

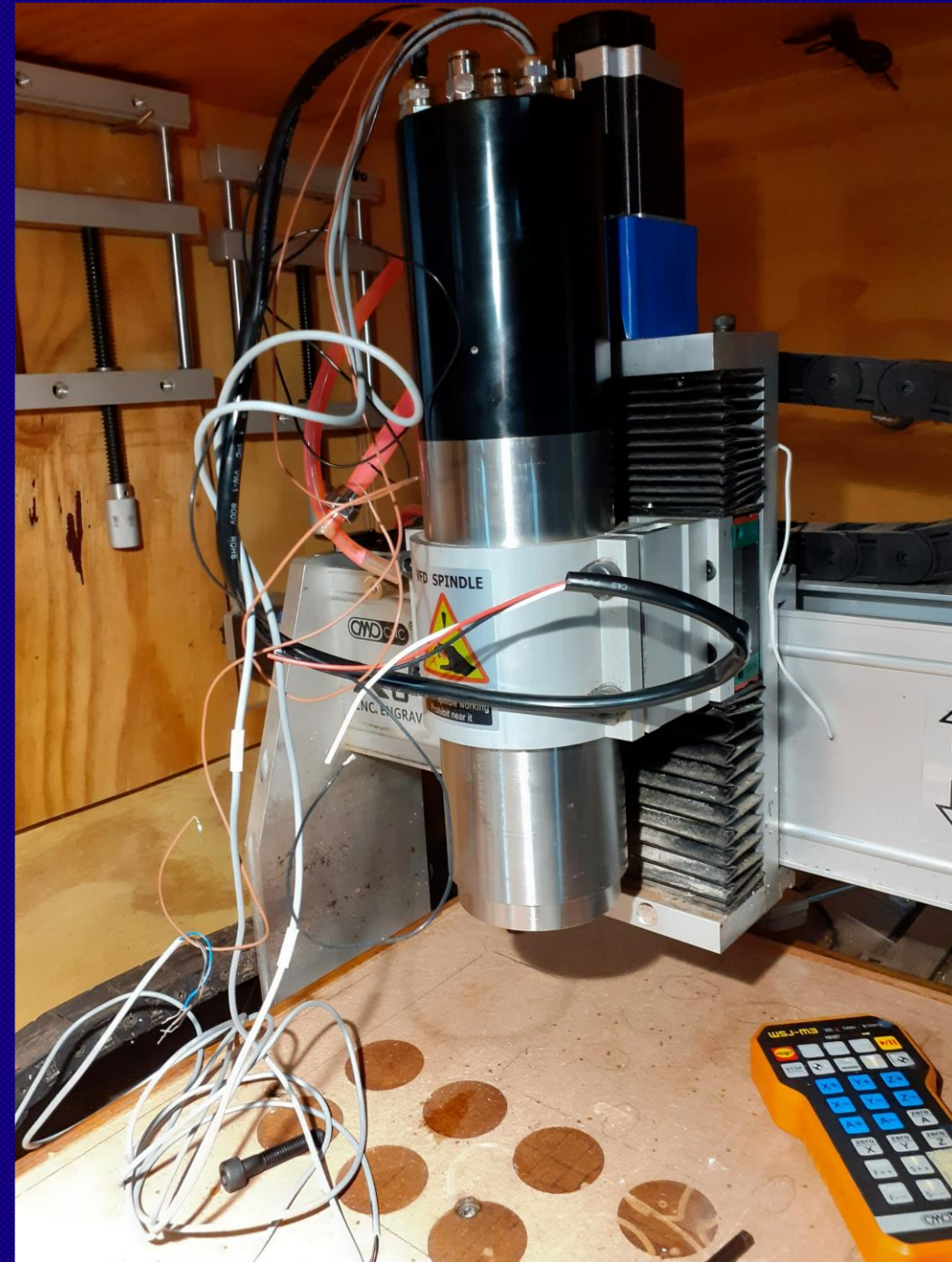
# Important considerations to consider during the installation of a router spindle with a build-in pneumatic automatic tool changer

Aim:

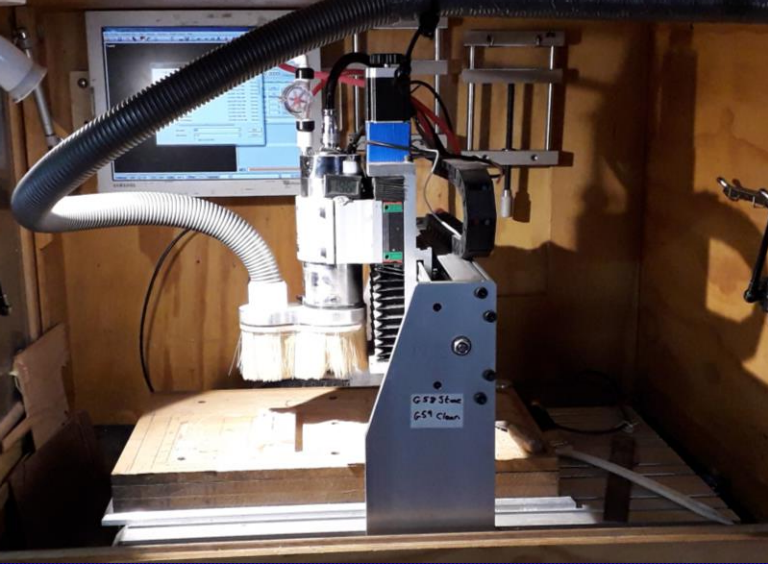
To construct an automatic tool changing system, including an 8 tool-holder rack that is mounted outside the working envelop of the router. Enable safety systems to protect the operator and the machine.

Danie Gouws

Jan 2022



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

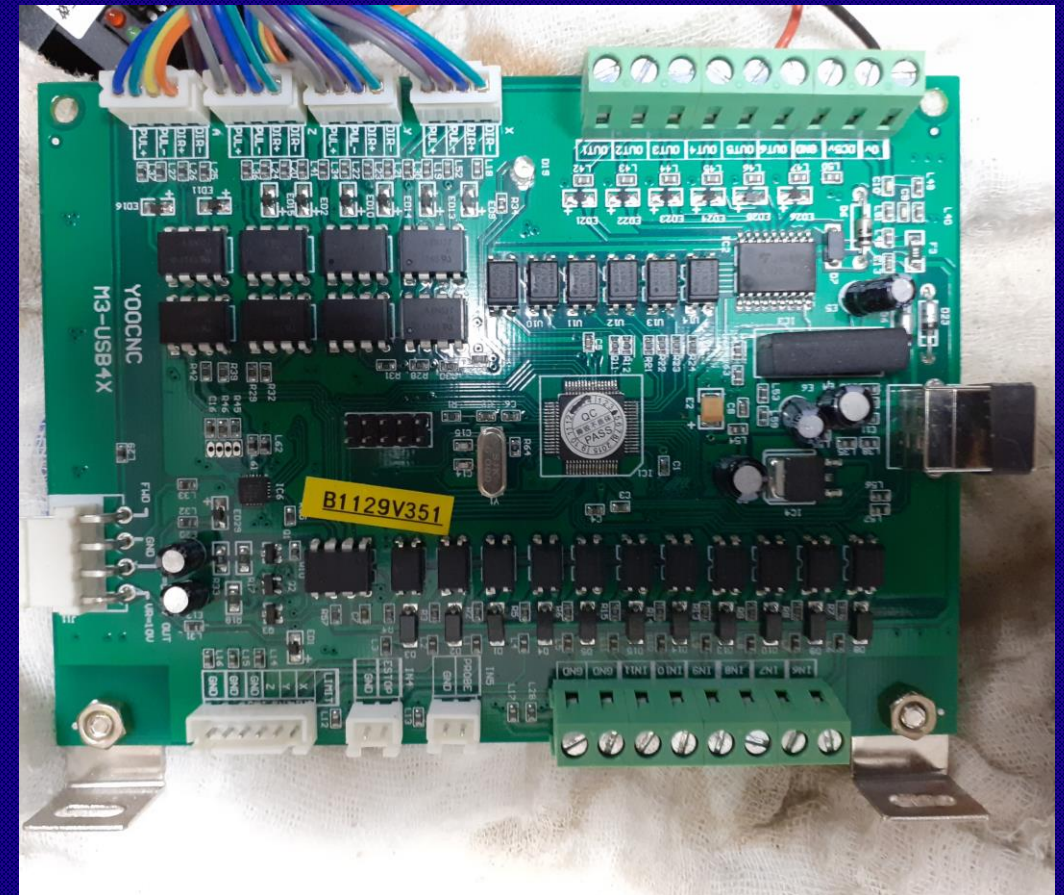


CNC Router acquired in 2016

Replacing the current 2.2 kW, 24000 rpm 2-pole motor, 400Hz, ER20 collet system, 80 mm diameter, water cooled spindle

Mach3 USB card: 5 inputs and 5 open collector outputs

Automatic tool height sensing after each manual tool change

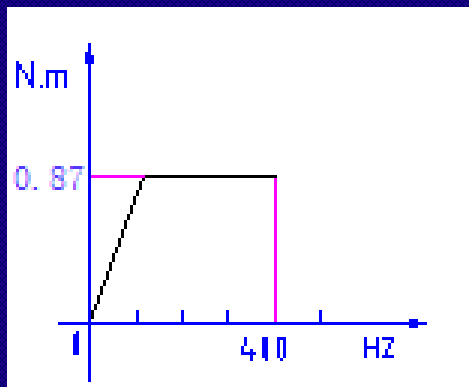


# JGL 2.2 kW with a build-in pneumatic automatic tool changer

- Dr Des Horn and myself each acquired a spindle
- 4-pole, 800 Hz, 24 000 rpm, 80 mm diameter
- ISO20 ER16 collet system
- Water cooled, flow rate 0.5 L/kW/min, min be > 1.5 l / min
- 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 has good references on the Internet

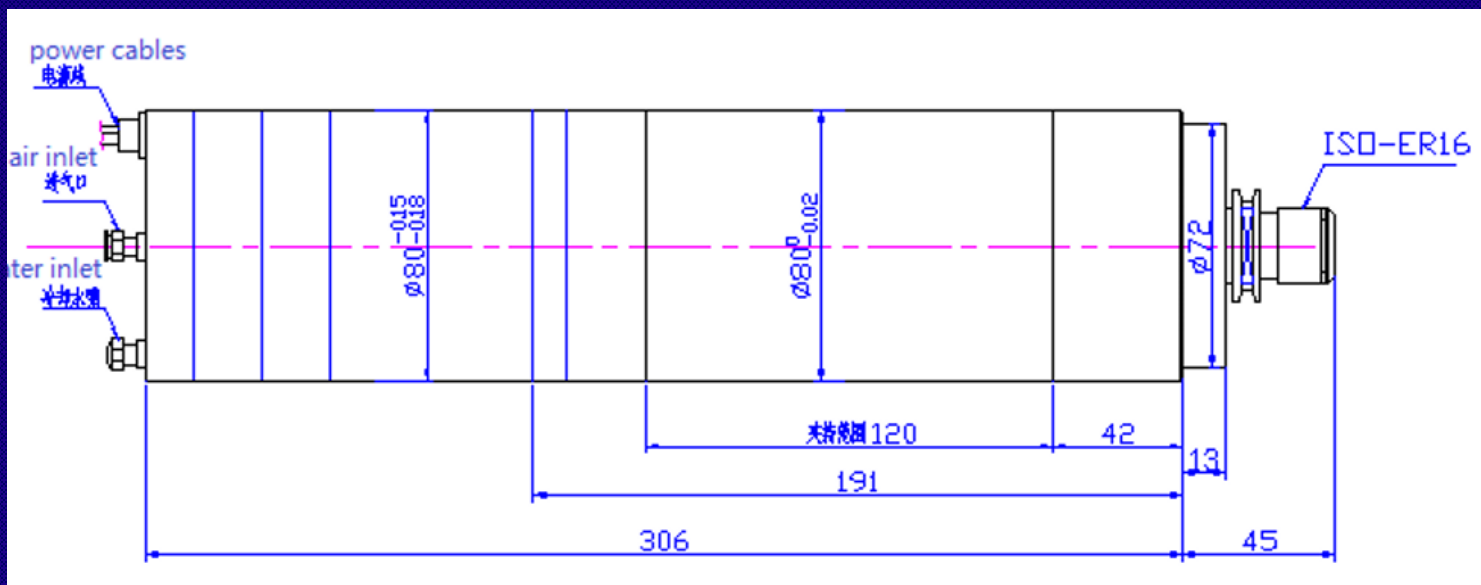


# Replacing the original 2.2 kW 24000 rpm 2-pole spindle with the ATC JGL 4-pole spindle



Torque curve for 400Hz 2 pole 2.2 kW ATC spindle

Dimensions of new ATC spindle



## Spindle pneumatic interface:

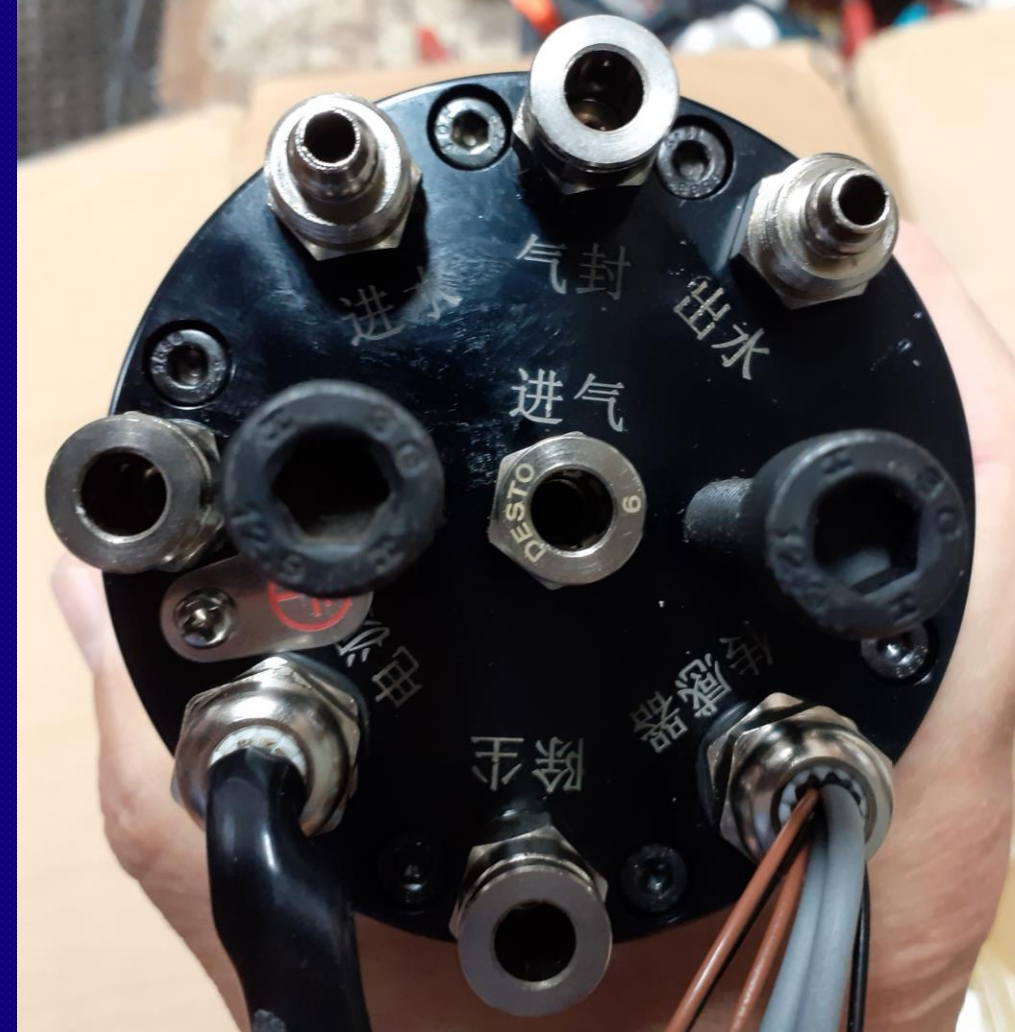
Air pressure supply: 600 – 800 kPa, 25  $\mu$ m filter

Line 1: bearings over-pressure, constant 100 – 150 kPa all the time the machine is operating

Line 2: tool-holder release: 600 – 700 kPa, after tool-holder release/clamping the air in line must be vented to atmosphere,

Line 3: dust removal from tool-holder taper :  $\pm$ 400 kPa

Line 4: “air return” to return cylinder to its initial position, 600 – 700 kPa (not required for “new” spindles)



Interface of original spindle



# Electrical interface of the ATC spindle

Typical induction proximity sensor



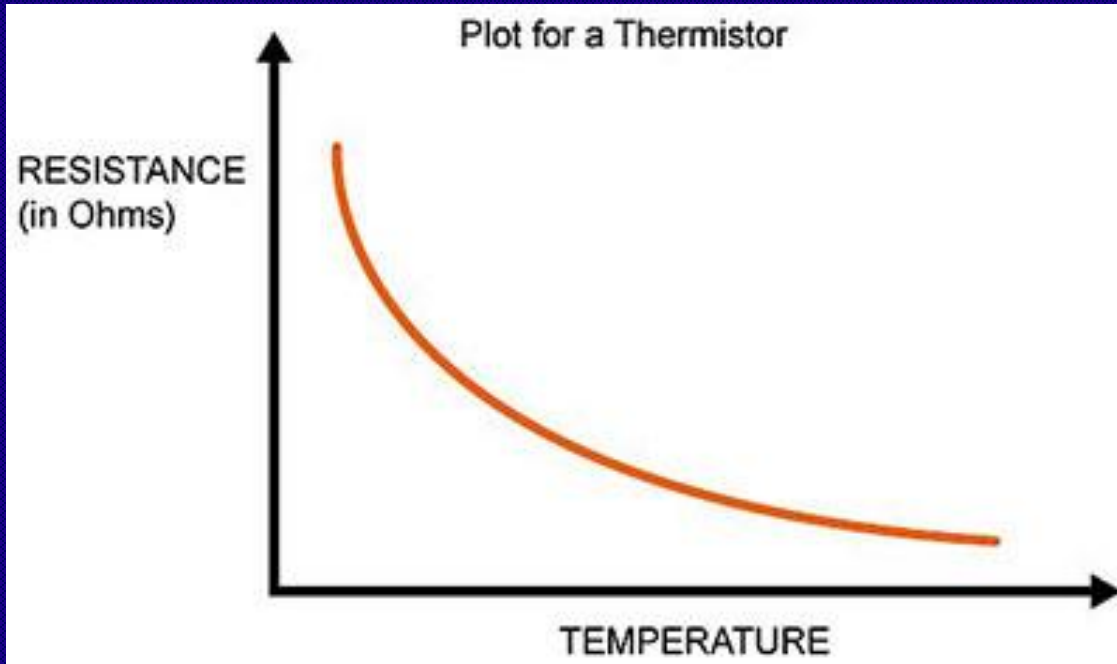
- 220V 3-phase 800Hz supply
- Two 12-30V PNP proximity sensors, one indicating positive signal with tool-holder in spindle and clamp; other has positive signal with spindle unclamp and toolholder removed.
- Two thermistors, mounted on the bearings, one with negative temperature coefficient (NTC) - very well characterized (both look-up table and algorithm) – to be used for an accurate temperature display and audible alarm above a critical temperature. Other with a positive temperature coefficient PTC with rapid change at around bearing's critical temperature – to be used to cut all power to machine.

# Negative temperature coefficient (NTC) thermistor

Resistance vs Temperature curve very well defined

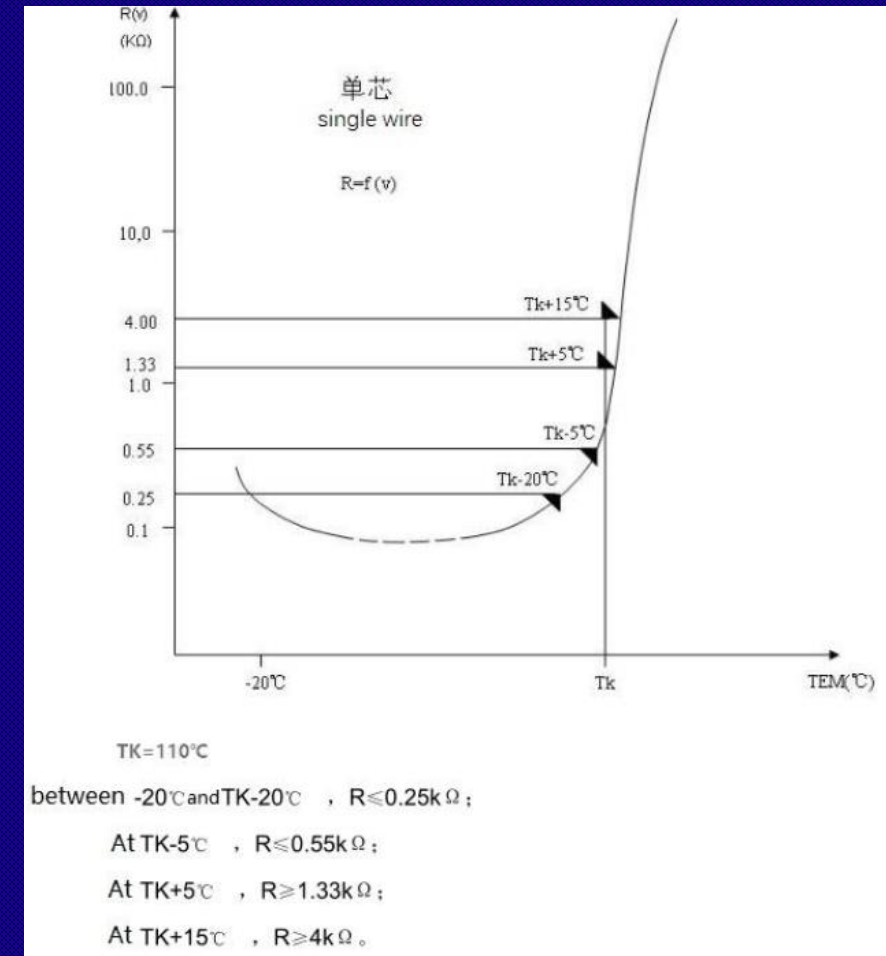
Both algorithm and lookup table

Very accurate spindle temperature display

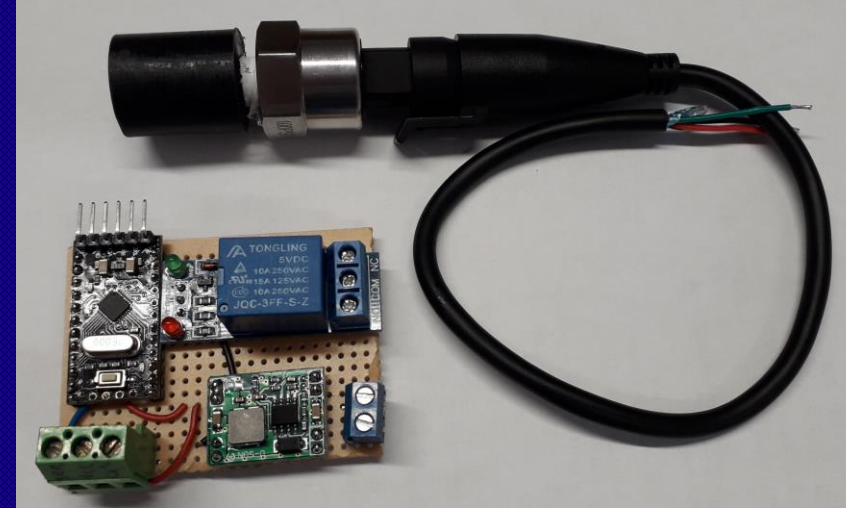


# Positive temperature coefficient (PTC) thermistor

Will be used to turn-off the router at the bearing's critical temperature



# Interfacing requirements with the system / CNC motion control card



## Inputs:

- Adequate air pressure sensor mounted in air line to input CNC card (input 1)
- Proximity sensors (12-30V), connected via opto-couplers to input of CNC card (inputs 2 and 3)
- NTC thermistor via micro-controller to display accurate bearing temperature, with audible alarm warning
- PTC thermistor via micro-controller to be used in series with “Emergency switch”

# Interfacing requirements with the system / CNC motion control card

## Outputs:

Bearing over-pressure air line, connected to machine's switch-on button

Tool-holder release from CNC card (output 1) and mechanical foot switch. Signal required from VFD to ensure tool release is not possible if spindle is still turning

Dust removal of tool-holder 's contact-area, done from CNC card (output 2)

Movement of ATC tool-rack using air cylinder, controlled by CNC card (output 3)

Activation of vacuum-cleaner for dust shoe, controlled by CNC card (output 4)

Typical solenoid valve required for tool-holder release, vent to atmosphere afterwards



## Other considerations

- Requires a visual display of coolant flow
- Will the additional 3 air lines and electrical looms fit into the current drag-chain?
- Will the tool-holder drop-out without any resistance or does it need to be hold and pulled out?  
Zero-resistance release will enable the current dust-shoe design to be used on the new spindle.
- CNC card's inputs and outputs must be galvanically isolated from external inputs and outputs



Proposal for tool-holder rack, situated outside working envelope and move inwards using linear bearings and a air cylinder. Automatic tool height determination after each tool change



Ref: Internet

Baie dankie

Thank you

Suggestions  
would be very  
much appreciated

