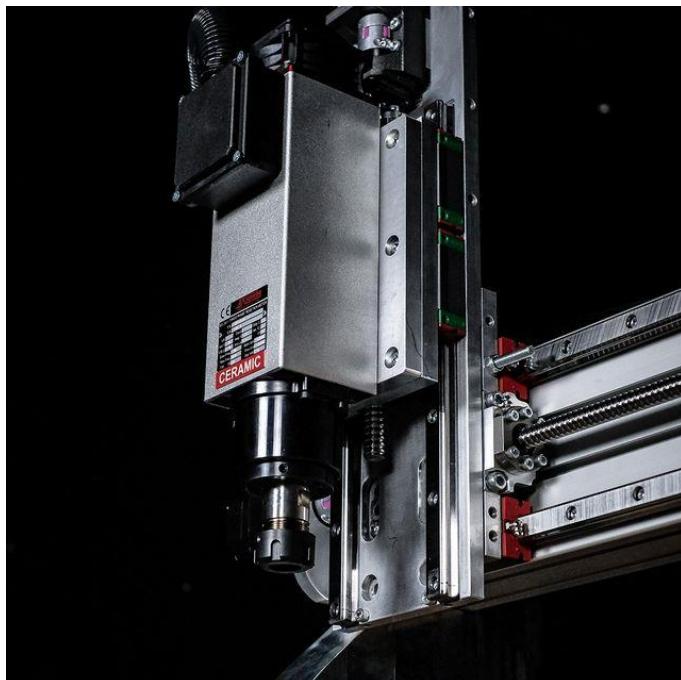




## Section 4 - Spindle Configuration, Tool holding and Cutting Tools



**4.0 ROBOTICS**



BG Precision  
Version 1.0  
April 2022

BG Precision PTY LTD

Unit 1/82 Brunel Road

SEAFORD

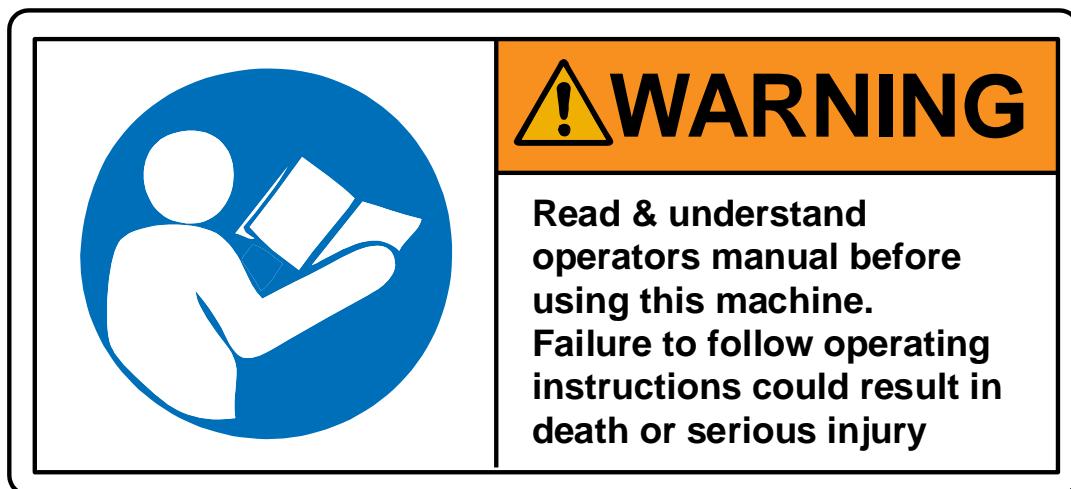
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Before using/turning on the machine, the device should be carefully checked to make sure all connections are secure and the device is technically sound.



**Ensure You understand  
the safety considerations  
of a machine provided  
in the open configuration  
without a safety  
enclsoure**



**Do NOT Interfere  
with the machine  
when under CNC  
control**



**NEVER LEAVE  
THE MACHINE  
WORKING  
UNATTENDED**

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## 1 INTRODUCTION

Thank you for purchasing your CNC system from BG Precision. This section of the manual is in relation to MTC~QTC~ATC Spindle configuration and is not specific to any one system in our range. Supplementary material will be provided specific to the machine make and model of which you have purchased.

Please ensure you read all the operational manuals for this CNC machine prior to attempting to use the system. Through-out this manual there are references to "A Trained Operator" or "Trained and Experienced personnel". These are defined as follows:

All persons that uses, or comes into contact with, the CNC router system MUST:

- understand what a CNC router is and can do
- read and understood the content of this user manual prior to using the system
- be able to exercise control of the router system at all times
- follow all the guidelines presented including the use of appropriate PPE
- seek further instruction if anything is unclear
- be sure that you have understood these instructions completely

Responsibility of use or misuse belongs to the end user. BG Precision PTY LTD and its affiliates accept no responsibility for use or misuse by the user. If you may not be able to use this product properly, we recommend that you do not begin use or cease use immediately.

This manual was not intended to cover every facet of machine operation. This manual serves to provide the information needed to safely operate and maintain the CNC router system. This manual has been designed to be used as an instruction tool as well as a reference tool for everyday work. Step by step instructions are provided where possible to help all levels of users understand the machine.

**NOTE:** Important aspects of machine use and best practice are highlighted and should be adopted where possible to maximise the machine tool life and performance. It is VERY IMPORTANT that all personnel read and understand the safety chapter BEFORE operating the machine. All Warning and Caution notices must be noted before interacting with the machine. Please refer to STEP 1 – Introduction to CNC for all safety considerations.

If there are any further questions or if anything is not clear, please contact us at [info@bgprecision.com.au](mailto:info@bgprecision.com.au)

## 2 SPINDLE SAFETY

1. Never leave the machine running unattended. Always be in close reach of the emergency stop button.
2. Use the right tool at the correct speed and feed rate.  
Do not force a tool or attachment to do a job for which it was not designed. The right tool will do the job better and more safely.
3. Do not touch a cutting tool immediately after use. It will be hot and may cause skin burns. Exercise caution when handling the collet and spindle nut if the cutting tool is hot. Keep a heavy glove or oven mitt on hand for the purpose.
4. Do not lay a hot cutting tool on its side. Create a rack for cooling off hot cutting tools.
5. Do not use dull, gummy, or damaged cutting tools. Keep bits and other cutting tools clean and sharp for best and safest performance.
6. After installing a cutting tool, make sure the collet is securely tightened. An unsecured cutting tool may fly loose from the collet and cause injury. Be sure that the adjusting wrenches have been removed and are secured before turning on the power.
- 7.



Before loading any tool or touching the spindle refer to Figure 1 and press the reset button BEFORE attempting to change the tool.



Figure 1: Reset to disable spindle relay

**DO NOT TOUCH** the spindle unless the reset button is flashing red and yellow on UCCNC control interface on your PC.

### 3 TYPES OF CNC SPINDLES

All our machines are equipped with a High Frequency (HF) Spindle which has better power and torque characteristics than a single phase fixed frequency spindle such as a trim router or drill. There is a frequency invertor inside the CNC Controller that controls the spindle speed by varying the frequency from 0-400hz. These CNC spindles are designed for axial and radial loads which are very present in CNC machining. They all have at least one ceramic bearing in the nose and tail of the spindle which have very long life and can withstand higher temperatures than normal spindles which don't heat up and distort when running at high speeds for a long duration.

There are 3 major type of HF (High Frequency) Spindle.

1. MTC – Manual Tool Change
2. QTC – Quick Tool Change
3. ATC – Automatic Tool Change (requires compressed air and complex automation)

#### 3.1 MTC

Manual tool change spindles are the most common. For MTC, the milling tool is placed directly into the ER collet in the spindle nose. This is the lowest-cost solution but requires the most operator interaction during tool changes. It is also the most robust due to its simplicity.

In your CAM software used to create the G-Code, if each operation can use the same tool, these operations can all be outputted to one G-Code file. If each operation uses different tools, you must output each different tool to multiple files and manually change each tool as required.

For Example, operation one uses a 6mm tool and operation two uses a 2mm tool. The operator will load operation one in the CNC controller, load the 6mm tool into the spindle and set the Z datum for the 6mm tool as required. When operation one with the 6mm tool is complete the operator must remember to open operation two, change to the 2mm tool and reset the job z datum for the new tool.

#### 3.2 QTC

This is a semi-automated process that can result in better cycle times when multiple tool changes are required for repeat operations and even multiple jobs using the same toolset. The user must configure multiple tools in toolholders, and the tool length offset can be measured and saved in your CNC control software such as UCCNC. The user must still manually change the toolholder when prompted but as the length of the tool and toolholder is premeasured resetting the new z datum for the new tool can be skipped for each tool change.

In the QTC spindle nose it has a mechanical mechanism, that easily lock to a HSK32-C toolholder for example. No air-pressure is required. This can be done by the user placing the toolholder in the spindle and locking it in place with just an Allen key.

When each toolholder is set-up and the offset is measured with your CNC control software, it is important you number your tools with a number convention that you can match to your CAM and G-Code when programming. Below is an example of 4 tools preloaded in 4 HSK32 toolholders numbered 1 – 4.



For example, if your job requires two tools to complete two operations, your CAM software will allow you to output your multiple toolpaths to a single G-Code file where it will call tool 1 and tool 2 as required during your machining operation. The advantage of the QTC arrangement is the CNC control software will apply the premeasured tool length offset when you change the tool which means no probing of the tool length is required during machining and it will continue with the job.

In all CNC spindle systems you need to set your job z datum at least once which can be done when any tool is in the spindle assuming that tool length offset has been measured.

### 3.3 ATC

The Automatic Tool Changer is a great system for industrial clients who use the machines for many hours a day, and really need the automatic tool change system. This is by far the most expensive solution. The motor itself is not such a high price, but you need many extra components like Pneumatics, and a Safety System, also the CNC controllers need to be programmed such that it can pick up and release tools in correct position.

Like the QTC Spindle, the user must configure multiple tools in toolholders, and the tool length offset can be measured and saved in your CNC control software such as UCCNC. Unlike the QTC system the user does not have to manually lock the toolholder in the spindle. The machine can be programmed to change tools with compressed air and automation control.

In all CNC spindle systems, you need to set your job z datum at least once which can be done when any tool is in the spindle assuming that tool length offset has been measured.

## 4 THE BASICS OF CUTTING TOOLS

We only recommend using Solid Carbide or Carbide Tipped bits in our CNC machines due to the high RPM and material removal rates or CNC machines can reach. Please ensure the bits you use are rated to the RPM available from the spindle. Not all endmills or handheld router bits are suitable for CNC router. The advantage of carbide over other alternatives is long tool life thanks to its hardness with well-matched rigidity and finish. Some basic terms to start off are outlined in

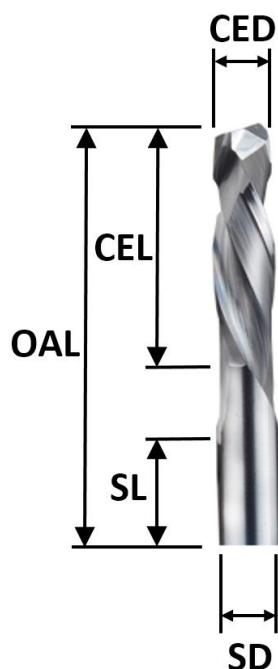


Figure 2: Basic cutting tool Terms

Common dimensions of the tools you need to be aware of are:

CED – Cutting Edge Diameter

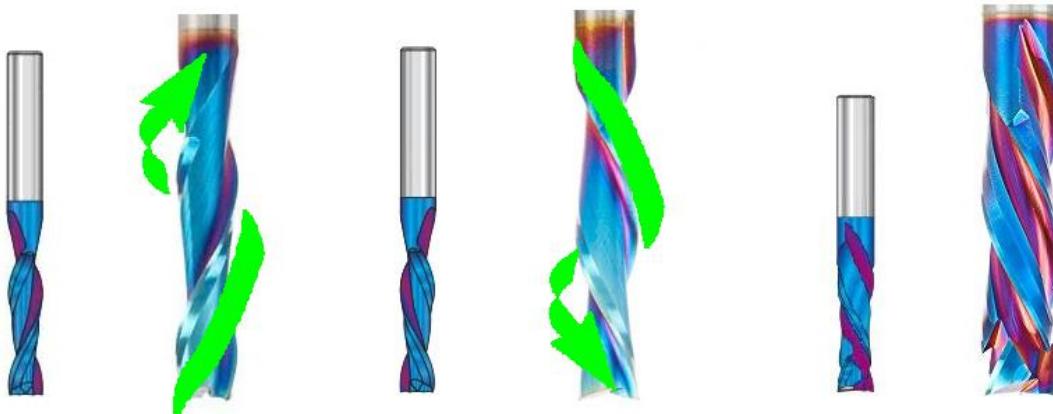
CEL – Cutting Edge Length

OAL – Over All Length

SL – Shank Length

SD – Shank Diameter

In choosing a cutting tool for any application, always select one with the shortest cutting edges and the shortest overall length that will reach the required cut depth. Excessive length intensifies deflection and vibration, which degrade cut quality and lead to tool breakage

**Upcut****Downcut****Compression**

The spirals edges on your cutting tool are known as flutes. The sole purpose of the flutes are to clear the cut chips while minimising friction on the workpiece. Nearly all tools are designed for clockwise rotation and your spindle is set to spin in a clockwise direction only. Depending on the direction of spiral of the flute, it will determine in which direction your chips will go. If the spiral of the flute is spiralling up when the tool spins clockwise, this is known as Upcut. When the spiral of the flute is spiralling down when the tool spins clockwise, this is known as Downcut. It is worth noting that this spiral rotation will exert a force on your workpiece.

In choosing a cutting tool for any application, always select one with the shortest cutting edges and the shortest overall length that will reach the required cut depth. Excessive length intensifies deflection and vibration, which degrade cut quality and lead to tool breakage.

#### 4.1 Upcut:

The Up-Cut Router Bit yields an especially clean & accurate cut, while effectively clearing chips from the cut. The “up-cut” shears from the bottom up, pulling chips from the bottom up, thus allowing deeper penetration with less stress on the tool.

The advantage of an Upcut bit is it will eject and force all the chips up and out of the cut. Making them very efficient at clearing chips. There are two major drawbacks of this to consider especially when working with timber. It has the tendency to cause tear-out of the material at the surface on the top edge and also wants to lift the material off the bed.

##### Applications:

- Cutting inlay pockets and shaping components
- Shaping / routing hardwoods and softwoods

- General purpose soft media machining

Excellent for Cutting:

- Aluminium
- Wood

#### 4.2 DOWNCUT:

The 'Down-Cut' cuts from the surface down leaving a smooth edge at the surface. Due to the downward flute geometry this router bit provides better work hold down, reduces material tear out on the surface and can reduce vibration when cutting thinner sheets. Down-Cut router bits are excellent for creating grooves, super effective on surface operations and dado cuts in plywood and composite materials.

The advantage of the Downcut bit, since the spiral of the flute is down, is that the material is forced back onto the bed and leaves a much cleaner top edge. The disadvantage is the chips are being ejected in a downward direct back into the cut reducing dramatically the chip clearance capabilities of the tool. There is also a tendency to tear-out the bottom edge.

For best results you can consider using a downcut tool for the first initial cut deep enough to cut into the surface of the material but shallow enough to still promote chip ejection. Then you could change to an Upcut bit to finish cutting through the material with a more aggressive pass depth to save time and noting the upcut will produce a better finish on the bottom edge. Do not forget the upcut does tend to lift your material so ensure its well clamped.

Applications:

- Cutting inlay pockets and shaping components
- Shaping / routing hardwoods and softwoods
- General purpose soft media machining

Excellent for Cutting:

- Laminate
- Melamine
- Melamine Particle Board
- MDF
- Veneered Plywood
- Wood

#### 4.3 COMPRESSION CUTTER

Compression end mills combine up-cut and down-cut geometry which provide a superior cut at greater depth than traditional upcut or downcut router bit. These bits are designed to leave clean edges on the top and bottom faces of any material. The compression bit's unique design pulls chips upward at the bottom of the material and downward at the top face, producing chip-free surfaces that are perfect for cabinet and furniture parts.

The bottom section of the compression cutter is ground like an upcut and then there is a turning point, usually at a height the same as diameter of the tool, where the cutter is ground like a downcut. This results when used correctly a clean top edge and clean bottom edge. For this to work you must ensure your first pass depth is greater than the changing point between upcut and downcut.

#### Applications:

- Profile cutting
- Cabinet making
- Shaping / routing hardwoods and softwoods

#### Excellent for Cutting:

- Laminate
- Melamine
- Melamine Particle Board
- MDF
- Veneered Plywood
- Wood

#### 4.4 SINGLE OR OFLUTE



Single Flute or OFlute have the ability for large chip removal, with single flute, up-cut design. The large, polished flute enables a very good chip clearance, less chance for chip re-welding, a superior surface finish and a longer tool life.

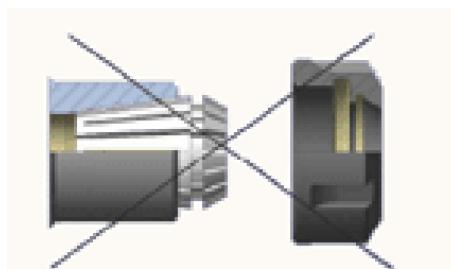
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With a high rake angle and relatively low helix, O-flute cutters manage to cut acrylic, polycarbonate, ABS, PVC and a host of other sheet polymers at very high chiploads without raising a burr or fracturing the edges of the kerf. Not only have we found these bits good for high precision cutting of all plastics, but they are very suited to cut Aluminium and Aluminium Composite Material also.

## 5 MTC/QTC/ATC - HOW TO USE COLLET SYSTEMS

All our HF (High Frequency) spindles (MTC/QTC/ATC) use collets to hold the cutting tool.

- It is very important that you use the correct collet size for the diameter of the shank diameter of the tool.
- It is very important that you use the correct collet family to suit the spindle or toolholder on QTC/ATC spindles. For example, ER16, ER20, ER25 or ER32
- To ensure your spindle and cutting tools live a long life, refer to section 1 for suggestions on collet maintenance.
- It is imperative you look after your collets and understand that they should be replaced on a regular basis.
- The tool is only inserted into the collet after the collet is seated correctly into the collet nut.



- Never use a tool beyond its recommended RPM.
- Always expect the unexpected.

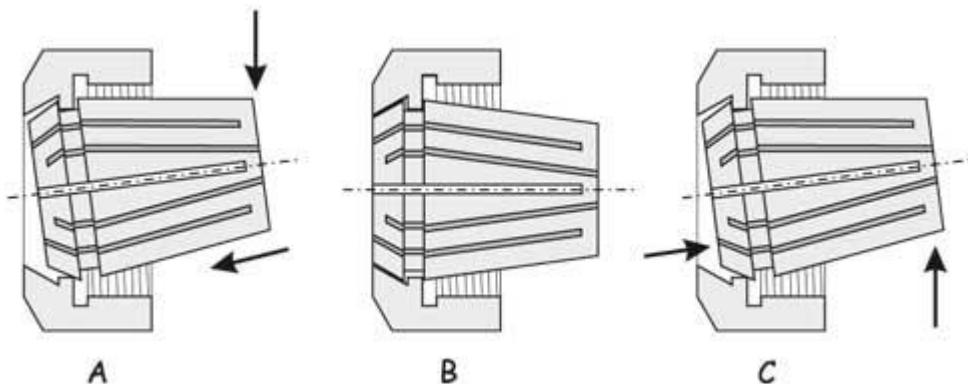


Figure 3: HF ER20 Collets

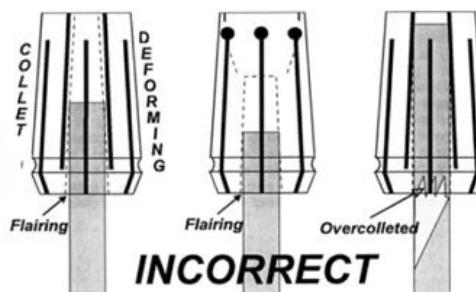
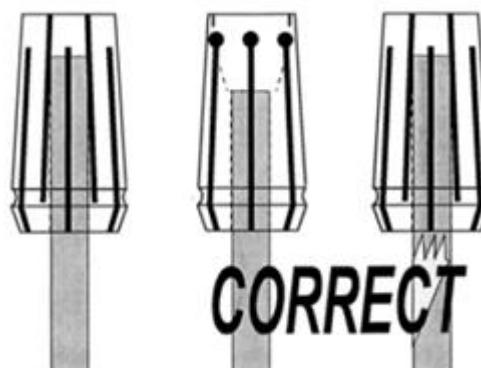
### 5.1 MOUNTING A COLLET AND TOOL

- 1) Choose the correct collet for your tool. Always stick to the cutter spec. If using a 3.175mm collet (1/8<sup>th</sup> inch) then use a 1/8<sup>th</sup> inch collet. Using the correct collet for your cutter will make safe tool mounting easier and safer.
- 2) Make sure the collet and collet nut are clean and debris free
- 3) Insert the collet into the collet nut until the collet seats. To do this, insert it on an angle, turn slightly and push it into the nut until it clicks into place on the eccentric flange. You should hear a

“click”. NOTE: if you mount a collet incorrectly into the spindle it will damage the collet and worse the spindle.



- 4) Mount the collet nut (now with seated collet) into the spindle head fixture and loosely tighten by hand only – just so the collet is on the threads of the spindle. If using a QTC/ATC toolholder the collet gets mounted into the toolholder not the spindle.
- 5) Insert the tool you wish to use. The tool is only inserted into the collet after the collet is seated correctly into the collet nut. (NOTE: you should have pre- selected your collet size for your tool choice)
- 6) Mount the tool so that you have enough tool stick out to carry out your machining operation. Be careful not under collet causing flaring or over collet resulting in deforming the collet as it tries to squeeze onto the flutes of the cutting tool.



- 7) The collet nut can now be used to tighten the collet into the spindle head/toolholder securing the cutter.
  - a) In MTC spindles, the HF spindle needs a special collet spanner to hold the shaft of the spindle from turning while you tighten the collet nut with a separate spanner
  - b) For QTC or ATC spindle refer to section 5.3 for tightening the collet nut



NOTE: in both cases for MTC/QTC/ATC you need only use the strength of your wrists to tighten the collet nut and care should be taken not to overtighten by using all your upper body strength



Be careful as you do this as you can slip and damage the cutter or cut/injure yourself. You will be exerting a tightening force with the locking spanner around and near a sharp cutter. So be careful!

- 8) Check the cutter is seated in the spindle and collet correctly by eye after you have installed the cutter and tightened the collet.
- 9) Take extra care when loading a tool and ensure the tool is mounted correctly prior to running a tool path and turning on the spindle

## 5.2 REMOVING A COLLET AND TOOL

- 10) To remove the cutter, slacken and undo the nut until resistance is felt. Most spindles have a double locking mechanism on the spindle thread. Then, using a collet wrench, further undo the nut until the collet is released from the chuck body. Removal of the collet from the nut is the reverse of the mounting procedure.

## 5.3 QTC AND ATC MOUNTING DEVICES



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As quality balanced toolholders are not cheap, we recommend the use if a mounting device to suit you toolholders. These mounting devices provide safe and secure tool holding while you set-up your cutting tool in the collet prior to loading in the QTC/ATC spindle. The locking rollers clamp the HSK/ISO toolholder in place without damaging the taper cone allowing you to tighten the collet nut safely. There is no better way to set up your HSK/ISO toolholders than with this toolholder mounting device.

## 6 QTC – QUICK TOOL CHANGE SPINDLES

**NOTE: This part is only valid if you have a QTC Spindle**



The QTC systems to be complete normally consist of the following components to function:

- 1) QTC Spindle
- 2) HSK toolholder
- 3) Torque Wrench
- 4) FIXED height tool probe
- 5) Material touch off probe

Depending on what QTC spindle comes with your system, will determine what size toolholder is compatible. Some use HSK32C toolholders which can hold ER16, ER20 or ER25 collets depending on the model of the HSK32 toolholder you get. The larger QTC spindles can hold HSK40 toolholders which are compatible with ER20, ER25 and ER32 Collets.

You can use your QTC system in many ways but the main advantage of QTC systems is the tool is already fixed in position in the toolholder which means the tool height does not change when you load or reload the toolholder into the spindle. Unlike a MTC, every time you change a tool, it would be very difficult to collet the tool at exactly the same height.

In the QTC system, as the tool height in each holder does not change (unless tool is broken or changed), we can use the UCCNC software to measure the height of each tool before commencing a job. Then when the toolpath is running the UCCNC software will simply ask you to manually change the tool and you will not need to stop and reference or set the tool height.

This is best done with a fixed probe in the same location running a “Tool Height” sequence. The reason the probe is best fixed in a location is the software will compare the differences between tool heights during a tool change sequence. To compare, they all need to be from the same reference height to begin with. This “Tool Height” should not be confused with work height, job height or Z datum values. You still set your job height as normal using the probe or Job Z datum button as normal on the surface of your material or your machine bed. This can be done with any tool after the tool heights are set.

## 6.1 HOW TO LOAD A TOOLHOLDER



### TeknoMotor QTC Toolchange Procedure

- 1. Stop the CNC (or other) machine, and make sure the spindle cannot start. (often there is a spindle off switch)**
- 2. Make sure the cover over the allen key hole is open.**
- 3. The Red DOT is facing up.**
- 4. The tool only fits in one way, make sure the DOT is also facing up.**
- 5. By hand push the toolholder into the motor.**

**See the next image  
for the next step**



**TeknoMotor QTC  
Toolchange Procedure**

**6. Push the toolholder in by hand. As far as possible.**

**7. You will see a small gap between motor and toolholder. This is normal**

**See the next image  
for the next step**



### TeknoMotor QTC Toolchange Procedure

**8. Using the  
Torque wrench we have  
included with the  
delivery of the motor,  
tighten until it slips/clicks**

**WARNING:** It is important  
that the allen key is  
tightened with the  
correct torque. The  
torque determines the  
holding force on the tool.  
Too low and tool is not  
held properly, too much  
and you can damage the  
thread.



### TeknoMotor QTC Toolchange Procedure

**9. Final step is to close the cover over the hole of the allen key, so no dirt or chips get in there.**

**You should also notice, that there is no gap between the motor and holder anymore.**

#### IMPORTANT NOTES:

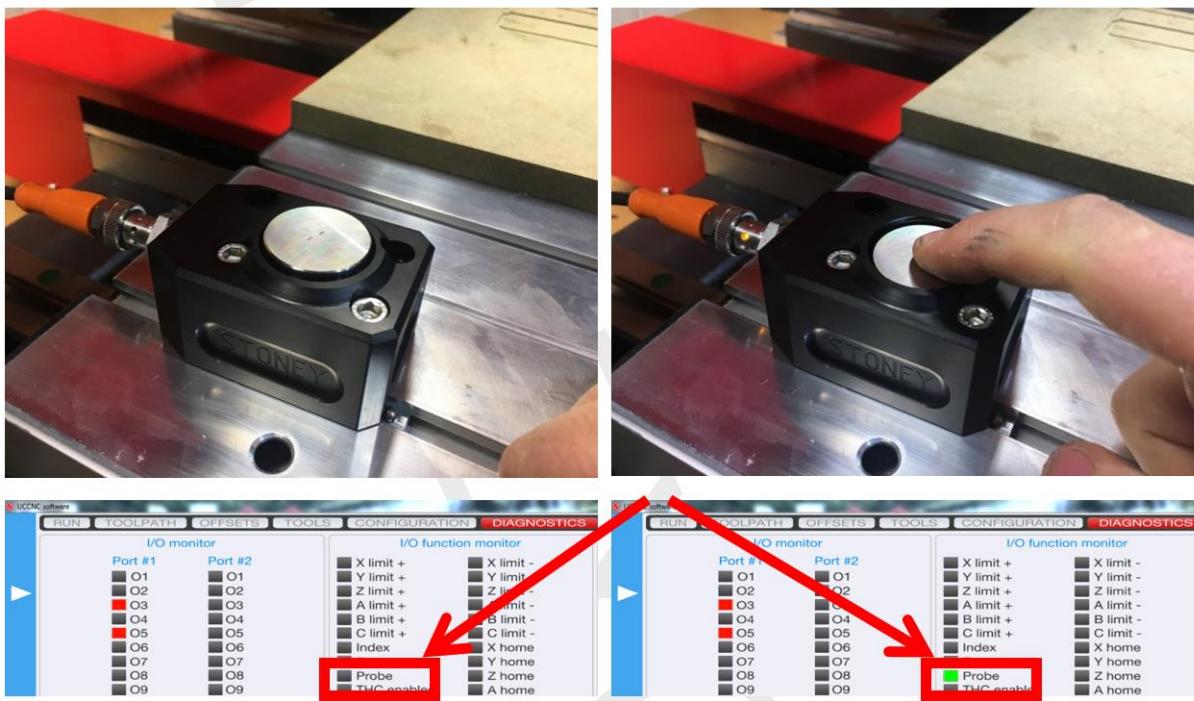
- You should always keep your toolholders clean from debris and grease especially around the mounting surface
- Use the taper cleaning cone to ensure the inside face of the spindle is always clean
- Do not drop your toolholders
- Make sure the torque allen key is seated correctly before turning to open or close
- Always close the brass cover to stop cutting chips and dirt getting into the mounting face on spindle
- When mounted correctly, the gap between the motor and holder should be gone.

## 6.2 CHECK FIXED HEIGHT TOOL PROBE

We have two type of Fixed height probes – One type is built into our vacuum table and requires the MDF spoilboard to be pushed aside to locate. The other type is a plunger type that is fixed to the T-slot table. Both types are fixed and should not be moved. If they are moved, you must ensure the return the the exact same location. When run, the automated sequence to measure the tool heights will automatically travel to this location on your machine table. If you have moved the FIXED height tool probe, then the sequence will fail and may result in a broken bit.



The fixed type relies on continuity between the cutting tool and the probe plate so make sure your tool is clean of swarf or cutting fouling.



The plunger type you can confirm is working at any time by pressing with your finger and checking the Probe status on the diagnostics screen.

### 6.3 LOAD TOOL INTO SOFTWARE AND MEASURE

The QTC UCCNC screen interface is explained in section 1. All the data entry fields are explained there in further detail.

- 1) You must “Home All” when you start UCCNC each time.
- 2) Identify what tool the software has in memory. If it reads 0 there should be no tool in the spindle

**TOOL in Spindle: 0**

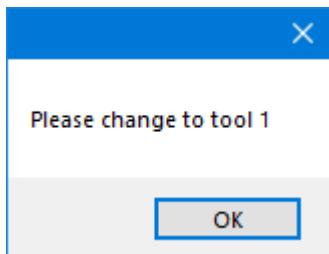
- 3) The “SELECT TOOL” is a data field that the user can use to enter in a tool number to commence a Quick Tool Change. Enter in the number “1” for example and press enter. Nothing will happen until you execute a “Change Tool”

**SELECT TOOL: 1**

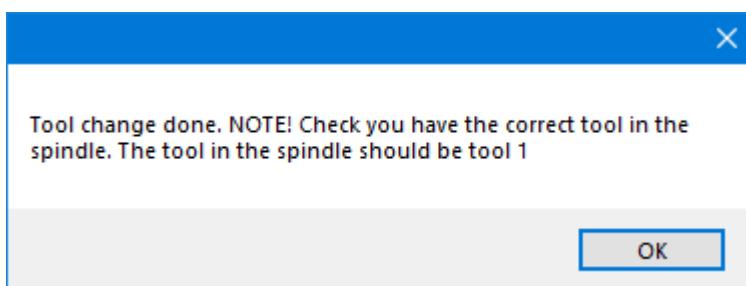
- 4) Select “Change Tool”. This is an automated sequence that will move the machine to a predefined location without warning for the user to execute a Quick Tool Change by unloading/loading a toolholder. It relies on the user entering a tool number into “Select Tool”, pressing enter and the number being different than “TOOL in Spindle”. There is a LED that will illuminate red when the “Change Tool” Sequence is being executed.



- 5) When prompted, as per the onscreen message, load the correct tool in the spindle. When complete press ok.



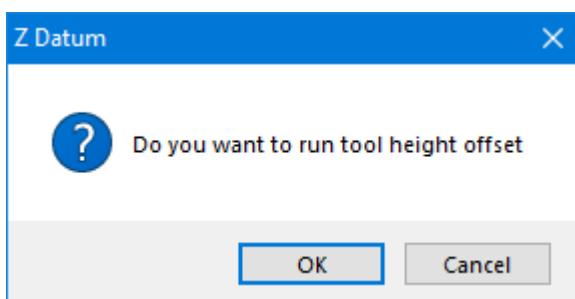
- 6) You will be asked to confirm the correct tool has been loaded into the spindle



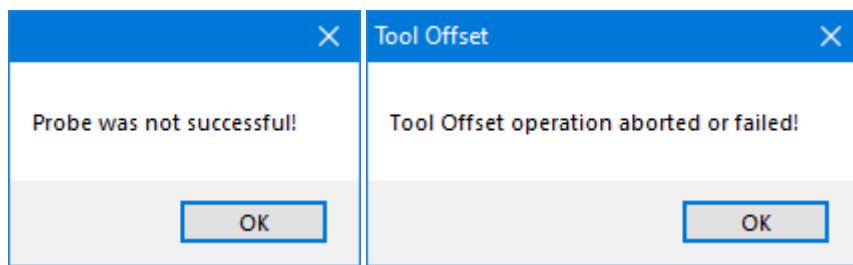
- 7) Next step is to run the "Tool Height" function. This clickable button allows you to set each individual tool height offset. You must load the correct tool in the spindle prior to running this function for the offset to be saved to the tool offset table.

**Set QTC Tool Height =>**  A small red rectangular button with the text "Tool Height" in white.

- 8) A message will prompt you to prepare for the automated function to continue



- 9) When acknowledged the machine will move to the fixed sensor on the table, probe to sensor, stop and retract. For more accuracy there is a double probe function where the 2<sup>nd</sup> probe will be slower than the first.
- 10) Now you can repeat the process for tool 2, 3, 4.....
- 11) Failure to successfully probe can result in the following messages, and you should probe again



## 6.4 QTC MAINTENANCE

To Be Added in next revision

## 7 ATC – AUTO TOOL CHANGE SPINDLES

**NOTE: This part is only valid if you have a ATC Spindle**

### 7.1 REQUIREMENTS

	<p><i>Supply the electrospindle with compressed air in accordance with ISO 8573-1, classes 2,4,3:</i></p> <ul style="list-style-type: none"><li>• <i>class 2 for solid particles: solid particles size &lt; 1µm</i></li><li>• <i>class 4 for the humidity: dew point &lt; 3°C (37.4°F)</i></li><li>• <i>class 3 for the total oil: concentration of oil &lt; 1mg/m³</i></li></ul> <p><i>Failure to comply with these specifications may result in product malfunction. The guarantee is not valid if pollutants are found during repair operations.</i></p>
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	<p><i>Follow the indication below:</i></p> <ul style="list-style-type: none"><li>• <i>If a lubricated air circuit is present in the machine, it should be insulated from the dry air circuit through a non-return valves.</i></li><li>• <i>The filters indicated in this section should be installed as near the electrospindle as possible.</i></li><li>• <i>Taking into account the fact that the efficiency of the filters is &lt; 100%, it is essential that the machine be fed with properly treated air; as a general guide, introduce compressed air with a purity rating complying with ISO 8573-1, class 7, 6, 4:</i><ul style="list-style-type: none"><li>◦ <i>class 7 for solid particles: solid particles size &lt; 40 µm</i></li><li>◦ <i>class 6 for the humidity: dew point &lt; 10°C (50°F)</i></li><li>◦ <i>class 4 for the total oil: oil concentration &lt; 5mg/m³</i></li></ul></li><li>• <i>at the end of the working day, empty the pneumatic system to enable the automatic purging of filters.</i></li><li>• <i>Carry out regular maintenance operations of the filters according to the manufacturer's indications, and replace them when they are saturated and lose effectiveness (approximately every 6/12 months).</i></li></ul>
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	<p><b>The cylinders of these electrospindles are double-acting: it is necessary to keep the cylinder under pressure to maintain the piston at the upper end stop, far from fast rotating parts.</b></p>
	<p><b>Never run even for small test without air supply. The motor can be damaged, if cylinder move from upper position to a lower position. In the lower position the cylinder make contact with the housing of the ATC to prevent load of cylinder to work on ball bearings. If the motor is running and the cylinder move to lower position it will result in catastrophic failure or the motor.</b></p>

## 7.2 WARMING UP

Every day, when the electrospindle is started up for the first time, leave it warm up slowly without load. This ensures that the bearings reach their running temperature gradually, and that the bearing races expand evenly.

The following warming up cycle is recommended:

- 50% maximum plated speed for 5 minutes.
- Warm the electrospindle up before machining whenever the machine has been left idle long enough for it to cool down to ambient temperature.

## 7.3 ATC MAINTENANCE

Read this section carefully before attempting any maintenance on the electrospindle. This section contains information that is important for the safety of maintenance personnel and for the reliability of maintenance work itself.

All applicable safety precautions must be taken whenever maintenance work is done on the electrospindle. In particular:

- Maintenance and/or lubrication must be performed only by qualified, expert personnel, with the authorization of factory management, in compliance with applicable safety directives and standards, and with the use of suitable tools and instruments.
- When performing maintenance, always wear suitable clothing such as tight fitting work overalls and safety shoes. Never wear long or slack clothing or clothes with parts that hang loose.
- When performing maintenance on a machine, cordon it off and mark it clearly with panels stating "MACHINE UNDERGOING MAINTENANCE".

During all maintenance work make sure that the electrospindle is:

- disconnected and insulated from the electrical power supply;
- fully stopped (not still spinning).

Maintenance managers must ensure that their team is trained to ensure optimum coordination and safety. All persons performing maintenance must remain fully visible to colleagues at all times so that they can signal for assistance if necessary.

#### *7.3.1 SCHEDULED MAINTENANCE AND CLEANING THE SPINDLE SHAFT TOOL HOUSING*

Always keep the tool housing in the spindle shaft perfectly clean and free from dust, grease, coolant, oil, metal shavings, and corrosion or lime scale.

Dirty housings cause incorrect tool seating, misalignment with respect to the spindle's axis of rotation, and tool slippage. Dirt can also damage the surface of the housing, causing poor machining precision, and causing risk of injury to operating personnel.

For this reason, check at every tool change for the manual tool changing spindles and at least once a day for the automatic tool changer electrospindle that the surfaces of the spindle shaft, taper, tool housing and tool itself are perfectly clean.

These parts can be cleaned using standard commercial detergents for metal surfaces. When cleaning, take the opportunity to check the condition of the surfaces for wear or damage.

#### *7.3.2 CHECK THE GRIPPER TIGHTENING*

Frequency: **DAILY**

Before using the electrospindle, ensure that the gripper is in the correct position and it is tightened correctly.

In the open collet position measure the distance between gripper and the shaft (E.M. distance). If the E.M. distance change during the checks means that the gripper is not tightened correctly. Please screw the gripper in the correct position and tighten it.

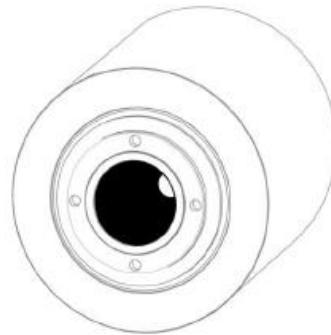
#### *7.3.3 CHECK THE CLEANING OF TOOL-HOLDER CONE AND CONICAL HOUSING OF THE ELECTROSPINDLE SHAFT*

Frequency: **DAILY**

Before using the electrospindle, ensure that the conical surface of the tool-holders and the conical surface of the electrospindle shaft are thoroughly clean, with no particles of dust, grease, cooling liquid, oil etc.



**ISO**  
Conical surface of the ISO tool-holder  
(highlighted in black)



Conical surface of the ISO spindle  
shaft (highlighted in black)



**NO!**



***Do no direct jets of compressed air into the spindle shaft when the tool-holder is absent.***

***Do no direct jets of compressed air on the nose spindle and in particular in seals labyrinth area.***

#### 7.3.4 PROTECTING THE CONICAL SEAT IN THE SPINDLE SHAFT

Frequency: DAILY



***The seat of the electrospindle shaft cone must always be protected from impurities: use a closing device.***



***At the end of the day when the machining operations are finished, always remove the tool-holder from the electrospindle to avoid any problem of sticking between tool-holder and electrospindle shaft. Protect the electrospindle shaft cone from dust.***

#### 7.3.5 CLEANING THE TOOL-HOLDER CONE

Frequency: EVERY TWO WEEKS

Carefully clean the conical surface of the tool-holders with a clean soft cloth and ethyl alcohol.

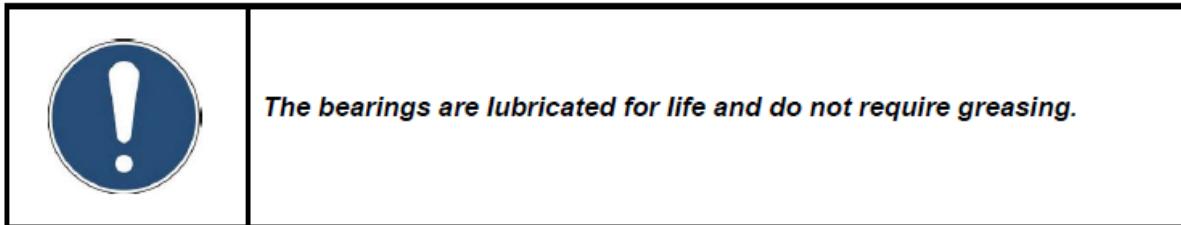
#### 7.3.6 CHECK THE CONNECTIONS

Frequency: MONTHLY

Check the integrity of the electrical cables of both power and signal and the fixing of connector. Check the seal of the tubes and connectors of the compressed air circuits.

#### 7.3.7 OCCASIONAL MAINTENANCE

Clean the grill of the cooling fan and remove any objects blocking the airways and control the fixing screws.



***The bearings are lubricated for life and do not require greasing.***

## 7.4 TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
<b>Excessive vibration during machining</b>	<ul style="list-style-type: none"> <li>• Unbalanced tool.</li> <li>• Incorrectly fitted tool.</li> <li>• Excessive cutting parameters.</li> <li>• Incorrect inverter settings.</li> <li>• Tool too big or too heavy.</li> </ul>	<ul style="list-style-type: none"> <li>• Balance the tool.</li> <li>• Check that the tool is correctly fitted.</li> <li>• Adjust (reduce or increase) the various cutting parameters.</li> <li>• Check the inverter settings.</li> <li>• Try machining with smaller tools.</li> </ul>
<b>Bearings noise</b>	<ul style="list-style-type: none"> <li>• Damaged bearings.</li> </ul>	<ul style="list-style-type: none"> <li>• Send the electrospindle to Teknomotor S.r.l.</li> </ul>
<b>The electrospindle get very hot and is stopped by the PTC thermistor signal</b>	<ul style="list-style-type: none"> <li>• Incorrect inverter settings.</li> <li>• Power settings too high.</li> <li>• Machining speeds too low for the power requirement.</li> <li>• Cooling fan grill blocked.</li> <li>• Cooling fan broken.</li> </ul>	<ul style="list-style-type: none"> <li>• Set the inverter parameters according to the plated values.</li> <li>• Contact the Teknomotor Technical Office.</li> <li>• Check the cooling fan grill and remove any blockage.</li> <li>• Replace the broken fan.</li> </ul>
<b>S1 sensor doesn't run</b>	<ul style="list-style-type: none"> <li>• The sensor is not plugged correctly</li> <li>• The sensor is not energized</li> <li>• The tool holder is not the proper tool holder</li> <li>• The pull stud is not correctly fixed on the tool holder</li> <li>• The sensor is not in the correct position</li> </ul>	<ul style="list-style-type: none"> <li>• Check the sensor connection</li> <li>• Check the sensor power supply</li> <li>• Check the tool holder type</li> <li>• Check the pull stud tightening</li> <li>• Trim the sensor</li> </ul>
<b>S2 sensor doesn't run</b>	<ul style="list-style-type: none"> <li>• The sensor is not plugged correctly</li> <li>• The sensor is not energized</li> <li>• No air pressure</li> <li>• The sensor is not in the correct position</li> </ul>	<ul style="list-style-type: none"> <li>• Check the sensor connection</li> <li>• Check the sensor power supply</li> <li>• Check the pneumatic circuit</li> <li>• Trim the sensor</li> </ul>
<b>S3 sensor doesn't run</b>	<ul style="list-style-type: none"> <li>• The sensor is not plugged correctly</li> <li>• The sensor is not energized</li> </ul>	<ul style="list-style-type: none"> <li>• Check the sensor connection</li> <li>• Check the sensor power supply</li> </ul>
<b>S5 sensor doesn't run</b>	<ul style="list-style-type: none"> <li>• The sensor is not plugged correctly</li> <li>• The sensor is not energized</li> <li>• No air pressure</li> <li>• The sensor is not in the correct position</li> </ul>	<ul style="list-style-type: none"> <li>• Check the sensor connection</li> <li>• Check the sensor power supply</li> <li>• Check the pneumatic circuit</li> <li>• Trim the sensor</li> </ul>