# LMCS – Safe Work Procedure

## CNC OPERATIONS

**DO NOT use this equipment unless you have been instructed in its safe use and operation and have passed the safety accreditation**

### PERSONAL PROTECTIVE EQUIPMENT


Safety glasses must be worn at all times in work areas.


Long and loose hair must be contained.


Hearing protection must be worn.


Sturdy footwear must be worn at all times in work areas.


Close fitting/protective clothing must be worn.


Rings and jewellery must not be worn.

### PRE-OPERATIONAL SAFETY CHECKS

- ✓ Locate and ensure you are familiar with all machine operations and controls and emergency stops.
- ✓ Ensure the machine, power cords etc. are in safe working condition.
- ✓ Check workspaces and walkways to ensure no slip/trip hazards are present and that no one will be harmed by you operating the machine.
- ✓ Ensure all guards are fitted, secure and functional. Do not operate if guards are missing or faulty.
- ✓ Ensure table and work area is clear of all tools, off-cut timber and sawdust.
- ✓ Start the dust extraction unit before using the machine (if not operating automatically).
- ✓ Check you have completed verification of your project.
- ✓ Material is flat and safely secured to the base.
- ✓ Operate the safety switch and install the router bit.

### OPERATIONAL SAFETY CHECKS

- ✓ Activate the machine.
- ✓ Keep your fingers away from the base and gantry at all times

### ENDING OPERATIONS AND CLEANING UP

- ✓ Switch off the machine when work completed.
- ✓ Unplug and remove the router bit and return to storage area.
- ✓ Reset all guards to a fully closed position after use.
- ✓ Leave the machine in a safe, clean and tidy state.

### POTENTIAL HAZARDS AND INJURIES

ⓘ Kickback: wood may catch or jam and be flung back violently.

ⓘ Airborne dust.

ⓘ Eye and hearing injuries.

ⓘ Contact with blade at point of operation, potentially severe injuries.

### DON'Ts

- ✘ Do not use operate equipment without wearing appropriate PPE.
- ✘ Do not use faulty equipment. Immediately report suspect equipment.
- ✘ Do not surface irregular stock, branches or wood with embedded nails or screws.
- ✘ Do not put your hands any closer than 150 mm from the cutter head when it is rotating.
- ✘ Do not router surface stock less than 300mm long by 20mm wide or 6 mm thick
- ✘ Do not router stock with structural defects.
- ✘ Do not cut pieces with shattered ends.
- ✘ Never leave the machine running unattended.
- ✘ Do not use heavy pressure to a point the machine slows down audibly at a starkly reduced pitch.

**This SWP does not necessarily cover all possible hazards associated with this equipment and should be used in conjunction with other references. It is designed as a guide to be used to compliment training and as a reminder to users prior to equipment use.**

***This information is modified from Frontline Safety www.frontline.edu.au***

| Issued | Issued For | Prepared | Checked | Approved | Rev. |
|---|---|---|---|---|---|
| 22.09.2022 | Endorsement by Safety Com | R Wilson C de Groot | | | 03 |

# Safe Operating Procedures – CNC equipment

## PREREQUISITES

Assessments for all machines and equipment that are included in the Orange and Red dots must be completed.

A basic knowledge of CAD software is also required.

## BACKGROUND INFORMATION & READING

This video will assist you in following safe work practices:

CNC Router Safety - YouTube

CNC Routers Can Do ALL That? - WOOD magazine - YouTube

CNC Basics - What You Need To Get Started - YouTube

Videos need to be viewed prior to arranging an assessment.

This machine instruction presentation needs to be reviewed prior to arranging an assessment (insert link to Richards PPP).

## FITNESS TO OPERATE CNC

Members are expected to refrain from working on these power tools and machines if they acknowledge their own level of physical ability inhibits them from doing so safely.

However, if assessors determine that a member has some level of physical impairment that makes it unsafe to use machines, they will have no option other than to assess the member as not having the capacity to do so safely.

You can still do your projects, just complete the CAD design, mark the timber and ask another shed member with CNC experience execute the job for you.

## GENERAL RULES & TIPS

- **If recycled material is used, all timber MUST be visually checked for nails and screws. After that the timber MUST also be checked with the metal detector. Processing CCA treated timber is not permitted.**
- **When commencing operation ensure dust extraction system is switched on either manually or automatically.**
- **Operation of the CNC machine is not permitted whilst the shed is unattended.**
- **When the machine it in operation the plastic chain forming a no entry safety barrier must be in place.**
- **The shed has a fully licensed copy of V-Carve which can generate the G-Code necessary for operation of the machine. To improve efficiency members can download the free version and carry out their designs away from the shed. Members can then upload the design to the PC with V-Carve and set the tooling parameters and generate the G-code.**
- **The maximum cutter diameter permitted is 20 mm. That is a function of noise and limiting exposure of severe injury from impacts.**
- **The CNC router may only be used on wood, acrylic plastics and foam. It must not be used on ferrous metals, stone and other materials. The use of the CNC machine on brass, copper and aluminium is determined on a case by case basis. Be aware the metal cannot be cooled.**
- **At a later stage a laser head may be added, although laser engraving and cutting share many of these features this procedure will not cover those operations.**

## SPECIFIC RULES & TIPS

**All projects must be placed on a waste board, to avoid damage to the machine base.**

**All projects must be checked by one of the members of the core group of the CNC machine. A supervisor on duty may not be part of that core group, see details under PROJECT VERIFICATION**

# LAKE MONGER COMMUNITY SHED

**A member is not permitted to operate the machine without prior agreement for the project, That agreement is only in place for the specific scope of that project. That agreement also includes a verification of the holding down method.**

**The machine must be operated in accordance with this set of instructions (insert link to Richards PPP). A laptop will be available for following these instructions near the machine.**

**All work pieces must be secured with clamps or two sided tapes. Be aware when using tapes the machine tip is not cooled.**

## COMMON OPERATIONS ON THE CNC MACHINE

The CNC machine can cut, drill and engrave material as required. The CNC machine has a large operating area and at this stage can work in three axis. Consideration is being given to add horizontal (4th axis) machining too.

Permitted materials have already been stipulated above. The member is required to supply their own material or purchase material from the shed.

Members are also required to supply their own cutters. Collets of different sizes are available as part of the machine. The shed has a basic range of cutters available for purchase which would in many cases suffice. Once completed with the project, the member can elect to keep the cutter(s) or donate them back to the shed. Those donated cutters can be used for future inductions for example.

## PROJECT VERIFICATION

**Verification of projects covers mainly safety aspects. The verification is not aimed at verifying the practicality or features of the design and execution. Typically the verification covers for the design:**

- **The completeness of the design;**
- **Tool selection and machining specifics. (rpm selection, feed rate, ramp rate (see also tables at the bottom);**
- **Animation verification of toolpath and especially in relation to penetration of the work piece and how deep the cutter is moving etc.**

**Whilst V-Carve is the package provided in the shed, a member may present designs and G-code generated from other packages provided the above can be readily verified in the package used. In such case the member would need to bring a laptop with the software installed. Software for such packages is not to be installed on computers in the shed, unless agreed by the board.**

**Once the G-code is generated it must not be altered, changes trigger a re-verification. Minor tweaking as possible on the machine itself is permitted.**

**The second stage of the verification takes place just prior to machining once the work piece is secured to the base. The core group member will go through the securing of the work piece, basic machine operation and zero point (origin) settings.**

**Tables for generic parameter verification:**

### Typical cutting speeds

# LAKE MONGER COMMUNITY SHED

| Material | Ø 1 mm | Ø 2 mm | Ø 3 mm | Ø 4 mm | Ø 5 mm | Ø 6 mm | Ø 8 mm | Ø 10 mm | Ø 12 mm | Ø 16 mm | Ø 20 mm | MAX CUTTING SPEED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Notional RPM | | | | | | | | | | | |
| | 12000 | 12000 | 12000 | 10000 | 10000 | 9000 | 8000 | 8000 | 8000 | 6000 | 5000 | m/min |
| | Cutting speed m/min | | | | | | | | | | | |
| Soft plastic | 38 | 75 | 113 | 126 | 157 | 170 | 201 | 251 | 301 | 301 | 314 | 600 |
| Hard plastic | 38 | 75 | 113 | 126 | 157 | 170 | 201 | 251 | 301 | 301 | 314 | 550 |
| Soft wood | 38 | 75 | 113 | 126 | 157 | 170 | 201 | 251 | 301 | 301 | 314 | 500 |
| Hard Wood | 38 | 75 | 113 | 126 | 157 | 170 | 201 | 251 | 301 | 301 | 314 | 450 |
| MDF | 38 | 75 | 113 | 126 | 157 | 170 | 201 | 251 | 301 | 301 | 314 | 450 |

## Feed rate per revolution

| Material | Ø 1 mm | Ø 2 mm | Ø 3 mm | Ø 4 mm | Ø 5 mm | Ø 6 mm | Ø 8 mm | Ø 10 mm | Ø 12 mm | Ø 16 mm | Ø 20 mm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nominal RPM | | | | | | | | | | |
| | 12000 | 12000 | 12000 | 10000 | 10000 | 9000 | 8000 | 8000 | 8000 | 6000 | 5000 |
| | Feed Rate in mm / Tooth / Revolution | | | | | | | | | | |
| Soft plastic | 0.025 | 0.030 | 0.035 | 0.045 | 0.065 | 0.090 | 0.100 | 0.200 | 0.300 | 0.350 | 0.400 |
| Hard plastic | 0.015 | 0.020 | 0.025 | 0.050 | 0.060 | 0.080 | 0.090 | 0.100 | 0.150 | 0.180 | 0.200 |
| Soft wood | 0.025 | 0.030 | 0.035 | 0.060 | 0.070 | 0.090 | 0.100 | 0.110 | 0.160 | 0.200 | 0.220 |
| Hard Wood | 0.020 | 0.025 | 0.030 | 0.055 | 0.065 | 0.085 | 0.095 | 0.095 | 0.155 | 0.190 | 0.190 |
| MDF | 0.050 | 0.070 | 0.100 | 0.150 | 0.200 | 0.300 | 0.400 | 0.500 | 0.600 | 0.800 | 1.000 |

## Feed rates in mm/min for various cutters

| | | | | Milling feed rate in mm/min 1 flute | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | Ø 1 mm | Ø 2 mm | Ø 3 mm | Ø 4 mm | Ø 5 mm | Ø 6 mm | Ø 8 mm | Ø 10 mm | Ø 12 mm | Ø 16 mm | Ø 20 mm |
| | Notional RPM | | | | | | | | | | |
| | 12000 | 12000 | 12000 | 10000 | 10000 | 9000 | 8000 | 8000 | 8000 | 6000 | 5000 |
| | Feed Rate in mm/min | | | | | | | | | | |
| Soft plastic | 300 | 360 | 420 | 450 | 650 | 810 | 800 | 1600 | 2400 | 2100 | 2000 |
| Hard plastic | 180 | 240 | 300 | 500 | 600 | 720 | 720 | 800 | 1200 | 1080 | 1000 |
| Soft wood | 300 | 360 | 420 | 600 | 700 | 810 | 800 | 880 | 1280 | 1200 | 1100 |
| Hard Wood | 240 | 300 | 360 | 550 | 650 | 765 | 760 | 760 | 1240 | 1140 | 950 |
| MDF | 600 | 840 | 1200 | 1500 | 2000 | 2700 | 3200 | 4000 | 4800 | 4800 | 5000 |

| | | | | Milling feed rate in mm/min 2 flute | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | Ø 1 mm | Ø 2 mm | Ø 3 mm | Ø 4 mm | Ø 5 mm | Ø 6 mm | Ø 8 mm | Ø 10 mm | Ø 12 mm | Ø 16 mm | Ø 20 mm |
| | Notional RPM | | | | | | | | | | |
| | 12000 | 12000 | 12000 | 10000 | 10000 | 9000 | 8000 | 8000 | 8000 | 6000 | 5000 |
| | Feed Rate in mm/min | | | | | | | | | | |
| Soft plastic | 600 | 720 | 840 | 900 | 1300 | 1620 | 1600 | 3200 | 4800 | 4200 | 4000 |
| Hard plastic | 360 | 480 | 600 | 1000 | 1200 | 1440 | 1440 | 1600 | 2400 | 2160 | 2000 |
| Soft wood | 600 | 720 | 840 | 1200 | 1400 | 1620 | 1600 | 1760 | 2560 | 2400 | 2200 |
| Hard Wood | 480 | 600 | 720 | 1100 | 1300 | 1530 | 1520 | 1520 | 2480 | 2280 | 1900 |
| MDF | 1200 | 1680 | 2400 | 3000 | 4000 | 5400 | 6400 | 8000 | 9600 | 9600 | 10000 |

# LAKE MONGER COMMUNITY SHED

| Material | Milling feed rate in mm/min 3 flute | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ø 1 mm | Ø 2 mm | Ø 3 mm | Ø 4 mm | Ø 5 mm | Ø 6 mm | Ø 8 mm | Ø 10 mm | Ø 12 mm | Ø 16 mm | Ø 20 mm |
| | Notional RPM | | | | | | | | | | |
| | 12000 | 12000 | 12000 | 10000 | 10000 | 9000 | 8000 | 8000 | 8000 | 6000 | 5000 |
| | Feed Rate in mm/min | | | | | | | | | | |
| Soft plastic | 900 | 1080 | 1260 | 1350 | 1950 | 2430 | 2400 | 4800 | 7200 | 6300 | 6000 |
| Hard plastic | 540 | 720 | 900 | 1500 | 1800 | 2160 | 2160 | 2400 | 3600 | 3240 | 3000 |
| Soft wood | 900 | 1080 | 1260 | 1800 | 2100 | 2430 | 2400 | 2640 | 3840 | 3600 | 3300 |
| Hard Wood | 720 | 900 | 1080 | 1650 | 1950 | 2295 | 2280 | 2280 | 3720 | 3420 | 2850 |
| MDF | 1800 | 2520 | 3600 | 4500 | 6000 | 8100 | 9600 | 12000 | 14400 | 14400 | 15000 |

| Material | Milling feed rate in mm/min 4 flute | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ø 1 mm | Ø 2 mm | Ø 3 mm | Ø 4 mm | Ø 5 mm | Ø 6 mm | Ø 8 mm | Ø 10 mm | Ø 12 mm | Ø 16 mm | Ø 20 mm |
| | Notional RPM | | | | | | | | | | |
| | 12000 | 12000 | 12000 | 10000 | 10000 | 9000 | 8000 | 8000 | 8000 | 6000 | 5000 |
| | Feed Rate in mm/min | | | | | | | | | | |
| Soft plastic | 1200 | 1440 | 1680 | 1800 | 2600 | 3240 | 3200 | 6400 | 9600 | 8400 | 8000 |
| Hard plastic | 720 | 960 | 1200 | 2000 | 2400 | 2880 | 2880 | 3200 | 4800 | 4320 | 4000 |
| Soft wood | 1200 | 1440 | 1680 | 2400 | 2800 | 3240 | 3200 | 3520 | 5120 | 4800 | 4400 |
| Hard Wood | 960 | 1200 | 1440 | 2200 | 2600 | 3060 | 3040 | 3040 | 4960 | 4560 | 3800 |
| MDF | 2400 | 3360 | 4800 | 6000 | 8000 | 10800 | 12800 | 16000 | 19200 | 19200 | 20000 |