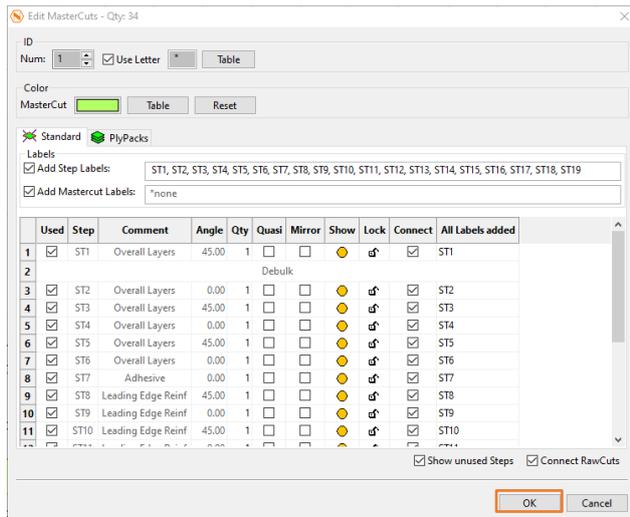


Figure 261



Changing MasterCut Color:

The ability to vary the colors of our MasterCuts as desired also gives us the opportunity to use the same colors as in our 3D. This way you can see immediately which MasterCut belongs where (Figure 263; from E2. Lay-up Sequence).

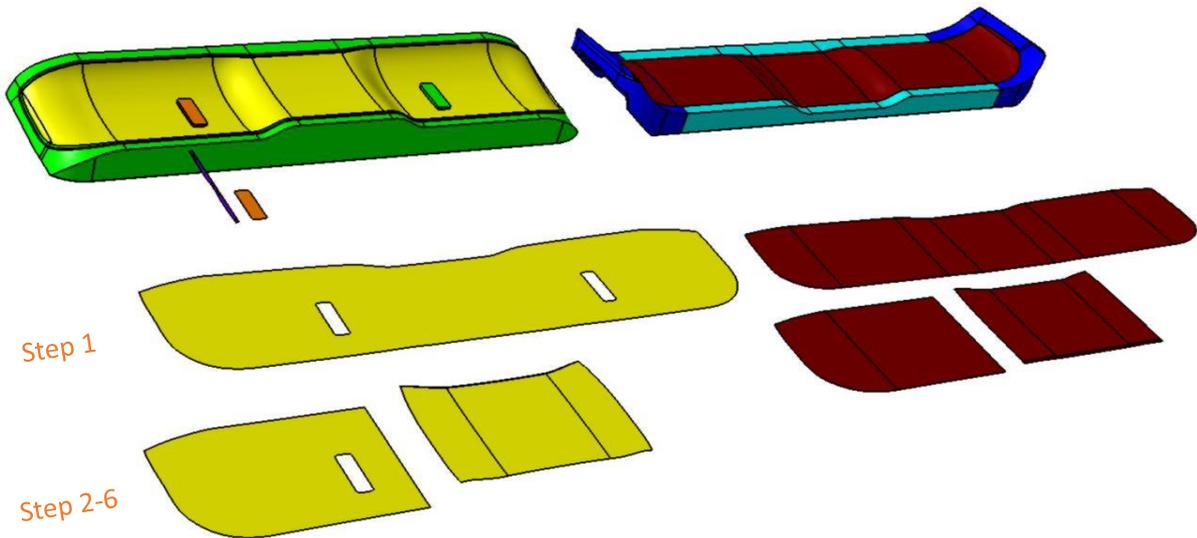


Figure 262

Depending on your preferences and the amount and complexity of your geometries this may makes sense for you or not. However, to give you an idea of how to assign MasterCut colors, the next steps will show you how it works.

- To change the color of our MasterCuts we can do this for single mastercuts just by double click. Further we can also select several MasterCuts at the same time, right-click and then select **[Edit MasterCuts]** (Figure 263).

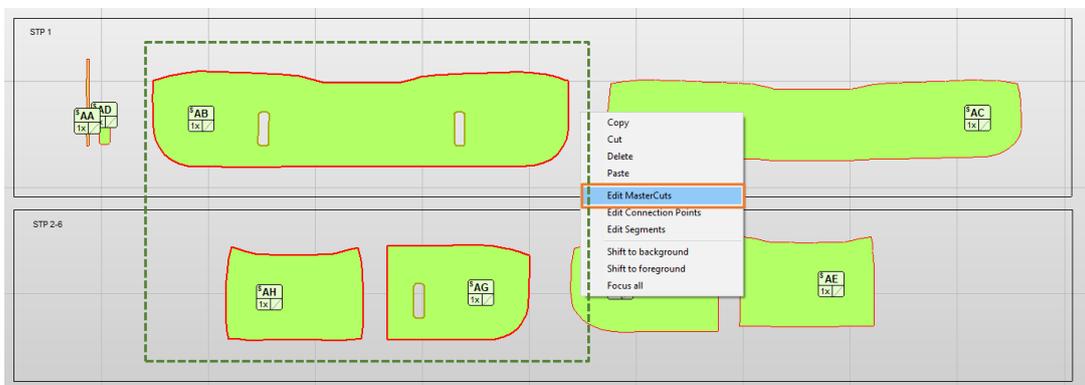


Figure 263



54. Inside the Edit MasterCuts dialog, below the ID controls, we will find the color controls (Figure 264). Here we can modify the colors of all selected cuts at the same time. Therefore we can just change the color by clicking on the Color-Button  whereby all marked MasterCuts are getting the same color.

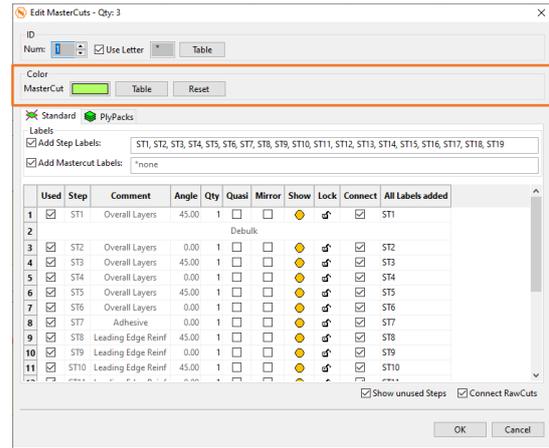


Figure 264

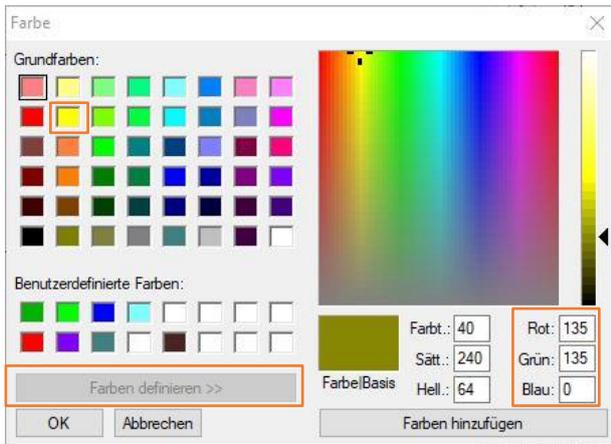
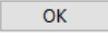
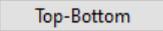


Figure 265

55. By clicking on the define colors button  the Color Dialog will extend and will give you the option to define new colors by entering the RGB (Red, Green, Blue) values directly. Based on Figure 262, since our selected MasterCuts are colored yellow (RGB 135,135,0), we can also simply enter this values and click  to confirm.

56. Back in the Edit MasterCuts dialog click  as well.

We can repeat these steps for all other MasterCuts, but to speed things up a bit I have set up a color table, already including all colors.

Attention: It is important here that the ID of our MasterCuts are actually assigned with the top-bottom  pattern as described in step 51. Otherwise, the colors will not be assigned to the correct MasterCuts.

57. To assign the colors of all MasterCuts via a ColorTable, select all MasterCuts by  or right click in the Drawing Area and **[Focus all]** (see also step 48).

58. Next, right-click inside the Drawing Area and then select **[Edit MasterCuts]** (see also step 49).

59. Back in the Edit MasterCuts dialog click  (Figure 266).

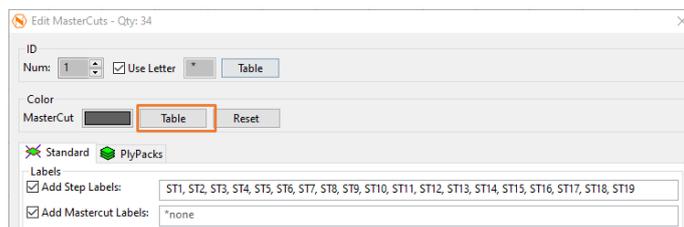


Figure 266



- 60. If the appearing Colour Table is not empty as shown in Figure 267 just press the -Clear Table- button.
- 61. Next click **Import Table** (Figure 267).
- 62. In the rear wing example folder, you will find the "rear_wing_mc_color_table01.txt" file. Select this file and click on open **Öffnen** (Figure 268).

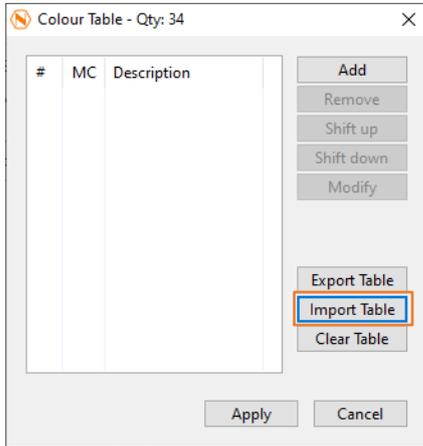


Figure 267

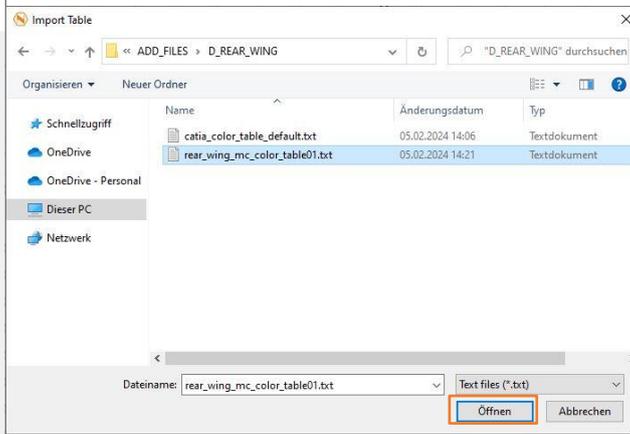


Figure 268

- 63. The included colors of the selected color table file are imported and listed as shown in Figure 269. Click **Apply**.

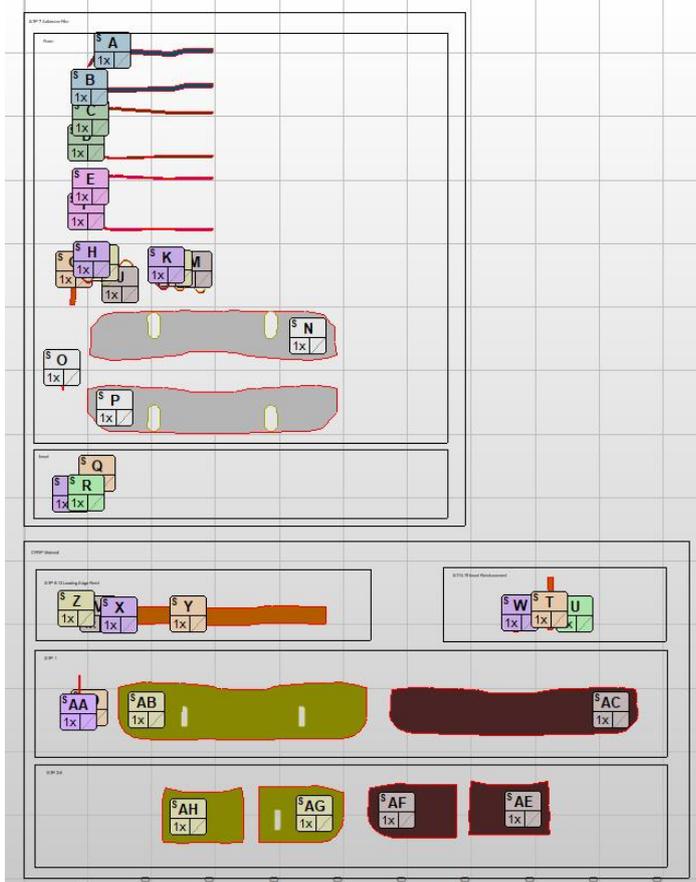


Figure 270

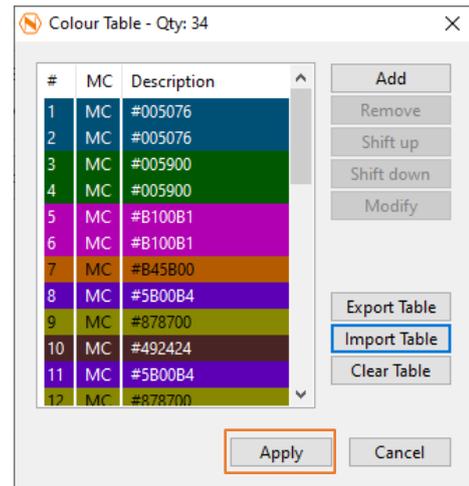


Figure 269

- 64. Click **OK** to close the Edit MasterCuts Dialog as well.

Figure 270 on the left shows our MasterCuts file with the correct colors.



Assigning the right Steps to our MasterCuts:

- 66. Now after we set the MasterCut IDs and added the correct colors we can proceed with assigning the right steps to our MasterCuts. Therefore first select all MasterCuts from the Adhesive Material. They are assigned to step 7 now. Right-click somewhere in the Drawing Area and further select **[Edit MasterCuts]** (Figure 271).

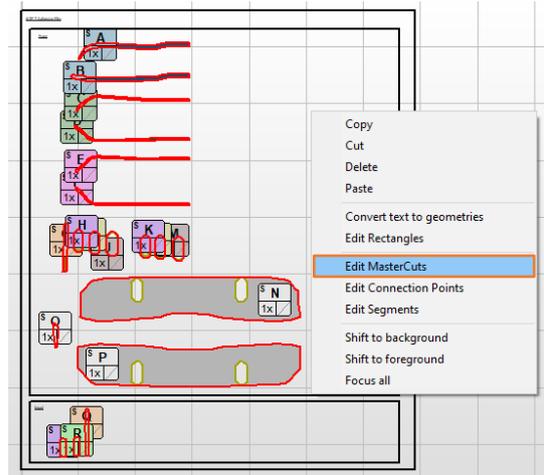


Figure 271

- 67. Since we just need step 7 for our selected MasterCuts we must deselect all other steps. Therefore right-click on the label of the **[Used]** column and select **[Disable steps]** (Figure 272).

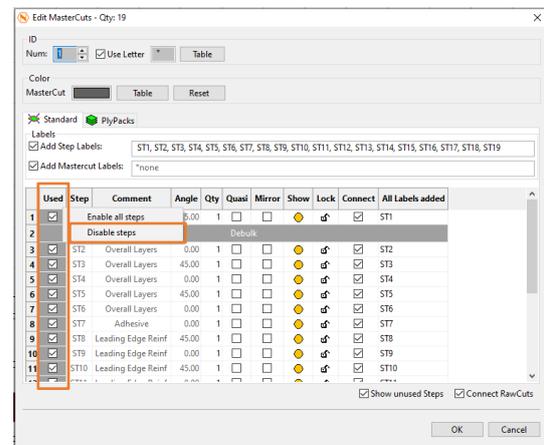


Figure 272

- 68. Now select ST7 on position 8 again (Figure 273).

- 69. Click to confirm.

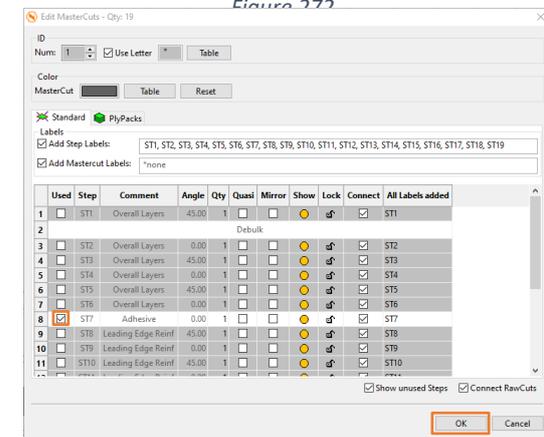


Figure 273

- 70. Next select all MasterCuts from STP 8-13 Leading Edge Reinf and open the Edit MasterCuts Dialog.

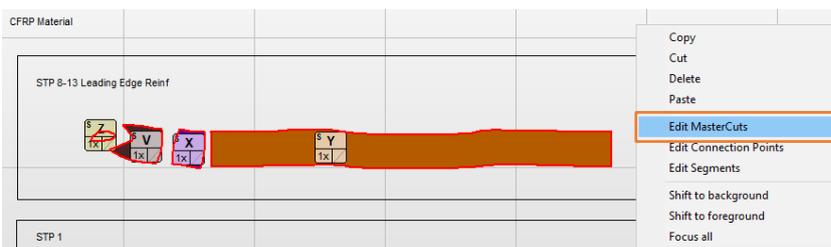


Figure 274



71. Ensure that just Steps 8, 9, 10, 11, 12 and 13 are enabled for our selected MasterCuts. Click **OK** to confirm.

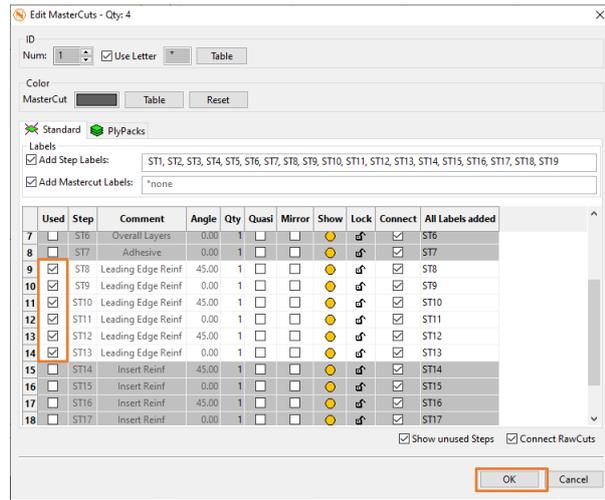


Figure 275

72. Repeat these steps for the insert Reinforcement steps. They are assigned to steps 14, 15, 16 17, 18 and 19 (Figure 276).

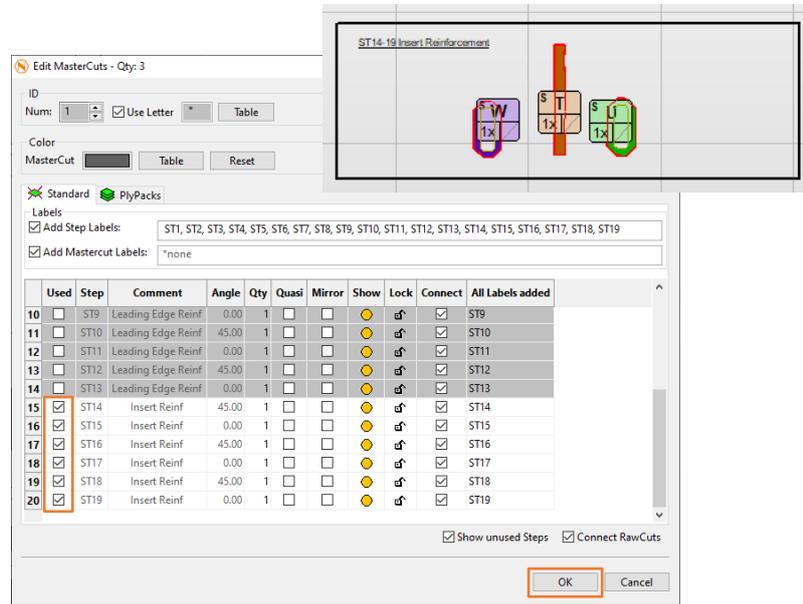


Figure 276

73. Repeat these steps for the overall MasterCuts of STP 1 (Figure 277)...

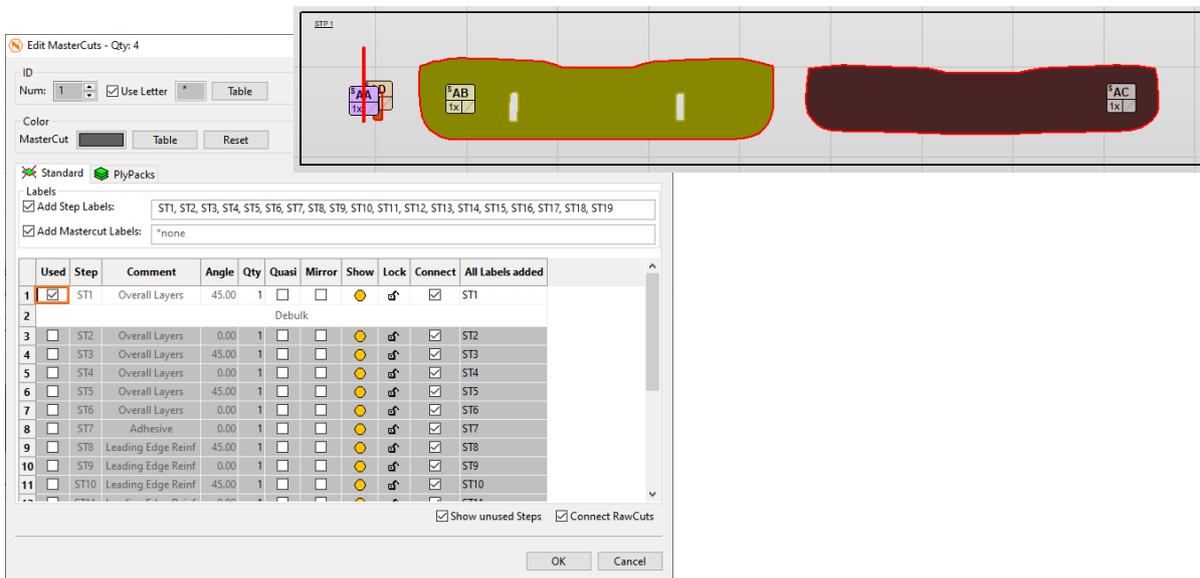


Figure 277



74. And finally, also for our MasterCuts assigned to STP 2-6 (Figure 278).

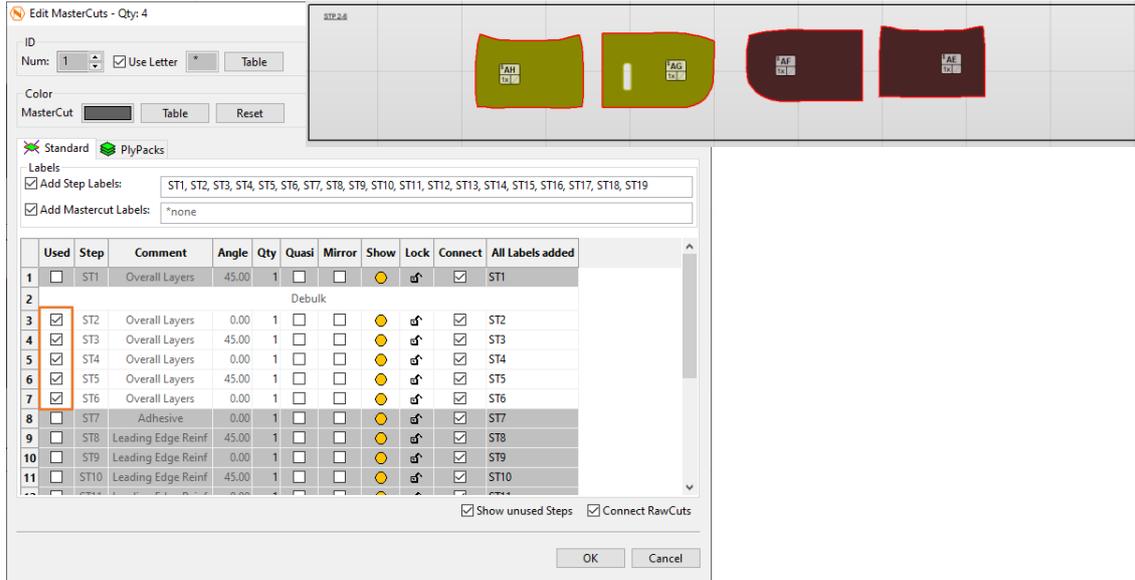


Figure 278

Mirroring:

As mentioned in the introduction to this chapter, the easiest way to generate mirrored cuts is not in 3D but rather in NestKing. This can be done with just a few mouse clicks.

- 75. To tell NestKing that we need mirrored cuts for our first 13 MasterCuts with ID A to ID M we first select them and open the Edit MasterCuts dialog with a right-click → **[Edit MasterCuts]** (Figure 279).
- 76. To make the table a little clearer, we can hide all unused steps: Therefore deactivate the **[Show unused Steps]** checkbox as indicated in Figure 279.
- 77. If the Mirror check mark is set for the respective step, a mirrored version of this cut will also be added to our nest in addition to the normal cut for this step. So, we will finally get two cuts, one normal and one mirrored cut. If you also take a closer look at the MasterCut ID boxes you will see that also the mirror sign is indicated now (Figure 280).
- 78. Finally click **OK** to close the Edit MasterCuts dialog and confirm our settings.

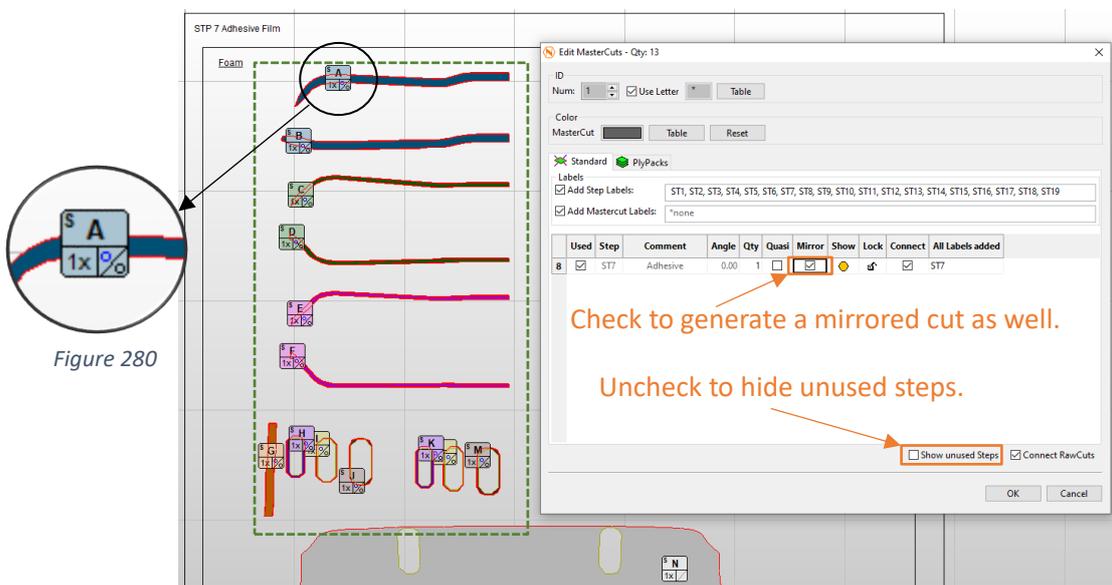


Figure 280

Figure 279



79. In addition, there are several other MasterCuts that contain steps whose plies must also be mirrored:

- MasterCut with ID O. Just double-click on this MasterCut and activate the **[Mirror]** box (Figure 281).

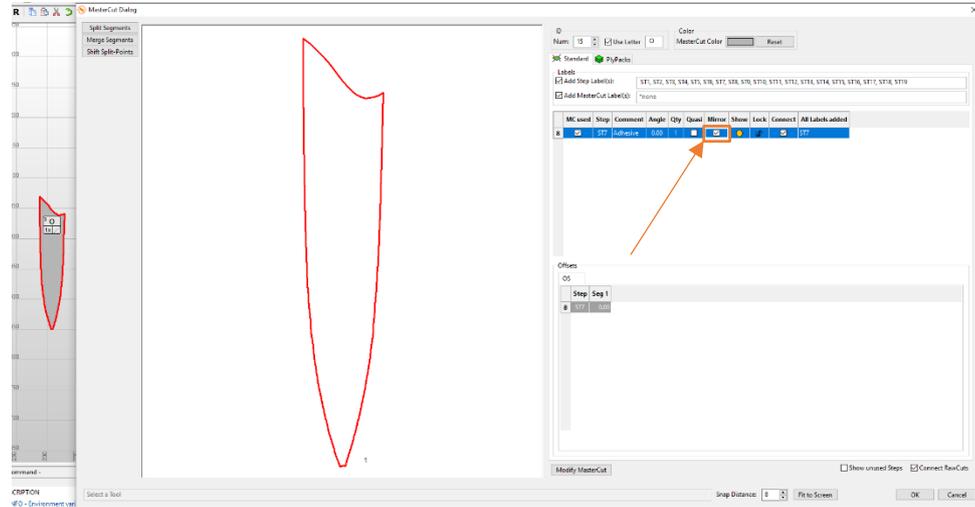


Figure 281

- MasterCuts with IDs Q, R and S (Figure 282).

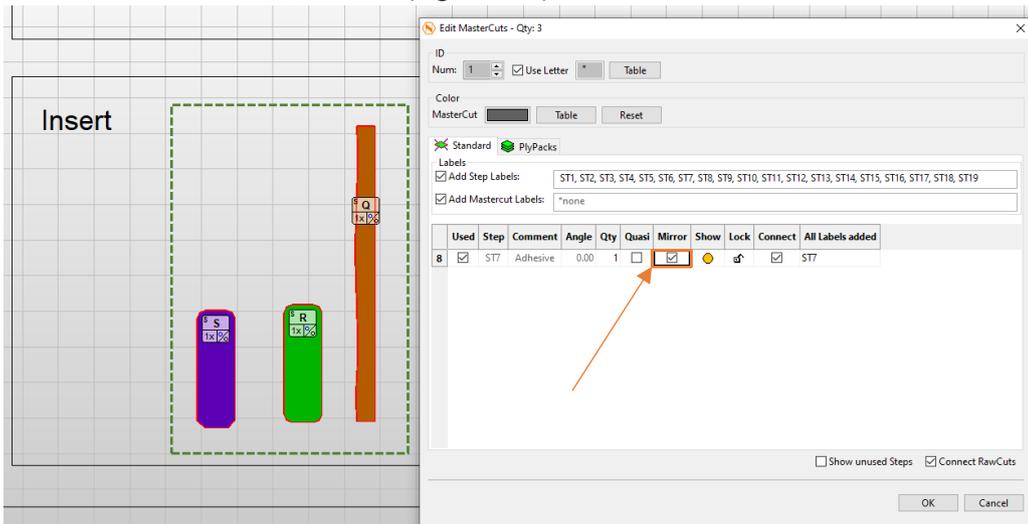


Figure 282

- MasterCuts with IDs X, V and Z (Figure 283).

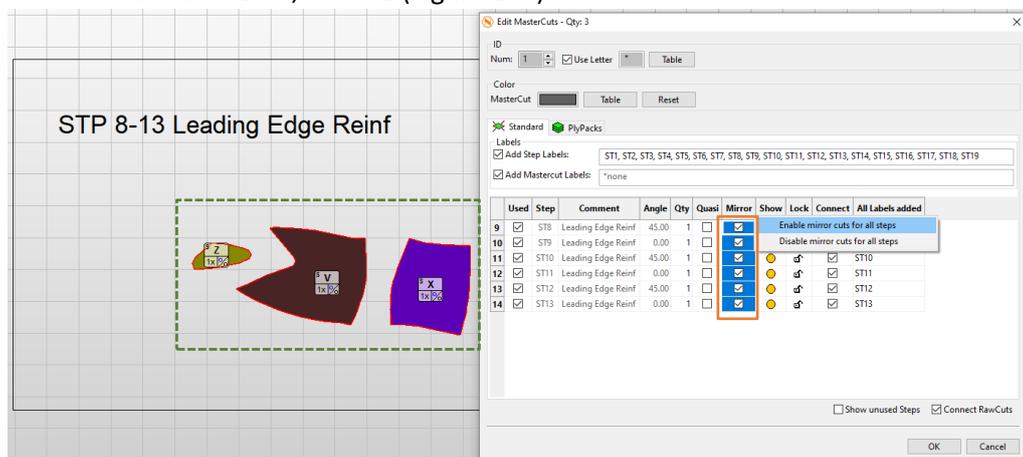


Figure 283



- MasterCuts with IDs T, U and W (Figure 284).

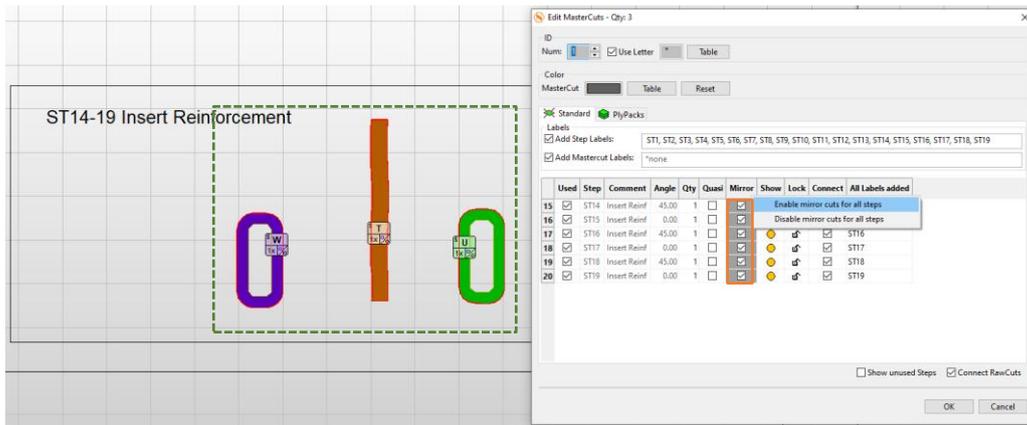


Figure 284

- MasterCuts with IDs AA and AD (Figure 285).

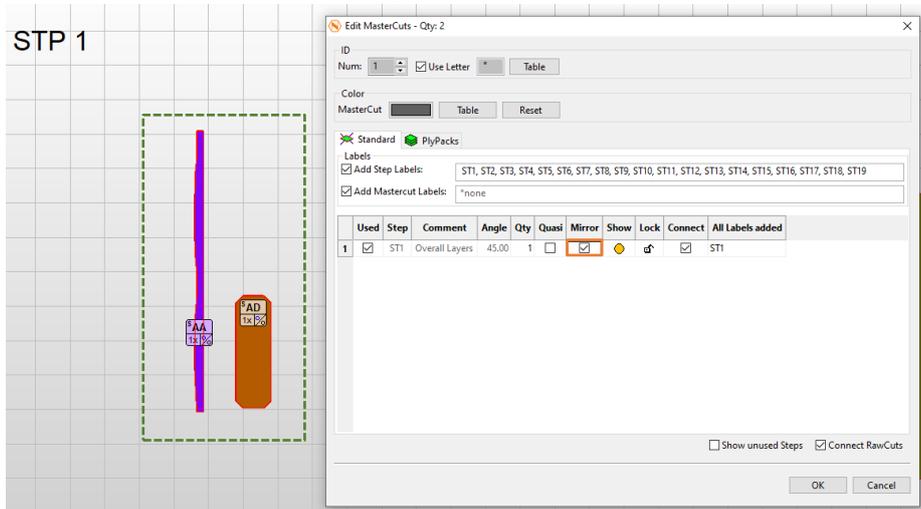


Figure 285

- And finally, MasterCuts with IDs AG and AF (Figure 286).

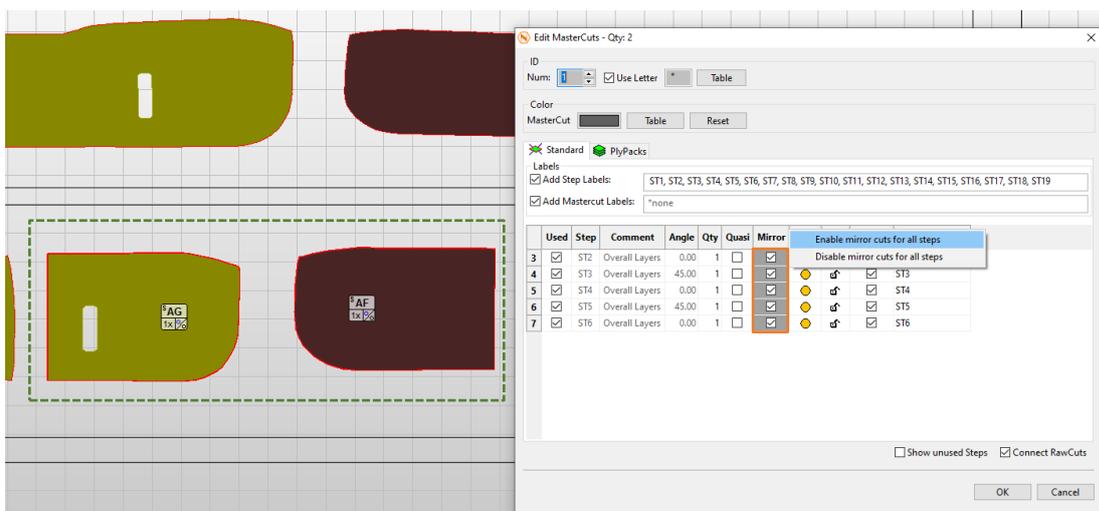


Figure 286



Splitting MasterCut geometries:

Very good! We have already finished our Adhesive plies as well as Step 1 as emphasized by Figure 287. These MasterCuts just contain one step/layer, thus there is no splitting and offsetting required.

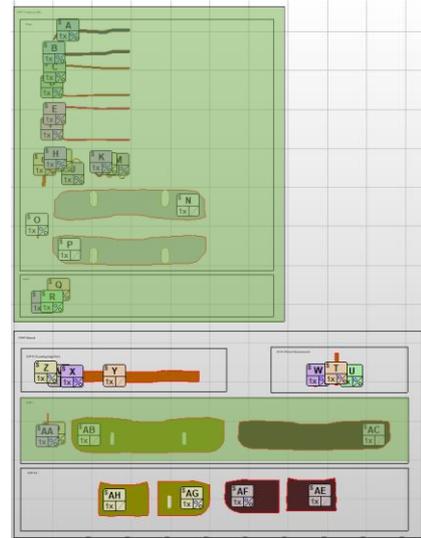


Figure 287

80. Before we can start with splitting there is one more thing missing. MasterCuts AA and AD are currently just added to STP 1. Actually we need them for STP 2-6 as well. Thus, let's simply copy these two MasterCuts and add them to STP 2-6. Therefor just select MasterCut AA and AD and use the **CTRL + C** shortcut on your keyboard or click the copy button  in the main toolbar.

To paste the copied MasterCuts we can press **CTRL + V** or use the paste button  of the main toolbar.

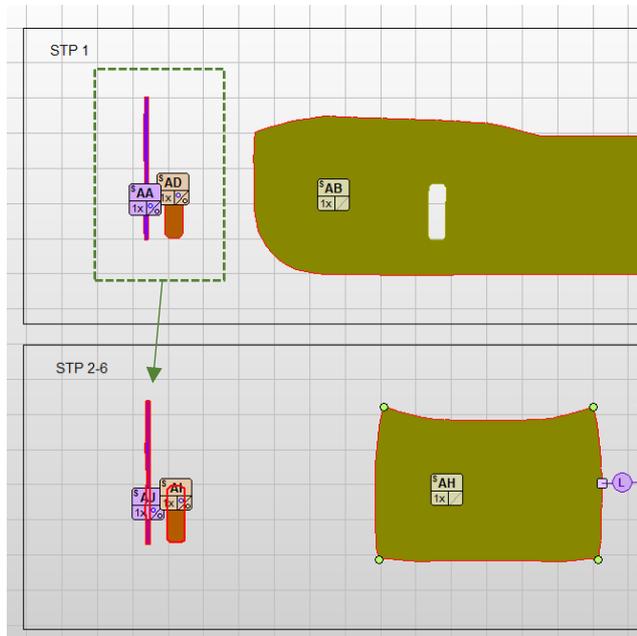


Figure 288

81. Further we have to assign the correct steps to our copied MasterCuts AJ and AI. Therefor, select both of them again, right-click, select **[Edit MasterCuts]** to open the Edit MasterCuts dialog (Figure 289).

82. Here we can activate on **[Show unused Steps]** to show all steps.

83. Deselect ST1 and select ST2, 3, 4, 5 and 6 instead.

84. Also ensure that the **[Mirror]** checkboxes are checked as well.

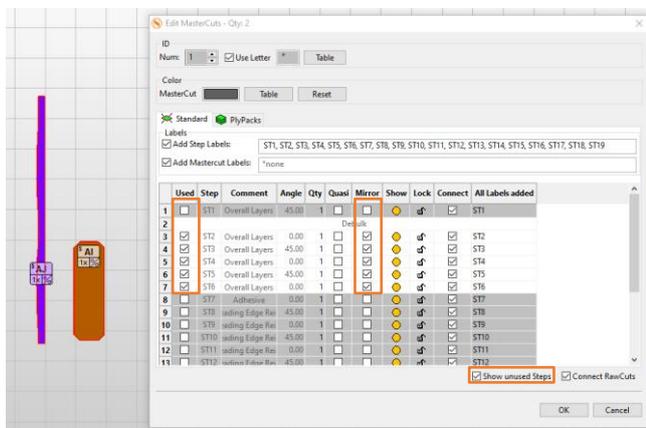


Figure 289



Proceeding with Leading Edge Reinforcement MasterCuts (ST 8 to ST 13) we will split the outer geometries into segments. These segments will be used for the linking tool. Further the equalizer tool will be used to tell NestKing which segments should behave the same regarding their offsetting behavior.

- 85. Double-click on MasterCut Z to open its MasterCut dialog.
- 86. On the top left corner of the dialog you will find the splitting tool **Split Segments** as indicated in Figure 290.

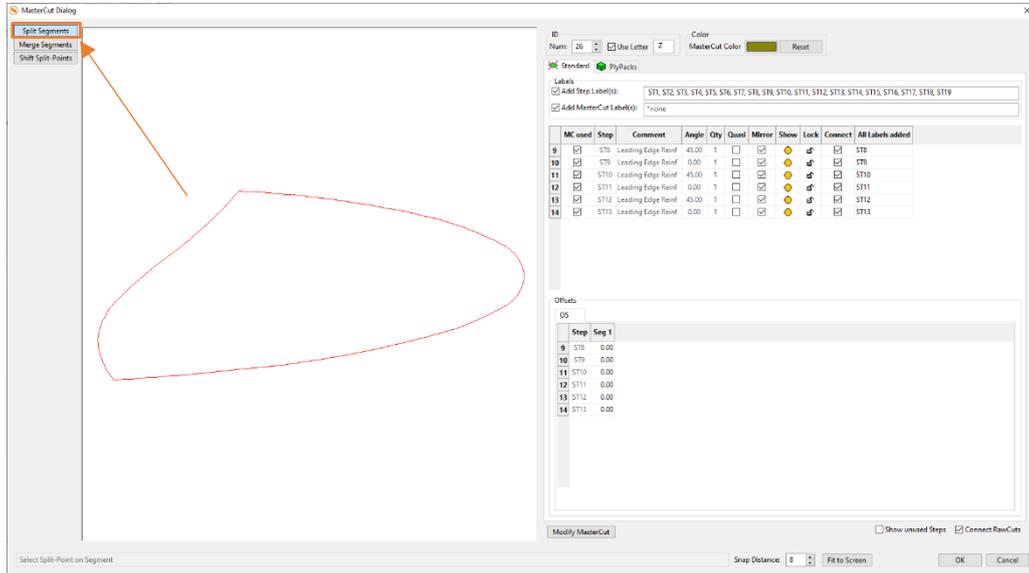


Figure 290

- 87. Next pick both corners (Figure 291). Click **OK** to confirm and leave the MasterCut Dialog.

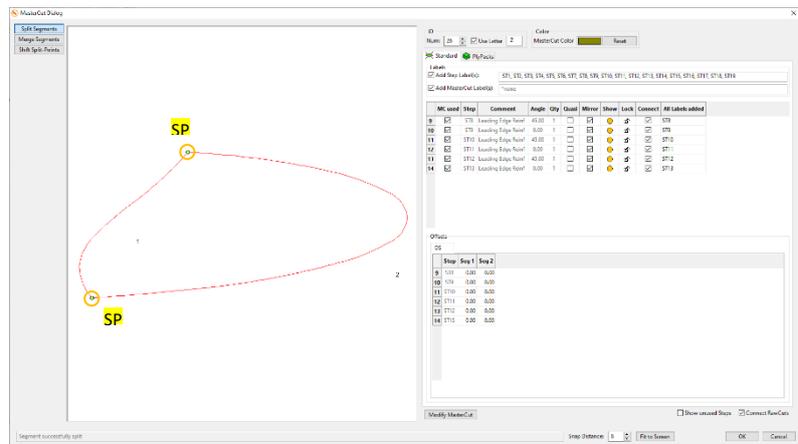


Figure 291

- 88. Repeat these steps for MasterCut V and split the outer geometry as shown in following Figure 292...

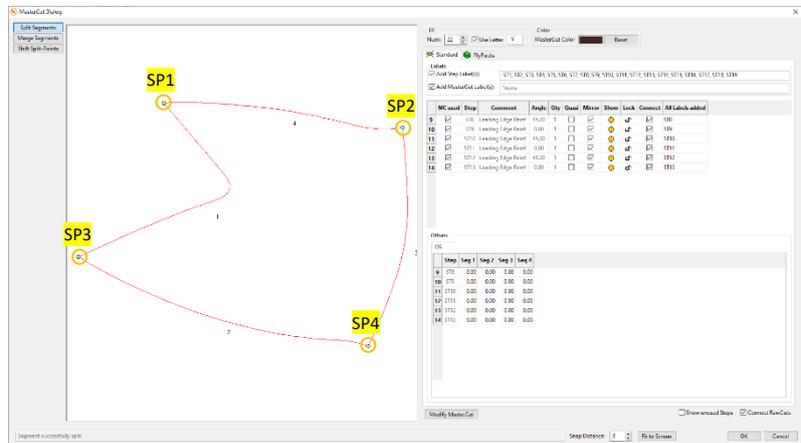


Figure 292



- 89. ... and for MasterCut X and split the outer geometry as shown in Figure 293...

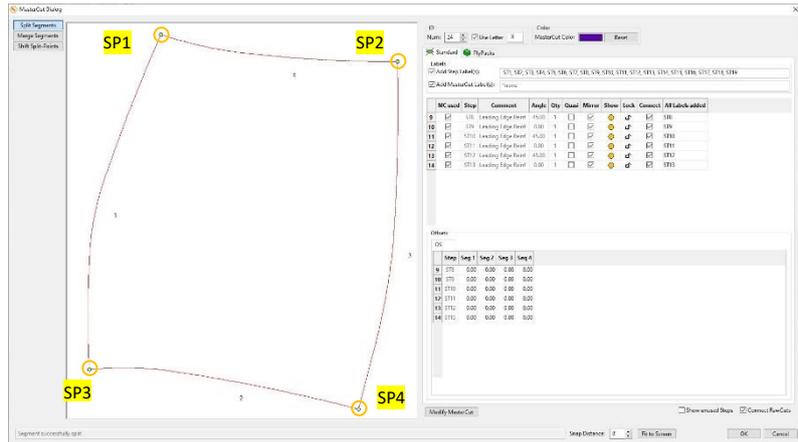


Figure 293

- 90. ... and for MasterCut Y and split the outer geometry as shown in Figure 294...

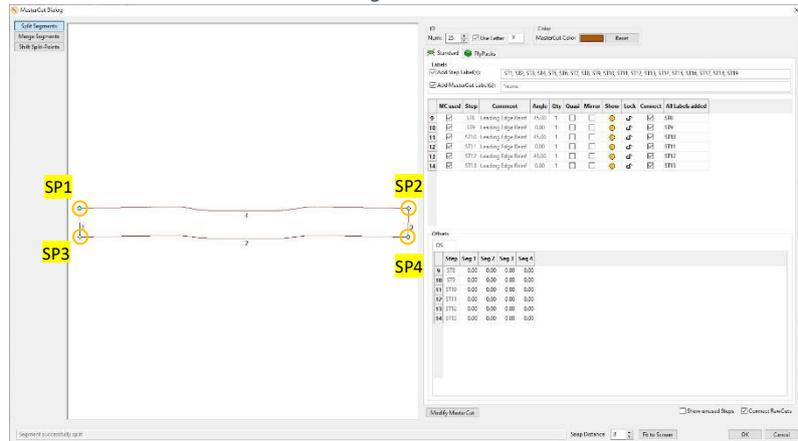


Figure 294

- 91. ... and for MasterCut T and split the outer geometry as shown in Figure 295...

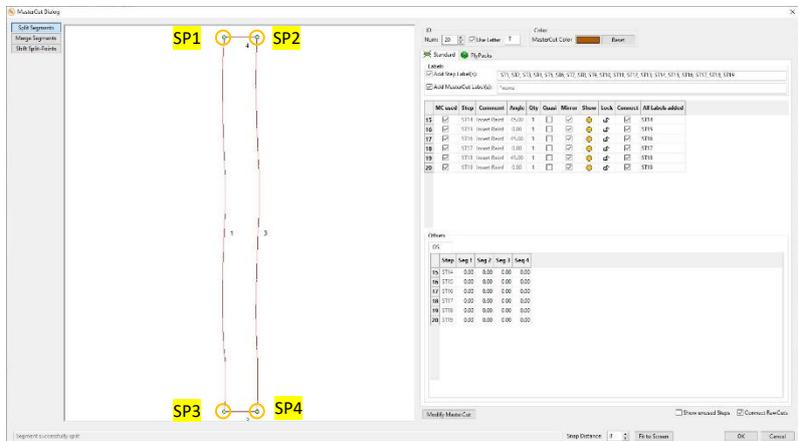


Figure 295

- 92. ... and for MasterCut AJ and split the outer geometry as shown in Figure 296...



Figure 296



93. ... and for MasterCut AH and split the outer geometry as shown in Figure 297...

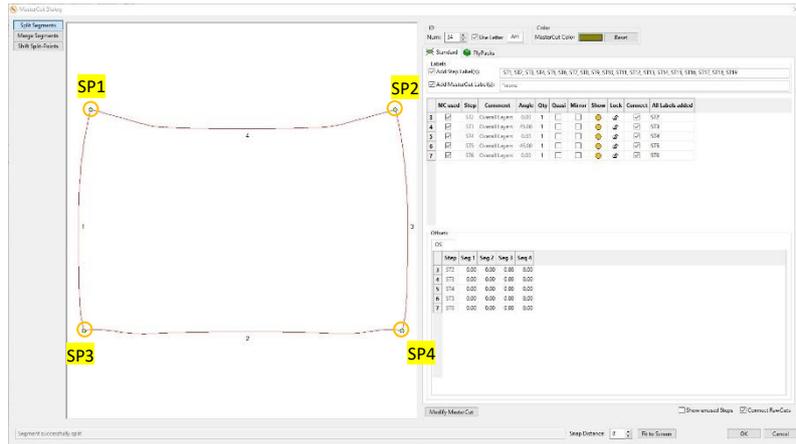


Figure 297

94. ... and for MasterCut AG and split the outer geometry as shown in Figure 298...

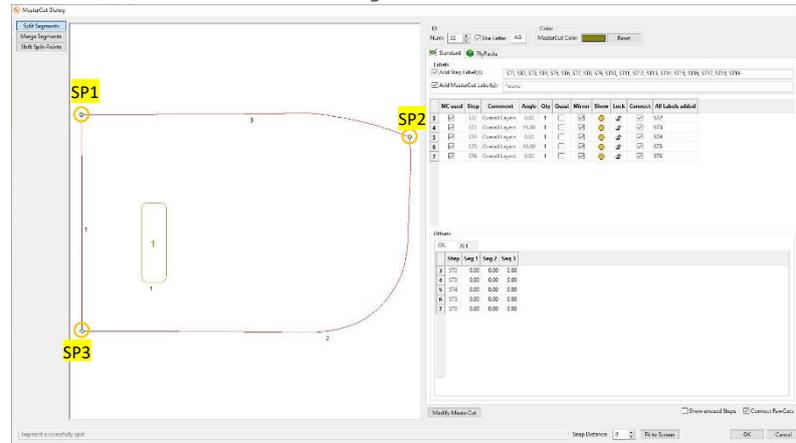


Figure 298

95. ...and for MasterCut AF and split the outer geometry as shown in Figure 299...

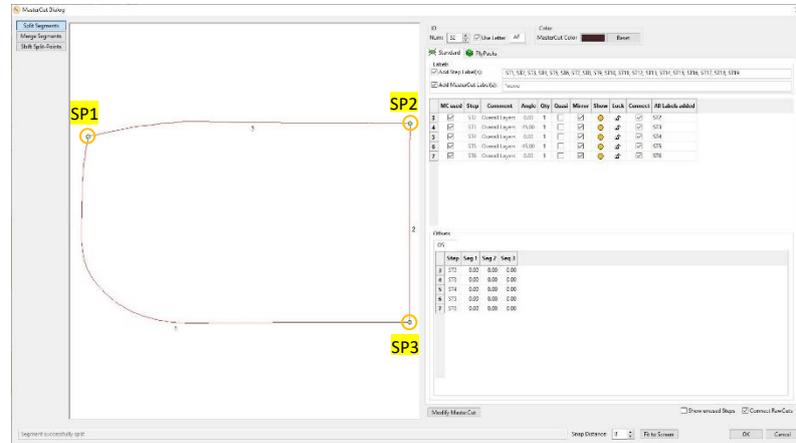


Figure 299

96. ... and for MasterCut AE and split the outer geometry as shown in Figure 300...

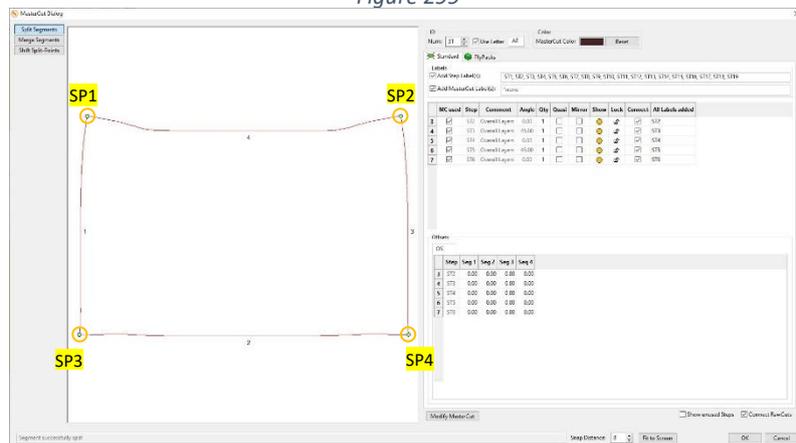


Figure 300



Linking MasterCut segments with the Link Tool 

Very good! Now we can link the MasterCut segments, we just created, with each other.

- 97. Select the Link tool in our main tool bar  (Figure 301).

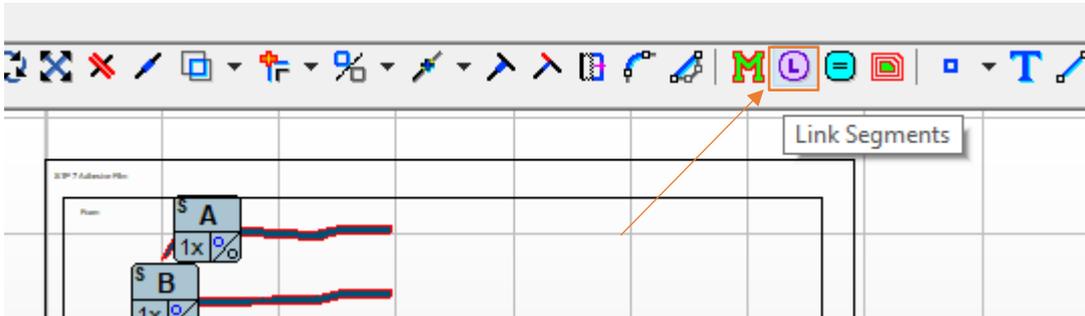


Figure 301

- 98. And link the segments of our Leading Edge Reinforcement MasterCuts. To get the same behavior later, when modifying the links, it makes sense to select the segments one after the other as emphasized in Figure 302.

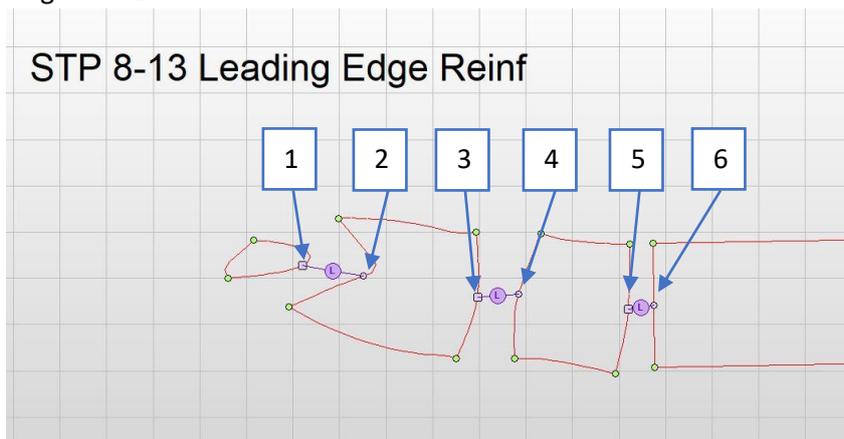


Figure 302

- 99. Next link all touching segments of our Insert Reinforcement MasterCuts together(Figure 303).

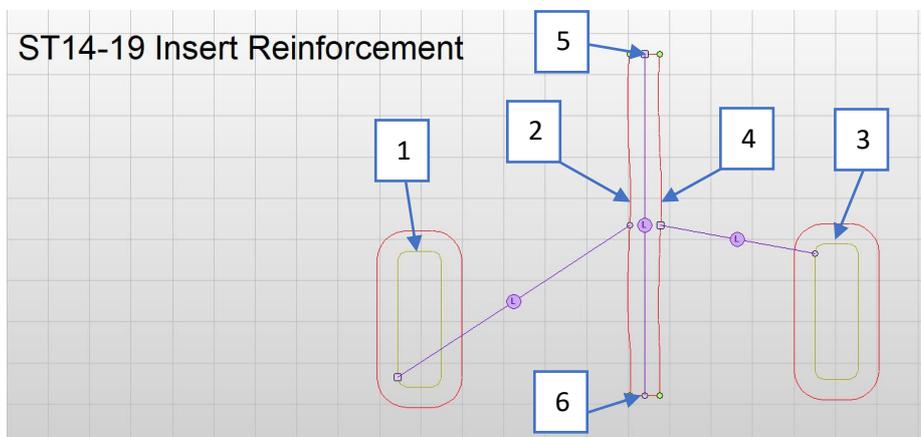


Figure 303



100. Link all touching segments of our overall layers from step 2 to 6 (Figure 304).

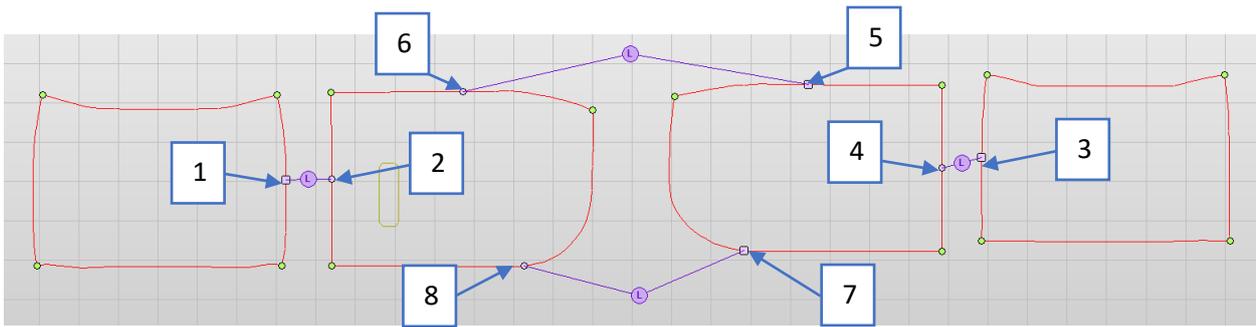


Figure 304

101. Link all touching segments of MasterCuts AJ and AI according to Figure 305.

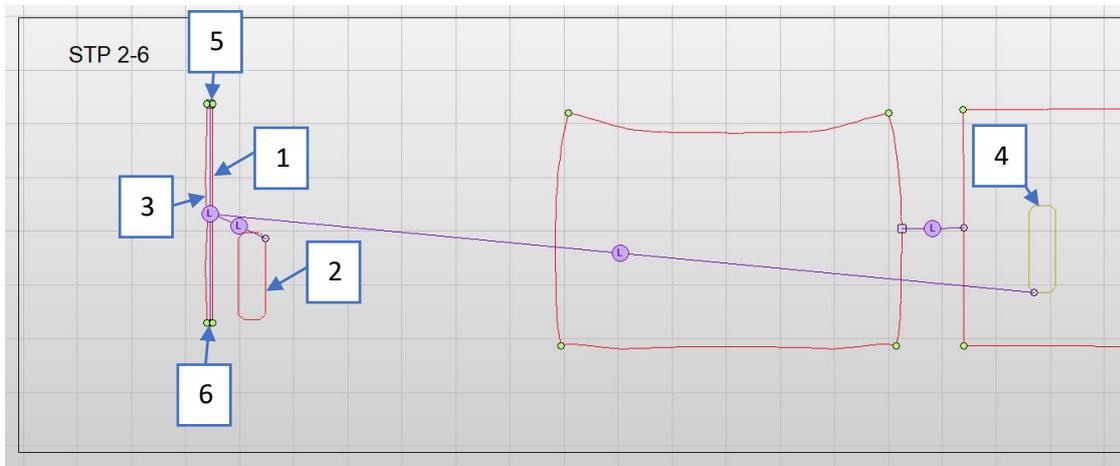


Figure 305



Setting equalizer links 

By using equalizer links, we can connect several segments (not just 2 like the standard links) with each other. There is always a master segment in which the offsets for each individual step can be defined. These offsets are then automatically adopted for all other segments, which are referred to as slave segments.

With regard to the Leading Edge Reinforcement MasterCuts all outer segments, as emphasized in Figure 306 in orange, should behave the same. Back in Chapter E2. *Lay-up Sequence* it is written that these should be stepped back by 30 mm for layers 8 and 9 and by 15 mm for layers 10 and 11.

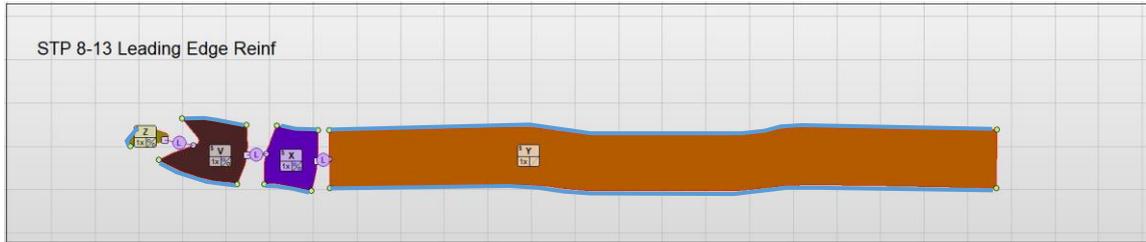


Figure 306

Of course, we can just select all these outer segments, right-click in the Drawing Area and **[Edit Segments]** to modify all segments at the same time as shown in Figure 307 below.

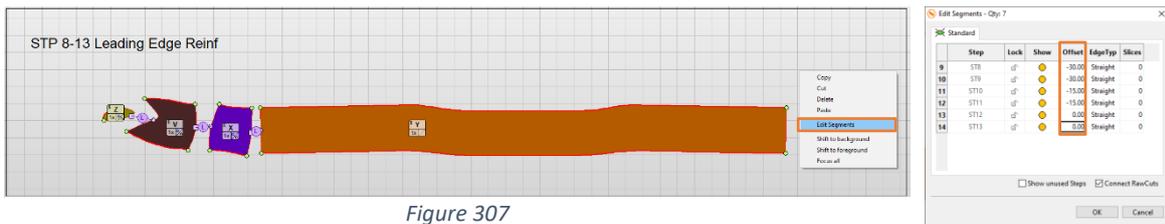


Figure 307

The problem is that these values need to be changed, e.g. 30mm offset is too much and 27mm would suit ST8 and ST9 much better. You need to reselect all of them and change the appropriate values. The risk of something being forgotten or overlooked is not insignificant. However, if you link the segments together using the equalizer, it is always clear that these segments behave in the same way. When making changes, all you need to do is adjust the offsets of the master segment and these will then be automatically applied to all other slave segments.

We can also use the equalizer to extend standard links, since standard links are usually only possible between two segments.

Since we mirror the cuts of the left three MasterCuts X, V and Z in the Leading Edge Reinforcement MasterCuts, it would be great if the offsets of the left segment in the middle MasterCut Y were also automatically transferred to the right segment (Figure 308). We can also use an Equalizer for this.

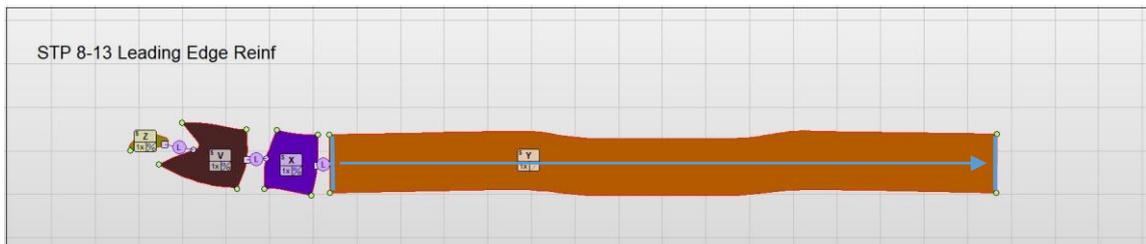


Figure 308



102. Click on the Equalize Segments button  in the main toolbar (Figure 309).

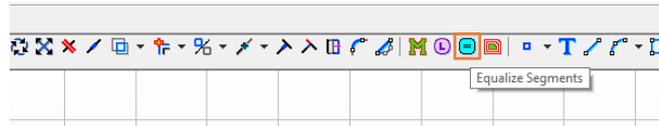


Figure 309

103. Select all outer segments (Figure 310). As stated in the Command box, click **-SPACE-** or **-ENTER-** on your keyboard to confirm.

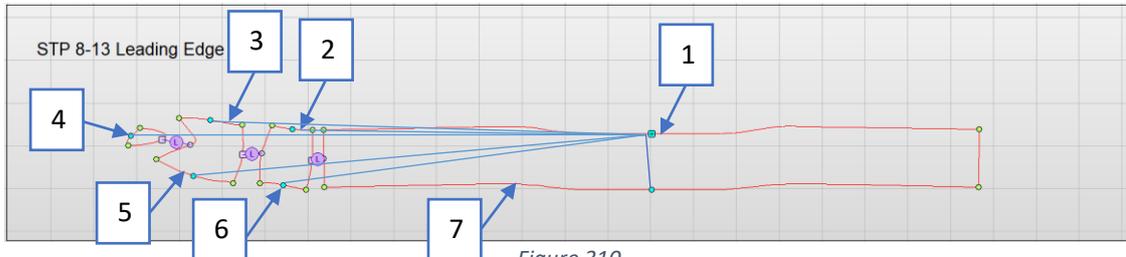


Figure 310

104. To quit the Equalizer tool just press **-ESC-** on your keyboard.

Consider that the first selected segment is also the master segment. We can also change this later by double-clicking on one of the equalizer marking points. The Edit Equalizer dialog gives us the opportunity to add new segments, to remove segments and also change the master segment (Figure 311).

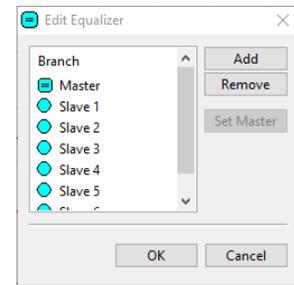


Figure 311

105. To set the offset values in accordance with chapter E2. Lay-up Sequence, double-click on the master segment of our Equalizer signed with 1 in Figure 310.

106. Enter the appropriate values to the offset column as indicated in Figure 312.

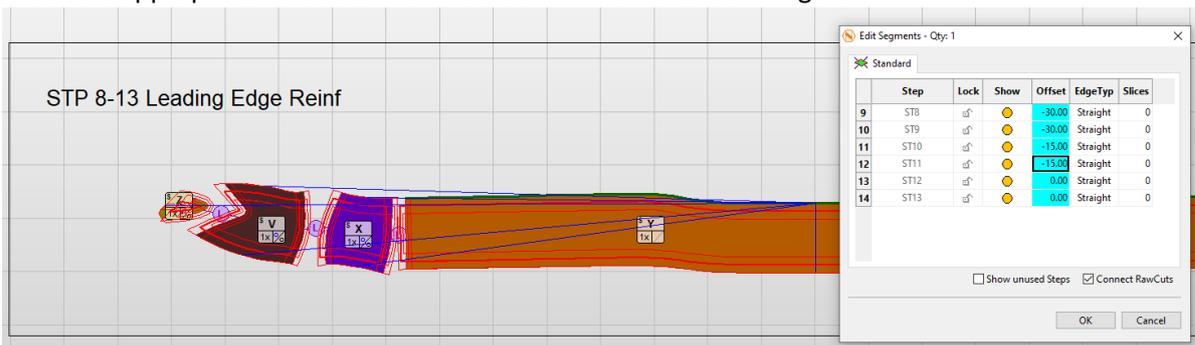


Figure 312

107. Next activate the Equalizer Tool by clicking  in the toolbar again or by using the **-EQUALIZE-** command.



108. Now link the left and right segments to transfer the offsets from segment 2 to 1 as emphasized in Figure 313.

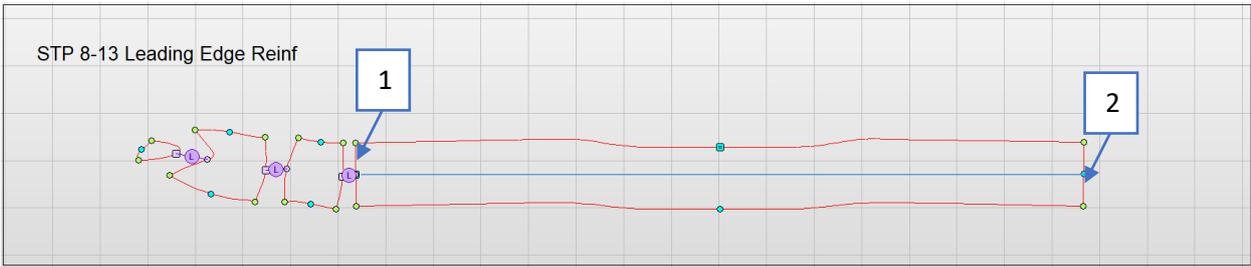


Figure 313

Note: If there is a linked segment included in the equalizer link group, this linked segment will always be the master segment of the equalizer link. This master segment controls the offsets of all slave segments. In this case the master segment can't be changed (Figure 314). Further it is also not possible to add more than one linked segment to the same equalizer link group.

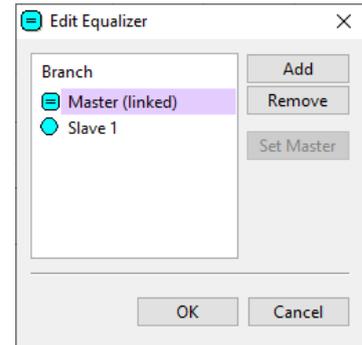


Figure 314

109. As shown in Figure 315, combine following segments with the equalizer tool to six equalizer groups.

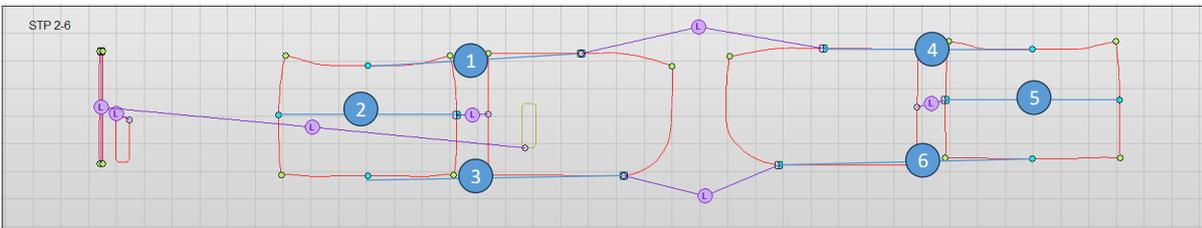


Figure 315

110. Now all standard and equalizer links are set. Check if the generated plies are OK or if they need some further fine tuning.

Click  (Generate RawCuts) (Figure 316).

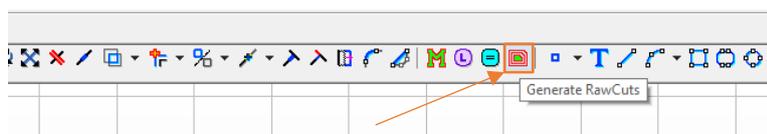


Figure 316



A closer look at the Description Box at the bottom left tells us, that generating the RawCuts caused a warning: “MasterCut AJ – No cut left at position 6!”.

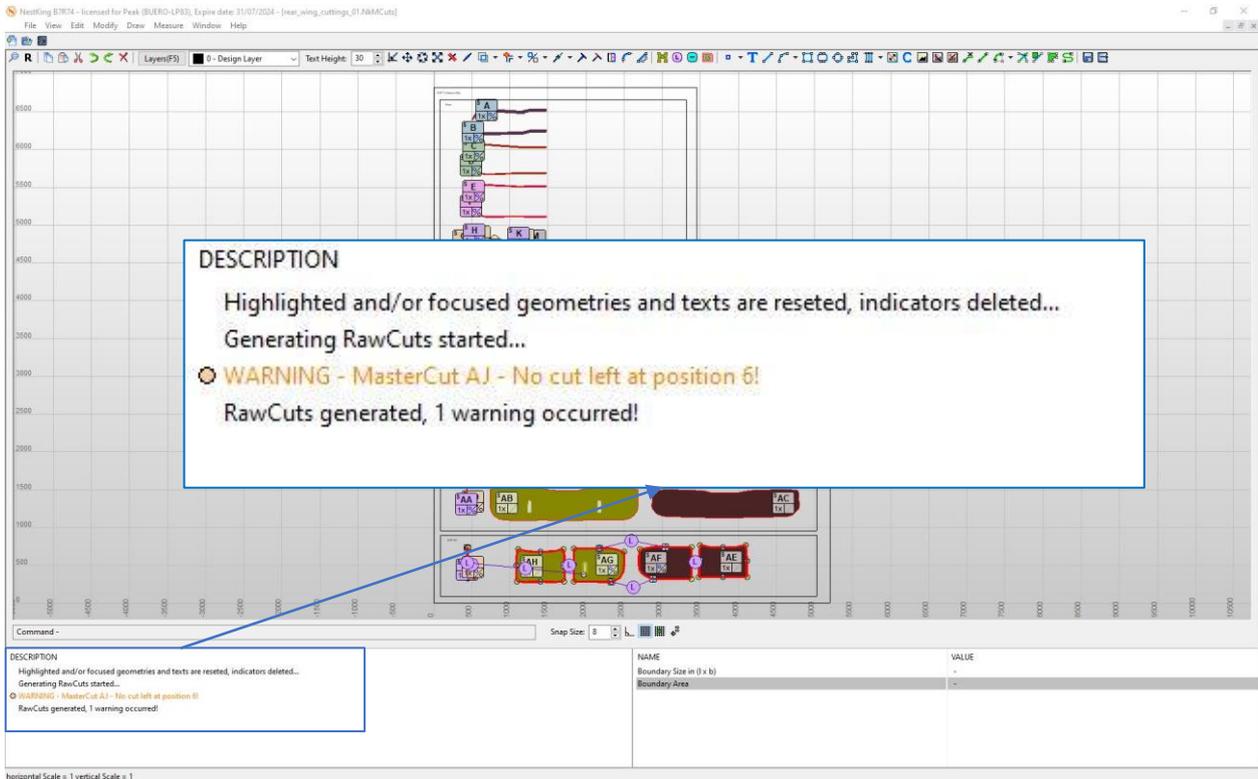


Figure 317

111. This means that the offsets were chosen so that with MasterCut AJ there is no longer any cutting left at position 6. Let's take a closer look by clicking on the warning message

⚠ WARNING - MasterCut AJ - No cut left at position 6!

112. NestKing automatically set up the window so that our MasterCut AJ is displayed in its entirety (Figure 318). The left and the right segments of MasterCut AJ are controlled by 2 Links. Double-click on the first link, as emphasized by the orange arrow in Figure 318, to open the Edit Links dialog.



Figure 318



113. As the warning states the problem occurred at position 6 (Figure 319). Now we have following options to avoid that our RawCut of position 6/ST5 disappears completely.
 - a. First, we can reduce the offset step from 5 mm down to 1 mm until the ST6 finally gets a cut. Since, an offset step of just 1 mm is literally nothing.
 - b. Thus, it is suggested to change the **[Offset direction]** from 'both' to 'Seg2' instead. By clicking on the position 6 label (Figure 319) the cuts generate at this step are highlighted. Nevertheless, we will recognize that there is still no cut appearing now, thus we also need to modify the link of the second segment on the left as well.

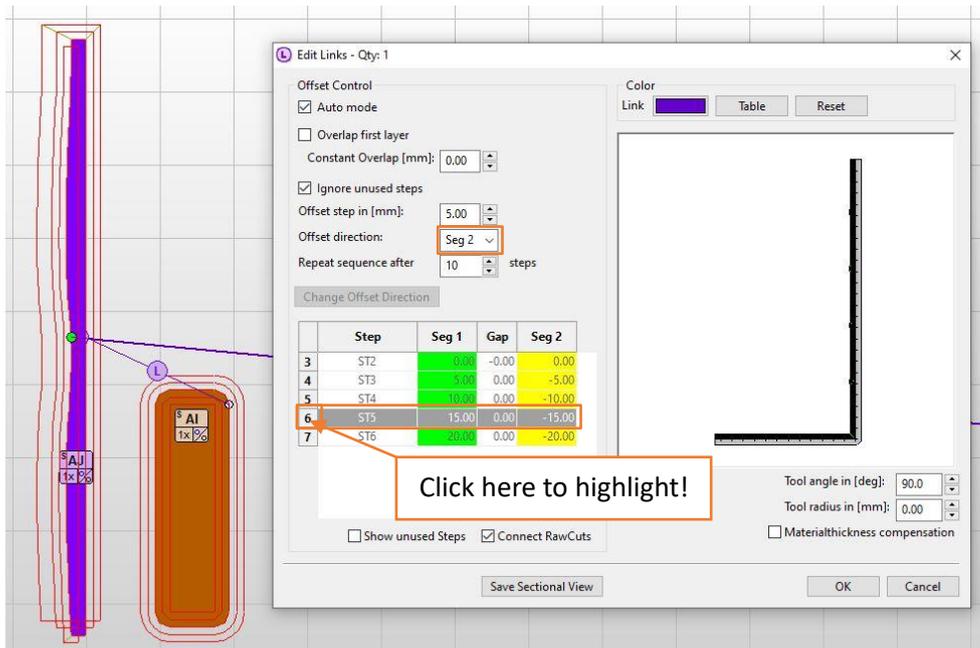


Figure 319

114. Close the Edit Links dialog with **OK** and double-click the second link (Figure 320).
115. Change the **[Offset direction]** from 'both' to 'Seg2'. Now the RawCut at position 6 is generated and visible (Figure 320).

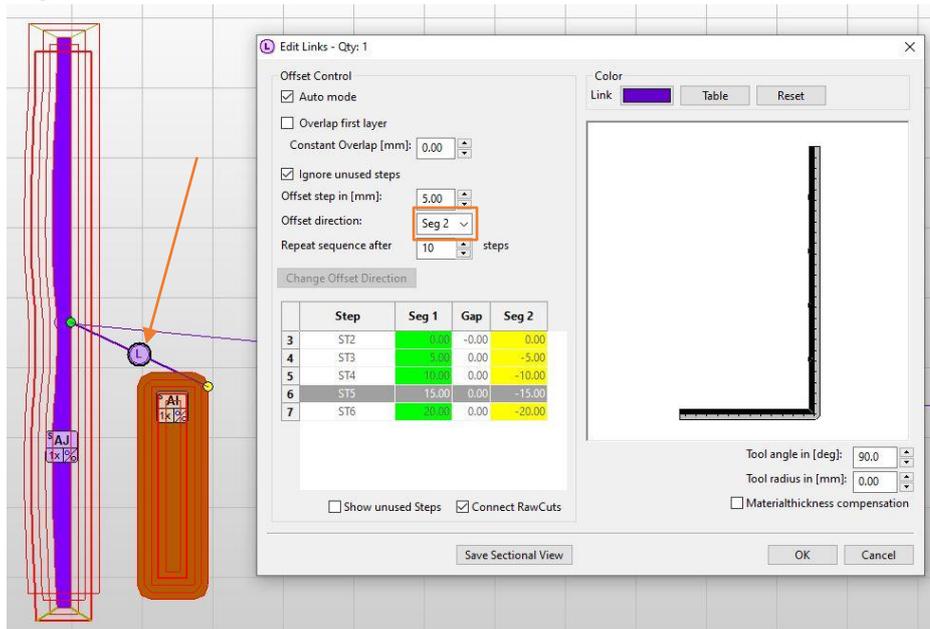


Figure 320



116. Click **R** (Reset) in the toolbar to clear the Description Box (Figure 321).

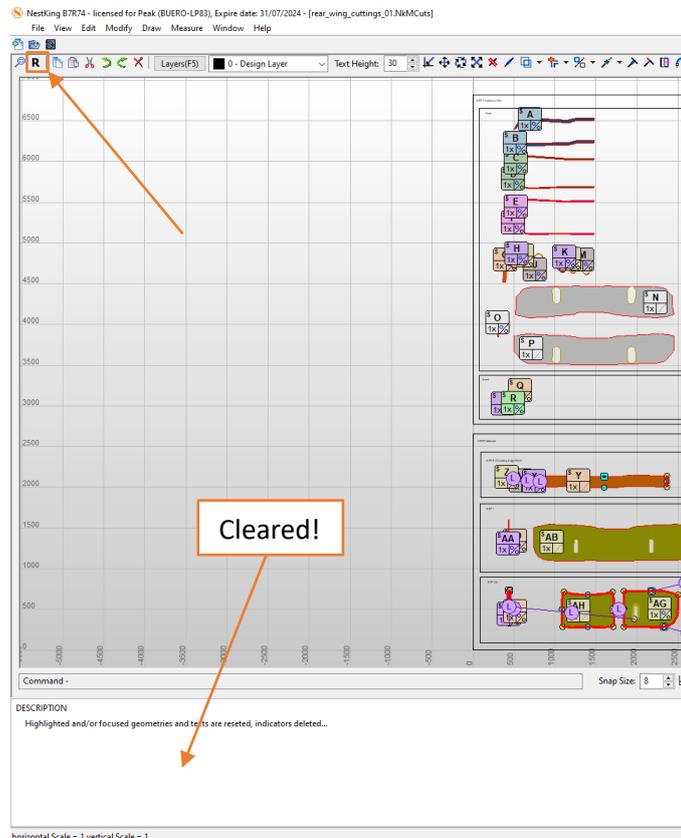


Figure 321

117. Click  (Generate RawCuts) in the main toolbar → The warning is gone (Figure 322).

DESCRIPTION

Highlighted and/or focused geometries and texts are reseted, indicators deleted...
 Generating RawCuts started...
 RawCuts generated, no warnings!

Figure 322



Next check each MasterCut and its generated RawCuts on laminability:

The Leading Edge Reinf RawCuts (STP 8-13) are fine and ready for nesting.

However, if we take a closer look at the MasterCuts of the Insert Reinforcement (ST14-19), we see that some of these cuts cannot be laminated cleanly.

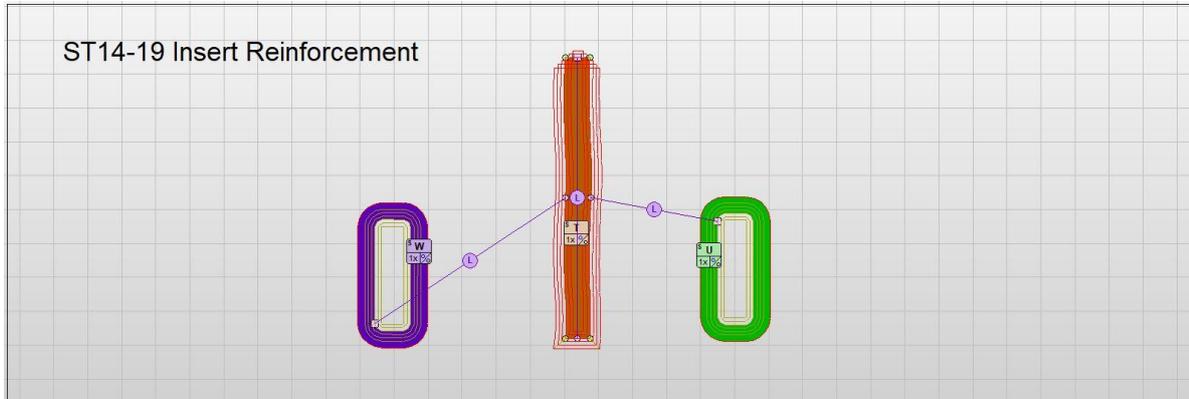


Figure 323

As shown in Figure 324, the blanks must be placed around two 90-degree edges to ensure clean overlaps. Thus, it makes sense to add slices to the inwardly offset segments of MasterCut W, and U and the outwardly offset segments of MasterCut T.

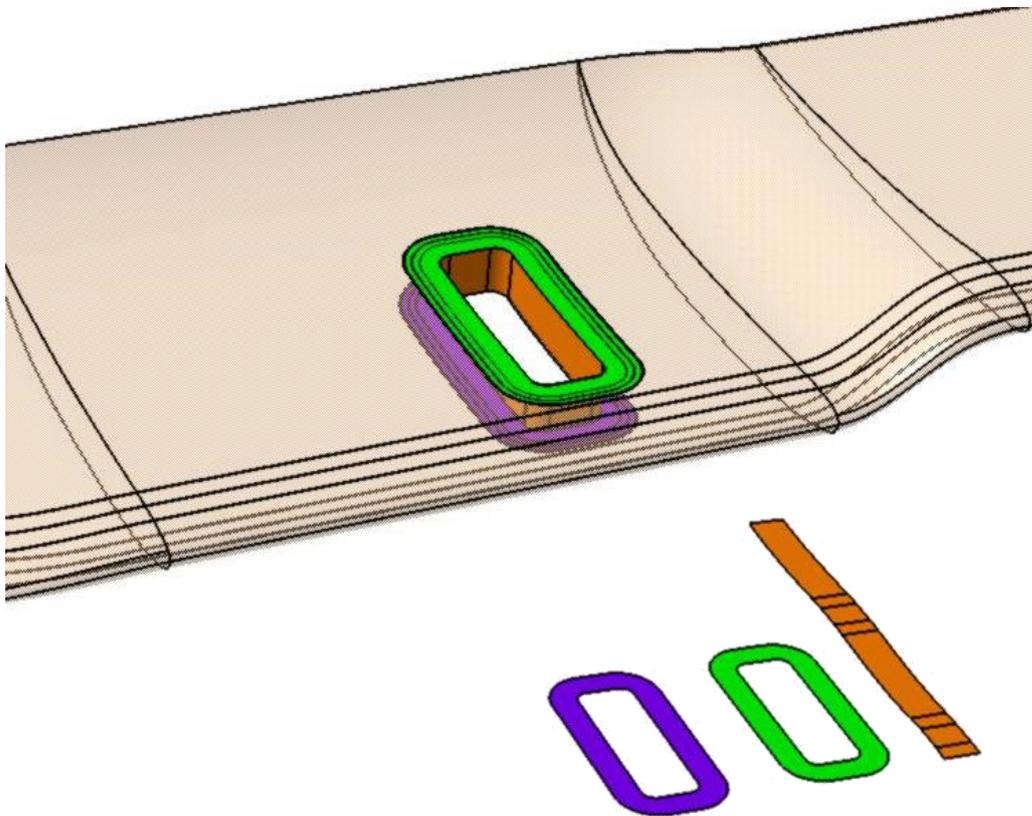
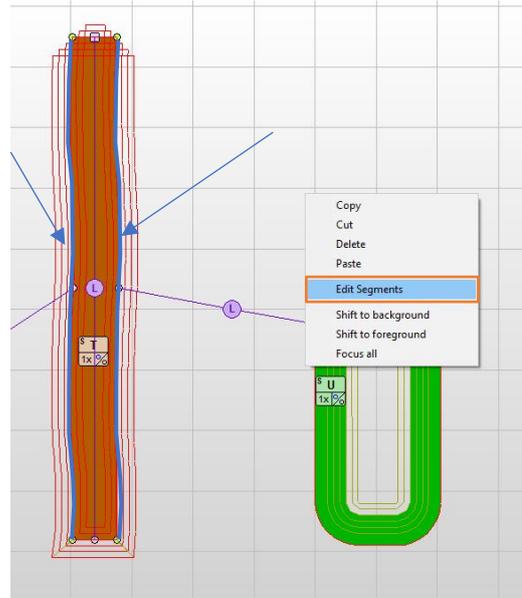


Figure 324



118. Select both vertical segments on the left and right, right-click and click on **[Edit Segments]** (Figure 325).



119. By clicking on the Step Position number (Figure 326) you can highlight the associated RawCuts of this step. Conversely, you can also simply click on the RawCut and NestKing to highlight the corresponding step in the Edit Segments Dialog.

This makes it easy to figure out which steps need to add slices to. Use 8 slices for ST15, 10 slices for ST17 and 12 slices for ST19 (Figure 326).

Click to confirm.

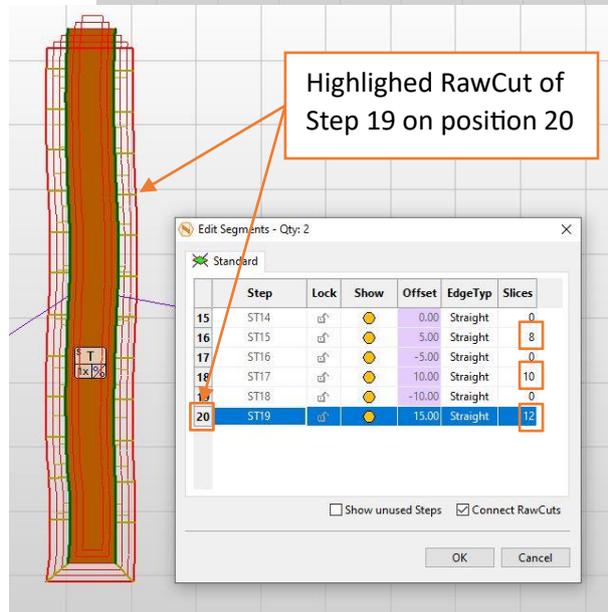


Figure 326

120. To finish MasterCut T change the connection types on the lower end from “Straight1” to “V-Dart”:

Select both Connection Points as indicated in Figure 327.

Right-click somewhere inside the Drawing Area and select **[Edit Connection Points]**.

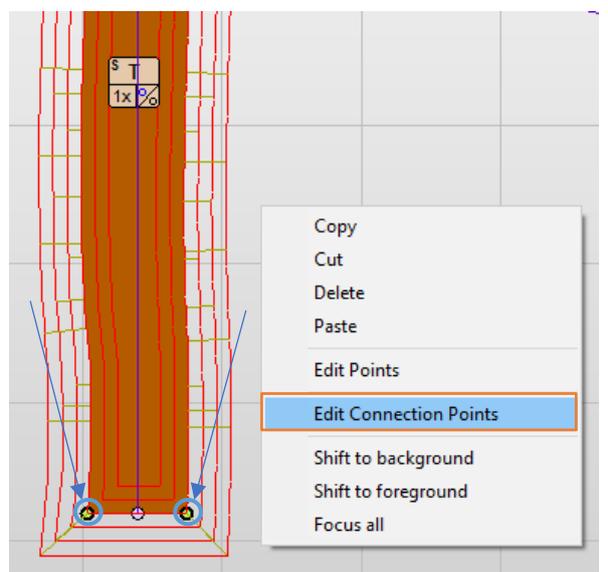


Figure 327



121. To change the connection type (abbreviated with ConTyp in Figure 328) right click on the ConTyp label and select **[Open Connection Point Dialog]** as shown on the left.

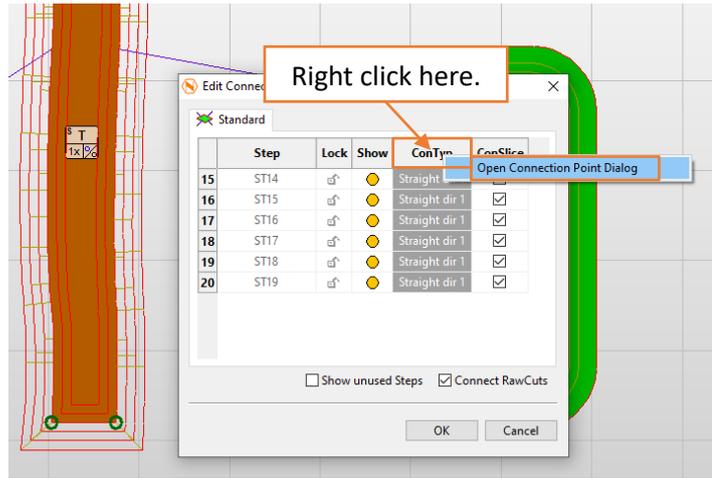


Figure 328

122. Next switch the connection type from “Straight dir1” to “V-Dart” (Figure 329).

123. Click to confirm.

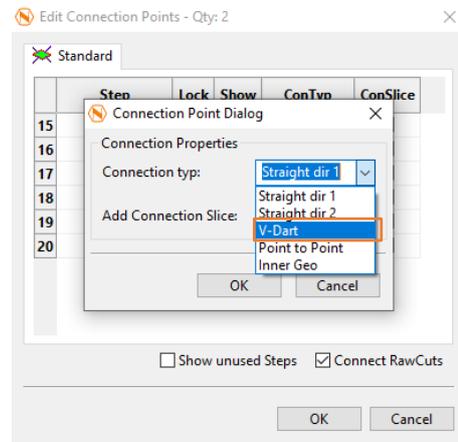


Figure 329

124. As emphasized in Figure 330 the Connection Typs of all steps are set to “V-Dart”. Instead of connecting the RawCuts Straight at this points V-Darts are added instead. V-Darts are better suited for 90 degree bendings as we have them in this case. Click to confirm our settings and close the Edit Connection Points dialog.

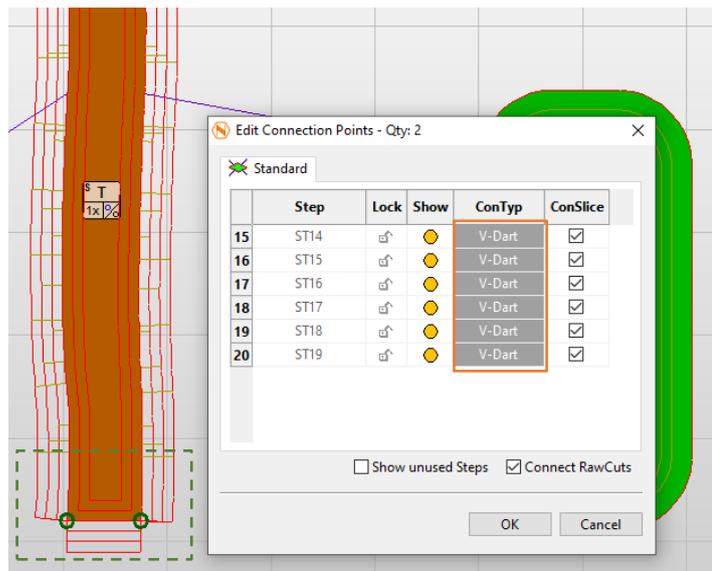


Figure 330



125. Further we can also add slices to the inwardly offsetted RawCuts of MasterCuts W. In this case we just need slices at the four inner edges.
Double-click on the MasterCut to open the MasterCut dialog.
126. By changing from the OS (Outer Segments) to the IS 1 (Inner Segments 1) offset tab and clicking on the most inner RawCut geometry (see Figure 331) we can highlight the corresponding step. The offset of the most inner geometry is 10 mm... we need to remember this value for the next steps.
127. Click **Modify MasterCut** to open the MasterCut Sketcher Dialog (Figure 331).

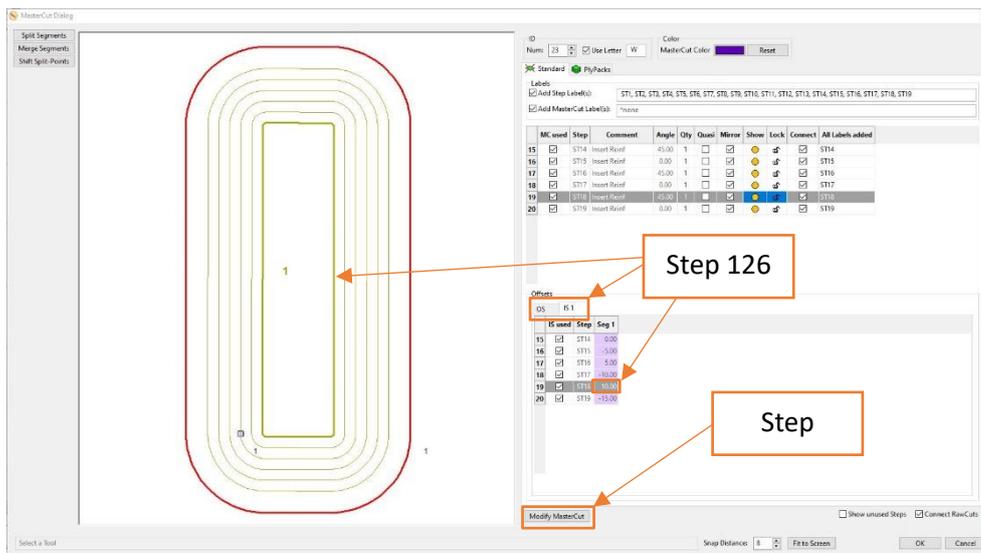


Figure 331

128. Inside the MasterCut Sketcher Dialog we can modify our mastercut geometries, add new geometries or also delete them if required. In this case we want to add slices at the for inner corners. Thus, select **[Offset – straight edges]**, as shown by Figure 332.
(Actually, it does not matter if we use the Offset tool with round or straight edges in this case.)

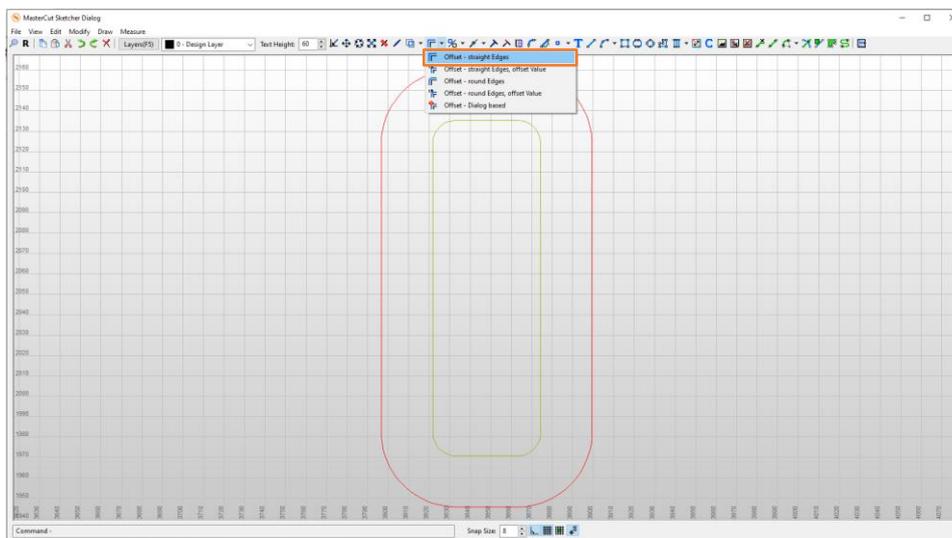


Figure 332



129. As shown in Figure 333 the command box states that we need to select an offset geometry first.
Select the inner geometry (Figure 333).

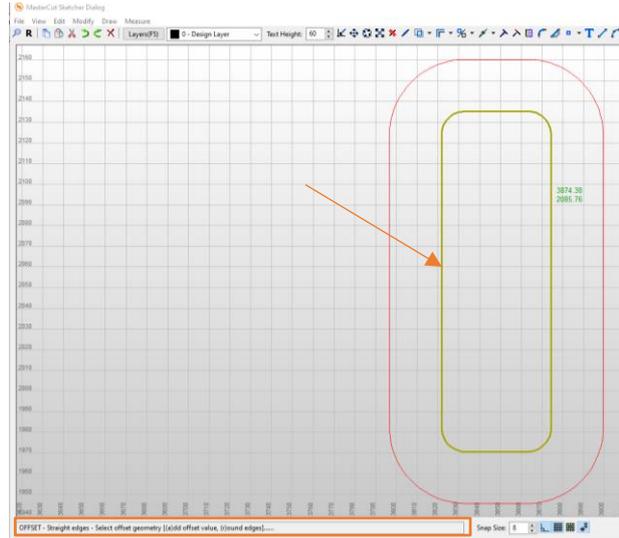


Figure 333

130. Now offset the inner geometry by at least 10 mm (See step 126).
Enter 11 mm just to add some safety distance (Figure 334).
Press **SPACE** or **ENTER** to confirm.
Now the Command Box shows 11 mm for the offset value:



Figure 335

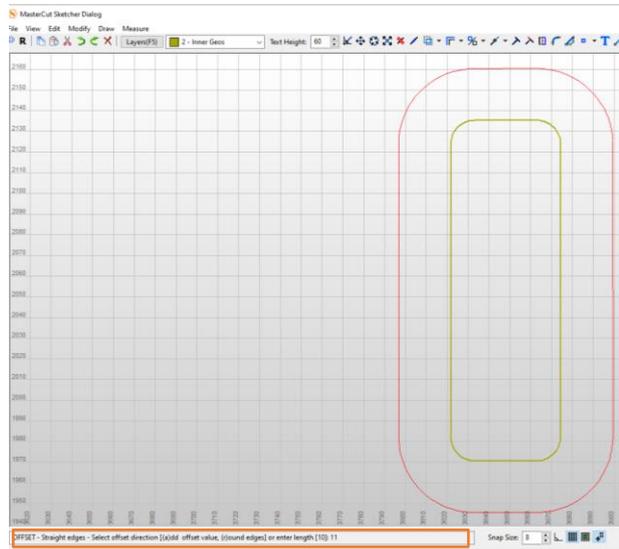


Figure 334

131. Click somewhere inside the inner geometry to add the offset geometry (Figure 336). Make sure the new geometry is also at layer 0 as we only need it for design purposes.

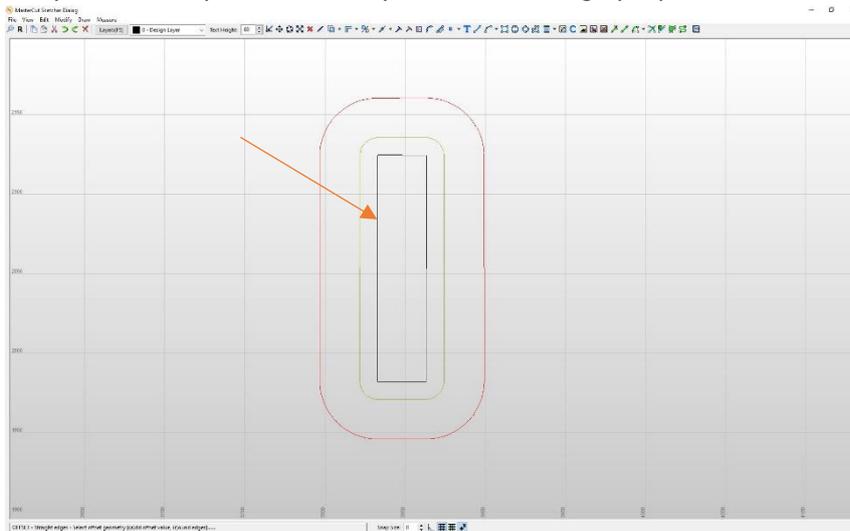


Figure 336



132. Next change the active layer to inner layer 2 2 - Inner Geos and select (Line) (Figure 337).

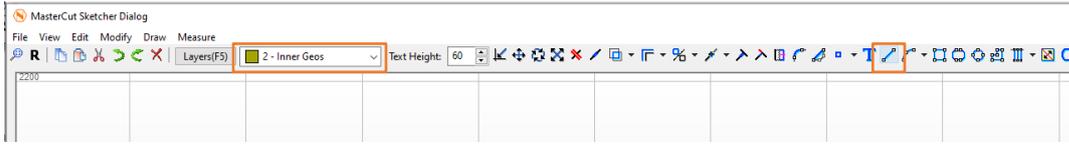


Figure 337

133. Since we don't want to draw straight lines here and don't need the grid for selecting the line points, ensure that (Orthogonality; -F8-) and (Snap Grid; -F10-) are not active (Figure 339).

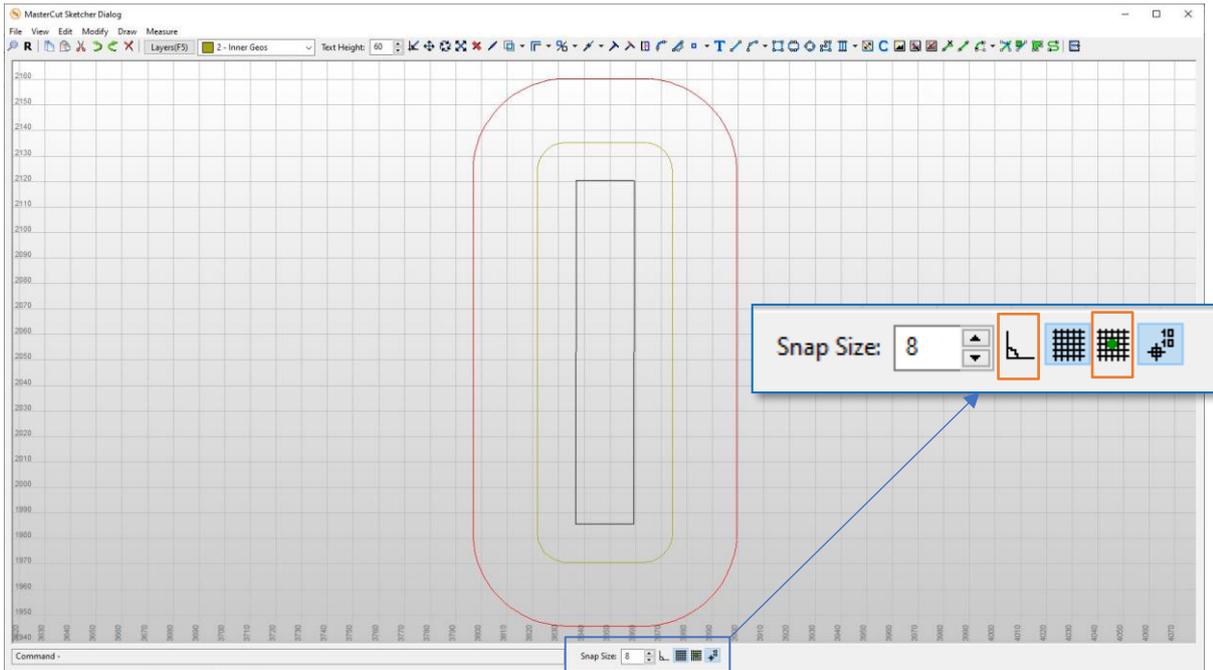


Figure 339

134. Draw five slicing lines at each corner of the inner geometry (Figure 338).
Attention: As indicated in the Detail View ensure that slices are not touching or intersecting. Otherwise NestKing will interpret them as splitting segments (see *step 168* starting at page 147 and following).

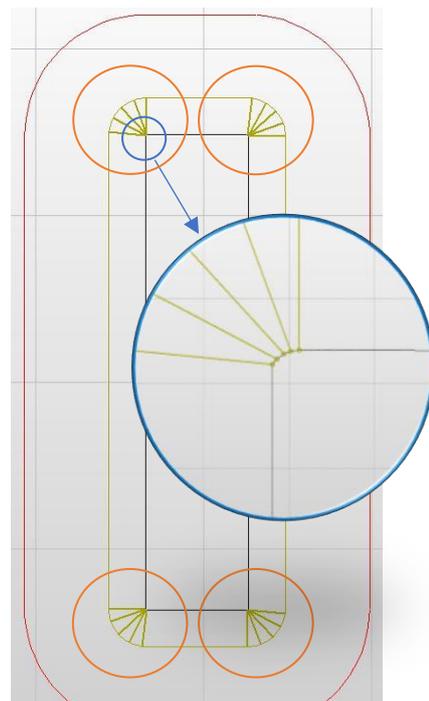


Figure 338

135. Exit the sketcher with .



Figure 340



136. Since we do not assign any properties from the original mastercut to our generated slice geometries and their connection points, just press **OK** to confirm the changes.

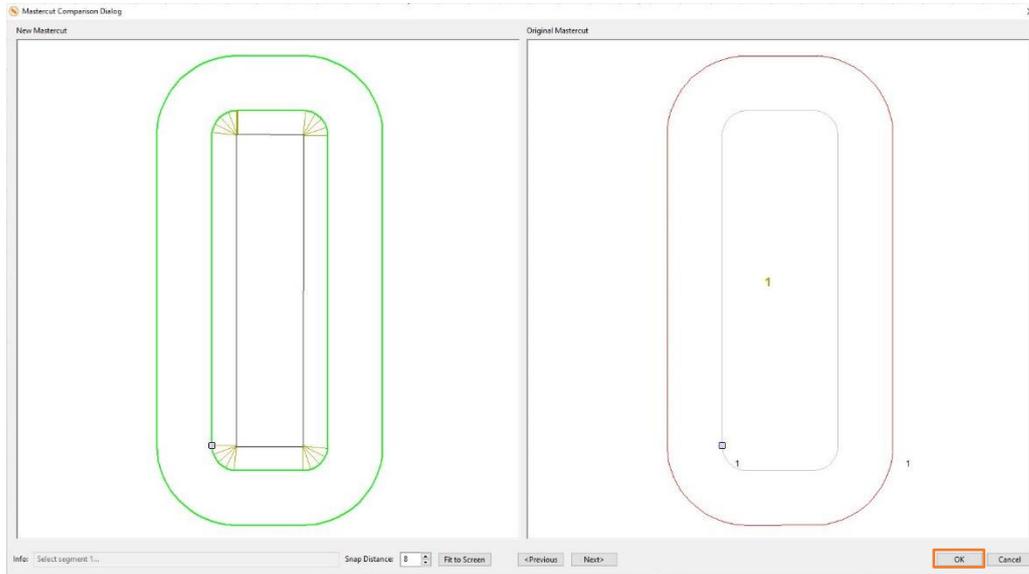


Figure 341

137. By clicking on the most inner geometry, represented by ST18, again we now will see that all slices are used for this RawCut (Figure 342). The same is also valid for ST16. To vary the positions of the slices the outer two slices and the center slice of each corner are applied to ST16 and the other two slices of each corner to ST18. The first possibility to achieve this solution is to set the **[IS used]** checkbox for all slices in the MasterCut Dialog (Figure 342). But there is also a more elegant and easier solution. Therefore close the MasterCut Dialog with **OK**.

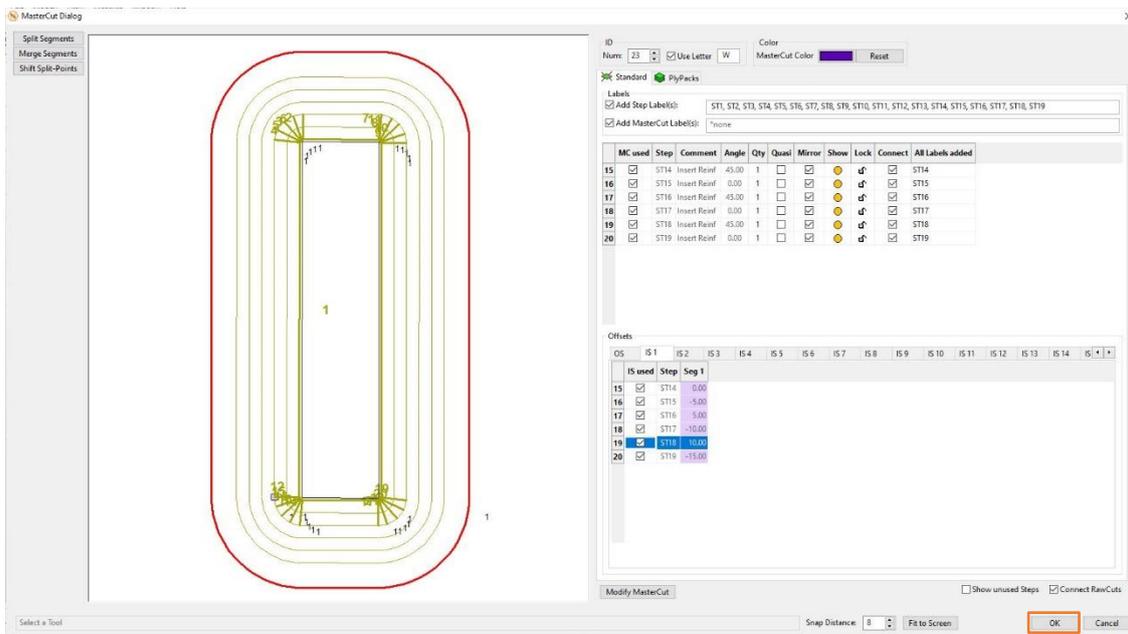


Figure 342



138. Back in the Sketcher Space select the outer slices and the center slices of each corner (Figure 343).
139. Right click somewhere in the sketcher area and select **[Edit Segments]** (Figure 343).
140. In the Edit Segments dialog check **[Used]** for ST16 and deactivate it for all other steps as indicated in Figure 344. Confirm with **OK**.

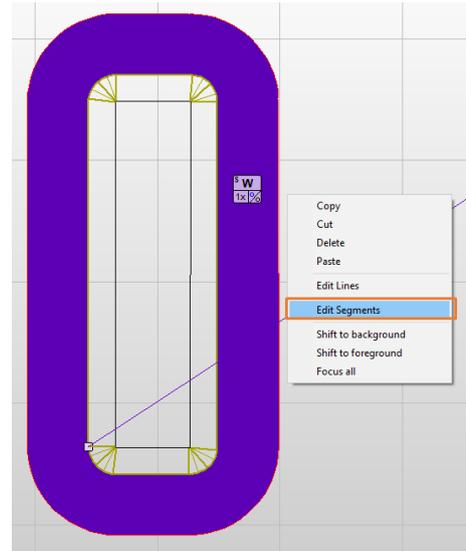


Figure 343

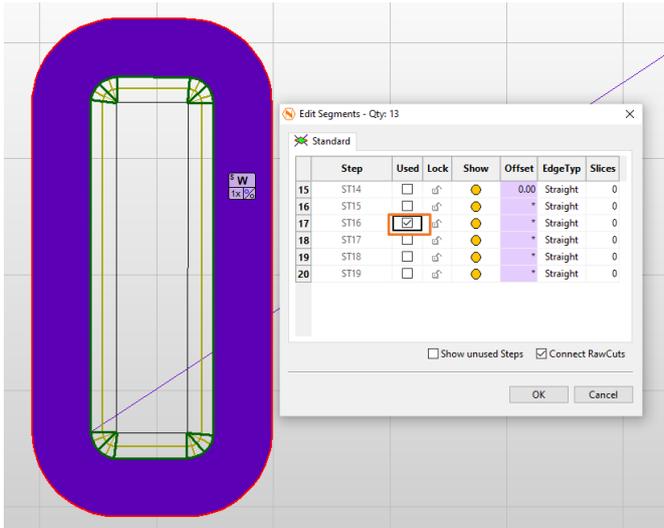


Figure 344

141. Repeat the last three steps for ST18, but use the two remaining slices for each corner instead (Figure 345).
142. Right-Click and select **[Edit Segments]**.
143. Deselect all checkboxes of the **[Used]** column except of ST18.
144. Click **OK** to confirm!

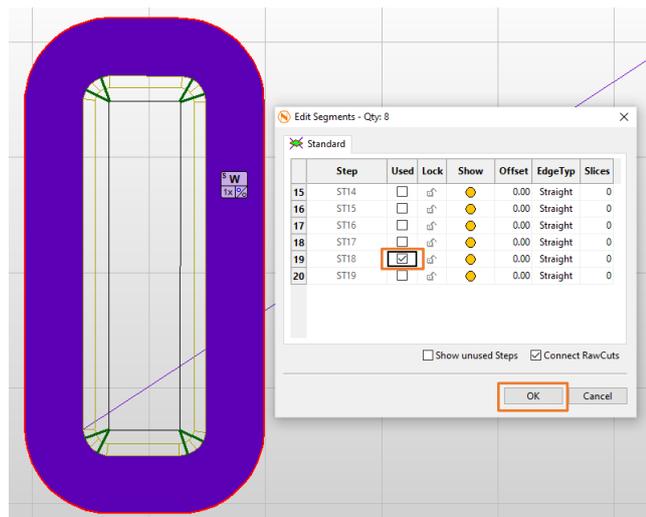


Figure 345



145. If we now open the MasterCut dialog of MasterCut W we will see that STP16 just uses the two outer and the center segments for each corner. Therefore click on the row label stating 17 for STP 16 to highlight the appropriate RawCut for this step (Figure 346).

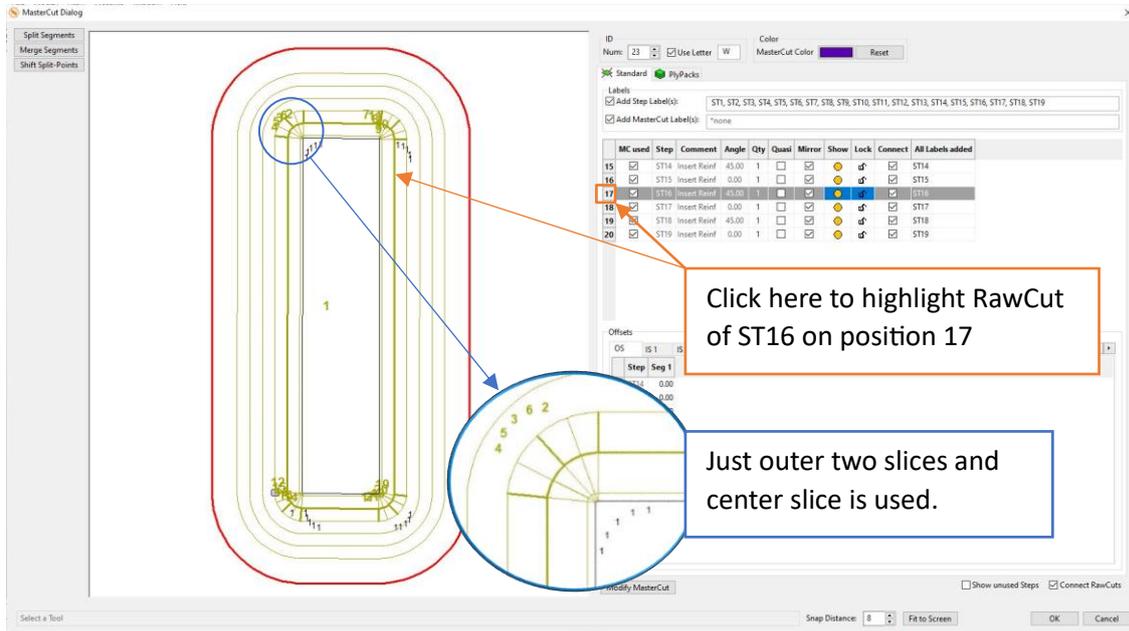


Figure 346

Further by clicking on Position 19 we can also check if the slices of ST18 are set properly.

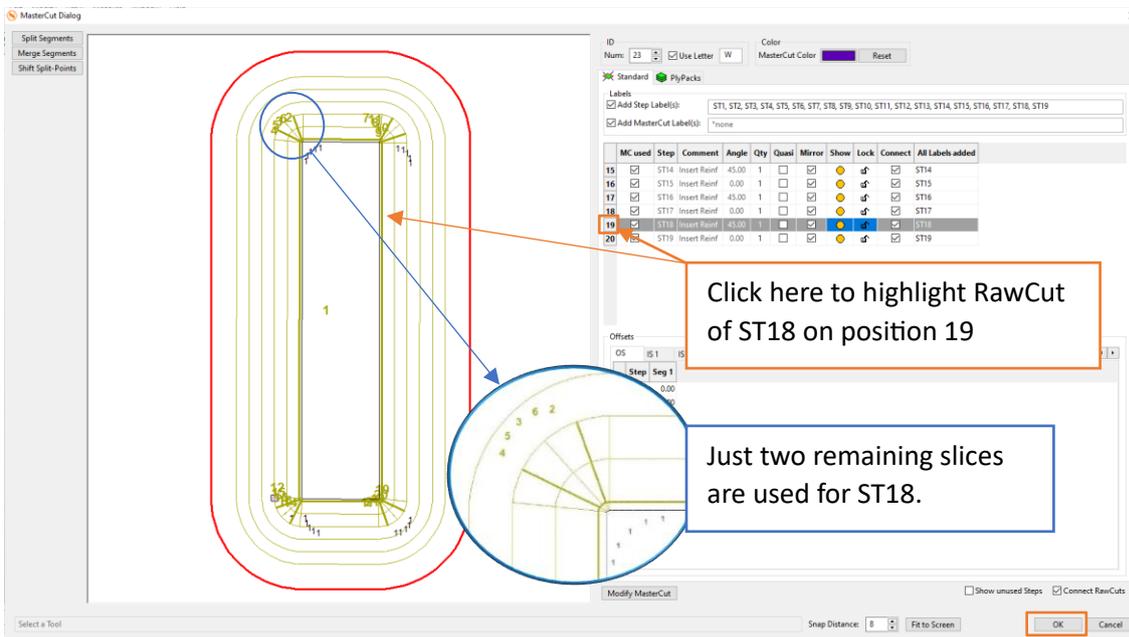


Figure 347

Perfect! Now we can leave the MasterCut Dialog with **OK**. MasterCut W is finished as well.



146. Next we can focus on MasterCut U (Figure 348).

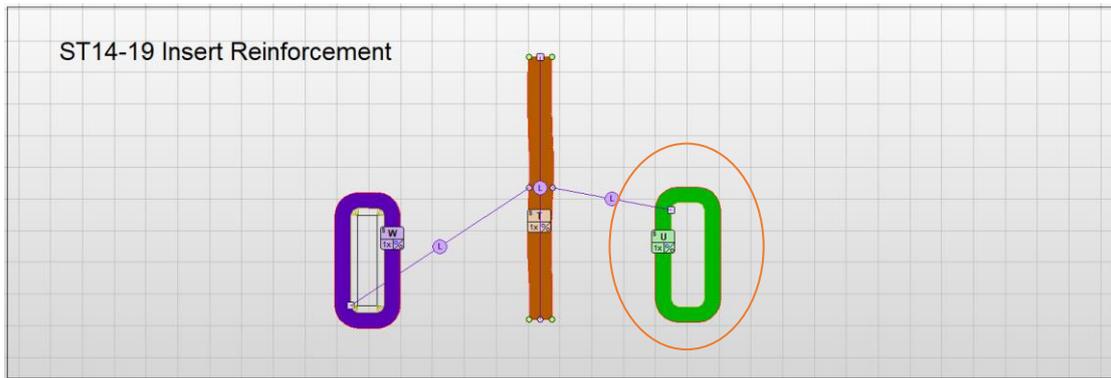


Figure 348

The situation is basically the same as for MasterCut W. We just want to add additional slices at the inner corners of the inwardly offsetted geometries of ST16 and ST18. So let's repeat all steps already applied for MasterCut W. Start with *step 125* on page 134 and open the MasterCut dialog by double-clicking on MasterCut U and finish with checking the final results as described in the previous *step 145* on page 139.

The following figure shows the final highlighted RawCuts of ST16 on the left and ST18 on the right.

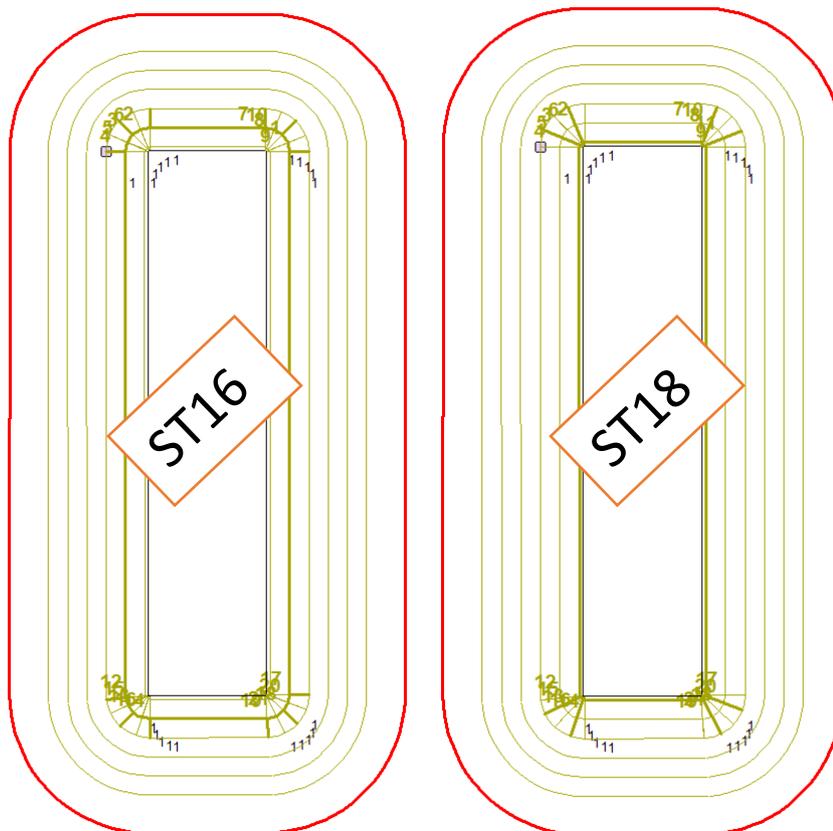


Figure 349



Now we can focus on the MasterCuts with their RawCuts for STP 2-6 at the bottom.

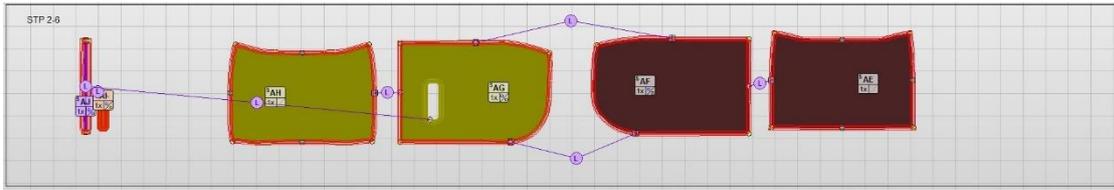


Figure 350

First, we have to consider, that these MasterCuts are forming the second to the sixth layer of the outer shell. Under consideration of Figure 351 (already known from E2. Lay-up Sequence on page 92) the cuts of the bottom tool are extended and the cuts of the top tool need to be trimmed. Cuts of the bottom tool are generated by MasterCuts AH and AG on the left. Cuts of the top tool are generated by MasterCuts AF and AE on the right.

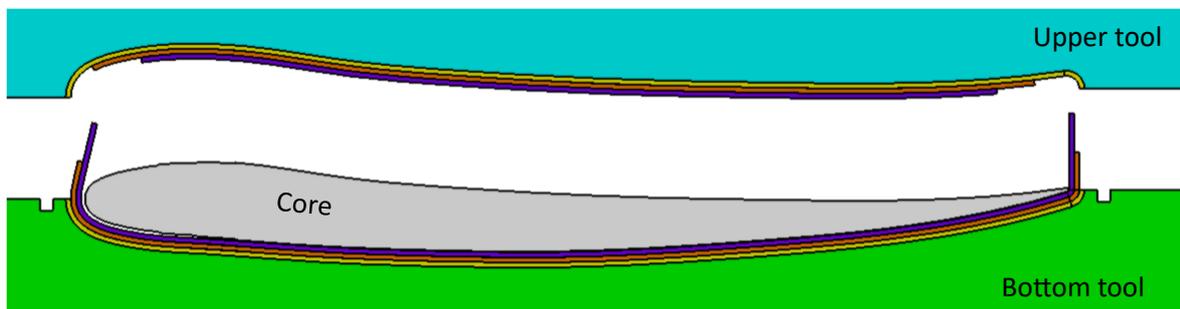


Figure 351

147. Select the affected links, right-click and click on **[Edit Links]** (Figure 352).

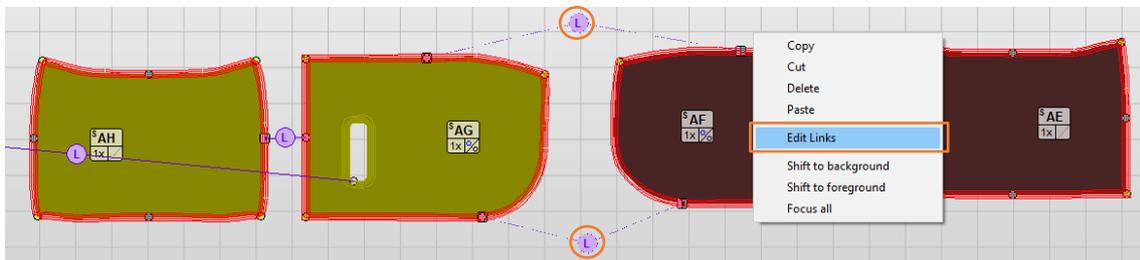


Figure 352

148. Uncheck **[Auto mode]**. Figure 353 also emphasizes that the green point of the link represents **Seg 1** and the yellow point represents **Seg 2** in the Edit Links Dialog.

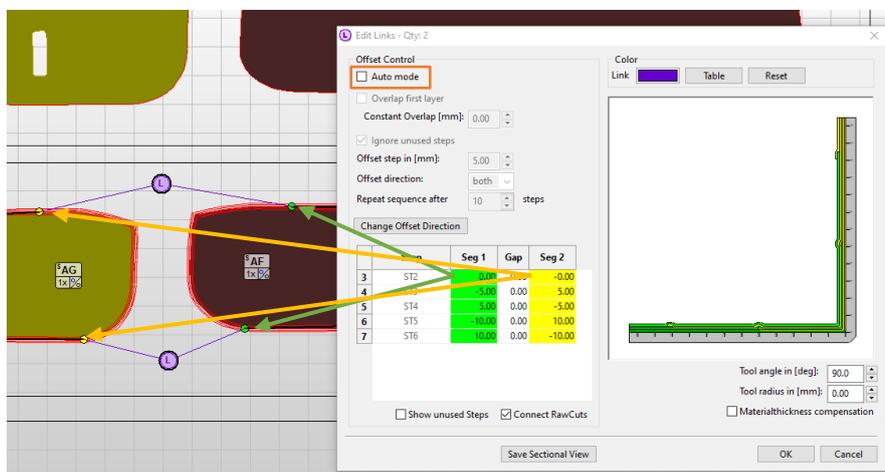


Figure 353



149. Consider that the offsets of MasterCut AG, represented by **Seg 2**, needs to be in positive direction and the offsets of MasterCut AF, linked to **Seg 1**, in negative direction. You can change these offset values manually or you can also use the AutoFiller:
 Right click on the Label of **Seg 1** and select **[AutoFiller]** (Figure 354).

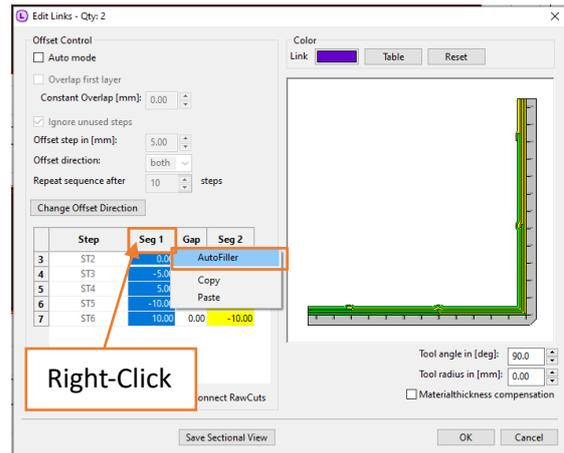


Figure 354

150. Since we start with ST2 our first offset should be “-10” mm, the second one “-20”, the third one “-30” mm and so on. In order to get this negative delta value set **[Delta]** to “-10” and the **[Direction]** to “Negative(-)” (Figure 355).

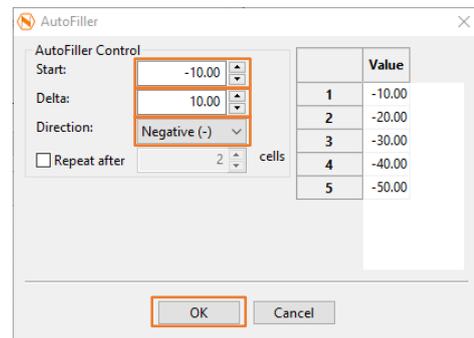


Figure 355

151. Click **OK** to confirm these settings.

152. Checking the results in the Sketcher Space we will see that the offsets are now exactly how we want them to be. Click **OK** to confirm.

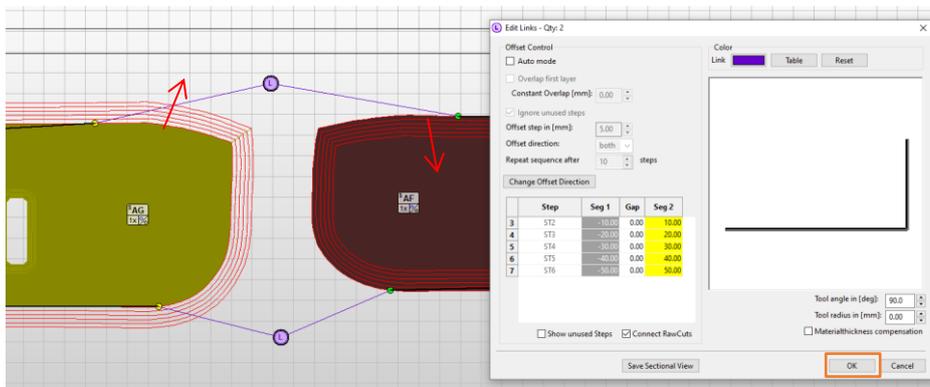


Figure 356

153. Since we are starting with ST2 we also need a starting offset not equal to zero for the link connecting the mounting pocket Segments as shown in Figure 357 as well. Therefore let's double click this link.



Figure 357



154. As indicated in Figure 358, the table starts with “0” mm at ST2, which is the same offset value as for ST1. Thus, we have to start with “5” mm for ST2 and end with “+25” mm for ST6.
Deactivate the **[Auto mode]** (Figure 358).

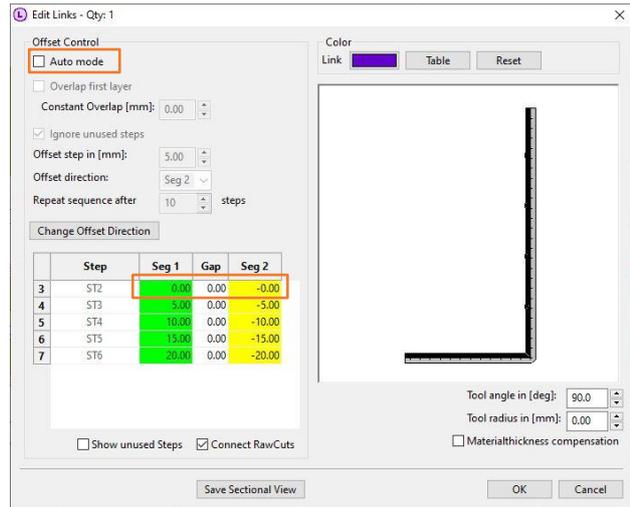


Figure 358

155. To change the offset values we can use again the AutoFiller. Thus, we just need change five values, changing them by hand is also fine, that is up to you. Finally, the offsets should look like indicated in Figure 359.
Click **OK** to confirm.

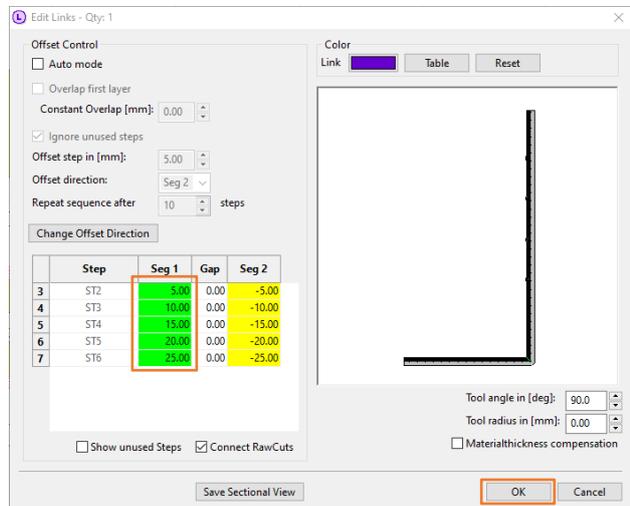


Figure 359

156. The same also counts for the link between MasterCut AJ and AI (Figure 360). But in this case the RawCut of ST6 of MasterCut AI would almost disappear if we would set the final offset of ST6 to “25” mm. Thus, we can also start with “0” mm again, with 5 steps in between this is not a problem regarding mechanical properties. Click **OK** to confirm.

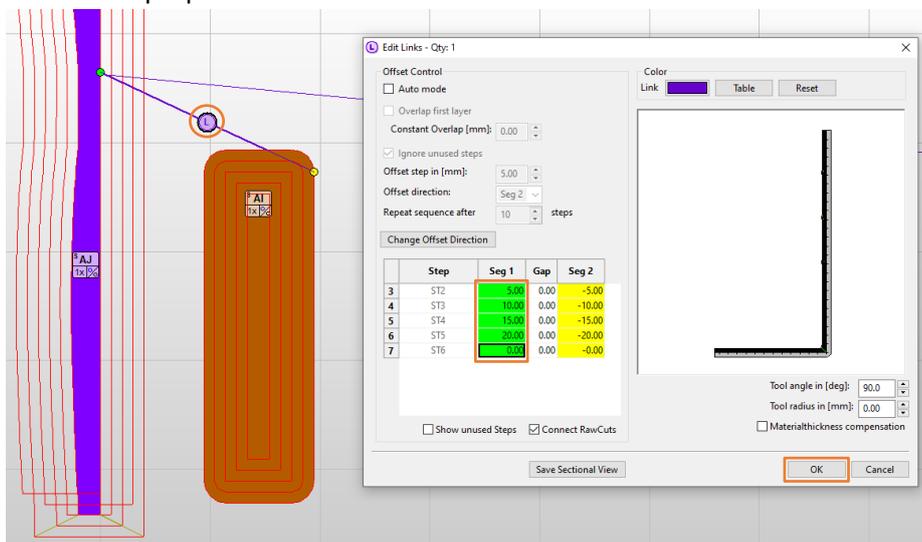
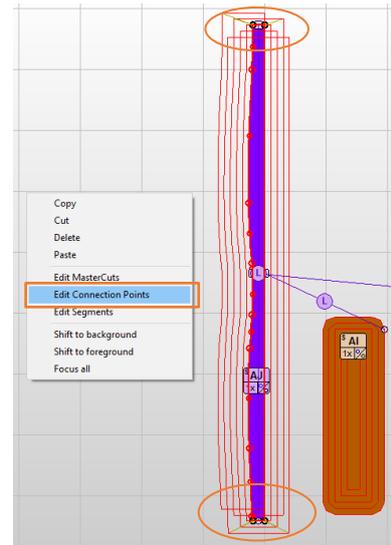


Figure 360



157. Focusing on MasterCut AJ, same as for MasterCut T, change the connection types (see Figure 361) of MasterCut AJ from “Straight1” to “V-Dart”. Therefor select the MasterCut, right-click and **[Edit Connection Points]**.



158. Next right click on the **[ConTyp]** (Figure 362). Click on **[Open Connection Point Dialog]**.

159. Change Connection Typ to “V-Dart” (Figure 363).

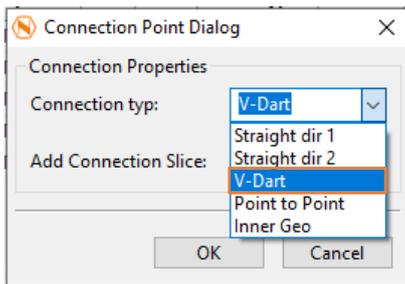


Figure 363

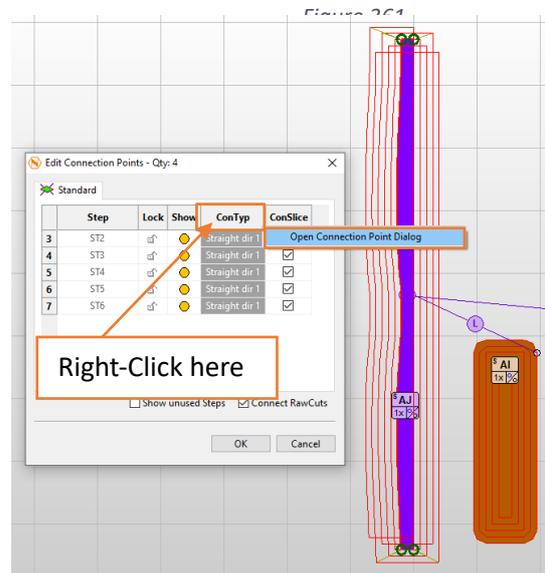


Figure 362

160. As emphasized by Figure 364, instead of connecting the RawCuts Straight at the connection points V-Darts are used instead.

Click **OK** to confirm the new settings and close the Edit Connection Points dialog.

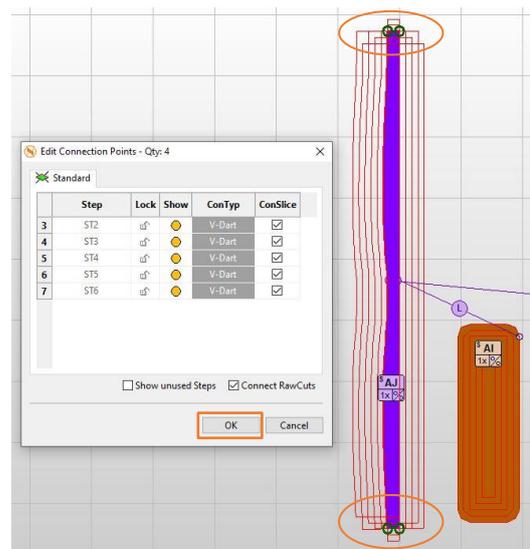


Figure 364



161. Next MasterCut AJ also needs slices to ensure easy and clean trapping around the 90° tool edges. Thus, select both vertical segments (Figure 365), right-click and select **[Edit Segments]**.



Figure 365

162. For the selected Segments all Offset values from ST2 to ST6 are positive. Thus, slices for all these steps are required. Select “8”, “9”, “10”, “11” and “12” slices (Figure 366).

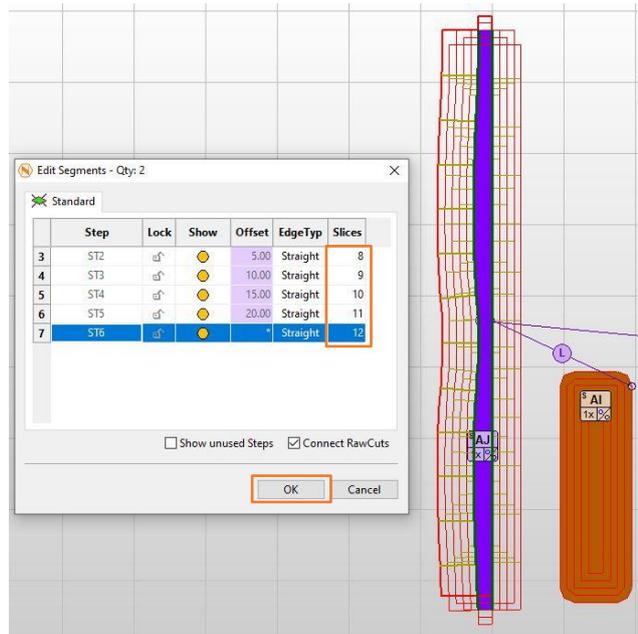


Figure 366

163. Click **OK** to confirm the Edit Segments Dialog.

164. Very nice! We have just finished the setup process! Now we can save  the file and leave the sketcher with **Exit** .



Figure 367



165. Next click  (Generate MasterCut Output) (Figure 368).

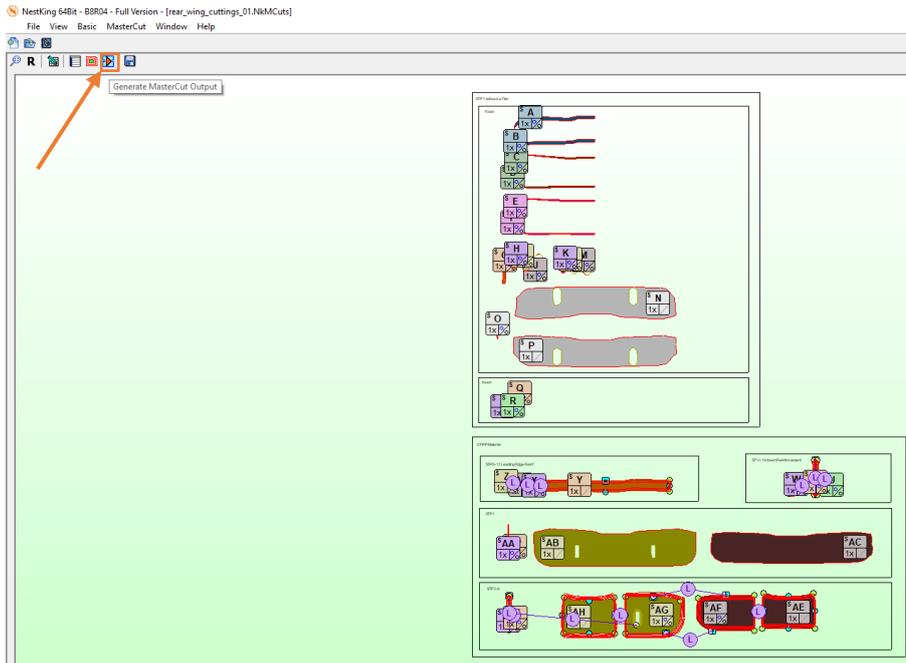


Figure 368

166. As shown in Figure 369 a nest dimension check warning appears stating that two RawCuts are oversized for the used material. According to the Description Box affected Steps are ST1 of MasterCut AB and ST1 of MasterCut AC. Abort the MasterCut Output generation by clicking no

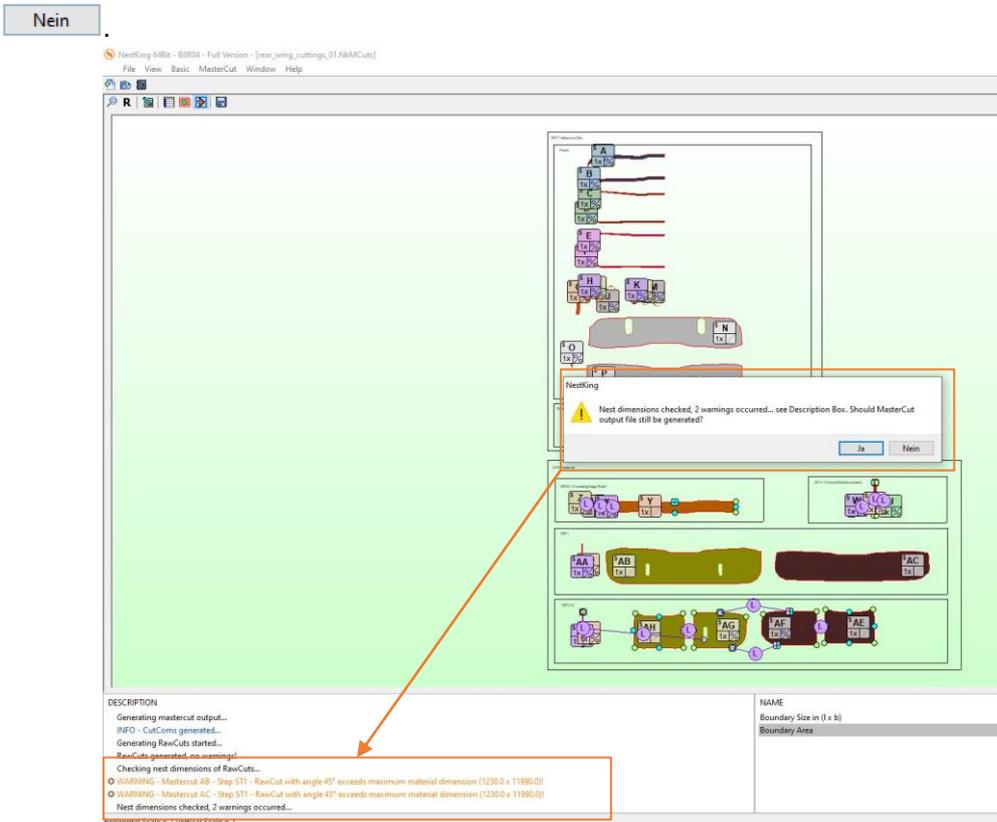


Figure 369



167. Taking a closer look at the Description Box we will see that there are also two dots next to the warning message itself. This indicates that we can also click on the Warning Messages to zoom to the MasterCut causing the problem.



Figure 370

Enter the Sketcher space (shortcut **S** or click in the main toolbar), double click on MasterCut AB to open the MasterCut dialog box.

168. The problem is that if we turn the RawCuts of ST1 by the defined 45° the resulting cut will exceed the nest width of 1230 mm (equals material width minus material margins on top and bottom). Now we have two possibilities.
- First, we can change the angle of ST1 to from 45 to 0 degrees (see also Figure 239 on page 102).
 - Further we can also split the RawCut of ST1 into two pieces. Therefore click the **Modify MasterCut** (Figure 371).

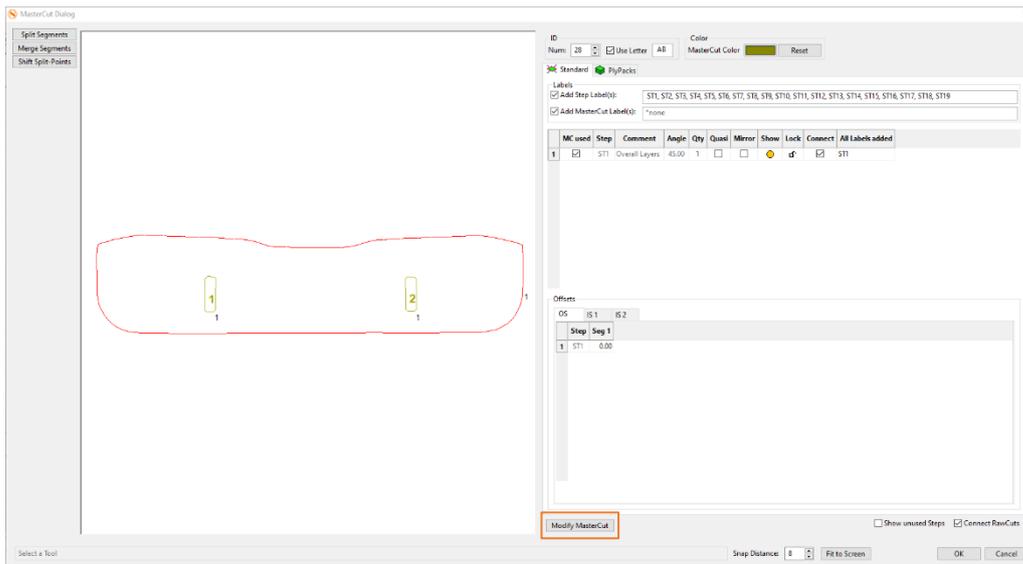


Figure 371



169. In the MasterCut sketcher Dialog select layer 2 (Figure 372).

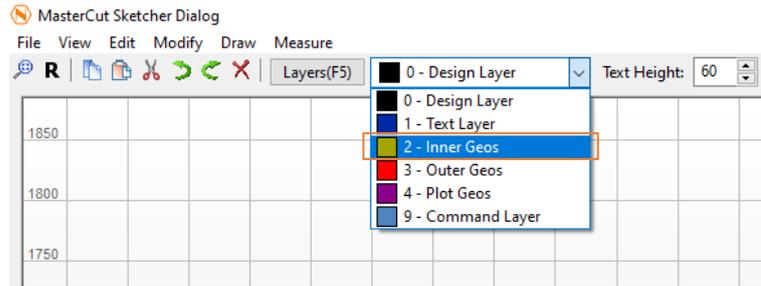


Figure 372

170. Ensure that orthogonality  (-F8-) is activated.



Figure 373

171. Next select  (line) (Figure 374).



Figure 374

172. First to get a center point draw a horizontal line between the two pocket holes as shown in Figure 375.

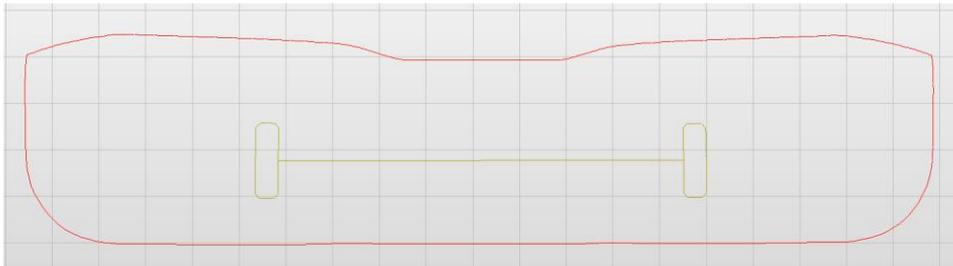


Figure 375

173. Next, use the center point of the horizontal line to draw a vertical line as shown in Figure 376



Figure 376

174. Delete the horizontal line by pressing **DEL** on the keyboard or clicking the delete button  in the main toolbar.

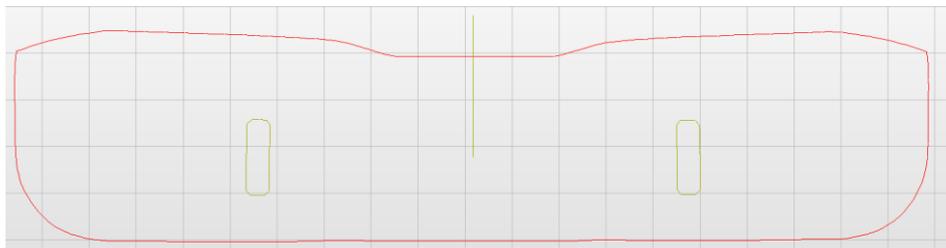
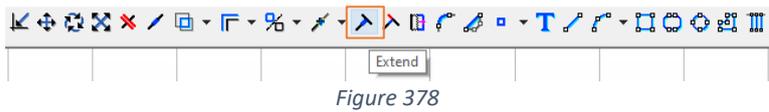


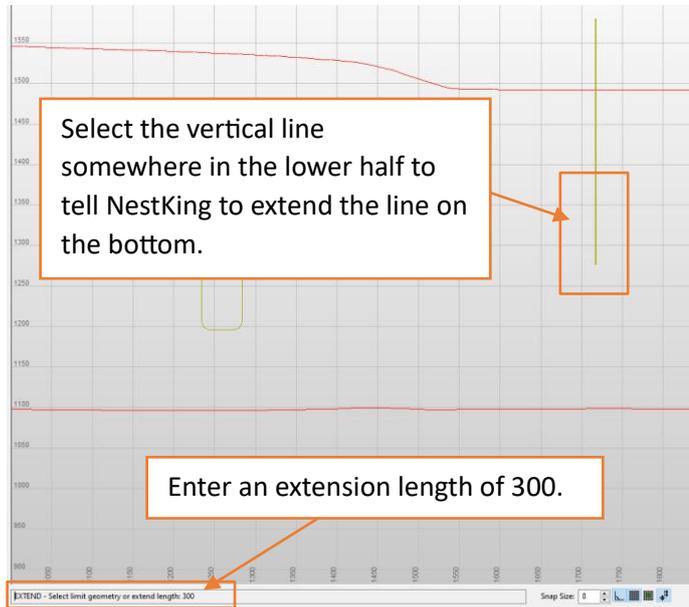
Figure 377



- 175. Select  (Extend) in the main toolbar.



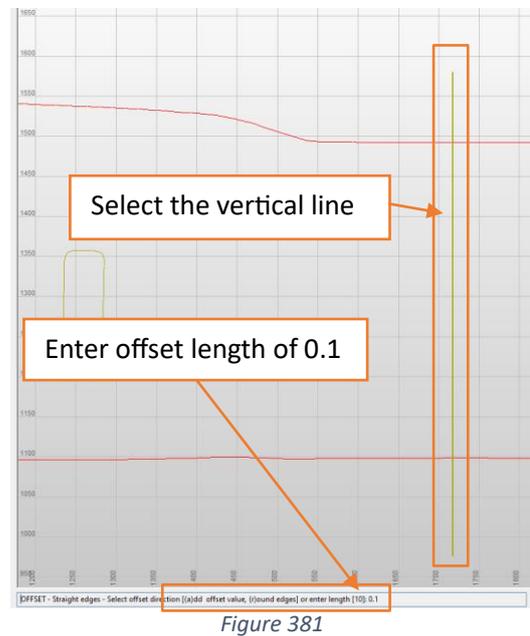
- 176. Select the vertical line somewhere on the lower half and enter an extend length of “300” (Figure 379).
- 177. Click **-SPACE-** or **-ENTER-** to extend the line.



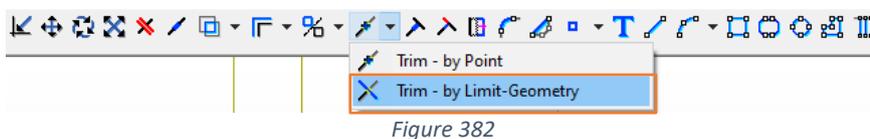
- 178. Next select  (Offset Geometry) (Figure 380).



- 179. Select the vertical line as the offset geometry.
- 180. Enter “0.1” for the offset length as shown in Figure 381.
- 181. Click on the left or right side of the vertical line to generate the offset line.



- 182. Next select  [Trim - by Limit-Geometry] tool as shown in Figure 382.





183. Now the Command Box asks for a geometry to be trimmed. Select the first vertical line somewhere inside the red geometry, forming the outer contour of the MasterCut.

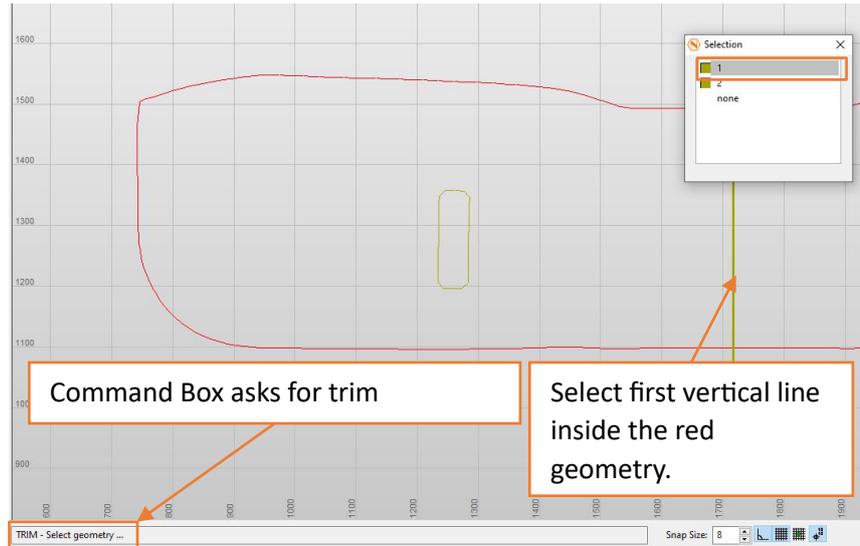


Figure 383

184. Next the command box asks for a geometry used to trim the first selected vertical geometry. Select the red outer geometry of the MasterCut.

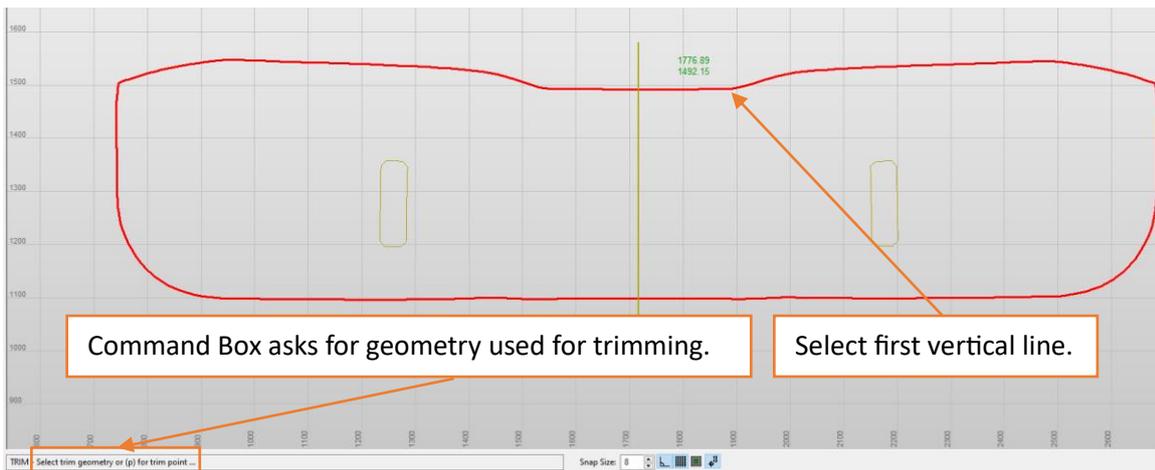


Figure 385

185. Repeat these steps for the second vertical line as well. Select the second vertical line somewhere inside the red geometry.

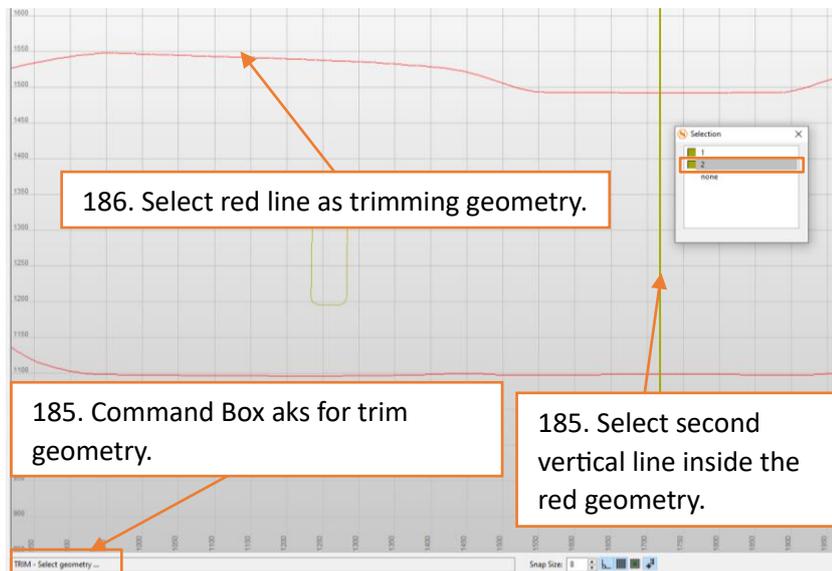


Figure 384



187. If we take a closer look both vertical lines are now ending at the red contour splitting the red geometry into two pieces.

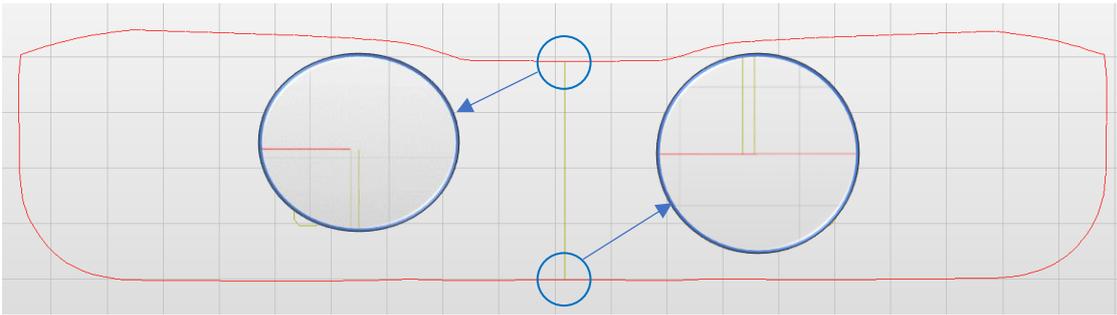


Figure 386

188. Exit the mastercut sketcher  (Figure 387).



Figure 387

189. Now the MasterCut Comparison dialog asks if properties of any existing segments should be assigned to the two newly added inner geometries and their connection points. That is not the case. Confirm with .

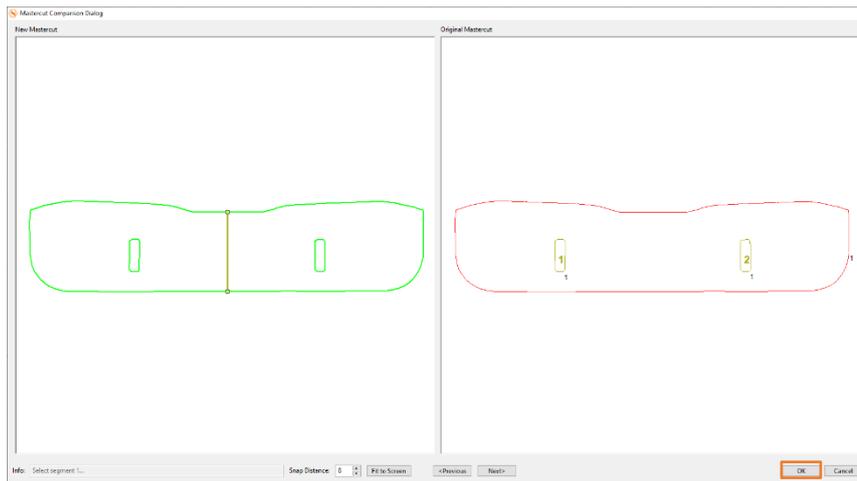


Figure 388

Back in the MasterCut dialog we now got see that two additional inner Segments IS3 and IS4 are generated with the two vertical lines (Figure 389).

Additionally, there is also a new button which allows us to change the direction of action . This button just appears for inner segment groups, which directly border on another inner or outer segment. With this button you can control which part of the outer geometry, split by the splitter segment, should be kept.

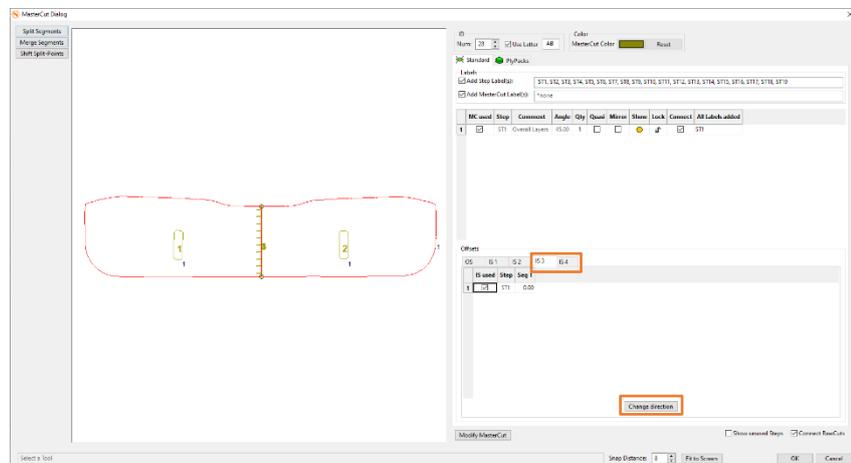


Figure 389



190. Zooming in we will see that the direction arrows of IS3 as well as the directions arrows of IS4 are pointing to the left. Both have the same action direction and just the left part of the RawCuts would be kept. To split the RawCut into two pieces we have to switch the direction of action of the right segment(group) IS4. Therefore go to the IS4 tab and click **Change direction**.

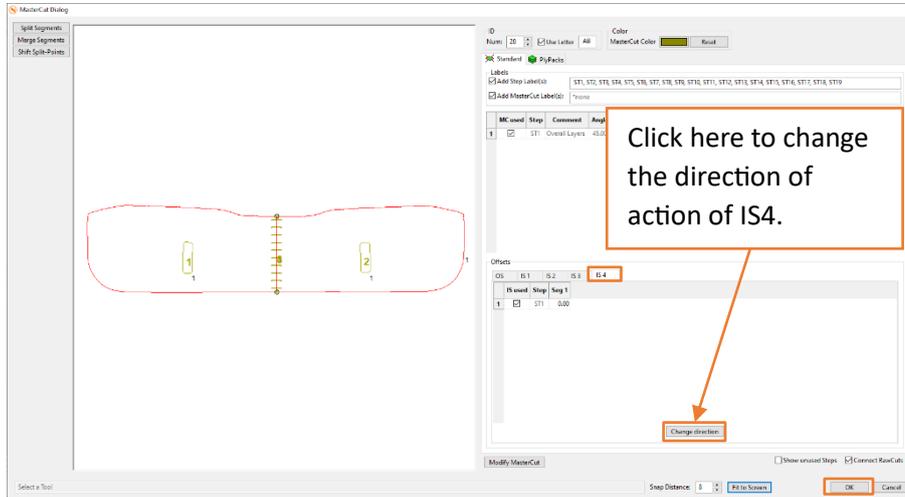


Figure 390

As shown in Figure 390 the RawCut of ST1 is now split into two Cuts which should fit into the nest container, even if rotated by the defined 45°. Click **OK** to leave the MasterCut dialog.

191. As stated in the warning message, since the RawCut of ST1 of MasterCut AC is also too large for the given nest dimensions we also must split it into two cuts. Therefore repeat step 168 starting from page 147 to the previous step 190 for MasterCut AC ST1. The final MasterCuts AB and AC will look like presented in Figure 391.

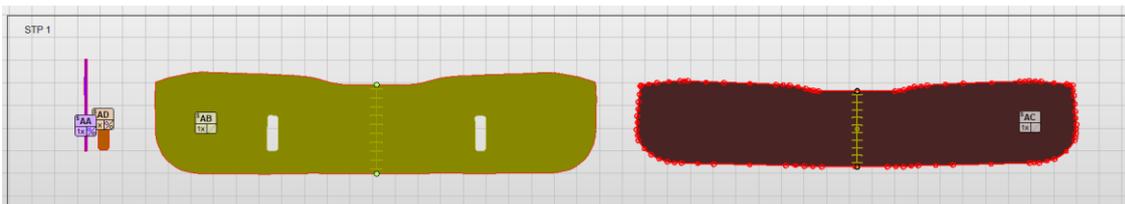


Figure 391

192. Now we can save the file  and leave the sketcher .



Figure 392



193. Next click  (Generate MasterCut Output) again.

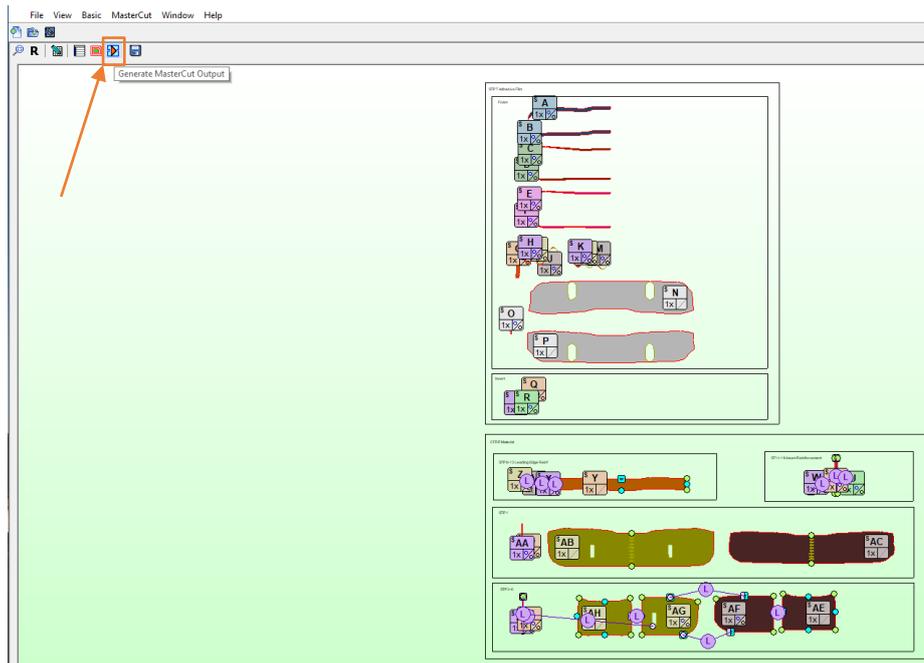


Figure 393

194. Very good! Now everything runs without any warnings, and we get the MasterCut Output data. Here you also find the already known Nest button as indicated in Figure 394. If you want to nest just proceed with 5) Nesting on page 59.

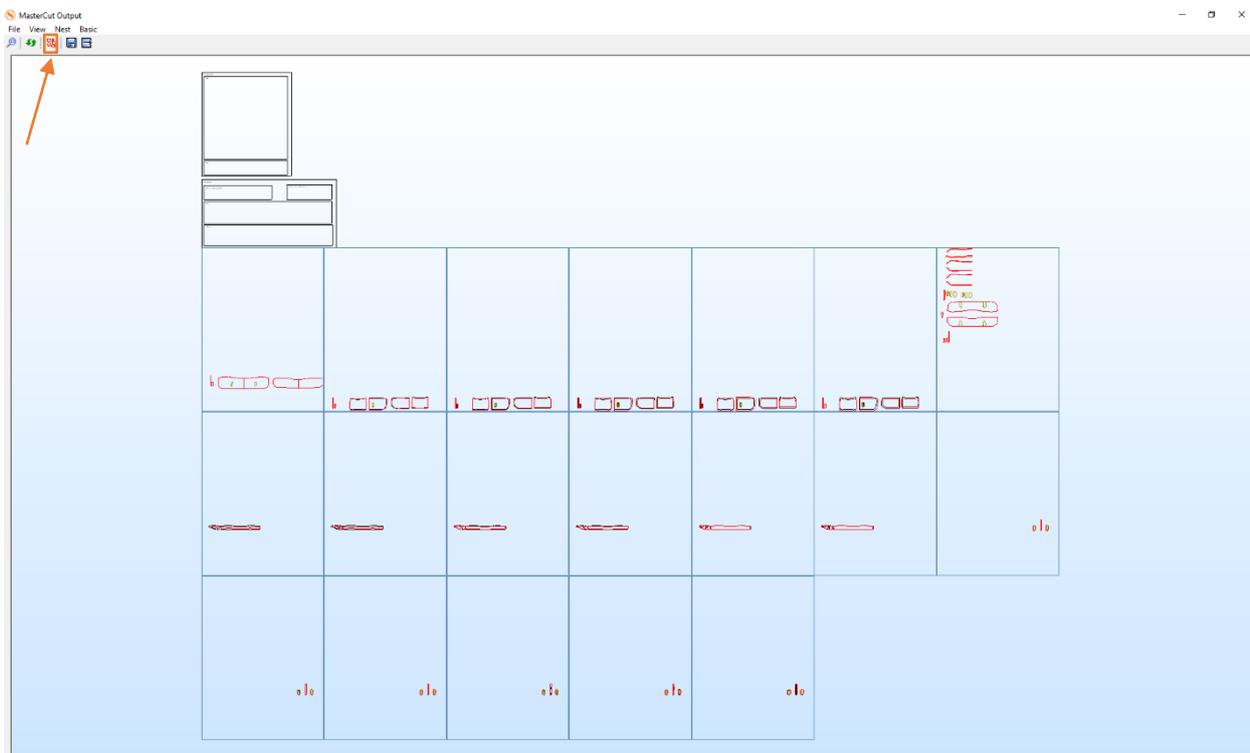


Figure 394



E4. Editing RawCuts

There are two different options to edit RawCuts in case you are not happy with the cuts generated by the NestKing algorithm. Both options are shown in this chapter.

1. First open the “rear_wing_cuttions_01.NkMCuts” file again.
2. Assume that for whatever reason we want to change the outer shape of RawCut ST4 of MasterCut AH as indicated in Figure 395.

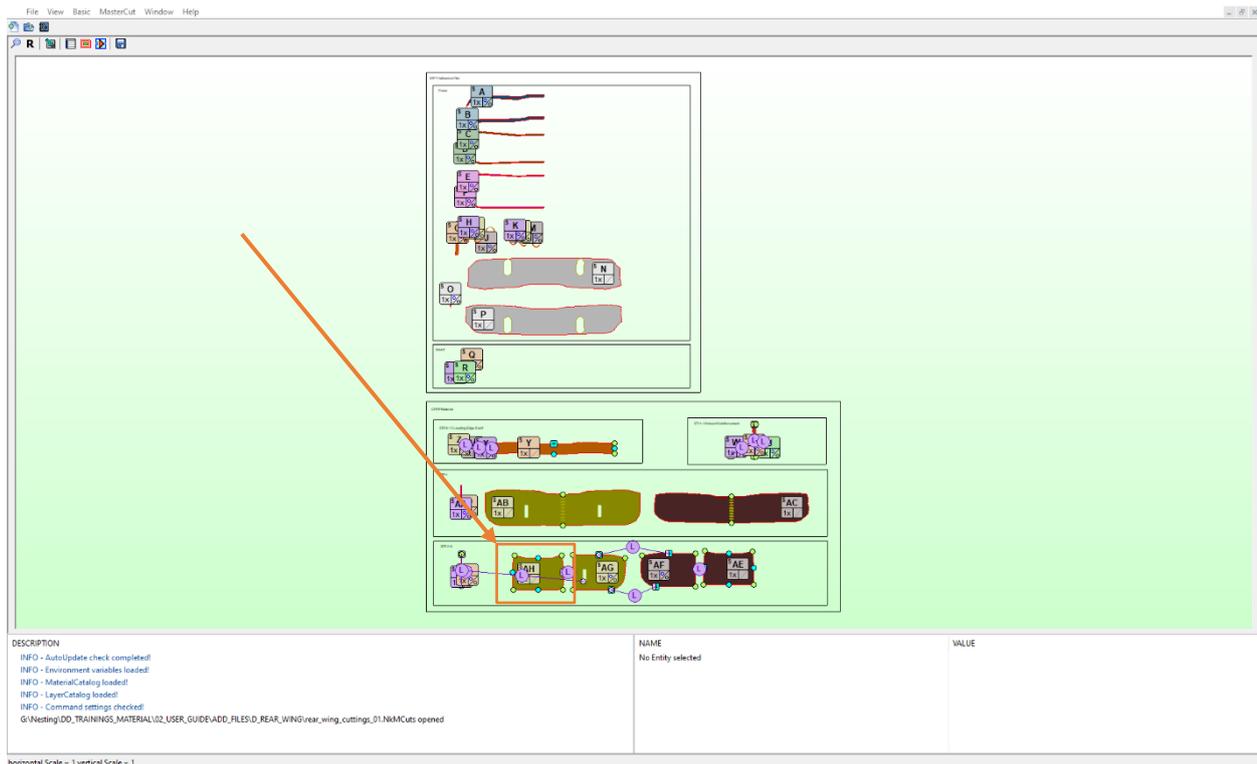


Figure 395

3. Enter the Sketcher workspace  or using shortcut **-S-**.

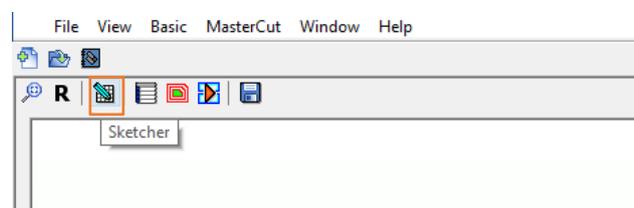


Figure 396

4. Next double click on MasterCut AH to open the MasterCut Dialog.



Assume we want to add a circle in the center of the RawCut of ST4. As already mentioned, we have two options to accomplish this task: Modification of the MasterCut and Editing the RawCut.

4.1. Modification of RawCuts via the MasterCut Sketcher

First, we can do this by adding the circle to the MasterCut itself and deactivate the circle geometry for all other steps. Incidentally, this circular geometry does not even have to be within the outer MasterCut contour but can also be placed outside as shown in following steps.

1. Enter the MasterCut Sketcher by clicking **Modify MasterCut** (Figure 397).

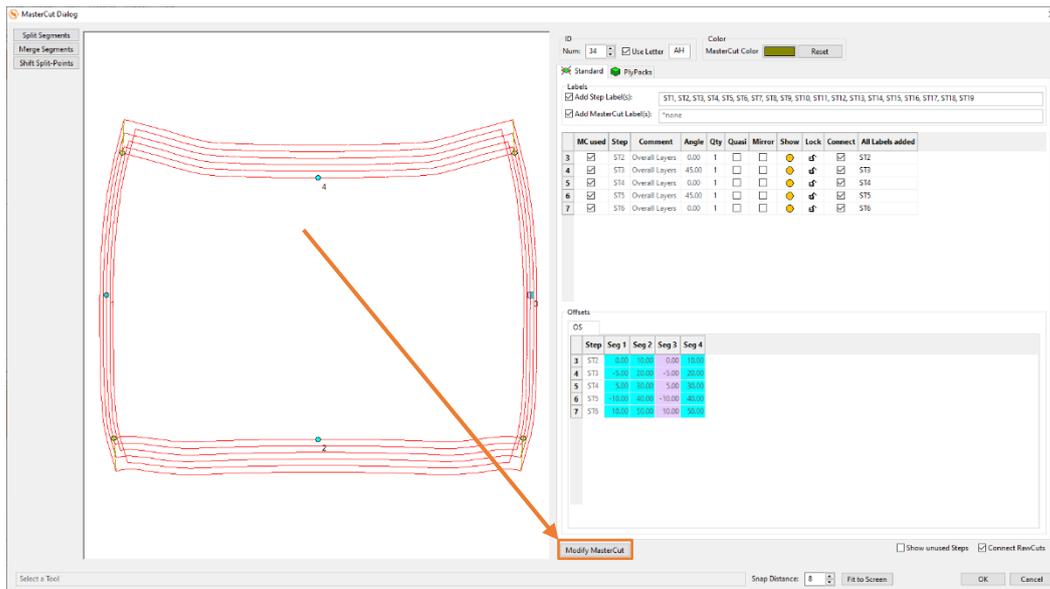


Figure 397

2. Inside the MasterCut Sketcher Dialog draw two circles on Layer 2 **2 - Inner Geos**, one in the center of the MasterCut and the other one on top, slightly outside the outer contour, as indicated in Figure 398 below.

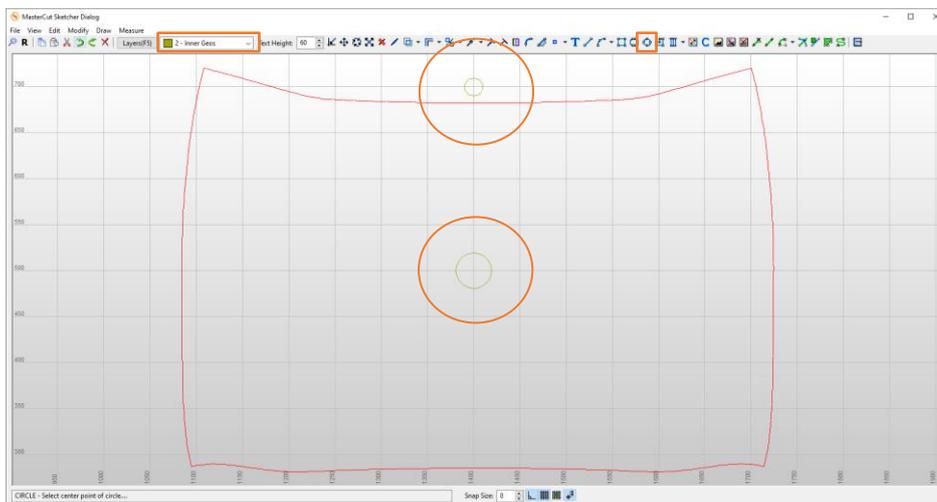


Figure 398

3. Leave the sketcher via the Exit button at the main toolbar



4. Regarding the MasterCut Comparison Dialog we can confirm with **OK**.

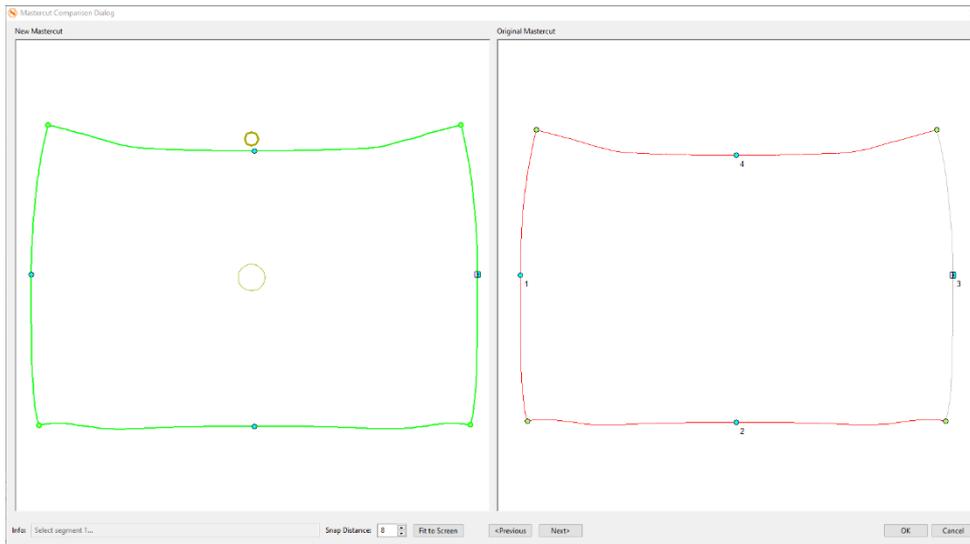


Figure 399

5. As you can see NestKing accepts inner geometries outside the outer contour without complaining. In contrary it even adds the top circle to the RawCut as long it is inside or intersecting the outer contour of the RawCut itself. Just click through the steps and see how the added circles influences the resulting cuts (Figure 400).

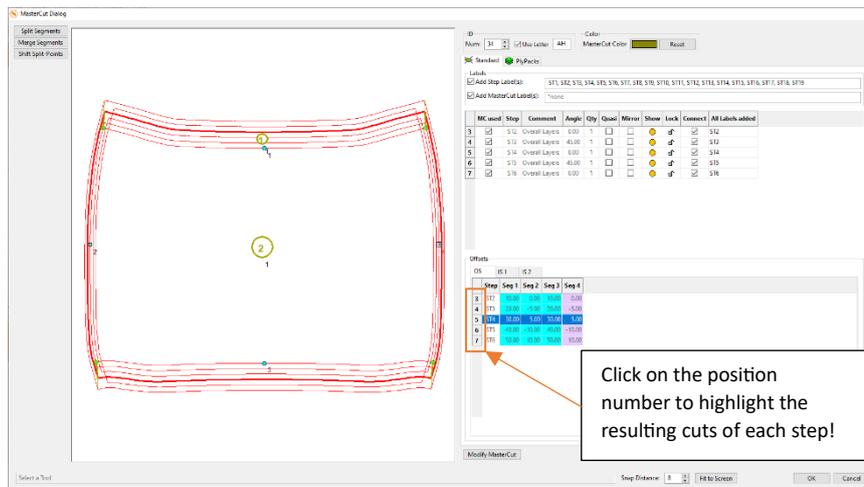


Figure 400

6. Since we just want to change the Cut of ST4 deactivate the added circles, managed by TAB IS1 and IS2, for all other steps (Figure 401).

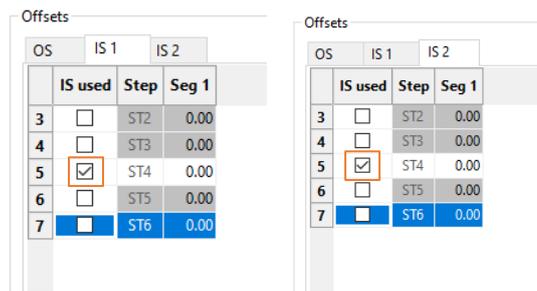


Figure 401



- If you click through all steps again you will recognize that the circles are now just added to the cut of ST4 and ignored for all other steps.

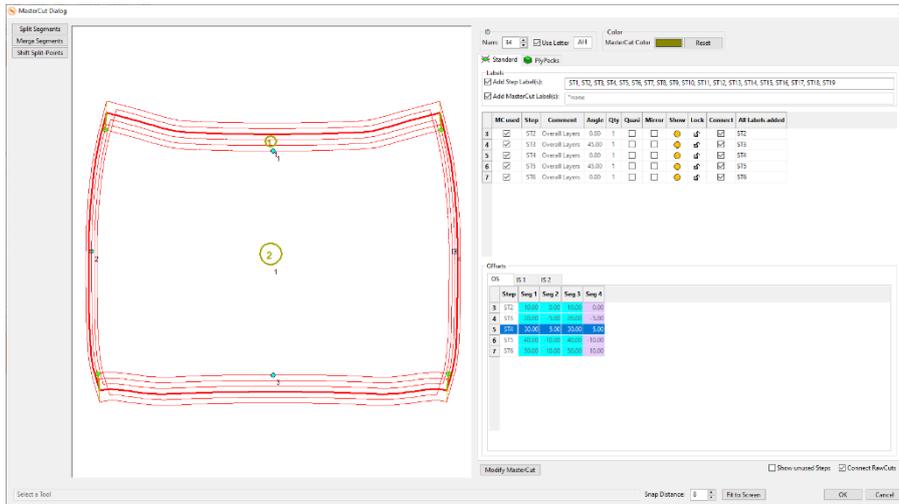


Figure 402

4.2. Editing of RawCuts via the RawCut Sketcher Dialog

- Further, as the second option, we can also modify RawCuts directly. Therefore double-click the position label of the cut we want to modify. For example, if you want to edit the RawCut of ST3 double-click on associated row label, in this case **[4]** as shown in Figure 406. It makes no difference whether you double-click the row label in the offset grid or in the control grid.

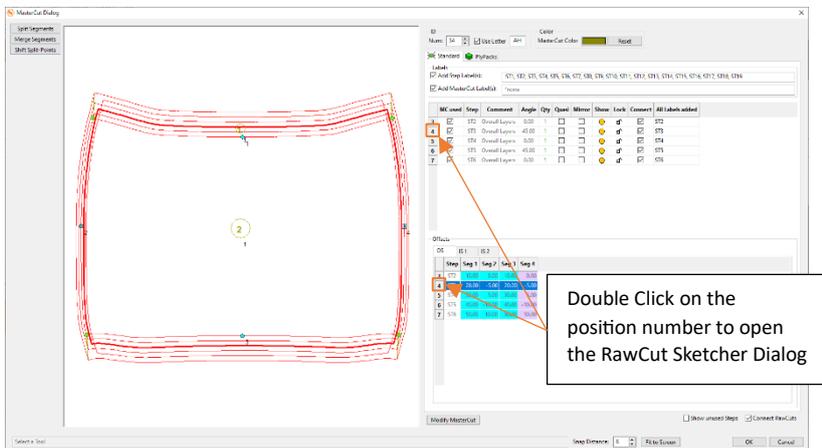


Figure 403



- Inside the RawCut Sketcher Dialog you can do basically everything you want. You can even delete or deactivate all existing geometries and just add a rectangle geometry on layer 3 as shown in Figure 404.

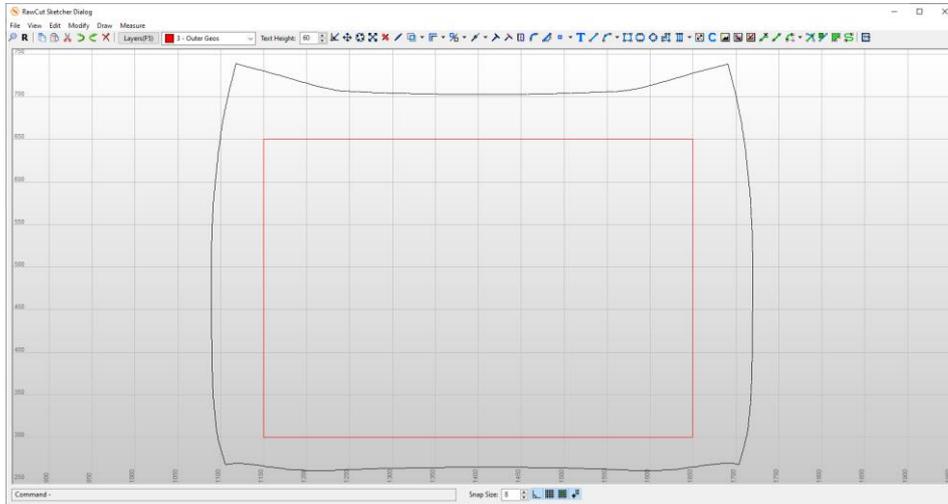


Figure 404

- Leave the sketcher via the Exit button at the main toolbar.
- Now we can see, that the RawCut of ST3 is indicated in grey. This tells us that this RawCut is locked and does not react to any changes of any offsets anymore. It will remain as it is, and it will be added to the MasterCut Output instead of the automatically generated RawCut. Further, also the lock sign is closed now (Figure 405), stating that the RawCut of this step is locked.

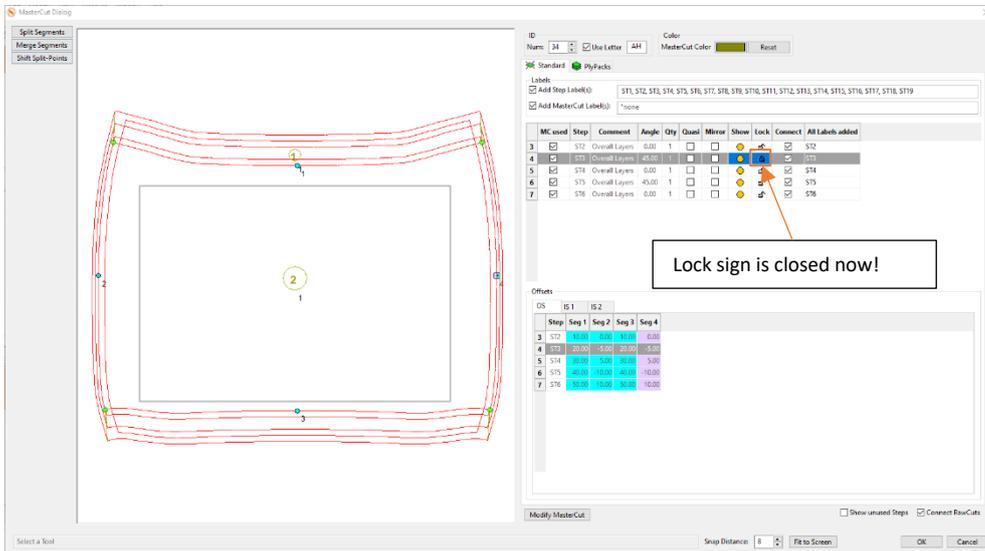


Figure 405

- Attention:** When unlocking the RawCut again, the automatically generated RawCut data will overwrite the modified RawCut data and its data will be lost. So be careful with unlocking locked RawCuts.

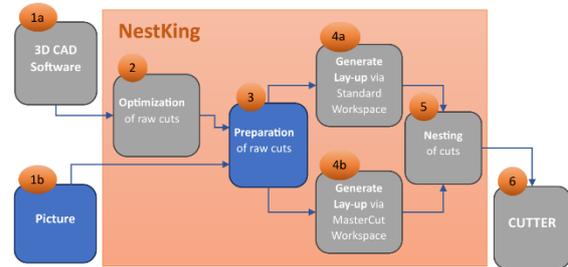
Figure 406



F. Example Toolbox Insert – Working with Pictures

The cut data is derived from pictures.

This chapter aims to give you an overview of how to import pictures into NestKing and use the built-in image processing tools to derive basic geometries. The example used involves the creation of a foam insert for a toolbox to store the tools in production clearly and sorted. The tools considered are a marker pen, a Stanley knife, an Allen key set, a scissor, a caliper, and a standard knife used for lamination. Here we go!



- Open NestKing and click  (New File) on the top (Figure 407).

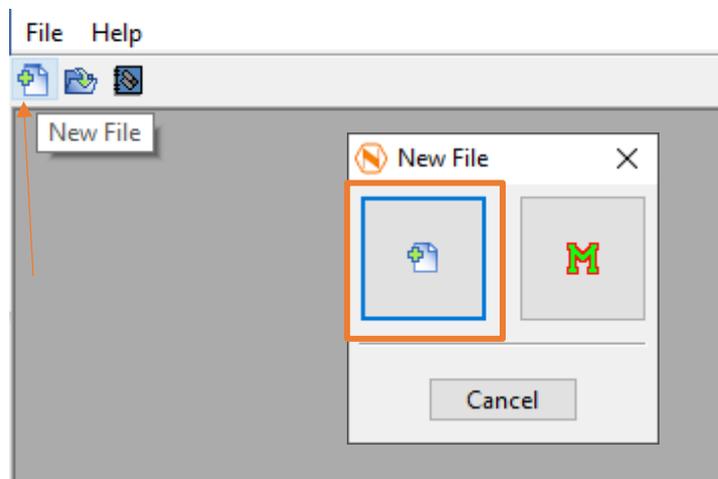


Figure 407

- Open sketcher by using the shortcut **S** or click the sketcher pencil button on the Main Toolbar  (Figure 408).

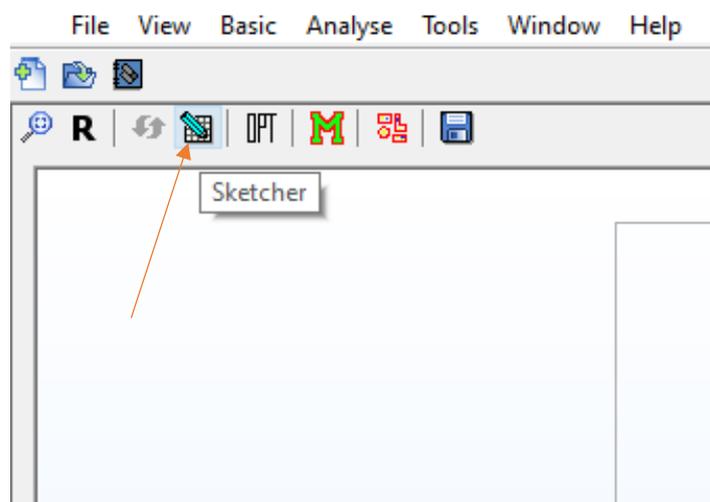


Figure 408



- LOAD PICTURE:** Click  (Load Picture) on the Main Toolbar (Figure 409).

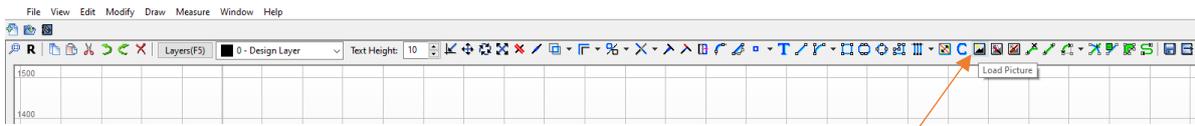


Figure 409

- Go to the directory containing the example pictures, select them all and click open .

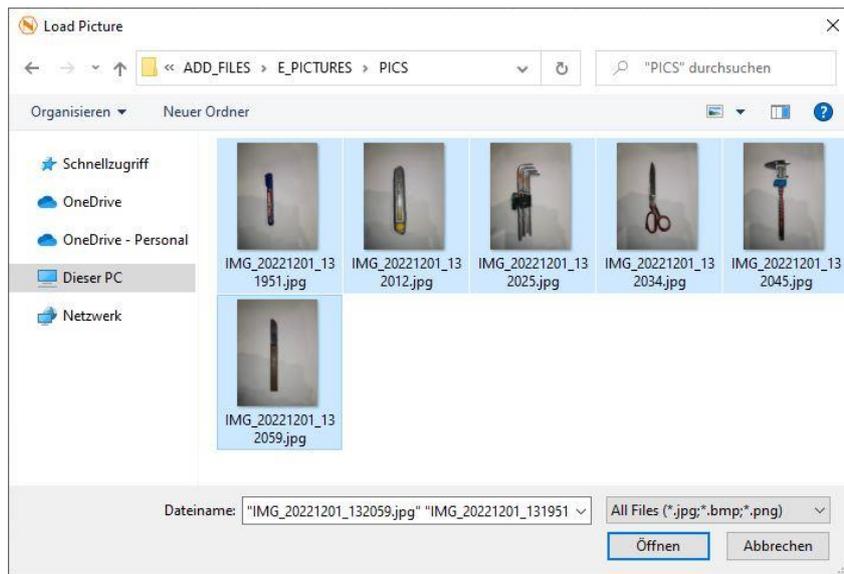


Figure 410

- Now all six pictures are shown inside the Drawing Area and can be shifted wherever you want. Click somewhere inside the Drawing Area to pick an insertion point.

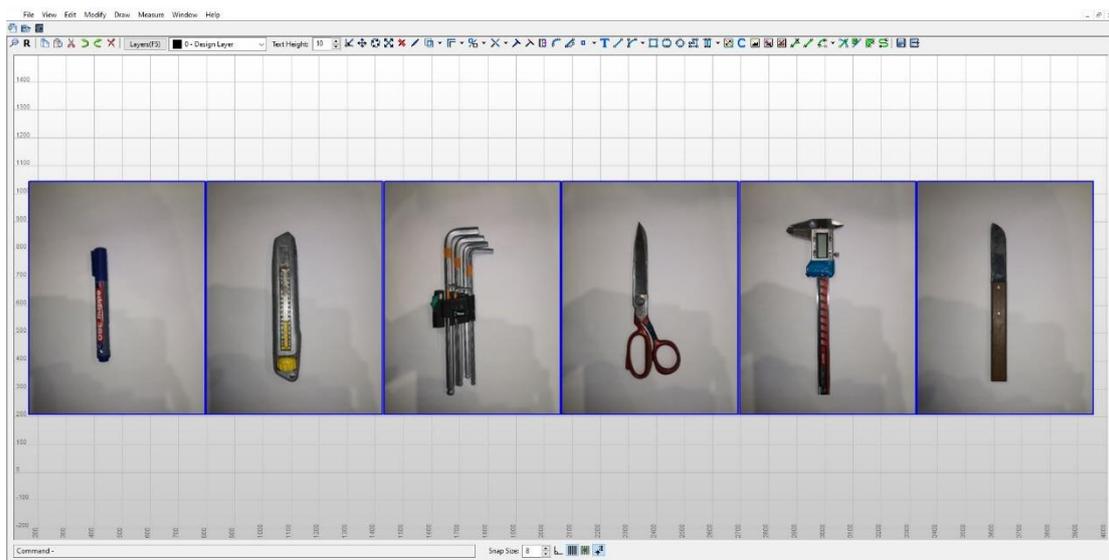


Figure 411



7. **SCALE:** Next, we need to scale each picture to the real size of the tool. Figure 412 shows the original lengths:

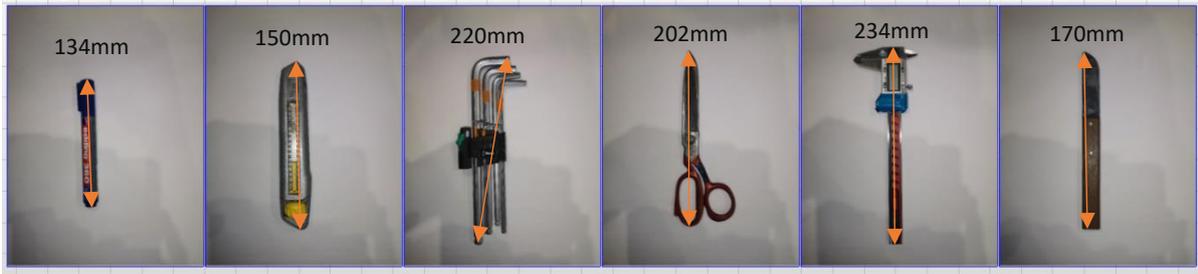
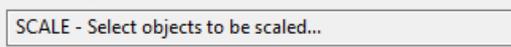


Figure 412

Starting with the marker pen on the left we know that it should be 134mm long.

- a. First, click the scale tool button  located on the Main Toolbar or use the **-SCALE-** Command.
- b. The Command Prompt prompts asks for an object to scale. Select the first picture depicting the marker pen.



- c. Next NestKing requires a scaling center point **SCP** . Zoom in and select one of the bottom pixels of the marker (Figure 413).

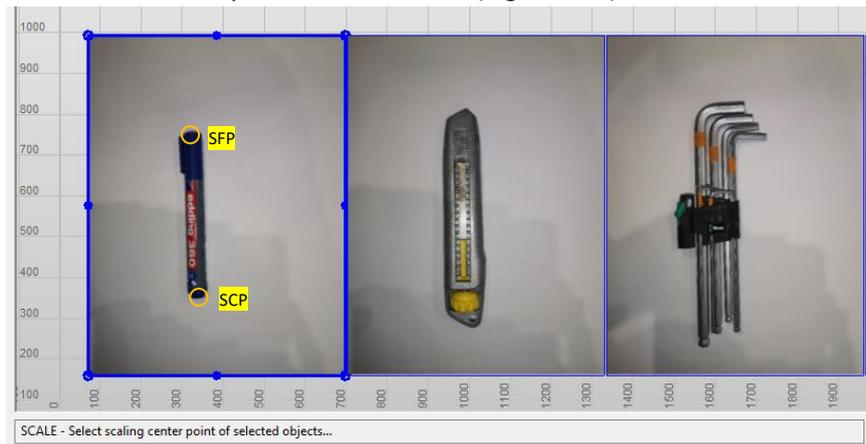


Figure 413

- d. For the scaling fix point **SFP**  select one of the top pixels of the marker pen (Figure 413).

- e. Now you can move our mouse and the outer boundary box of the picture will be scaled accordingly. As stated in the Command Prompt, the first scaling option is to pick the end point anywhere on the Drawing Area. The second option is to enter a scaling factor or a scaling length .

Since we already know the required length of the pen, entering the scaling length is the easiest way in this case. So just enter "134" and confirm with **-SPACE-** or **-ENTER-**.

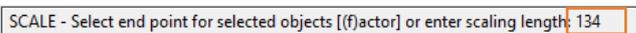


Figure 414

- f. As indicated in Figure 414, we can use  (Point to Point Measure) to verify that the scaling is correct.



g. Repeat this step to scale the remaining five tools. The result is shown in Figure 415.

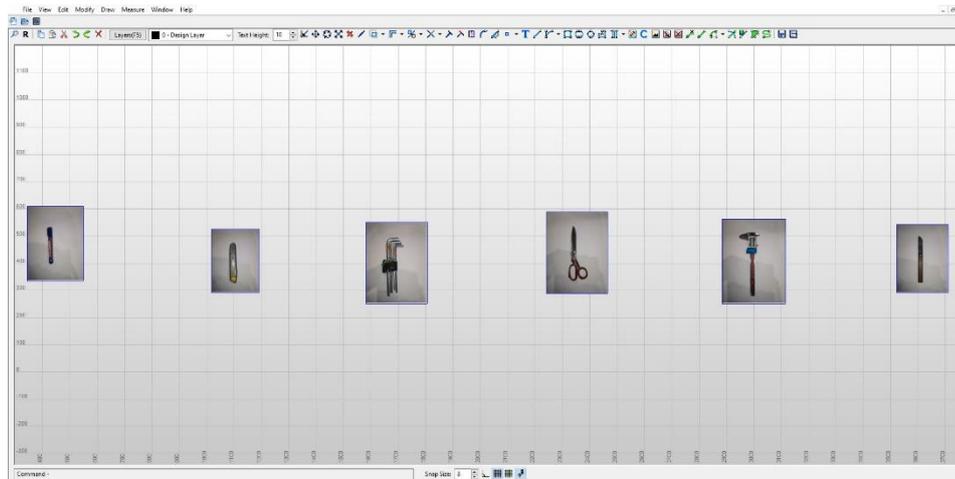


Figure 415

8. **PROCESS PICTURE:** In this context, picture processing is the derivation of the outline of the object that is displayed on the picture. Therefor we have two options:
- (1) First, if we want to process just one picture at a time double-clicking on the picture itself to open the Picture Dialog.
 - (2) Second, you can use  (Process picture) for processing one or also multiple pictures at a time.

We will use both ways, starting with the first, processing one picture at a time:

- a. Double-click on our first picture, showing the marker pen.

Note: Inside the Picture Dialog you can change position, size and angle of the picture. Mirroring is also possible, respectively we can also change the path to the original picture file if required.

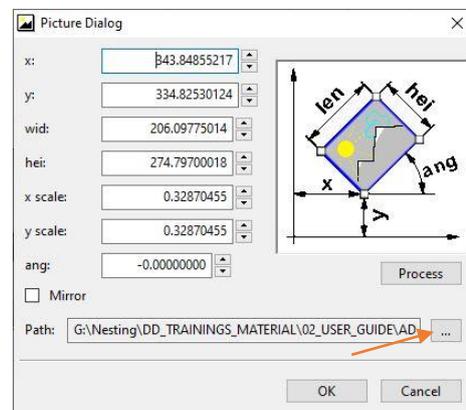


Figure 416

Note: If you change the directory of the picture file or rename it, the relative and absolute path saved inside the file are not valid anymore. In this case NestKing will just show an empty picture frame stating that no picture is found. If so, you can redefine the path to the picture here.



b. Click **Process** in the Picture Dialog to open the Picture Manipulation Dialog:

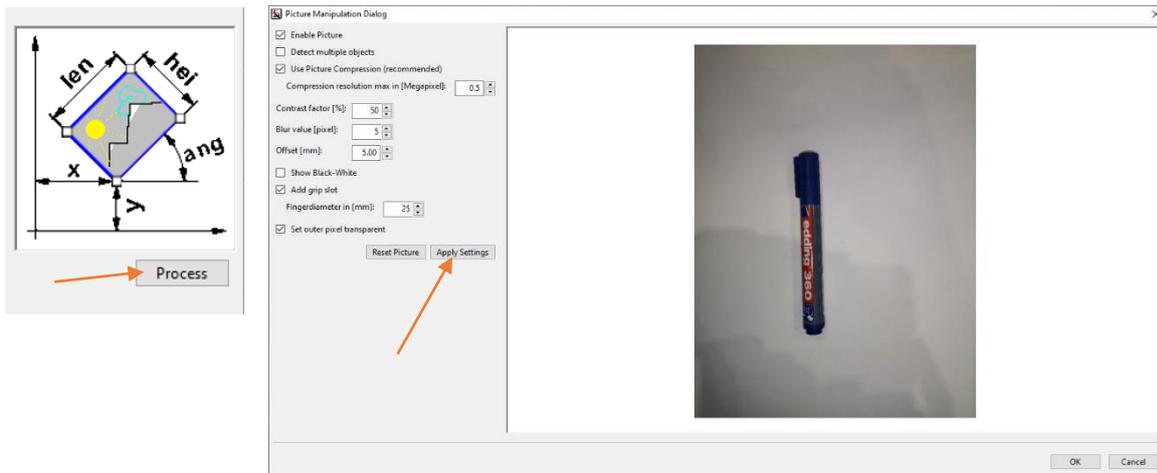


Figure 417

All settings of our Picture Manipulation Dialog, as shown in Figure 417 on the left, are described in more detailed in Table 11. Feel free to play around! You can always reset all settings to the initial settings by just clicking **Reset Settings**. This reset settings button replaces **Apply Settings**, as indicated in Figure 417, after you change one of the following settings.

Name	Description
Enable Picture	We can enable our picture if we don't want it to be considered for nesting.
Detect multiple objects	If picture contains more than one object, activate this checkbox.
Use Picture Compression	If active, our picture is compressed before modification. It is highly recommended to use picture compression because high-resolutions lead to longer processing times. The default value of 0.5 megapixel is usually fine.
Contrast factor [%]	The contrast factor is an important value for deriving the outline of the pictured object. It can be used to fine tune the resulting geometry and needs to be higher when the contrast between the background and the tool is low and vice versa.
Blur value [pixel]	The blur value is also an important value for deriving the outline of the pictured object and can be used to fine tune the resulting geometry as well. This value needs to be higher when the sharpness of the picture is low and vice versa.
Offset direction	Offset values higher than 0mm generates an offset geometry of the generated object contour, which is used as outline instead.
Show Black White	Shows the picture in black and white.
Add grip slot	Adds a grip slot to the contour with the given finger diameter as defined by the -Finger diameter- setting.
Set outer pixel transparent	Sets the outer pixels outside the generated outline to transparent.

Table 11

Note: Please consider that poor image quality can't be balanced by NestKing at a certain point. So, it is recommended to use pictures with a high contrast between background and the pictured object itself.

c. To check all initial settings click **Apply Settings** respectively if you have already played around a bit, just press **Reset Settings** instead.



- d. The resulting contour looks not bad. We may be able to reduce the **[Offset mm]** value to 3mm to reduce the clearance between the tool and the foam insert.

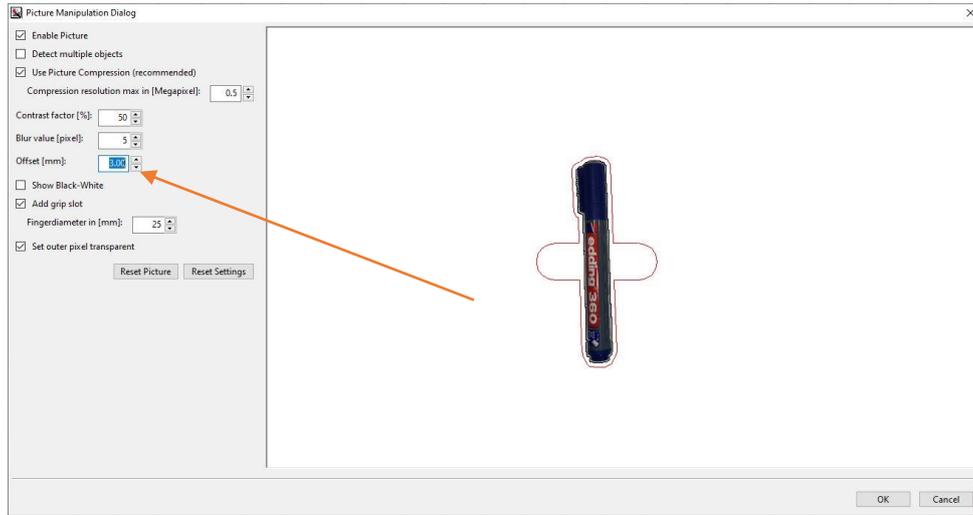


Figure 418

- e. Confirm the Picture Manipulation Dialog with **OK**.

- f. Confirm the Picture Dialog also with **OK**.

Now we will use the second option, processing multiple pictures at a time.

- 9. Therefore select the remaining five pictures and click (Process picture) on the Main Toolbar.

- a. Reduce the offset value from 5mm to 3mm (Figure 419).

- b. Confirm with **OK**. The outcome is shown on Figure 420.

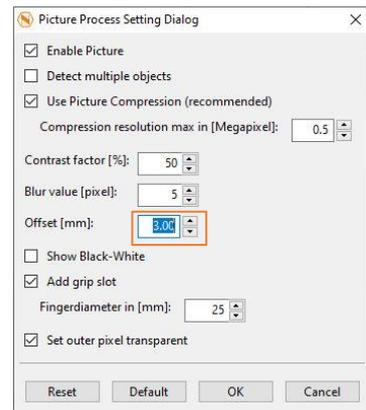


Figure 419

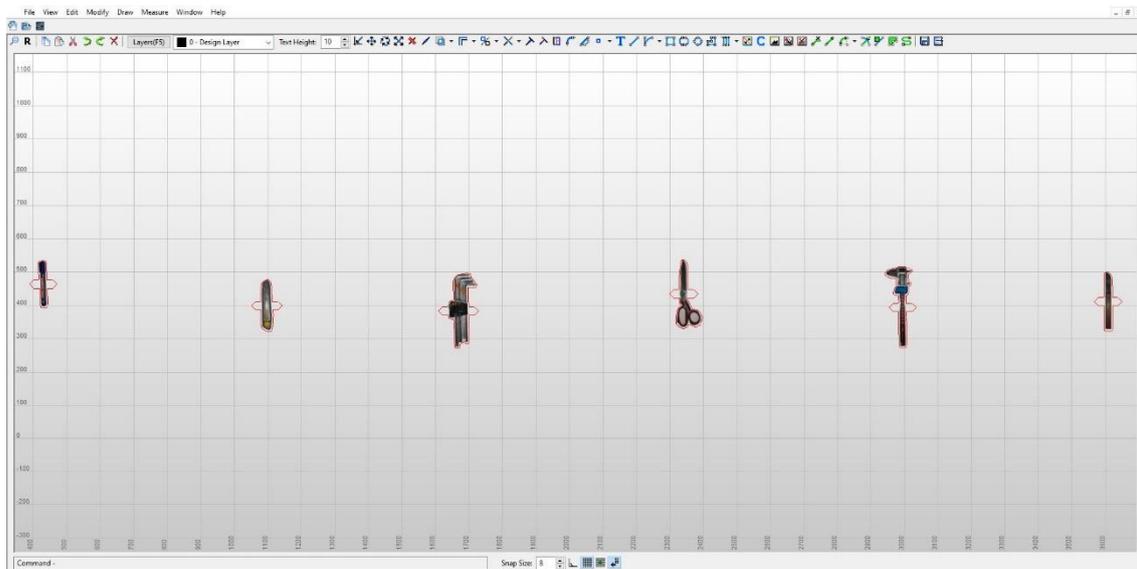


Figure 420



- RECTANGLE:** Draw a rectangle  on layer 3 with a length of 450mm and a height of 300mm with its start point on the origin (Figure 421). This rectangle represents the outer boundary of our foam insert.

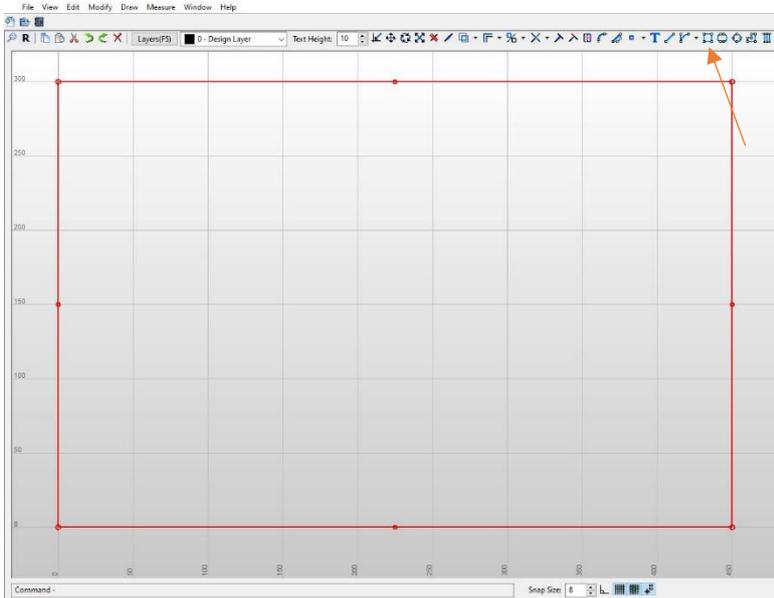


Figure 421

Note: You can also change size and position of the rectangle using the Rectangle Dialog. Therefore double-click on the rectangle geometry and apply following settings:

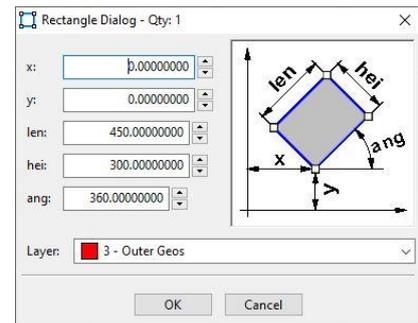


Figure 422

- SHIFT AND ROTATE:** Next shift all picture objects inside our foam boundary rectangle. Therefore pick  (Shift) in the Main Toolbar or use the **-SHIFT-** Command to activate the shift tool. Further use the rotation function  (**-ROTATE-** Command) to rotate single or multiple picture objects at a time. The result could look something like that:



Figure 423

- SAVE:** Click  to save the changes into our file (e.g. picture_example01.dxf).
- EXIT:** Leave the sketcher with .



3. **EXPORT FOR LASER:** NestKing also offers an *[Export for laser]* function in the File tab (Figure 424). With this function only the generated tool contours and other geometries like foam insert boundary as well as text objects are saved into our export file. This file can be directly used for laser cutting.

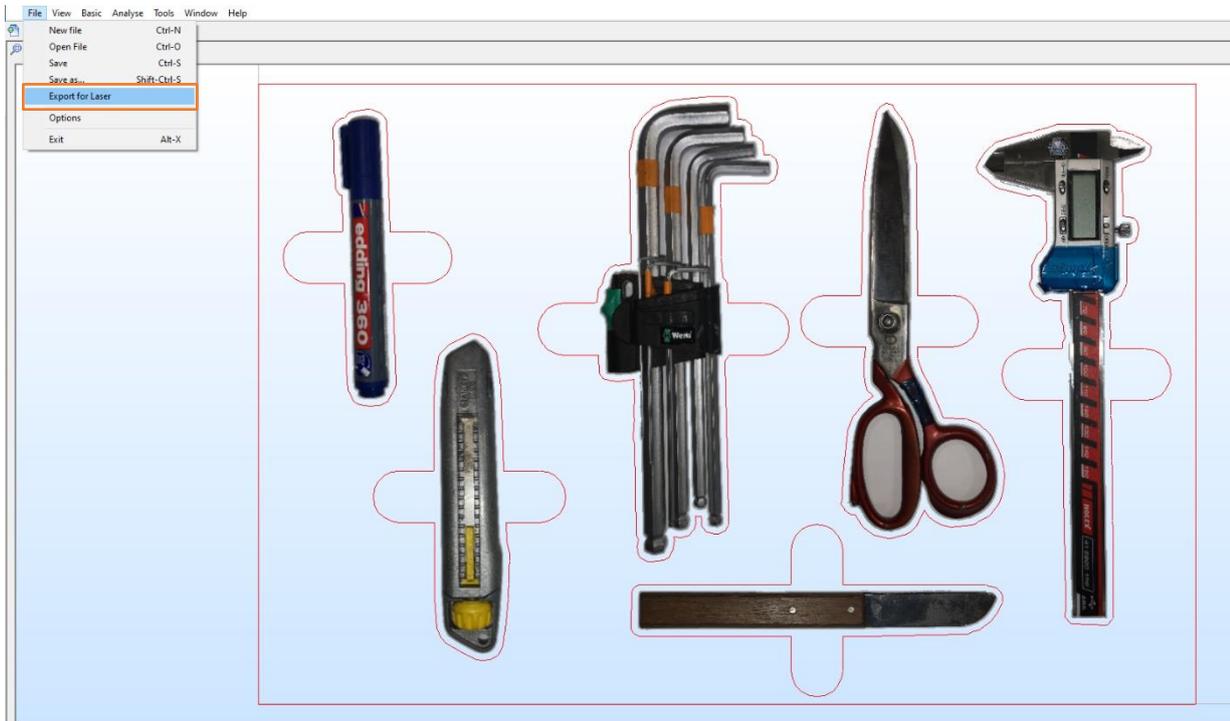


Figure 424

Note: There is also the option to use generated outlines of pictures for nesting as well. Thus, you can also apply this process for generating cut data out of photographed cut templates. Mixing them with raw cuts derived from 3D data is also possible.



G. Material Catalog

G1. Introduction

For managing materials NestKing offers a material catalog manager. The corresponding button  is located next to the  (New File) and  (Open File) buttons as highlighted in Figure 425.



Figure 425

As shown in Figure 426, in this catalog you will find three different material categories: Global, local and file specific materials.

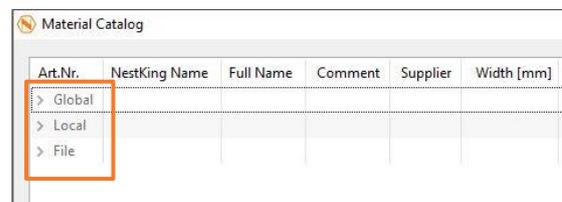


Figure 426

GLOBAL Materials: The file containing all the information about our global materials is usually saved somewhere on the server, accessible for everybody using NestKing within the company. The supported file format is CSV. You can define the path to this file during the NestKing set-up process or you can also add it afterwards inside the Material tab of our Options Dialog (File – Options – Material) as highlighted in Figure 427: **[Path to global material file]**.

LOCAL Materials: The local material file is generated automatically during the NestKing set-up process and is usually saved in the user’s local data directory. You can also change this path inside the Options Dialog as emphasized in Figure 427: **[Path to local material file]**.

FILE Materials: NestKing always cross checks if used materials can be found in our global or local material data. If that’s not the case, the material is defined as file-specific and listed in the -File- category.

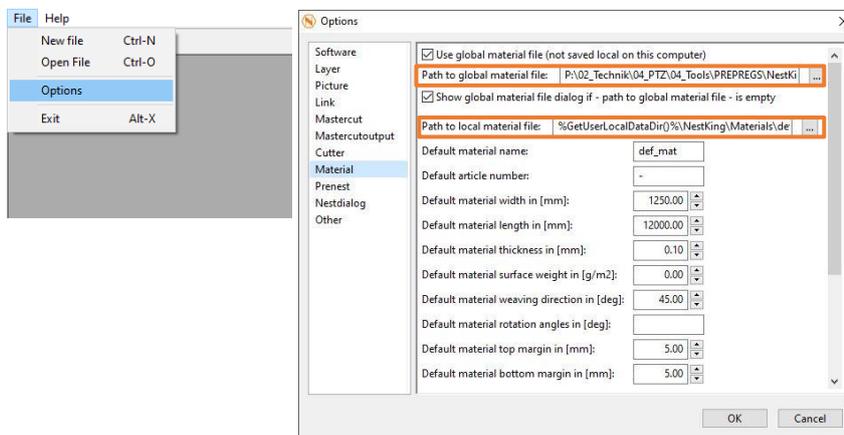


Figure 427



If you want to set-up your own global material file, you can either use the *global_material_template.csv* file attached to this user guide, respectively you can copy the material file from the local material file directory [**Path to local material file**] as indicated in Figure 427. Our material data csv-file needs to contain following columns:

Name	Description
ArticleNumber	Article number of the material.
NestKingName	Abbreviation of the full name of the material used for NestKing -mat-Command.
FullName	Full name of the material.
Supplier	Supplier of the material.
Width[mm]	Width of the material.
Length[mm]	Length of the material.
Orientation[deg]	Orientation/weaving direction of the material, depending on the weave of the material (usually 0° for plain weaves, 45° for twill weaves). Note: The orientation/weaving direction only matters if one of the mirror checkboxes is check in the Nesting Dialog. Cuts are mirrored along this weaving direction (see also <i>G3. Weaving Direction of Composite Fabrics</i> for more details).
RotationAngles[deg]	Allowed rotation angles of the material during nesting in [deg] (e.g. 0,90,180,270)
MarginTop[mm]	Material margins are used to compensate material placement inaccuracies on the cutter table itself. Normally for composite materials 5 to 10 mm are used.
MarginBottom[mm]	
MarginLeft[mm]	
MarginRight[mm]	Note: The default nest dimensions are calculated by the material area minus the assigned margins: $\text{nestwidth} = \text{materialwidth} - \text{MarginLeft} - \text{MarginRight}$ $\text{nestheight} = \text{materialheight} - \text{marginTop} - \text{MarginBottom}$
Thickness[mm]	Thickness of the material. Note: This value is important for the Edit Link Dialog in order to apply the material thickness compensation correctly (see also page 81).
SurfaceWeight[kg/m2]	Surface weight of the material. Note: This value is used to calculate the overall weight of the cuts to estimate the weight of part (see chapter 5.5. <i>Cutter Report</i>).
Comment	Any additional information can be added here.
SubstituteFor	If the material substitutes another material, the name of this material is added here.
ReplacedBy	If the material is replaced by another material, the name of this material is added here.
IsHidden	If the material should be hidden in the material list insert “yes”, otherwise “no”.
ChangeReport	If any changes on the material are made this column will contain all relevant information for traceability: <ul style="list-style-type: none"> - What was changed. - Who did the change. - Date of change.

Table 12



G2. Editing Materials

For editing the global and local material files it is highly recommended to use NestKing Material Edit Dialogs to do the job. This ensures that all information is always entered and saved correctly.

Note: Consider that modifications of global materials are valid for all NestKing users inside your company. Thus, make changes wisely.

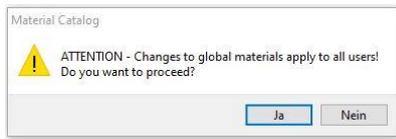


Figure 429

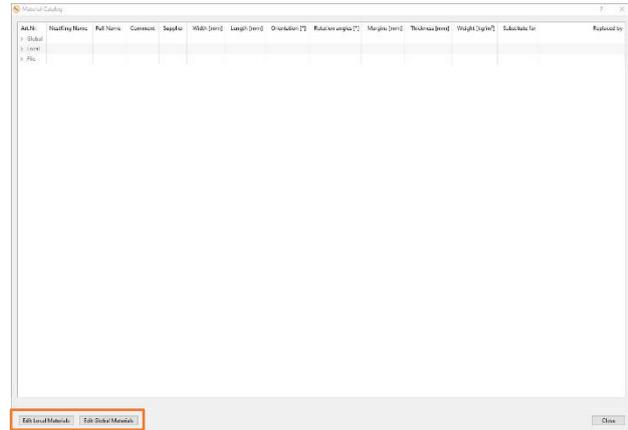


Figure 428

After clicking one of the edit buttons

Edit Local Materials **Edit Global Materials** and confirming with -Yes- if required, the Material Catalog Edit Dialog will appear.

As shown in Figure 430, here you can add, remove, modify, and shift materials in the list up and down. In addition, you can also export, import and clear entire material files if required.

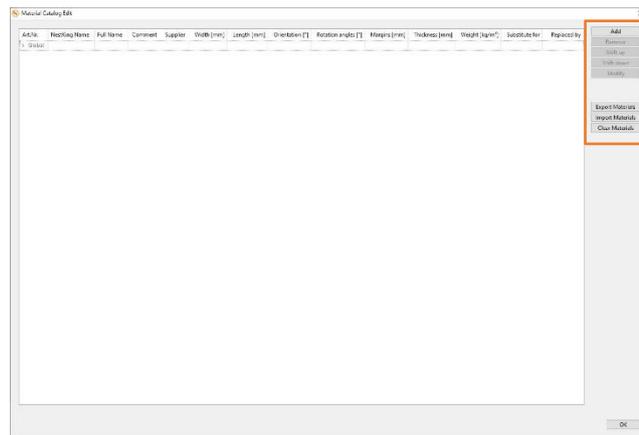


Figure 430

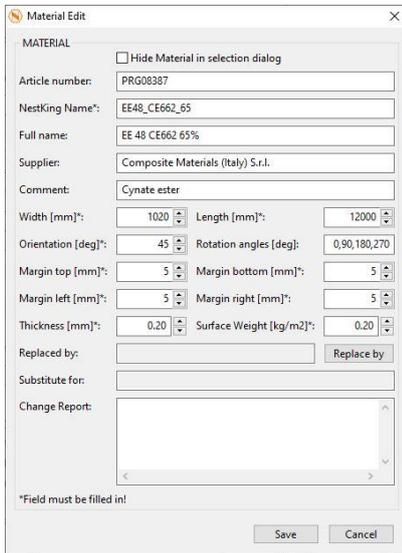


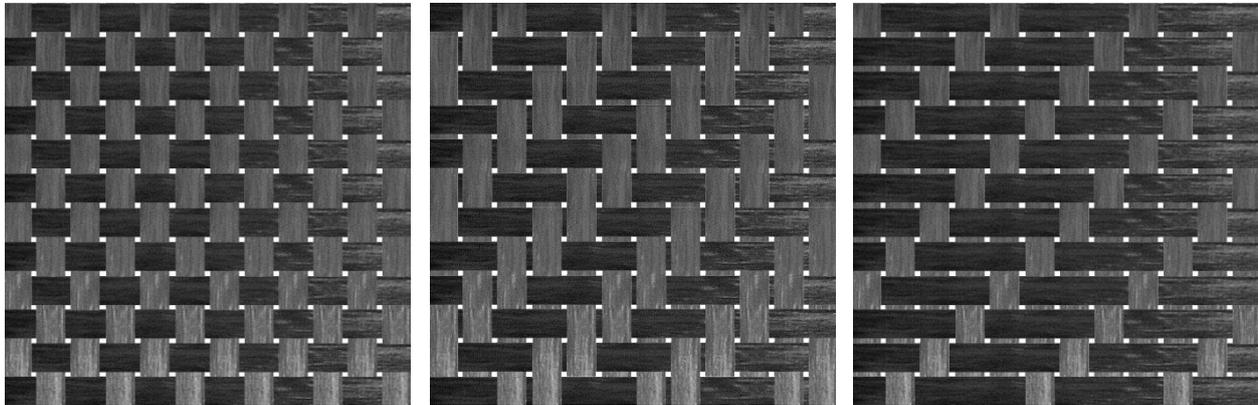
Figure 431

Figure 431 shows the Material Edit Dialog. Here you can change all relevant material data as described in Table 12.



G3. Weaving Direction of Composite Fabrics

The weave pattern used has a major impact on the appearance of the composite fabric material. The most common weave patterns are plain weave, twill weave and satin weave as shown in Figure 432.



Plain Weave

Twill Weave

Satin Weave

Source: <https://store.acpcomposites.com/woven-fabric-style-guide>

Figure 432

Especially in fabrics with twill weave you can see the arrow-like texture pointing from bottom left to top right as shown in Figure 432 middle. Thus, the weaving direction in this case would be 45° . When using twill weave, for example in bodywork parts of racing cars, it looks more dynamic if these “arrows” of the outer visible composite layer are pointing in the driving direction.

If we also want to create a mirrored part, it is important to use exactly this weaving direction as mirror axes. This ensures that the “arrows” on the outer visible composite layer of the mirror part also point in the driving direction as well.

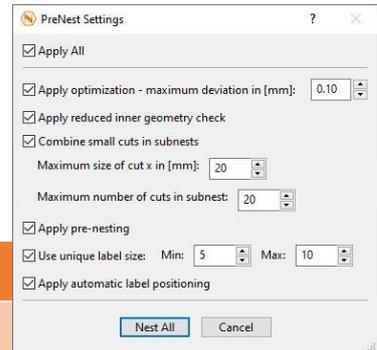
To Summarize: The weave direction/orientation angle of materials is important if mirrored parts are also to be created.



H. Nesting Dialogs

H1. PreNest Settings

The functionality of each check box item of the PreNest Setting Dialog is described in Table 13.



Name	Description
Apply all	Check/uncheck all checkboxes at once.
Apply optimization	If activated optimization as already described in chapter 2) <i>Optimization of imported cuts</i> is applied.
Combine small cuts to subnests	If marked, all cuts ...
Maximum size of cut x in [mm]	... with a boundary rectangle length smaller than -x- and boundary width smaller than -x- are combined to a subnest ...
Maximum number of cuts in subnest	... containing the specified maximum number of subcuts (in this case 20). For further information see also following section <i>H1.1 Subcuts and Subnests</i> .
Apply pre-nesting	Unmark this checkbox if you don't want to pre nest your cuts. If this is the case, the initial position of the cuts in the Nest Dialog will be the same as indicated in the Drawing Area.
Use unique label size	The -Min- value describes the minimum allowed text height (used for labels on smaller cuts) and the -Max- value describes the maximum text height (applied on labels on larger cuts). Note: Labels on layer 4 are not affected by this setting.
Apply automatic label positioning	If active, all labels added on layer 1 are repositioned by the automatic label positioning feature. Note: Labels on layer 4 are not affected by this setting.

Table 13

H1.1 Subcuts and Subnests

Imagine you have a lot of small cuts scattered all over your nest between larger cuts. The risk of forgetting one of these small cuts while clearing the cutter table by hand is high. The subcut function combines these small cuts (called subcuts) to a container cut, also referred to as subnest as shown in Figure 433. This subnest can be removed from the cutter table as a whole and handed over to the clean room as a single package.

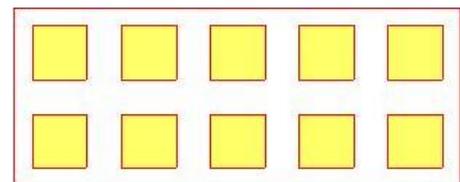


Figure 433

Note: We can also force NestKing to generate a subnest of certain cuts by using the -sub- NestKing Command.



H2. Nest Dialog

The Nest Dialog can be divided into three levels (Figure 434):

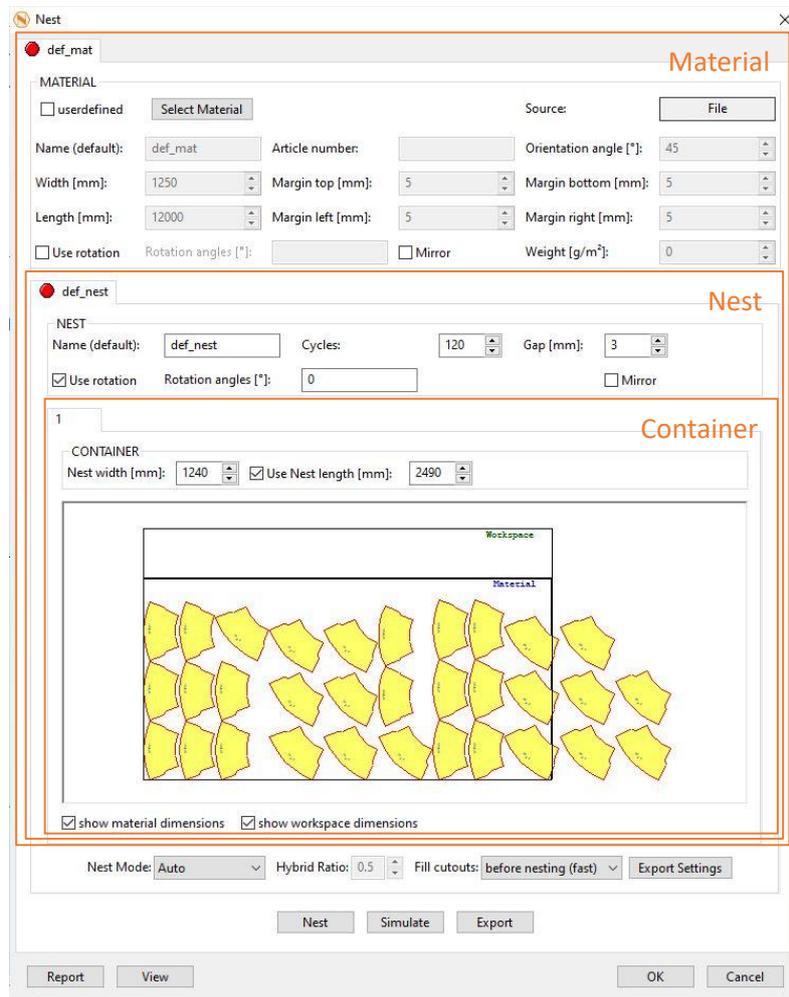


Figure 434

Material Level:

One file can contain cuts made of different materials. Cuts of the same material are collected and presented in one material tab. For dividing cuts into different materials, the `-mat-` NestKing Command can be used.

Nest Level:

Further, cuts made of the same material can be split into separate nests. Each tab presents one nest. For dividing cuts of one material into individual nests, the `-nst-` NestKing Command can be used.

Container Level:

Cuts of the same nest are automatically divided into separate containers during the nesting process once the nest exceeds the predefined nest length.

The following section explains material, nest and container levels in more detail.



H2.1 Material Level

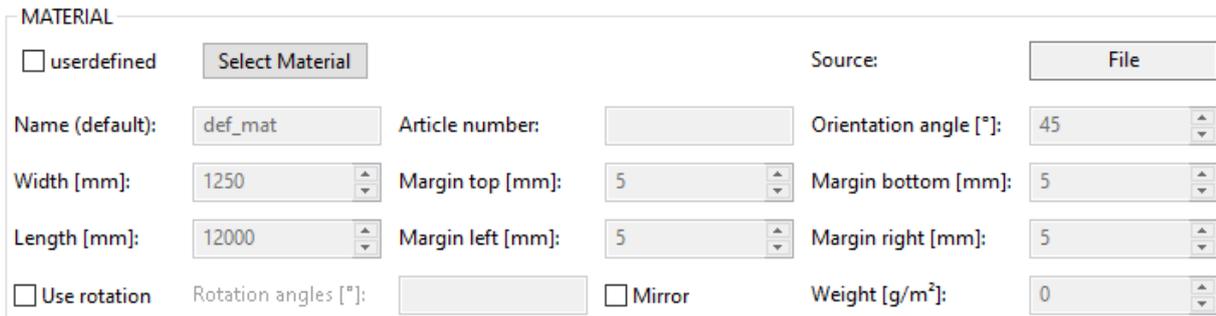


Figure 435

The first level represents the material level. By using the -mat- NestKing Command different materials can be assigned to the cuts of a single file. If there is no material defined, the default material (def_mat) will be used. The settings for the default material can be changed in the Option Dialog in the material tab as indicated in Figure 436.

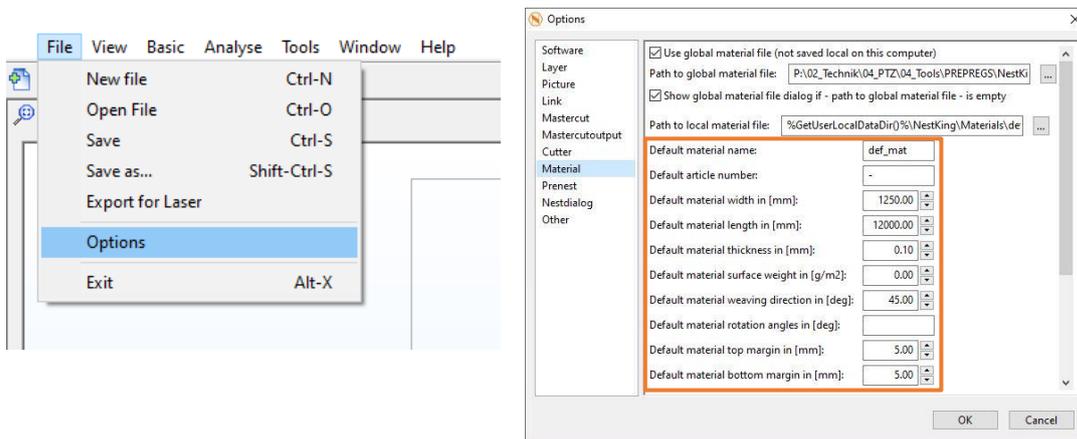
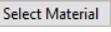


Figure 436

Beside defining the material by NestKing Commands  it is also possible to change the material using the Nest Dialog. We simply select a material of the build-in material database (click ) or we can also define our own material. Therefore check **[userdefined]** as shown in Figure 435, top left. Table 14 below gives additional information about each setting offered by the material box.

Name	Description
Name (mat)	Name of the material.
Article number	Article number of the material.
Orientation angle*	Orientation angle/weaving direction of the material. For more detailed information see section G3. <i>Weaving Direction of Composite Fabrics</i> .
Width in [mm]	Width of the material.
Length in [mm]	Length of the material.
Margin top in [mm]	The margin values describe the width of the stripes from the top, bottom, left, and right edges of the material sheet that are not used for cutting and nesting. So maximum nest size equals material size minus margin values. When the material sheet size exceeds the
Margin bottom in [mm]	
Margin left in [mm]	
Margin right in [mm]	



	cutter’s workspace, the cutter’s working range is the limiting factor for nest size.
Use rotation	If activated cuts of the material can be rotated during the nesting process to achieve better nesting results.
Rotation angles in [°]*	Allowed rotation angles of the material for the nesting process if [Use rotation] is activated.
Mirror	If checked nest tabs with mirrored nests are generated. The mirror angle of the mirrored cuts corresponds to the material orientation angle. For further information see also section <i>G3. Weaving Direction of Composite Fabrics</i> .
Weight in [g/m ²]	Weight of the material sheet in [g/m ²].

Table 14

***Note:** The allowed rotation angles can be entered like "0,180" (for unidirectional materials) respectively "d90". "d90" means delta 90°, and indicates, that the cuttings can be rotated by 90° steps (0°, 90°, 180°, 270°; used for example for fabric materials). If certain cuts, for example cuts of the visible first compound layer, should not be rotated during nesting, this can be defined by applying NestKing Command "rot 0" to the affected cuts.



H2.2 Nest Level



Figure 437

The second level describes the nest level. Each material can be split into any number of nests (e.g. step 1, step 2, step 3, etc.). This can be done by using the NestKing Command -nst-. If no nest is defined the default nest settings are used. The default nest settings can be changed in the Option Dialog in the NestDialog tab as highlighted in Figure 438.

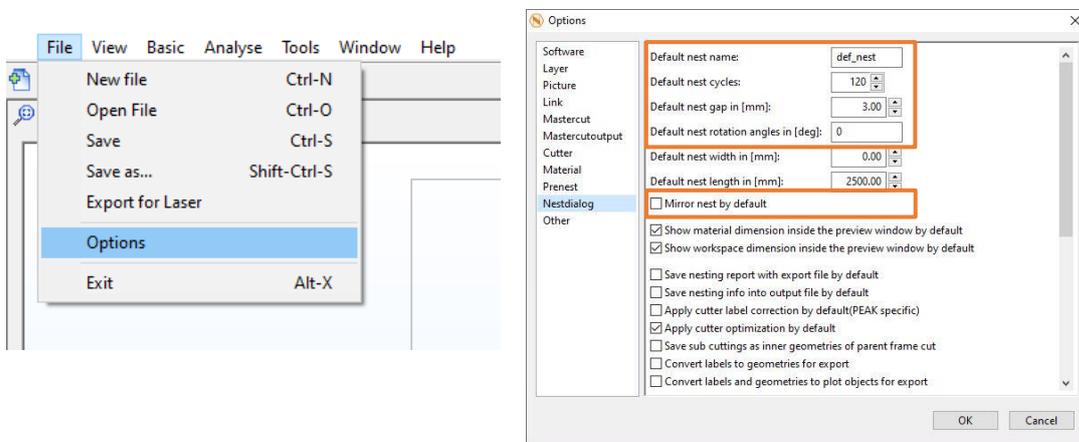


Figure 438

Table 15 below describes the settings of the nest level as shown in Figure 437 in more detail.

Name	Description
Name	Name of the nest.
Cycles	After reaching the defined number of nest cycles, the nesting process is automatically stopped.
Gap in [mm]	Minimum allowed distance between two cuts after nesting.
Use rotation	If checked cuts of this nest can be rotated during the nesting process to achieve better nesting results. Note: <i>[Use rotation]</i> on nest level overrules the <i>[Use rotation]</i> setting on material level.
Mirror	If checked another nest tab containing the mirrored cuts will be generated. The mirror angle corresponds to the material orientation angle. For further information see also section G3. <i>Weaving Direction of Composite Fabrics.</i>

Table 15



H2.3 Container Level

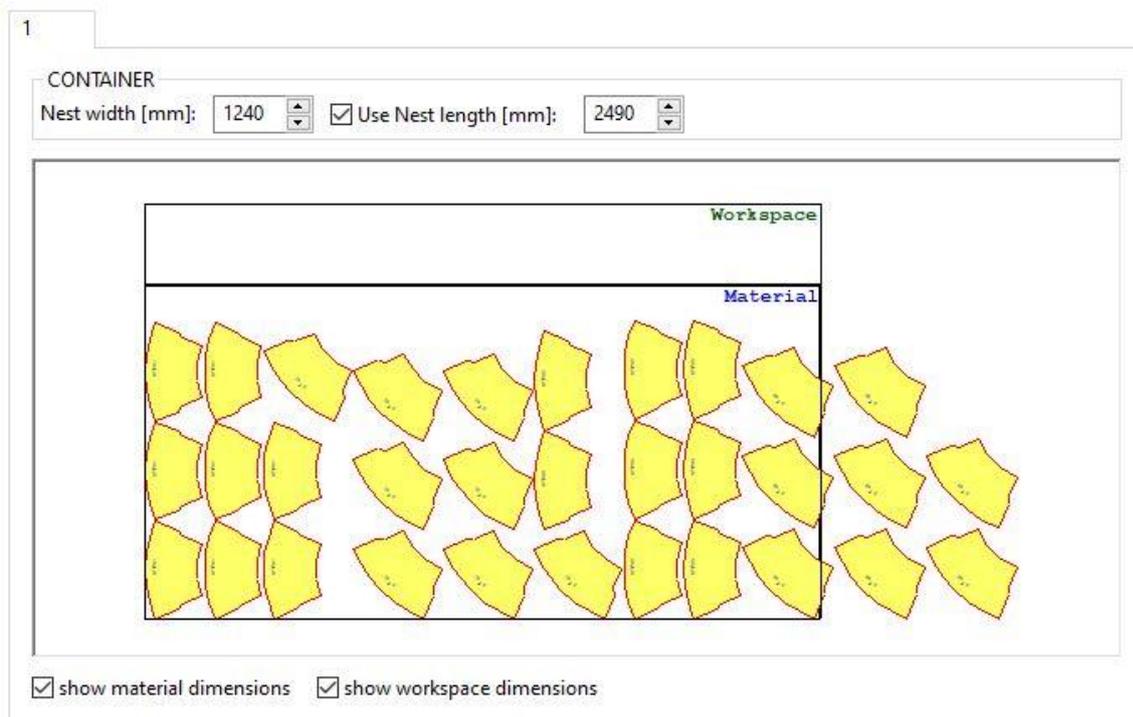


Figure 439

The third and final level represents the container level. Additional containers are automatically added by NestKing during the nesting process once the nest exceeds the boundaries of the nesting area. The nesting area is indicated as black rectangle in Figure 439 and is defined by the material and/or workspace dimensions minus the material margins as described in *H2.1 Material Level*.

Note: When the material sheet size exceeds the cutter’s workspace, the cutter’s working range is the limiting factor for nest size. This is typically the case for fabric materials that are supplied on spools. In this case the nest length is usually defined by the length of the cutter’s workspace, indicated in green in Figure 439. Workspace dimensions of the cutter can be changed in the Options Dialog as displayed in Figure 440. Inside the cutter tab you will find **[Workspace width in [mm]]** and **[Workspace length in [mm]]**. If you don’t want to apply any nest length limits, you can also simply uncheck the **[Use Nest length [mm]]** (Figure 439).

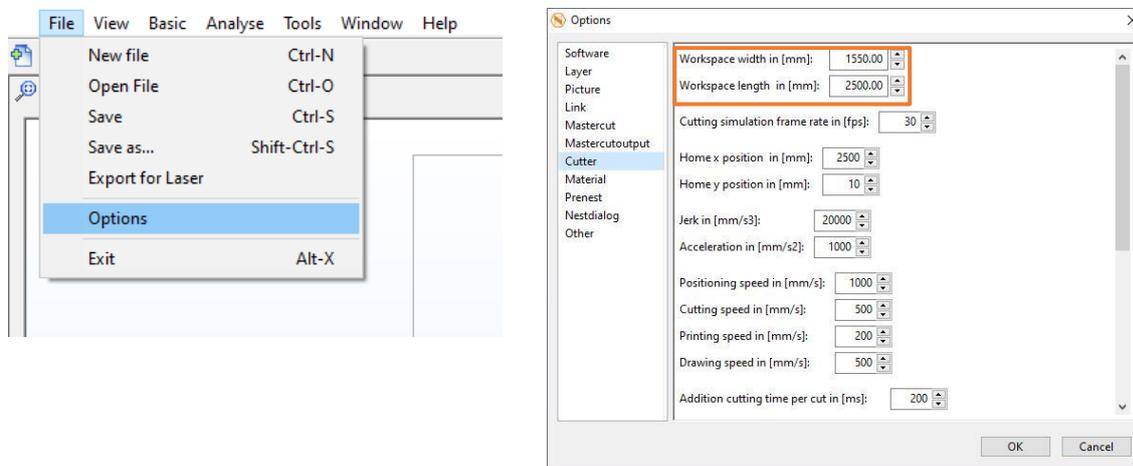


Figure 440



Name	Description
Nest width in [mm]	Nest width of the current container.
Nest length in [mm]	Nest length of the current container.
Show material dimensions	Hides/shows the material dimension as indicated in Figure 439 (blue rectangle)
Show workspace dimensions	Hides/shows the cutter’s workspace dimensions as indicated in Figure 439 (green rectangle).

Table 16

As shown in Figure 441 the bottom section of the Nest Dialog offers some additional features, which are described next.

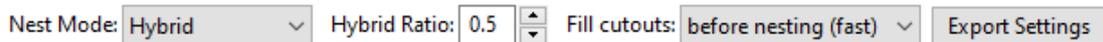


Figure 441

H2.4 Nesting Modes

Currently NestKing offers five nesting modes:

Name	Description
Auto	NestKing automatically selects an appropriate Nesting mode for the current nest depending on number of cuts and if rotation is allowed or not.
Tetris (fast)	Very fast nesting algorithm just suited for simple geometries without any undercuts.
NFP (accurate)	Uses No-fit Polygons for generating nests. Very accurate and considers cutouts and holes and fills them with smaller cuts if required (see next chapter H2.5 Fill Cutouts).
Hybrid	A combination between Tetris and NFP nesting algorithm.
NFP Rotation	Same as NFP, but also allows the rotation of single cuts during nesting to decrease material consumption and increasing nesting quality.
Autonester	Autonester can be added to NestKing as an Add-On and clearly delivers the best nesting results.

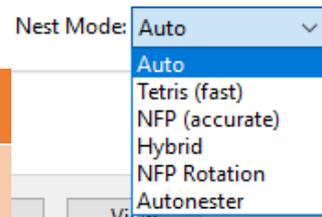
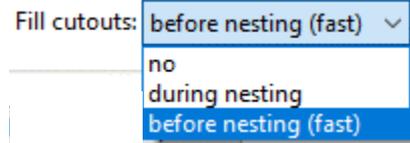


Table 17



H2.5 Fill Cutouts



Currently NestKing offers three modes to fill cutouts (hole in cuts):

Name	Description
No	Cutouts are not filled with other cuts.
During nesting	Cutouts are filled with other cuts during the nesting process (slows down the nesting process a bit).
Before nesting	Cutouts are filled with other cuts before nesting (fast).

Table 18



H2.7 Status Signs

The Nest Dialog also shows status signs (red, yellow or green dot in the tab title) as indicated in Figure 443. The color of the sign changes from red, stating that nothing is nested yet, to yellow as soon as the cuts are nested and from yellow to green when the nest result is exported with the button.

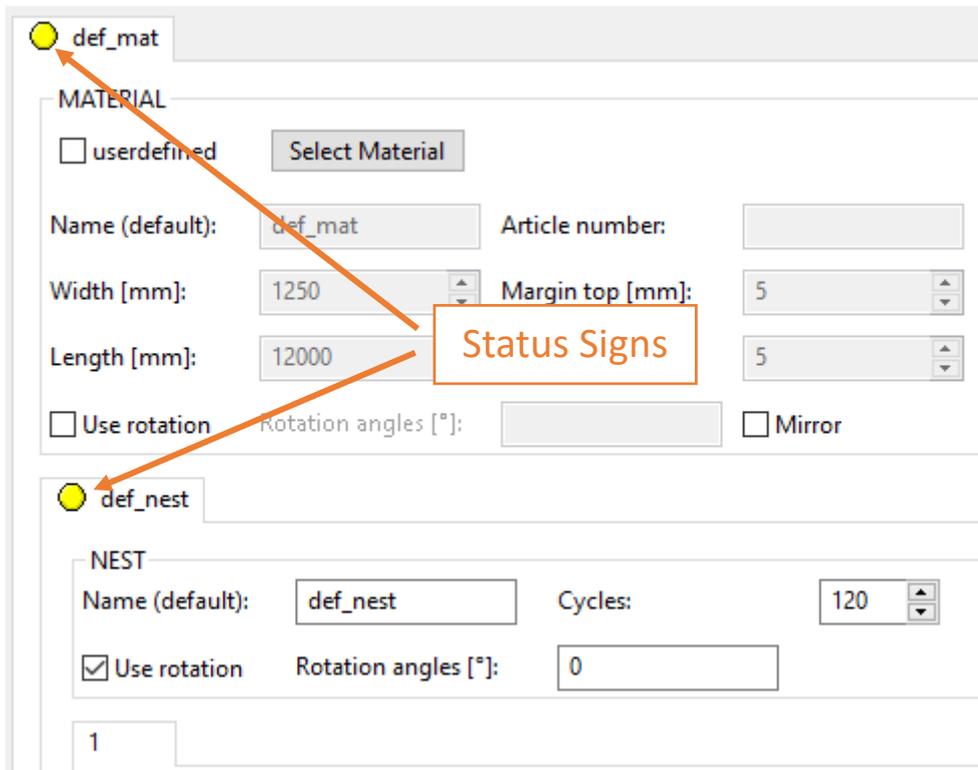


Figure 443