# **CNC Induction**

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# **CNC Induction**

In this induction you will learn

- the safe operation of the Multicam CNC router
- what you can achieve with router.
- how to prepare a simple design for fabrication.
- how to assign tool paths and export for the router.
- Cutting and finishing your job.
- how to identify problems and what to do when problems occur.

# Requirements

- An State Library membership.
- Closed footwear.
- Participants must be over 16 years of age

# Safe Usage of the CNC Cage

- The Edge staff supervisor to be present at all times
- A Hot Work Permit must be in place at all times
- Machine be used by inducted participants only.
- No person other than the operator or other authorized persons should be in the working area

# **General Personal Safety**

- SOP for Multicam CNC
- Enclosed footwear must be worn at all times.
- No loose or dangling jewelery or ID cards
- Long hair or beards must be tied up
- Avoid loose fitting clothing
- Personal Protective Equipment (PPE) must be worn when operating, supervising or observing the router in operation.

• SOP

for Manual handling of materials

# **Machine Safety**

When machine is running, keep clear of any rotating or moving parts eg. the cutting bit, spindle

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- moving gantry and head parts.
- Do not lean on machine whilst in operation.
- Parts of the machine, particularly cutting bits, will get hot so you may need gloves when handling/ or changing tooling.
- Maintain a clean workspace-check that the gantry and rails for tooling/materials left behind.
- Clean up as you work. The machine does the messy work for you to clean up!
- Use the right tool for the job. Different tooling pieces have a specific purpose and material.

# **Safety - Emergency Stop**

The CNC is fitted with an emergency stop.



This can be activated to bring the machine to an immediate stop in an emergency.

Note -if the machine is turned OFF mid operation, wait 1 minute to turn ON. After activating emergency stop, needs to be homed.

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# **Safety - Operator Hazards**

The CNC router is capable of **directly** causing death or serious injuries, including amputations, fractures, de-gloving, lacerations, contusions and crush injuries. The hazardous parts of the machine are:

#### The spindle

- The spindle spins at up to 18,000 rpm capable of cutting at over 10 metres/minute (m/m)
  - through metal
  - (or flesh)
- The bit takes at least 20 seconds to come to a complete stop.
  - Every time.
  - Even if you touch it.
- The bit can fracture, break or shatter.
  - A bit rotating 18,000 RPM will fly out about 50 km/hr
    - at your eyeball

#### The Gantry and Machine Head

The gantry can move at over 10 meters/min and weighs over 100 KG.

It can hit with enough force to knock a person over, or trap and mangle a limb.

### **Safety - Damage to Machine**

- The vacuum bed is soft aluminium. If it is damaged the machine is unusable.
- Drill bits are brittle, and will shatter or crack if dropped on concrete.
- The router will cut through metal clamps and screws

### Main parts on CNC machine

- Machine bed with vacuum suction
- Steel Gantry X axis
- Machine head Y and Z axis
- Spindle routing bits and collets spins at 16000rpm average
- Controller panel Manually control the gantry and load jobs
- Inverter enclosure- DO NOT OPEN! High Voltage. Main on/off switch is located here.
- Vacuum Pump manifold four sections can be isolated to increase vacuum.

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# **Machine Operation**

# **Router Preparation**

- Remove the waste cover board if required (2 person lift)
- · Check over the wasteboard for rough and uneven spots and sand down using scour pad
- Use compressor to blow dust away.

# **File Preparation**

The induction contains a introduction to VCarve to become familiar with creating tool paths and design orientation. We are going to make a simple stool from pre designed DXF files

- Tool paths are demonstrated on predesigned shapes
- Sending files to ouput so the CNC can fabricate

### **Prepare Files**

Export your file as a DXF, PDF and the original format.

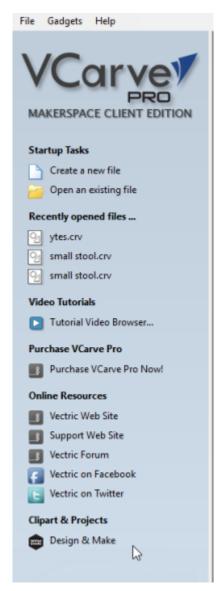
#### **Vcarve**

As of August 2017 we have moved to using Vcarve for inductions.

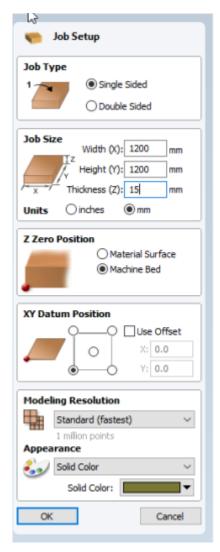
You can download Vcarve Pro and authorize it with The Edge's makerspace code.

86B4F-F467A-280D9-9F4C6-9C56B-4C528-BEE6F

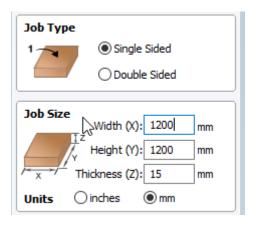
Create a new document



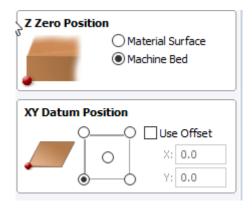
Define the Job



Make sure your material dimensions match your Job dimensions. For the inductions we use use a 2400x1200x17mm sheet. Measure all dimensions on the sheet!



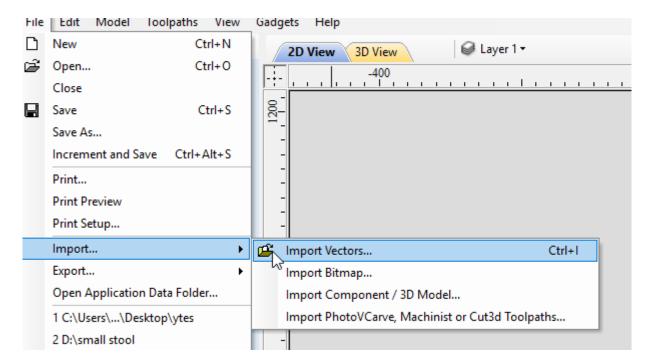
Ensure your Z Zero position is the Machine Bed



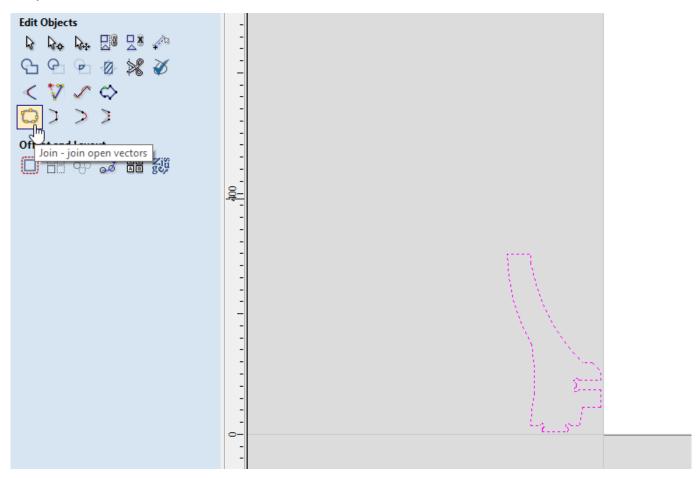
#### Import your first DXF shape with the correct thickness from the

zipped

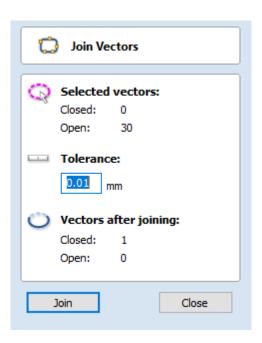
files. Drag and drop one file at a time.



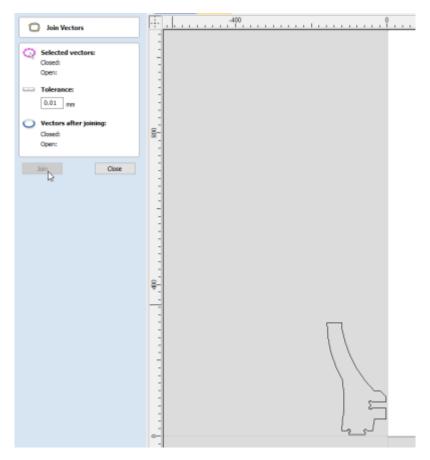
We need to check if the vectors need to be joined with the **join** tool.



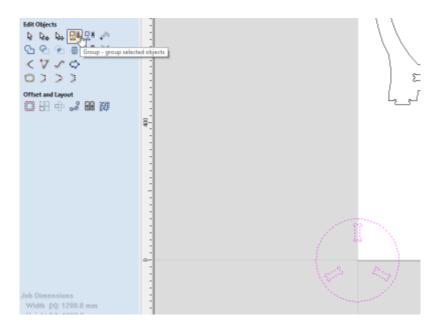
If you see open vectors, close them.



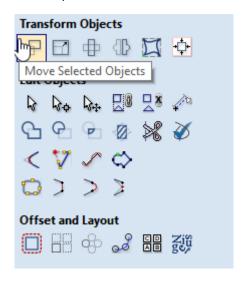
Your shape should be solid black

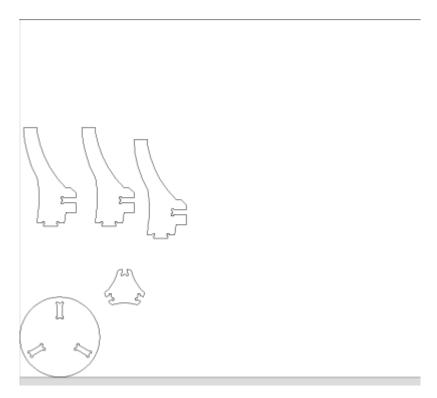


Import your next shape - if it has separate parts - group to move all together.



You Can move them easier using the move tool





#### **Create Tool Paths**

The router follows the tool paths to cut.

- 1. Right click on shape outline (or select from left menu)
- 2. Click Create toolpaths
- 3. Select routing type
  - 1. Routing offset this is for whole, complete shapes with no breaks. Cuts around the edge of the shape.
  - 2. Internal (female) cuts inside the shape.
  - 3. external paths (male) cuts outside the shape.
  - 4. Island Fill/Island Hatch removes all material **inside** an area.
  - 5. Engrave Paths single lines that don't join to make a shape (appear with a small arrow)

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#### **Tool Type**

Select the tool type you would like to use -For the induction we use either a 10mm 2 flute compression. You can import the entire

edge tooling

database into your version of Vcarve.

# **Depth, Feeds, Plunge and Speeds**

These are the settings which the router uses to operate. It is up to you to set them, then the supervisor to double check any existing settings.

#### **Depth**

Set the depth in the path dialogue.

- Depth How far **above** the bottom of the waste board the router starts its cut.
  - Currently add an additional 0.3mm below your material thickness
  - This may change after each service and/or waste board planing, your supervisor
  - If your material is 17mm thick (make sure to measure) then the cut depth should be 17.3mm

Your supervisor will help you select the correct feeds and speeds for your job.

#### Feeds, Plunge and Speeds

In the tool 'edit' menu set:

- Feed How FAST the router moves in the x,y dimensions. This is a constant linear speed in millimetres per minute (mm/min)
  - Feed rate = Number of cutting edges x chip per tooth x RPM
- Plunge How FAST the router move in the z dimension into the work material.
- Speed This is the rotation speed of the router bit on Revolutions per Minute (RPM)

Click Save as.. if the tool path will be repeated or Ok when done

# **Moving Designs to Machine**

### Sending Jobs to the Multicam

- Open the Multi Cam App Manager
- Select File Manager

- select Connect -Note CNC Machine must be on to connect
- Once connected ,select your saved job and select the arrow to move to machine

# **Loading a Tool**

Changing the tool is an operation only to be carried out by a Fabrication Lab Supervisor.

# **Loading the Router**

- Load material onto the waste board.
- · Align with bottom left corner of the bed
- Press TAB 1
- Load job using the folder button
- · Check the job preview

#### **Cutting with the Router**

- Don PPE
- turn on bed suction
- Turn extractor
- start the job the job will verify
  - if preview fails abort and review Enroute settings
- Start cut with green button

# While machine is operating

- Wear PPE!!!
- Observe the machine in operation
- Operator only inside yellow safety line

#### Pausing a Cut / Clearing Debris

If a piece is moving or get stuck in the extractor.

- Pause the cut with the red stop button
- · Wait for the machine head to withdraw
- Watch the controller
  - Wait for the spindle to stop
- Watch the spindle verify it has stopped.

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# **Use emergency stop if necessary**

Note -if the machine is turned OFF mid operation, wait 1 minute to turn ON.

# **Cleaning Up**

Move the machine head clear Use the extractor as a vacuum to clean debris Turn of the vacuum bed remove your job blow off bed with compressed air sand back wasteboard

# **Files**

dxf\_18.2mm\_asgard.zip

dxf\_17.5mm\_asgard\_250\_300.zip

asgard\_stool\_17.3mm\_thickness\_h300mm\_d250mm\_t10.zip

asgard\_stool\_17.9mm\_thickness\_h300mm\_d250mm\_t10.zip