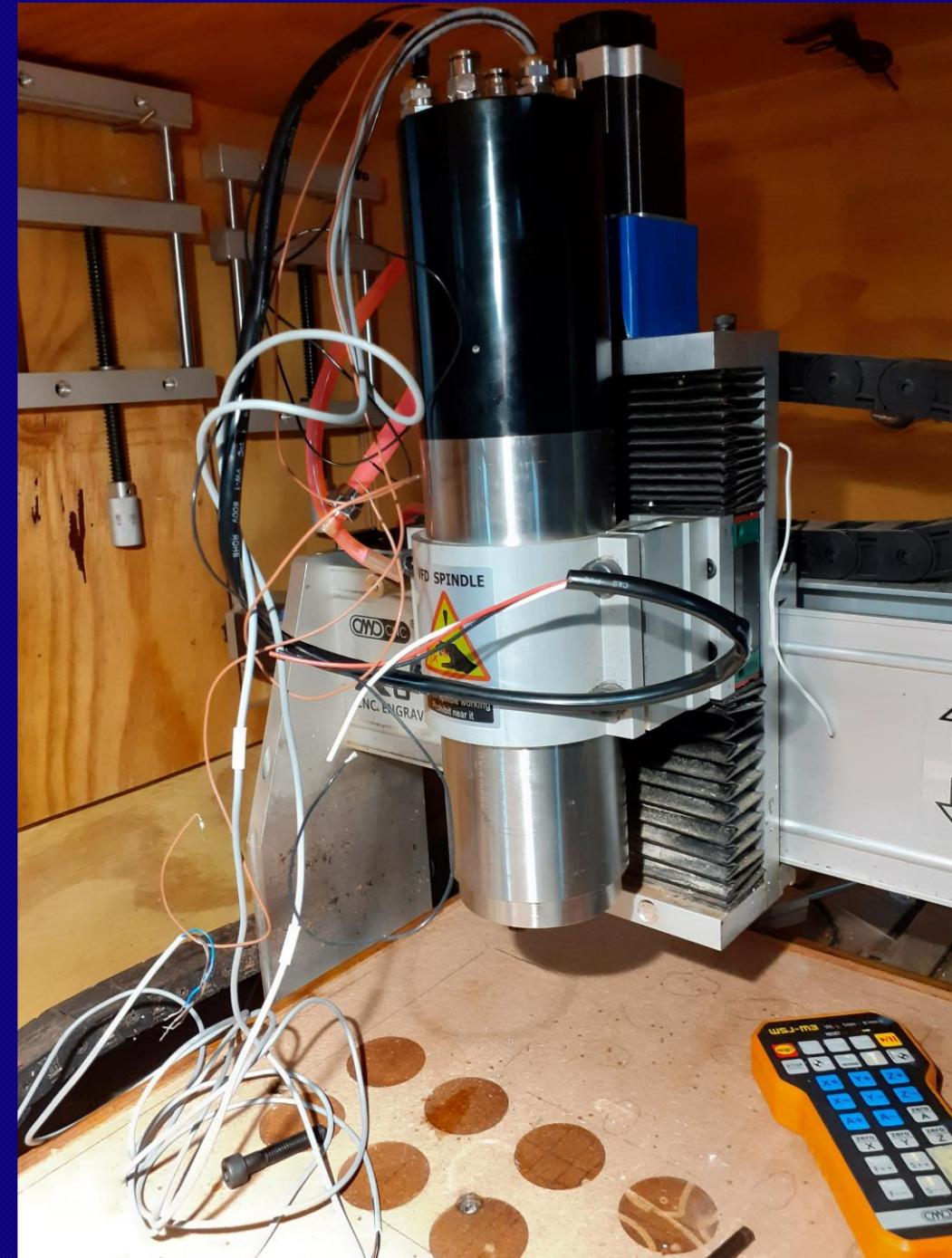


# Upgrading an OMNI 2200L CNC router with an ATC Spindle

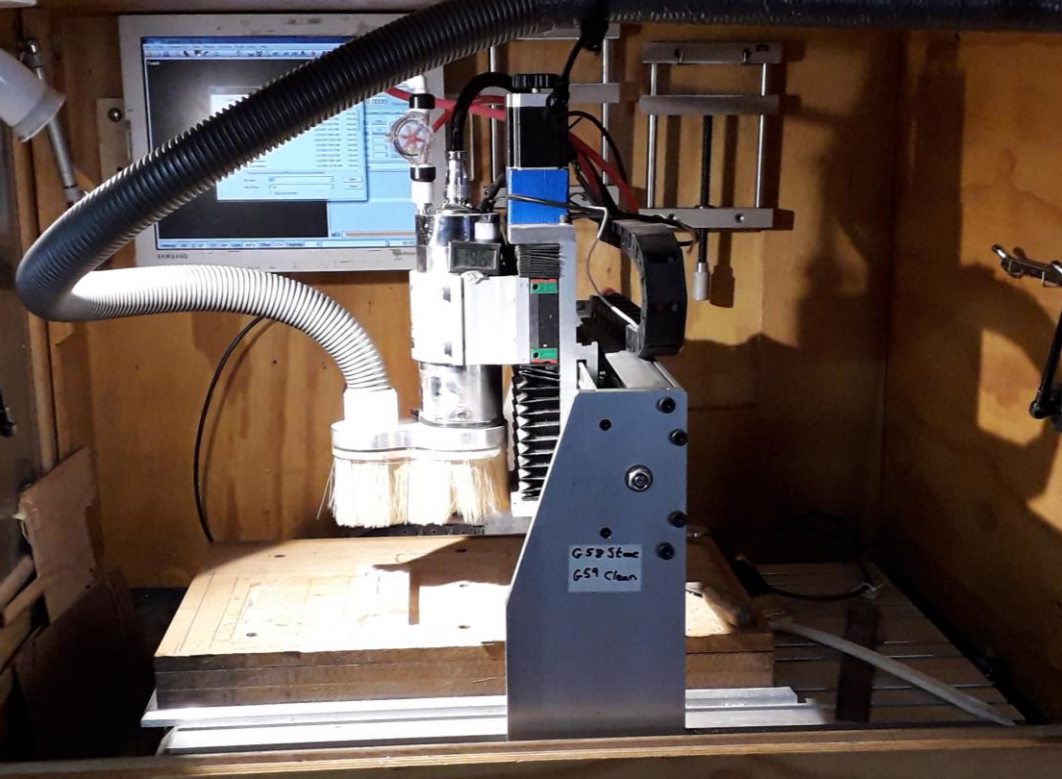
Aim:

To construct an automatic tool changing system, including a tool-holder rack that is mounted outside the working envelop of the router. Enable safety systems to protect the operator and the machine.

Danie Gouws Snr / Jnr  
May 2023



## Upgrade of an OMNI 2200L (600x400) CNC Router



CNC Router acquired in 2016

Work envelope of 560 x 380 x 90 mm

Motion controller card: 5 inputs and 5 open collector outputs

Mach 3 2010: Automatic tool height sensing after each manual tool change



# JGL 2.2 kW 4-pole with a build-in pneumatic automatic tool changer

- Dr Des Horn and myself each acquired a JGL spindle
- 4-pole, 800 Hz, 24 000 rpm, 80 mm diameter
- ISO20 ER16 collet system
- Water cooled
- Manufactured by JIANKEN High Speed Motor Co in China
- Acquired through Jan du Plooy, Evotek Industrial (China) / Nabteq (SA)
- Cost US\$ 1500, surface shipping cost (in bigger container) was negligible
- Spindle had good references on the Internet

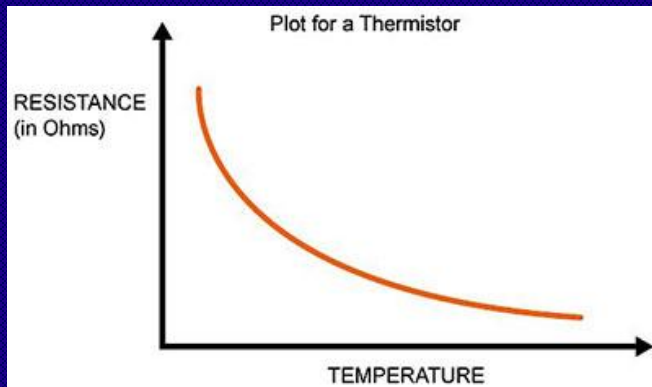


# Replacing the original 2.2 kW 24000 rpm 2-pole spindle with the ATC JGL 4-pole spindle

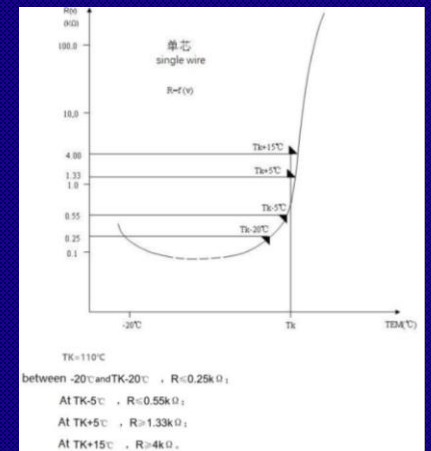


# Interfacing requirements Spindle to CNC motion control card

- Input 1: 12-30V PNP proximity sensor, indicating positive signal with tool-holder in spindle and clamp;
- Input 2: 12-30V PNP proximity sensor, indicating positive signal with spindle unclamp and toolholder removed.
- Input 3: NTC thermistor via micro-controller to display accurate bearing temperature, with audible alarm warning above 80 deg;
- Input 4: PTC thermistor via micro-controller to be used in series with “Emergency switch”



- Check for a condition where the spindle in clamped with no toolholder
- Interlock to prevent tool-change when spindle is rotating



## Interfacing requirements Spindle to CNC motion control card

Output 1: Tool-holder release 600 – 700 kPa, ensure tool release is not possible if spindle is still turning

Output 2: Bearing over-pressure air line, constant 100 – 150 kPa flow when the machine is operating, as well as activation of vacuum-cleaner for dust shoe

Output 3: Dust removal from tool-holder taper :  $\pm 400$  kPa

Output 4: Movement of ATC tool-rack using air cylinder, 100 – 150 kPa

Output 5: Activation of siren to indicate the status of tool-changing and a fault condition

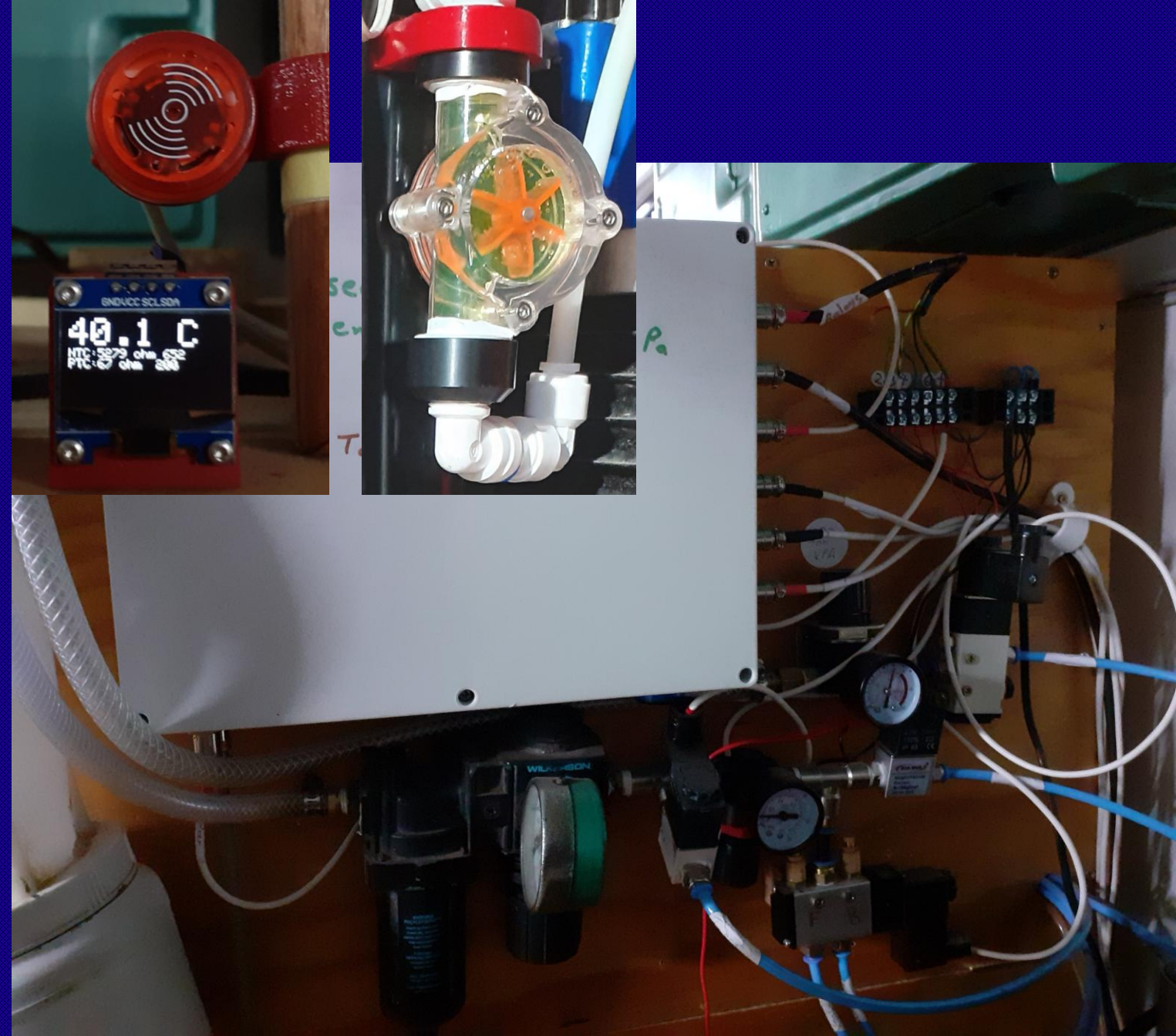
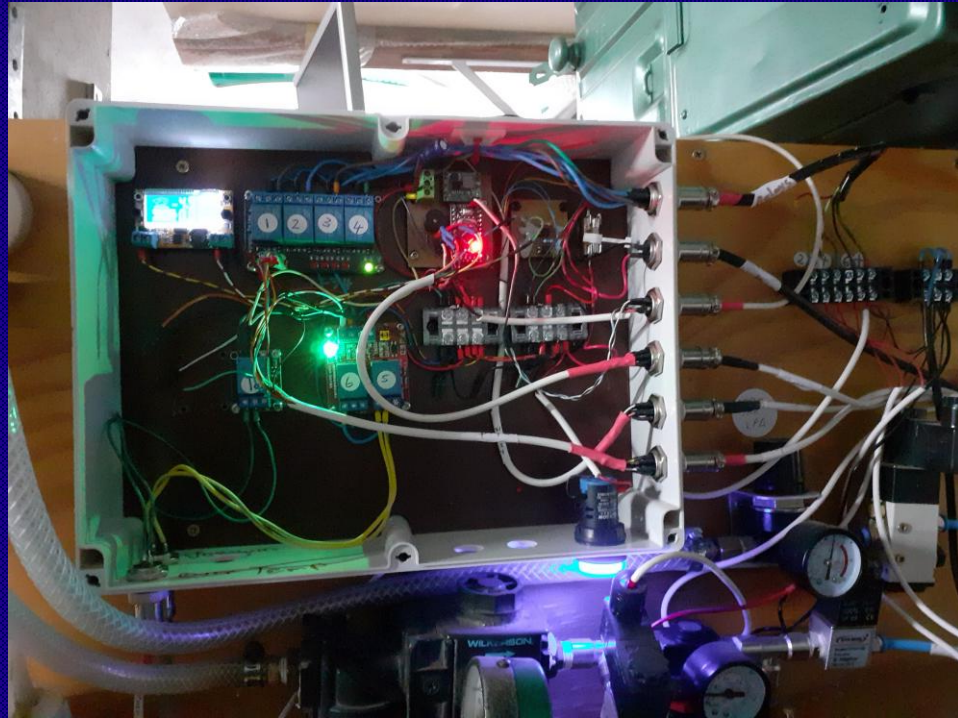
## Other considerations and requirements

- Electronic display of bearing temperature and a visual display of coolant flow
- Larger drag-chain that were able to clipped open
- Safety of the operator and machine is very important
- Tool-change operation must be executed with dust-shoe in place
- CNC card must be galvanically isolated from external inputs and outputs



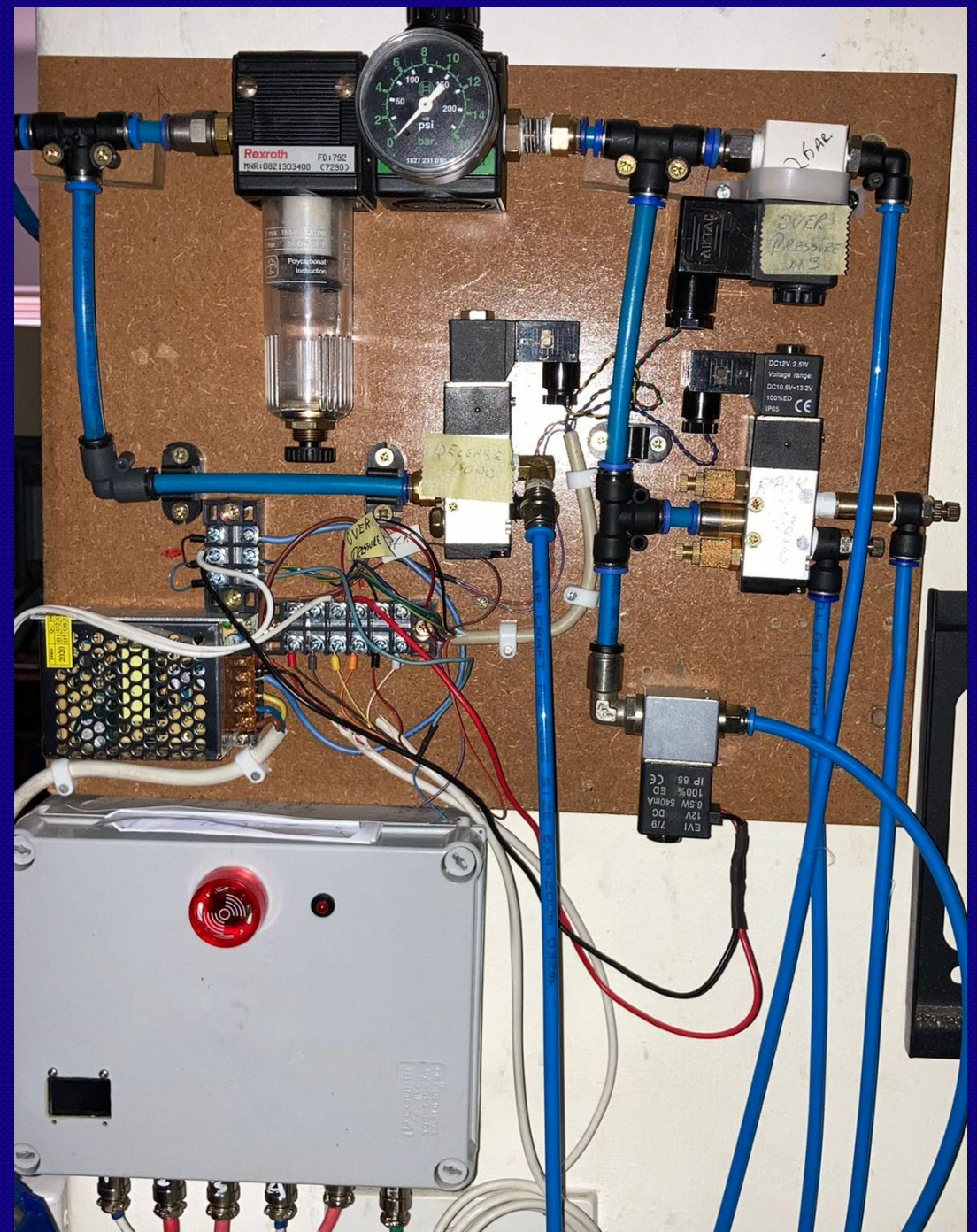
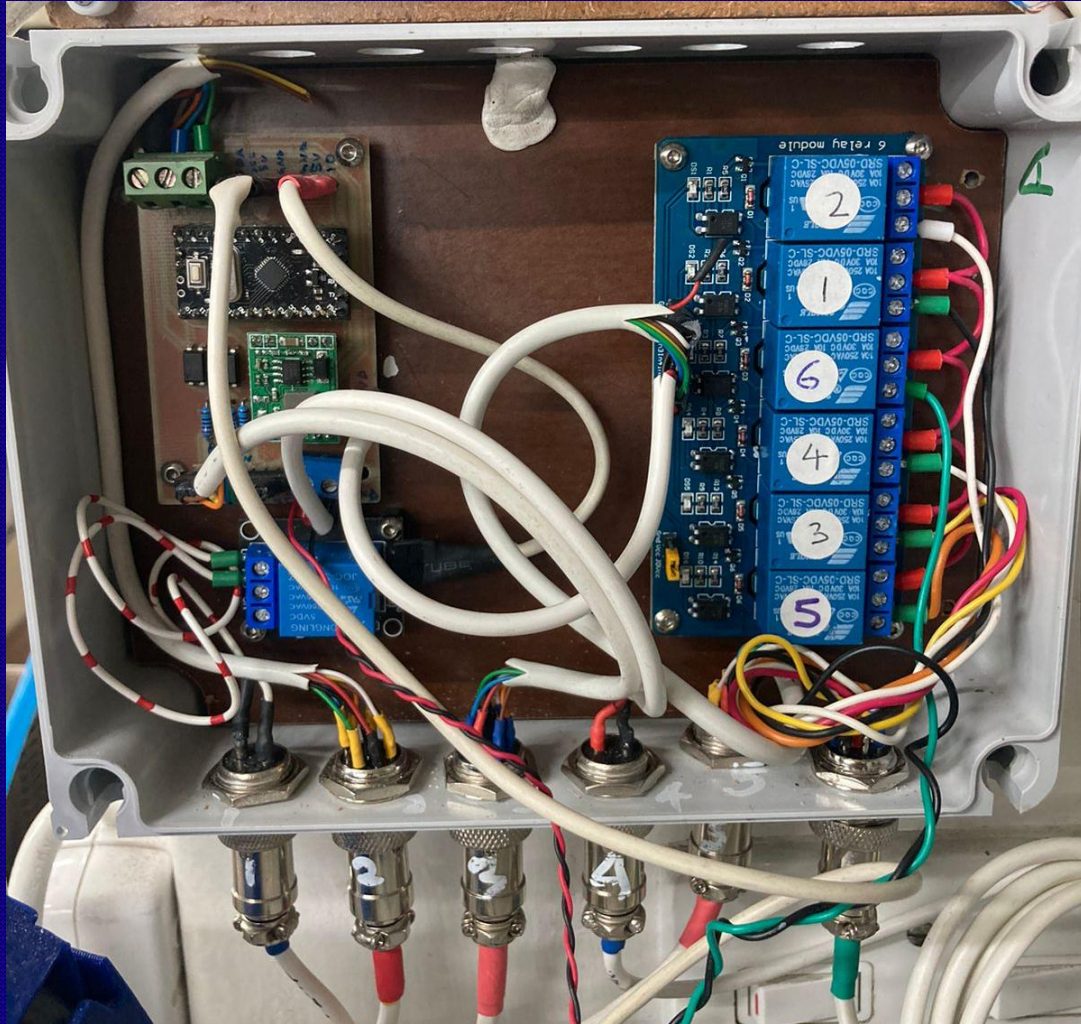
# Prototype electronic and pneumatic interface

Temperature conversions, display and over-temperature alarm done by Arduino Pro Mini



Second build with designed PCB and other insights

Des's setup .....



Based on  
Mach3 2010  
interface

Added a tool-  
change  
window with  
all the  
required  
information  
and buttons  
running  
macros

The screenshot displays the Mach3 CNC software interface. The main window shows a 2D plot of a part with blue contour lines and red dashed lines indicating tool paths. The top menu bar includes File, Config, Function Cfg's, View, Wizards, Operator, PlugIn Control, and Help. The toolbar contains various icons for file operations, navigation, and tool control. The right-hand panel features a 'Coordinates' section with input fields for X, Y, Z, and A axes, both in absolute and machine coordinates. Below this is a 'Tool Change' window with a list of tools and their positions, a 'Cur Tool Num' field, and a 'Cur Tool Pos' field. The 'MDI' field at the bottom right is empty.

**Coordinates**

Axis	Value	Machine
X Zero	+127.1406	-242.3844
Y Zero	+98.4688	-48.9125
Z Zero	+12.7000	-48.0094
A Zero	+0.0000	+0.0000

**Tool Change**

Tool Name	Color	Icon	POS	Tool Num
ATC Unclamp	Black	Hand icon	POS 1	207
ATC Clamp	Green	Hand icon	POS 2	2
ATC Unclamp C	Brown	Hand icon	POS 3	201
Clean ISO20 C	Brown	Hand icon	POS 4	13
Vac/ O Press C	Brown	Hand icon	POS 5	4

Cur Tool Num: 207  
Cur Tool Pos: 1

3 = End Mill 6 mm TC cutting wood OMNI

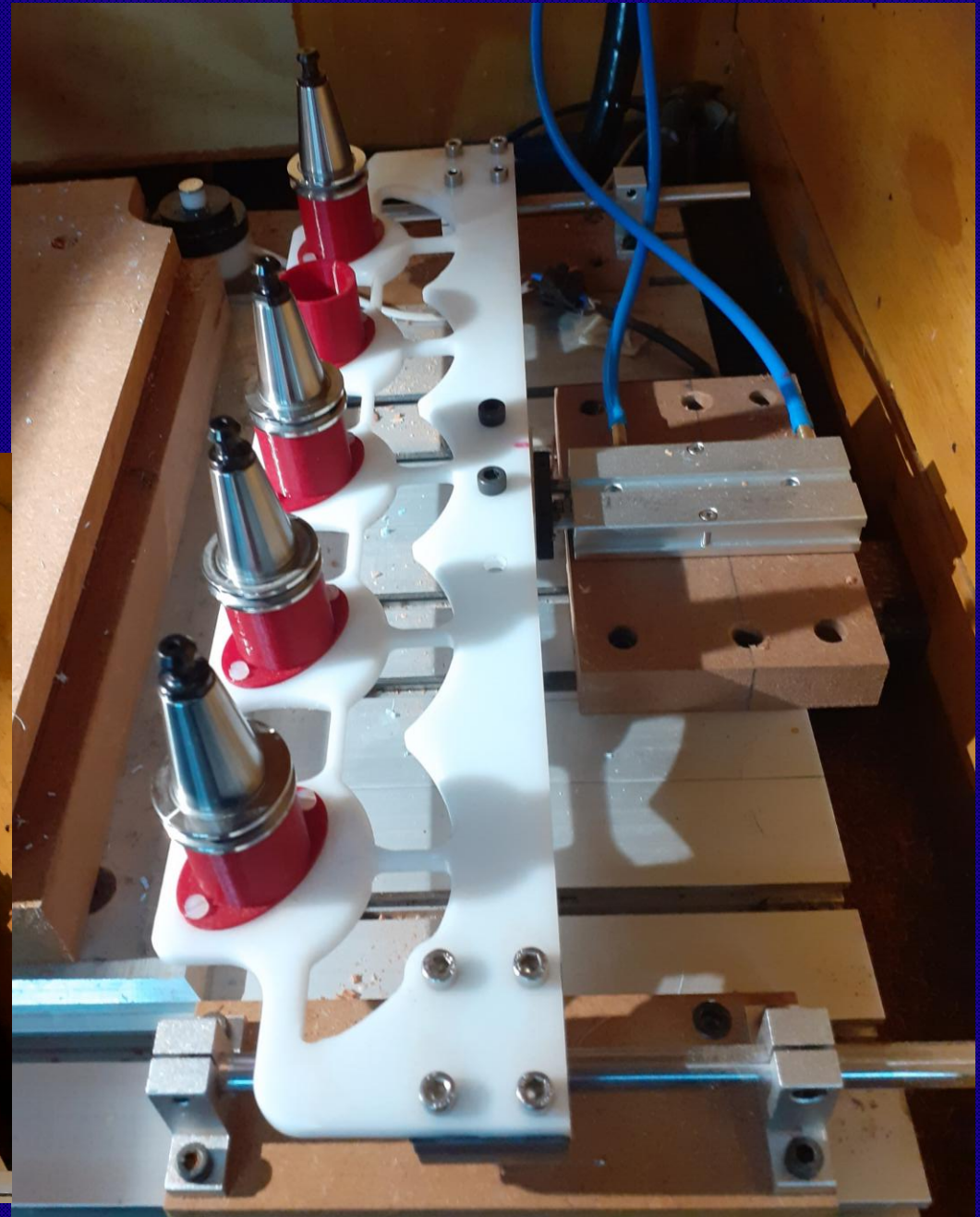
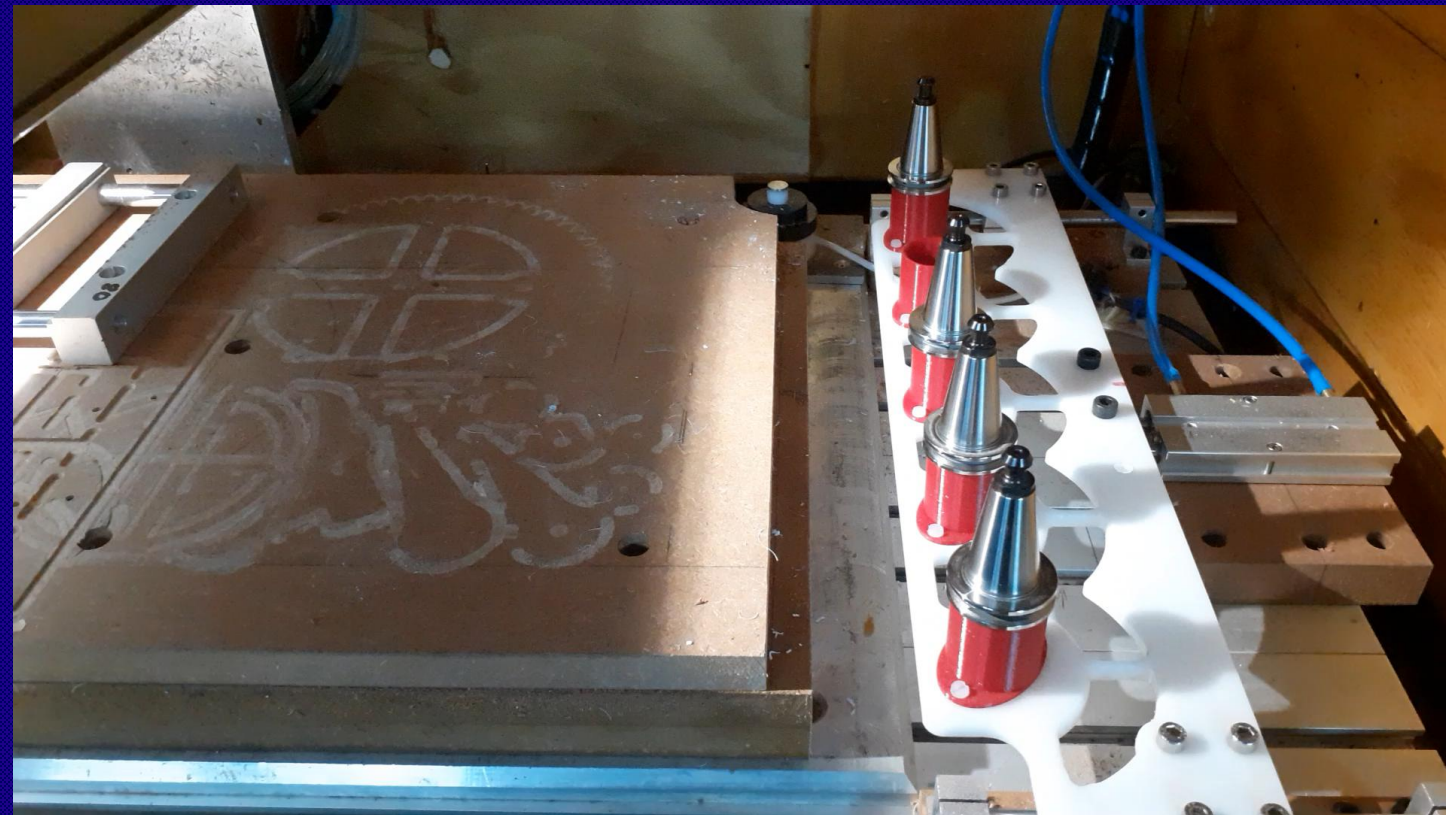
( Pocket pencil topx2 hss8 d7.5 )  
( Mach3 ATC Postproc Danie Aug 22 )  
N20 (Info:)  
N30 (File created: Monday May 01 2023 - 04:07 PM)  
N40 (for Mach3 ATC from Vectric )  
N50 (Material Size)  
N60 (X=230.000, Y=120.000, Z=12.000)  
N70 (. Zero at left bottom corner, machine 2 bottoms)

MDI:

Tool rack for 5 tools, acetal skeleton frame

3D printed tool holders, fixed to frame with nylon bolts

Pneumatically operated to move it into work-envelope



Measuring the Z tool height of tools



Zeroing of 1<sup>st</sup> tool  
on the material  
surface



Changing of tools during program



# Problems experienced

Most difficult task done so far in the workshop



Inability to call a subroutine from within another  
subroutine in Visual Basic

Baie dankie

Thank you