# Mill Manual for Estlcam

Part 1 Fundamentals and Preparation

### **Mill - Overview**



#### **Materials**

Plastic e.g.:

- Acrylic glass max. 10mm
- Polystyrene max. 5mm
- PE foil max 2mm
- Polyurethan

Wooden materials e.g.:

- Limetree
- Plywood• MDF und HDF

Materials that are not listed in the spreadsheet (Page 3 decision guide mill) shall not be used - unless the workshop team agreed to it

The following materials may not be used at all: acrylic glass XT, grey cardboard, fine cardboard (cardstock), bristol paper

#### Milling table surface

1000 x 600 mm

#### Milling work area

990 x 590 mm maximum work surface area is dependent on the tool diameter

#### Data format

CAD - 2D drawing in dxf - format

### **Drawing preparation**

#### attributes

- 1. Drawing in mm (in the right scale)
- 2. The drawing must be located on z=0
- 3. Draw a frame in the size of the sheet materials you are using and place the drawing in the frame.
- 4. No double lines (ensure a clean drawing)
- 5. If the DXF was created with Archicad, it should be opened and exported again in Rhino (Computer prefab Lab). Export scheme. 2007 Polylines.
- 6. Depending on the milling diameter there should be enough distance between the workpieces (10mm with mill diameter=3mm).

#### Order (Cutting and Carving)

All milling jobs (inner contor, outer contour...) must be on seperate layers. The milling operations always begin with the milling of the inner contours.

Frame for the material size > carving > inner contour > outer contour



#### Layer structure

#### 1. Layer: frame

Maximum size of the material 1000x 600mm

#### 2. Layer: carving

Polylines should be closed if possible. If Polylines extend to the edge of the outer contour, then the polylines must be drawn 2mm over the edge - see the green lines in the picture on the left.

#### 3. Layer: inner contours

e.g. hole of 3mm diameter - mill diameter of less than 3mm

e.g. thin "valleys" with margins that are smaller than the mill diameter can't be milled.

#### 4. Layer: outer contours

Keep a minimum of 10mm margin to the frame (the margin between different parts may vary).

e.g. Milling diameter = 1mm : Margin of 5mm Milling diameter = 3mm : Margin 10mm

#### 5. Layer: holes (if holes are existend)

the program does not detect points, instead draw circles

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# Mill Manual for Estlcam

Part 2 Operating the machine

## **1. Opening the file**

#### **Estlcam**

You can download a free version of the CAM program at **www.estlcam.de** to program the file indepentend of the prefab Lab.

#### Estlcam CAM 12,037\_A64



#### Layer

1. Open Layer list via View - Layer List





visible- invisible
 editable - ineditable
 delete layer

If a layer is invisible and should be visible again, the lock must be clicked first

#### **Program surface**

On the left side you can find every important command and program option. When selecting a menu, there will be more options depending on the command. By navigating the mouse over a menu, an information window will open with detailed information - alternatively click F1 while the cursor ist on the menu.

Select - selecting, editing or deleting already defined jobs

Tile - duplicate selected jobs or drawings in a defined quantity in vertical and horizontal direction as well as the distance in between

Delete - It is only possible to delete a job that was selected beforehand



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### 2. Defining zero



#### Select zero

- 1. Define zero (x = 0 / y = 0) for the CNC program
- 2. typically lower(front) left corner of the used material. It is helpful to draw a frame of the material size for defining the position of zero.

### 3. Mill decision guide

Before programming the different milling jobs, the mills should be selected. Consider the following: When carving, only the width is relevant, if you want to carve a width of 0,8mm into the material, you should choose a 0,8mm mill. If you want to cut through the material, the thickness and form is relevant.

The thicker the material (max. 12mm), the bigger the diameter of the mill should be. When choosing a bigger mill, the machine needs less cutting transits which results in a shorter cutting time than when using a thinner mill.

When cutting inner contours keep in mind, that corners can not be cut but instead a radius - depending on the diameter of the mill. To have a really small cornerlike radius you can choose a thin mill which results in a longer cutting time. The material can be reworked afterwards with a file.



pocket in MDF with a 2mm mill

Choose the right tool list in estlcam

default: soft wooden materials: MDF, HDF, plywood (birch, cottonwood)

hard wooden materials: airplywood (beech), screen print board

plastics: polystyrene, acrylic glass GS, polyurethane

Pa					Parameter	set:	Kunststtoff:Polystyrol,AcryIGS,Polyurethan			
			No	Name	ø	ZZ	Defau	lt		
R	2	?	1	Fräser 0,8mm	0,80mm	(0,5 Holzwerkst.hart:Sperrholz(Buche),Siebdruckpl.				
2	2	?	2	Fräser 1,0mm	1,00mm	(1,1 Kunststtoff:Polystyrol,AcrylGS,Polyurethan				
٩	5	?	3	Fräser 1,5mm	1,50mm	(1,6	0mm)	(700mm/min)	(400mm/min)	
3	5	?.	4	Fräser 2,0mm	2,00mm	(2,1	0mm)	(700mm/min)	(400mm/min)	××
3	5	?.	5	Fräser 3,0mm	3,00mm	(3,1	0mm)	(700mm/min)	(400mm/min)	
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#### Important!

Motor speed must be adjusted directly at the spindle depending on the chosen material.

hard and soft wooden materials 6

plastics 2



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 ► Fxy

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 (0,50mm)
 (600m

 ,00mm
 (1,10mm)
 (600m

 ,50mm
 (1,60mm)
 (700m

 ,00mm
 (2,10mm)
 700m

cutting transits depend on chosen mill

To cut 10mm MDF you can choose a 3mm mill, that has a cutting depth of 3,1mm per transit. Having set the overall cutting depth to 10,1mm, the machine needs 4 transits to reach the overall depth. The number of transits is always dependent on the thickness of the material and the mill.

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max cutting depth

0,8mm	Ø		carving only	
1mm	Ø	max 6mm	recommendation: thickness	0,5 - 2mm
1,5mm	Ø	max 8mm	recommendation: thickness von	0,5 - 3mm
2mm	Ø	max 10mm	recommendation: thickness von	0,5 - 6mm
3mm	Ø	max 12mm	recommendation: thickness von	0,5 - 8mm

With thicker materials please come to the workshop

### 4. Job definition

To define a mill job, select the according symbol on the left side, to match the right milling job. Choose the right mill according to the material - it will be highlighted in another color. After selecting job and tool, select the drawing to define it.

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			No	Name	ø	<b>L</b> Z+	Fxy	Fz Fz		
٩	£	?	1	Fräser 0,8mm	0,80mm	(0,50mm)	(600mm/min)	(400mm/min)		X
٩	ſ	?	2	Fräser 1,0mm	1,00mm	(1,10mm)	(600mm/min)	(400mm/min)		X
٩	5	?	3	Fräser 1,5mm	1,50mm	(1,60mm)	(700mm/min)	(400mm/min)	0	X
٩	ſ	?	4	Fräser 2,0mm	2,00mm	(2,10mm)	(700mm/min)	(400mm/min)		X
٩	ſ	?	5	Fräser 3,0mm	3,00mm	(3,10mm)	(700mm/min)	(400mm/min)		X
1	100 million (1990)									



- 1. Part cutting outer contours which mill, cutting depth, tabs or islands yes/no
- 2. Hole cutting inner contours which mill, cutting depth, tabs or pockets yes/no
- Engraving shallow cutting which mill, cutting depth, left side/ right side/ centered along shape
- 4. Drill cutting a hole

position the hole with a auxiliary construction, either a circle or a cross / instead of using this command you could alsocut the inner contour of a circle drawing

5. Text

choose the position (starting point) of the text, the font - edit with different parameters and select mill, cutting depth

6. Zero - position zero for the cnc program

#### **Create objects automatically**





All drawings that are placed on the same layer can be defined all at once. Make all other layers invisible and open the menu with automatic - create objects automatically.



Tick the right boxes: Parts and holes for outer contour, holes and parts for inner contour etc.

If there should be different sized holes on one layer, those can be selected with a size scale min to max

Confirm with OK, choose a mill, select everything and type in the cutting depth.

### 5. Overview

#### attributes

- 1. Cutting depth engraving = choose the cutting depth yourself cutting = thickness of the material + 0.1
- 2. Tabs: Means that the parts will not be cutted entirely but with a defined amount of tabs "bridges". Click on the drawing for positioning and set the length and height
- 3. Pocket: removes all material inside the selected contour. Depending on the form choose linear or parallel and also set a cutting depth.
- 4. Island: removes material inside a contour except a defined inner contour. IMPORTANT: First define the "island" as a part then define the outer contour with hole+island.
- 5. No: It makes sense to set the machining order to auto (default). The program determines an order depending on the jobdefinition and the selected tool. It is also possible to type in a number manually for certain or all objects. With edit maching the order can be shown and edited.



#### **Cutting depth**

The different cutting depths will be highlighted in different colornuances. Jobs that are shown in yellow don't have a defined cutting depth yet. You can either select them and define each on their own or you define the same cutting depth for all missing jobs when transferring to the CNC program.



#### Saving the file and transferring it to the CNC program

1. Before transferring save the file with file - save

2. When every job is defined and the file is saved, go to - file - start machining. The CNC program will open with your mill jobs.

File	Edit V	iew	Autom	atic	Tools	Setup
	Open					
	Update dra	wing				
	Add					
	Edit drawin	ng				
	Previously	open	L			
	Save proje	ct		1		
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### 6. Mounting the material on the vacuum table

#### function of the vacuumtable

The material that shall be milled is sucked down and fixed on the milling table through negative pressure. (It is not allowed to use screws). If the workpiece is smaller than the milling area, the remaining part of the milling table has to be covered with the black rubber mats, to produce efficient suction. **Important**: The zero-point on the top side of the material has to be set AFTER the vacuum pump has been turned on !!! Height difference through suction !!!



#### Overview of the related equipment to the vacuum table

- 1. On/Off Switch for the vacuum pump, mounted on the table leg
- 2. Rubber mat for covering the unused parts of the milling area
  - ► (to guarantee the most efficient suction of the vacuum table)



#### Switching on the vacuum pump

Workshop mill room: left side of the door



prefab Lab:

left mill: right on the edge of the table

ble right mill: left on the edge of the table





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### 7. Controller



#### **Joysticks**

just joysticks: going slow joysticks + accelerator: full speed possible

**D joystick** Z - axis ↓ G joystick ↔ X- axis ↑ Y - axis

**RB button** save measuring point

LB button (press 3 sec) CNC program start/stop

LT oder RT accelarator

define zero (press 3 sec) X : X -axis Y : Y-axis Z : Z - axis A : all axes

### 8. Mounting and changing the mill

#### **Overview**

- 1. Wooden finger to hold onto small things
- 2. Wrench to open and close the screwcap
- 3. Rubber mat to cover the not used milling work area and improve the suc tion
- 4. Switch to turn the vacuum pump on and off



#### Changing the mill

- 1. Press the locking button until the spindle isn't turning anymore. While still pushing the button, open/close the screwcap with the wrench.
- When opening there is a double resistance, after the first loosening you can unsrew the screwcap by hand, use the wrench when it tightens again.
  ▶ now you can change the mill.
- 3. Put the mill into the collet and tighten the screwcap, first by hand then with the wrench unti there is a resistance.





#### Spannzange und Fräser

- 1. Collet
- 2. Screwcap
- 3. Mill





#### travel length

When using thin materials it is important that the mill ist not clamped to high up the collet. The cutting depth cannot be reached and the following notice will appear.



The mill has to be reclamped which mean that you have to define z=0 again.

#### **Buying mills**

Mills can be bought in the workshop Mo-Fri from 9am to 6pm.

### 9. Zero und Homing

#### Homing

- 1. The CNC program automatically starts the homing process, when being opened. The machine locates itself and finds zero with buttons on each axis.
- 2. It is important that the step losses aren't too big, eventually you have to restart the homing process a few times (click the house on the right side).



starts homing process

3. The Step losses shouldn't be more than 1 or less than - 1. Eventually you have to restart the homing.

### Machine homed... Step losses: -X: 1 / 0,01mm -Y: -1 / -0.01mm



#### Zero

- 1. X = 0 und Y = 0 are located at the front left table edge at the engraved line. The material should be put in that corner and then fixed with the vacuum table.
- 2. Z = 0 must be freshly defined with each material and mill. It is located at the height of the materialsurface.

3. After clamping the mill, put on the vacuumtable and slowly move the spindle to the material using the controller. Put a thin piece of paper between the mill and the surface and continously move it.

4. Continue to move the spindle downwards until the paper is stuck between the material and the mill.

5. Zero the z-axis by pushing the B - button of the controller for 3sec.

6. Drive the spindle back up.





### **10. Overview**

#### **Opening the CNC program**

- 1. Open the CNC program by clicking file start machining.
- 2. On the left side you can see the position of the spindle in subject to zero in coordinates. By clicking the arrows you can slowly move the spindle. The tip of the arrow is the fastest speed.
- 3. In the middle of the screen you can see the mill path and the positioning on the table.
- 4. On the right side you can see the g-code, it describes the mill path in coordinates.
- 5. With the play-button below the g-code you can start the milling process, alternatively press the LB button for start/stop.

Estlcam CNC 12,068B "CNC\_Autostart.nc" / Machining time about 01:35:40



CO1 7-1 0000 5400

5.

### **11. Darstellung CNC**



The defined point **Zero** is shown as a blue cross (see picture down below on the left)

The **location** of the spindle is shown as a red cross (see picture down below in the middle of the right plate)



If you can't see the project in the CNC program: Revisit EstIcam and click "start machining" again.



### 12. Saving and milling

1. Before you start milling, save the file with Datei - Projekt speichern.

E Estlo	am CAM 12,06	i8B				
Datei	Bearbeiten	Ansicht	Automatik	Werkzeuge	Einstellungen	Lizenz: k
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#### pause / stop - abort

- 1. Stop button below the g-gode Spindle stops (and moves up)
- 2. ESC abort complete abort (spindle goes to reference point)
- 3. Emergency stop the spindle doesn't get power -> until it is released,the spindle cannot be moved, data that is not saved, is lost. Zero must be defined again.

#### aborting during the mill exchange

Move the spindle to a location anywhere in the working area of the mill. Define point z=0 with the button B on the controller "in the air". Then press start then stop to abort.

#### milling time

Milling time will be displayed at two places. The overall milling time at the beginning of the g-code, the time that is left on the upper left side of the screen.



To start milling, press the play-symbolbelow the g-code. Alternatively press the LB button of the controller. In the upper middle of the screen will be a notification when you have to change the mill.

After each mill exchange you have to define the zero again. Afterwards start the milling process with the play button.

It is possible to manually select a line of the g-code to continue milling from there.

20:	
21: Nr. 2 Drill machining: Drill 10	l
22: ▷ GOO X193.3333 Y213.3	
23: <b>∀ G00 Z0.5000</b>	
24: ↓ G01 Z-1.0000 F400	
25: <b>☆ G00 Z5.0000</b>	
26:	
27: Nr. 3 Pocketing parallel: Pocket 8	
28: DD GOO ¥105.7580 ¥279.2	
29: <b>∀ G00 Z0.5000</b>	
20· CO1 7-1 0000 5400	$\overline{}$

Turn on the vacuum table before milling

### 13. Optional: hooverhelp

It can be helpful to use the hoovering help while milling. For example when milling MDF or when there is a lof of cutting on a big plate.



The hooverhelp consists of two parts, the first one stays on the spindle permanently, the second one is magnetic and can be quickly put on or removed.

To define zero, remove the hooverhelp



Before you start the milling process, attach the hose of the vacuum cleaner to the adapter and position the hose in a way, that it does not disturb the mill or any moving axes.

Take care that the hose doesn't get stuck while milling.

### 14. Behaviour in case of fire or an accident







#### Fire (material is burning)

1. stop milling with the emergency stop

- 2. put the material on the ground
- 3. put the fire blanket over the material
- 4. call the workshop

#### Heavy fire (machine is burning)

- 1. stop milling with the emergency stop
- 2. activate the fire alarm and call 122
- 3. Call the internal emergeny number of TU Wien
- 3. Use the extinguisher
- 4. Leave the workshop

#### **First Aid**

- 1. Plasters and a first aid kit is next to the entrance door.
- 2. If there is a bigger injury call 144 and the internal emergency number.