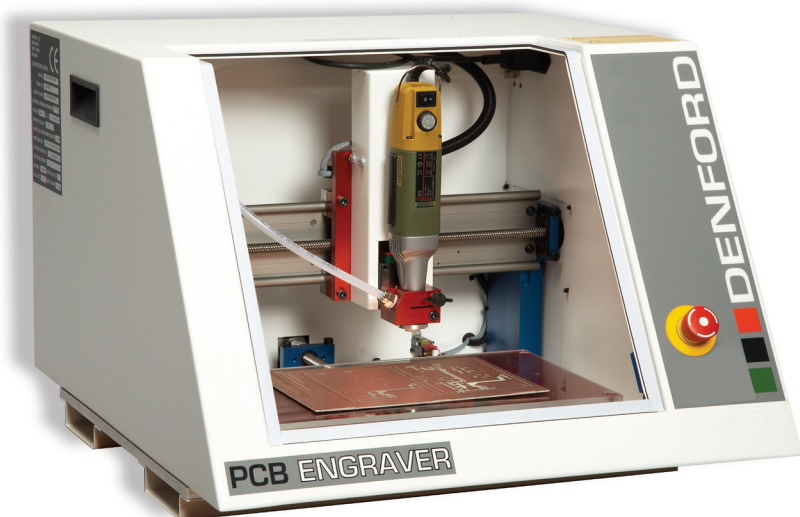




PCB Engraver
CNC Machine
User's Manual

UK
CA | CE
approved



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1: Notes



1 : Notes



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1: Warning Notices



Warranty Disclaimer.

The Warranty on your Engraver will be invalidated if any modifications are made to the machine or any additional ancillary equipment fitted, or any adjustments are made to the controlling devices without prior notification from Denford Limited. Please refer to the information held in your separate Warranty pack, for specific details.

Any portable appliance testing (PAT) carried out on this equipment must comply fully with the instructions outlined later in this chapter.



Maintenance Disclaimer.

Always obtain permission from the person responsible for machinery in your establishment, before accessing the electrical control panel or Engraver machine casings to carry out any maintenance work. All work must be carried out by personnel suitably qualified for each maintenance task, to avoid damage to the machine systems and injury to the maintenance personnel. Denford Limited cannot accept responsibility for any damage, injury and/or loss that may occur through incorrect maintenance of your Engraver.



Use of Machine.

Your Engraver is designed for machining common resistant and prototyping materials, including copper circuit board, plastic and acrylic. The appropriate tooling, speeds and feeds should be used as recommended by Denford Limited. Information regarding the safety specification of the materials to be cut can be obtained from Denford Limited. Facility is provided for connecting a vacuum system for dust extraction. Always use the machine coupled to such a system.

Your Engraver is not intended for use with any metals, other than the copper circuit board.

Do not remove the Engraver head and attempt to use it independently of the machine.

Do not machine any toxic, radio-active or volatile materials.

Use of the machine for any purpose other than those for which it is designed may result in injury, and may also invalidate the warranty.

The machine should only be used under constant supervision, to help guard against, and respond to, any unforeseen hazard such as fire or explosion. First aid and firefighting equipment (CO₂ Extinguisher) should be located nearby in a clearly signed and prominent position.

1: Warning Notices



Sound Level Disclaimer.

The Noise Level test published in this manual is for the machine and any essential equipment such as dust extraction equipment, and complies with the relevant standards. It cannot make provision for noise resulting from the cutting process, since this is a variable, depending on such factors as material, cutting data and tooling.

Any ancillary equipment supplied by Denford will also comply with the relevant standards. However, when used jointly with the machine in a machining environment, the combined sound levels emitted may require that Personal Protection Equipment, such as ear defenders, be used. Other factors, such as high ambient noise levels and nearby machinery and equipment can also increase the sound levels.

It may be possible to reduce the sound levels by changing the machining process and/or repositioning the machine and/or its ancillary equipment.

If, under these circumstances, it is felt that the sound level is still unacceptably high, then independent advice should be sought and complied with.

If you have any doubts and/or questions regarding the use, specification, servicing, or features of your machine, please contact Denford Customer Services.

Denford Limited reserves the right to change the specification and/or operating features regarding this CNC machine without notice or documentation.



Portable Appliance Testing.

In-Service Testing

This is the testing carried out as a routine to determine whether the equipment is in a satisfactory condition.

In-Service testing will involve the following:

- Preliminary inspection
- Earth continuity tests (for Class 1 equipment)
- Insulation testing (for Class 1 equipment)

Electrical testing should be performed by a person who is competent in the safe use of the test equipment and who knows how to interpret the test results obtained. This person must be capable of inspecting the equipment and, where necessary, dismantling it to check the cable connections.

1: Warning Notices

Portable Appliance Testing (continued).

If equipment is permanently connected to the fixed installation, e.g. by a flex outlet or other accessory, the accessory will need to be detached from its box or enclosure so that the connections can be inspected. Such work should only be carried out by a competent person.

Preliminary inspection

Formal visual inspections should only be carried out by persons competent to do so.

- Cables located so as to avoid damage
- Means of disconnection/isolation readily accessible
- Equipment positioned to avoid strain on cord
- Equipment is being operated with the covers in place
- Indiscriminate use of multi-way adaptors and trailing sockets is avoided
- Identify signs of overheating
- Identify signs of damage to insulation
- Check the correct size fuse is fitted (13A)
- Check the flexible cable connections and anchorage.

Before carrying out the following tests ensure the machine is disconnected from any external equipment or supplies.

Ensure Ethernet (RJ45) and USB (if applicable) connections are removed prior to testing.

Earth continuity Test (Class 1 equipment)

The test should be carried out at 25A for a period of 5 – 10 Seconds

The reading should be less than $0.1 + R$ (where R is the resistance of the lead)

Insulation Resistance Test (Class 1 equipment)

The applied test voltage connected between Live/Neutral and Earth should be 500VDC

The insulation Resistance should be greater than 1M Ohms

1: About this Manual

Using this manual This manual provides information describing how to transport, site, setup and operate the basic functions of your Denford Engraver CNC machine, including any operational features of hardware specific to the Denford Engraver series. This manual does not provide any information regarding the software packages used. Please refer to the help section within the appropriate software.

Please note that the Electrical Diagrams for your Engraver are not included in this manual - they are delivered separately in the standard equipment box supplied with your CNC machine.

If you have any doubts and/or questions regarding the specification, servicing, or features of your Engraver, please contact Denford Customer Services. Denford Limited reserves the right to change the specification and/or operating features regarding this CNC machine without notice or documentation.

Disclaimer Please note that due to the nature of hardware and software developments, the specifications and features of this product can change without notice. The information contained in this manual is correct at the date of printing only - February 2023. No liability can be accepted by Denford Limited for loss, damage or injury caused by any errors in, or omissions from, the information supplied in this manual.

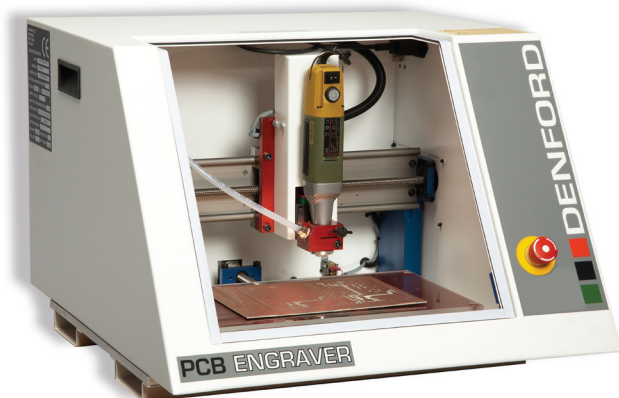
Screenshots Please note that any screenshots are used for explanation purposes only. Any numbers, wording, window or button positions may be different for the configuration of the CNC machine control software being used to control your Engraver.

Language This manual is written using European English.

Contact Any comments regarding this manual should be marked for the attention of our technical authoring team and referred to the following e-mail address: customerservices@denford.

1: Introducing your PCB Engraver

Congratulations on your purchase of a PCB Engraver CNC machine. In this manual you will learn how to setup and use your Machine correctly and safely.



Your Engraver is a full three axes CNC Engraver with a large work area, allowing machining of materials approaching 330 x 210mm in size. Suitable for all levels of education and training, it is manufactured to meet industrial standards. Together with rapid traverse rates of up to 5000 mm/min your Engraver is the ideal partner for the manufacture of Printed Circuit Boards. Your PCB Engraver is designed with you in mind - making the processes involved both safe and easy to use.

Main Features:

- Designed specifically for Education and Training.
- Manufactured to industrial standards.
- Programming via International Standards Organisation format (ISO).
- CE & UKCA approved for safety.
- Capable of cutting common resistant and prototyping materials, including Wood, MDF, Wax, Plastics and Acrylics.
- Links to various CAD/CAM software packages.
- Totally enclosed high visibility interlocked guard.
- Feedrate override controls.
- Dust extraction ready.

1: Before Beginning to Setup

Before beginning to set up your PCB Engraver, please check your separate order documentation, making sure that all items have been delivered to your establishment. Any missing or damaged items should be reported to Denford Customer Services as soon as possible.

The following equipment is supplied as standard with your Engraver CNC machine :

- PCB Engraver CNC machine. Note that the precise specification of your CNC machine will depend on any options selected at the time of ordering (see below).
- Range of Collets from 1mm to 3.2mm.
- Collet Spanner.
- Slot Drill.
- Depth Gauge.
- 1 x PCB Engraver warranty pack (UK Machines only).
- 1 x CD-ROM containing Denford VR CNC Machine Control Software and manuals, and Machine user's manual
- 1 x CD-ROM containing VR CNC Machine Control Software Security Key.
- 1 x RJ45 Ethernet cable.
- 1 x USB to RJ45 adaptor.

The following optional equipment may also be supplied with, or ordered for, your machine:

- Additional Software: CAD/CAM, Offline CNC Machine Control.
- CNC Machine Control software security keys.
- Vacuum for dust collection.

2: Safety Features and Precautions

Safety Features Overview.

The following safety features are standard on your Machine:-

- Emergency stop button.
- Manually operated, totally enclosed guard door with guard switch.
- Option to check CNC programs using toolpath graphics, prior to machining.
- Automatic tool retraction and spindle stop for tool changing.

Safety Precautions.

Safety is very important when working with all forms of machinery but particularly when working with CNC equipment, due to the hazardous voltages, speeds and forces that exist in the hardware. Follow the rules below at all times, when using your machine.

General Safety Precautions :

- Wear clothing suitable for machine operation and follow the safe working procedures in place at your establishment. When emptying the dust extraction system base unit or cleaning down the machine, wear suitable respiratory protective equipment. Other personal protective equipment, such as eye protection, overalls and gloves should also be considered.
- Do not place any objects so that they interfere with the guards or the operation of the machine.
- Never try to clean the machine if any part of it is rotating or in motion.
- Always secure the work on the table or in a fixture or vice.
- Ensure that the correct cable for the power source is used.
- Ensure the mains power is switched off (and unplugged) before starting any maintenance work on the machine. Depending on ancillary equipment supplied with machine there may be more than one power supply to the machine. When isolating the machine always ensure that all power sources have been disconnected. Post a notice informing others not to use the machine whilst undergoing maintenance.
- Hazardous voltages can still exist immediately after switching the machine off. Always wait at least 10 minutes before accessing the CNC machine electronics.
- If power fails turn off the mains power switch immediately and unplug the machine from the mains power socket.
- Correct maintenance is an essential part of the safe use of this machine (see the Maintenance section for further details).
- Observe caution when handling machine tooling, particularly with regard to hot and/or sharp cutters. Consider wearing protective gloves.
- When an emergency stop is required, press the circular red emergency stop button, located on the right side of the CNC machine front panel.
- If laser scanner fitted do not stare into laser beam. Refer to Scanner instruction manual for all aspects of safe use of laser.
- Visually check door and window for signs of cracks or chips. Any damage should be reported immediately to Denford and a suitable replacement obtained without delay.
- Regularly check door gas springs and/or hinges for correct operation and inform Denford of any deterioration.

2: Safety Features - Emergency Stop



The emergency stop button is located on the right front panel of the CNC machine. To activate an emergency stop, press the button fully in until it clicks.

A circular, red emergency stop button is located on the right front panel of your Engraver, as shown above. When pressed, it has the effect of stopping all axes movements and bringing the spindle to a controlled stop.

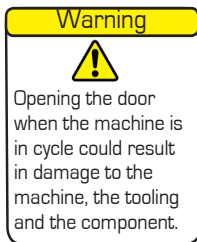
To activate an emergency stop, press the button in until it clicks. The emergency stop button will continue to cut all power to the machine drives, until the release sequence is performed.

To release a closed emergency stop button, turn the button clockwise until it springs back out.

After releasing an emergency stop, you will need to reset any CNC control software messages and home the CNC machines axes.

Check the emergency stop button is released before attempting to power up the Engraver.

2: Safety Features - Guard Switch



A guard switch is used on the door of the machine. The switch itself is fitted to the frame of the cabinet and the sensor is fitted to the door.

When the door is opened with the machine in cycle, the axes and spindle will stop. The axes can then be manually jogged, but the spindle will be inhibited. Closing the door will return the machine to full functionality, but will not cause the axes or spindle to restart.

When the door is opened with the machine powered up, but not in cycle, the axes can be manually jogged, but the spindle will be inhibited. Closing the door will return the machine to full functionality, but will not cause the axes or spindle to start.

If the machine is powered up with the door open, the axes and spindle will be inhibited until the door is closed and the machine has been homed.

2: Dust Extraction & General Dust Precautions

Note the floating head of your Engraver cannot function without a dust extraction system fitted and enabled.

Your Engraver is designed to run with a dust extraction system, used to remove any potentially harmful airborne dust particles from within the working area of the machine.

Denford can supply dust extraction systems for your machine, or you may wish to connect your own system. If using your own dust extraction system, ensure it is a CE/UKCA marked Dust Extraction System which is inspected according to HSE guidance.

Connect the pipe from your dust extraction system through hole in the left hand cabinet wall to the hole on the left hand side of the spindle motor adaptor plate.

It is a legal requirement to have the dust extraction system independently tested every 14 months to ensure that dust is kept well below the maximum exposure limits set by law.



General Dust Safety Precautions.

Obtain "material safety data sheets" from your material suppliers and enforce the recommended precautions. Be aware that certain hardwood and other material dust particles, such as oak and MDF, could contain known carcinogens. Please consult your materials supplier for further details.

Dust particles that remain inside the working area of the Engraver after a part has been machined, should be removed using a vacuum.

Never use a compressed airline for this purpose.

When emptying the dust extraction system base unit or cleaning down the machine, wear suitable respiratory protective equipment. Other personal protective equipment, such as eye protection, overalls and gloves should also be considered.

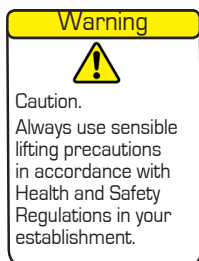
Dust particles on the floor can cause slipping. This should be monitored by the operator and removed before becoming a hazard.

Launder overalls regularly, provide good washing facilities with hot and cold water, soap and towels and encourage a high standard of personal hygiene.

Failure to fit and enable a suitable dust extraction system when machining known hazardous materials, and failure to adhere to the material safety data sheets, could lead to the following health problems which are among the potential effects associated with exposure to certain dust particles:

- Skin disorders.
- Obstruction to the nose.
- Rhinitis.
- Asthma.
- Nasal cancer.

3: Unpacking and Lifting your CNC Machine



If your CNC machine has been supplied inside a delivery box, cut the top of the box open and remove any packaging carefully. To obtain better access to the machine, remove all the sides from the delivery box. Your PCB Engraver weighs 43 kg and is designed for bench mounting.

With the bench mounting unit a suitable method of transportation must be used as the unit is not fitted with wheels: for example secure machine on a pallet and transport using a pallet truck.

If lifting by crane, suitable certified slings must be used as shown in following the illustration.



Denford do **not** advise manual lifting of this machine, however if no other suitable alternatives are available, the machine only could be lifted by at least 2 people, one at each end. Account should be taken of the non-uniform distribution of the weight of the machine. It is generally heavier at the right hand end than the left hand end. The use of suitably rated lifting bars through the hollow sections under the machine may assist in lifting the machine.

Always use sensible lifting precautions in accordance with Health and Safety Regulations in your establishment. Particularly in the case of manual lifting be aware of the danger of trapping.

Ensure that your CNC machine is both secure and balanced before lifting. Do not tip the machine whilst lifting.

All lifting equipment must be certified as being suitable for the loads involved.

3: Choosing a Site for your CNC Machine

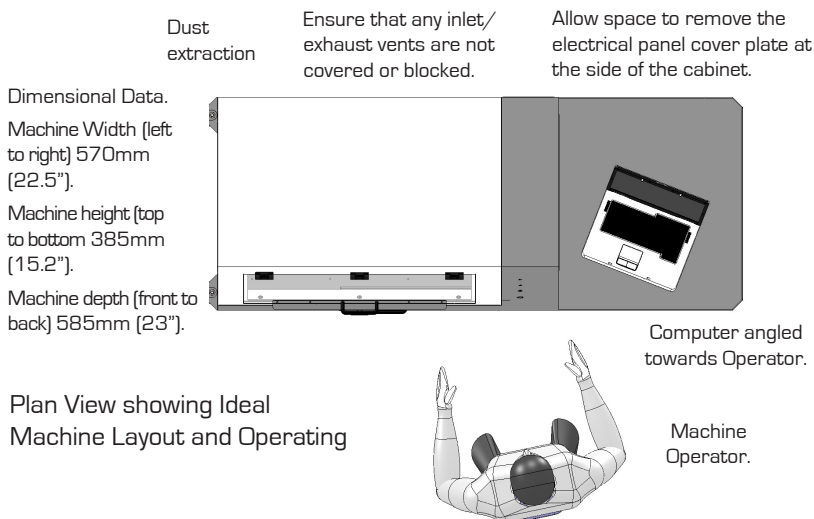
Site your machine in a well ventilated room. If the Engraver is supplied for bench mounting it should be sited on a bench of sturdy construction to take the weight of the machine and and of a height which enables comfortable operating and programming to take place.

Ideally, the user will operate the machine when standing at its front, with a clear view of both the machine working area (through the transparent guard window) and the personal computer being used as the controller unit (which should be angled towards the user), as shown in the diagram below.

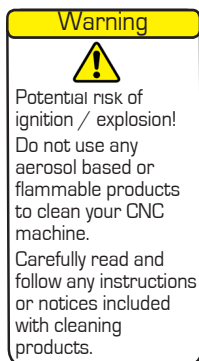
Sufficient room should also be provided for effective maintenance to be carried out around the machine itself. In particular, leave enough space for removal of the large plate covering the electronics at the rear of the cabinet. Positioning the PC on a movable workstation may allow easier access to the various vents, connectors and switches on the machine cabinet, when required.

Position any vacuum pumps used with the dust extraction at the rear, or under, the machine table. The use of a centralised extraction system or, where possible locating the extraction unit in a separate room, will help in noise reduction. If non-hazardous materials are being cut, and the extraction unit is not employed, then noise level will be significantly reduced, particularly if the cover on the side of the machine is secured in the closed position.

Do not place the machine in a position which allows any of the cabinet vents to be covered. Ensure all cables, pipes and flexes are routed to avoid the possibility of users tripping over them.



3: Removing Protective Coatings and Packaging



Once your Engraver has been sited and connected electrically, the protective coatings and transit packaging must be removed to prepare the machine for running:

- 1) The protective plastic sheeting on the guard door and window must be removed prior to cleaning them with an antistatic cleaner.
- 2) Tie-wraps may be used in the working area of the machine, to prevent movement of components during transit. Additional items from your order may also be supplied packaged inside the working area.

Warning - Aerosol based or flammable products must not be used to clean your CNC machine. To avoid the potential risk of ignition / explosion, ensure that any trapped solvent vapours can exit fully from any enclosed areas on the CNC machine. Wait at least 1 hour before attempting to operate the CNC machine.

4: Switching the Engraver On

Warning



Do not connect cables between any electrical hardware with the mains power switched on, since this could seriously damage components inside your CNC machine.

Warning



Never attempt to access the electronic hardware systems of the machine with the mains power switched ON.

Note that hazardous voltages can still exist immediately after switching off the power.

If the machine has previously been switched on, wait at least 10 minutes before attempting to open the electrical panel cover plate.

Many electronic components are sensitive to electrostatic damage - ensure components and/or personnel are suitably earthed to minimise this risk.

Follow these instructions to switch on your Engraver:

- 1) Check the Ethernet cable is fitted securely between the Engraver cabinet (located above or near the power cord) and either the RJ45 socket on your computer or into the supplied RJ45 to USB adaptor which is then fitted to your laptop or computer.
- 2) Check that all access panels are in position and securely fastened.
- 3) Check that all inlet/exhaust vents are clear from obstructions.
- 4) Check the flexible hose from your separate dust collection vacuum system is securely fitted to the connection hole, located at the top of the left side viewing window.
- 5) Check that the guard door is fully closed.
- 6) Plug the Engraver mains supply cable into an available power socket. Switch the power socket on.
- 7) The on/off power switch is located on the right-hand panel of the Engraver cabinet. To switch machine on depress the left-hand side of switch. The switch will illuminate when power is being supplied to the machine.
If the Engraver does not begin its power-up routine, switch off the mains power and check all connections and fuses.
- 8) Switch on the machine controller PC and start the CNC machine control software.

Establish a communication link between your machine controller and PC - for help please contact technical

4: Switching the Engraver Off

Warning



Never attempt to access the electronic hardware systems of the machine with the mains power switched ON.

Note that hazardous voltages can still exist immediately after switching off the power.

If the machine has previously been switched on, wait at least 5 minutes before attempting to open the electrical panel cover plate.

Many electronic components are sensitive to electrostatic damage - ensure components and/or personnel are suitably earthed to minimise this risk.

Follow these instructions to switch off your Denford Engraver off:

- 1) Wait for the Engraver to fully complete any machining or processing of any operational instructions.
- 2) Open the safety guard door and remove any finished parts from the working area.
- 3) Close the safety guard door.
- 4) Close down the communication link between the CNC control software and the Engraver, then exit the CNC control software, as described in your separate CNC Control Software User's Manual.
- 5) Shut down and switch off the machine controller personal computer.
- 6) Power down the Engraver by depressing the right-hand side of the red on/off mains power switch. The on/off switch is mounted on the right-hand cabinet panel,
- 7) Switch off the mains power socket.

Warning



Depending on ancillary equipment supplied with machine there may be more than one power supply to the machine.

When isolating machine always ensure that all power sources have been disconnected.

4: Homing the Machine Axes (Home Mode)

Note

The sequence of events required to home the Engraver will depend on the type of CNC machine control software being used - please refer to your separate CNC Machine Control Software User's Manual for specific details.

Immediately after establishing a communication link between the CNC control software and the Engraver, all three axes of the CNC machine must be homed. The process is commonly referred to as homing the machine, or datuming each of the three machine axes.

When a communication link is first established between the Engraver and the CNC machine control software, or when the CNC machine "loses" position, the software will not know the true position of the machine head in relation to the three machine axes.

Note

The CNC machine control software Jog and Auto Modes will not become available until the machine has been configured by homing all three machine axes.

Homing the CNC machine defines:

- The machine datum, by physically driving the machine head to a fixed zero reference point.
- The constraints of three dimensional co-ordinate grid system used for plotting any programmed movements, effectively the working envelope of the CNC machine.

Note

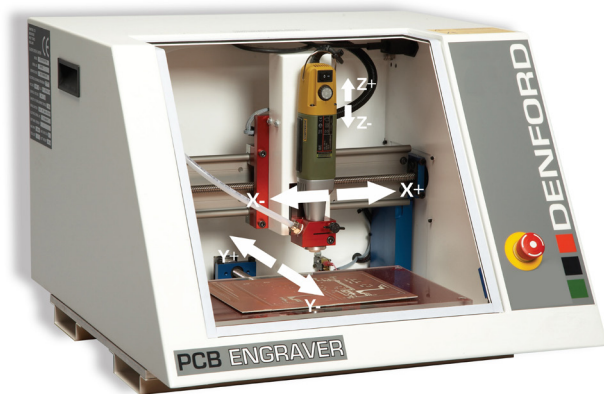
The machine datum position is set by Denford and can never be moved, since it defines the physical movement capability of the CNC

After homing the machine, the zero position of the three dimensional co-ordinate grid system is referred to as the machine datum. You can find the position of the machine datum by switching the co-ordinate display in your CNC control software to read Machine Co-ordinates. The position of the machine datum is achieved when the X, Y and Z panels of the co-ordinate display all read zero.

In addition to homing the CNC machine after it has first been switched on, we also recommend homing the CNC machine after loading or configuring any offsets.

4: Manual Control - Axis Definitions (Jog Mode)

Jog mode is used for manually controlling the CNC machine, moving the three machine axes, changing tools, operating optional equipment and configuring any offsets.



Axis Definitions.

X Axis - The X axis slides run at 90 degrees to the Y and Z axes, horizontally left and right, when viewed from the front of the machine. Minus [-] X movements run towards the left end of the machine and positive [+] X movements run towards the right end of the machine.

Jog Keys to move axis - arrow keys left and right

Y Axis - The Y axis slides run at 90 degrees to the X and Z axes, horizontally forwards and backwards, when viewed from the front of the machine.

Minus [-] Y movements run towards the front of the machine and positive [+] Y movements run towards the back of the machine.

Jog Keys to move axis - arrow keys up and down

Z Axis - The Z axis slides runs at 90 degrees to the X and Y axes, vertically up and down, when viewed from the front of the machine.

Minus [-] Z movements run down, towards the floor of the machine and positive [+] Z movements run up, away from the floor of the machine.

Jog Keys to move axis -Page up and Page down

4: Machine Operators Panels

Warning



Depending on ancillary equipment supplied with machine there may be more than one power supply to the machine.

When isolating machine always ensure that all power sources have been disconnected.

Mains Power Switch.

To supply power to the CNC machine, depress left-hand side of the switch immediately above the power inlet socket. To cut power to the CNC machine, depress right-hand side of switch.

Do not cut the mains power when machining or processing of any operational instructions is taking place. Note that cutting the machine power will trigger the closing of the interlock guard switch. This will lock a closed safety guard door in position, preventing access to the machine working area. The interlock guard switch will automatically reopen when power is next supplied to your Engraver.

Note

Activating an emergency stop will also trigger the interlock guard switch. This will prevent a closed safety guard door from being opened.

Emergency Stop Button.

The emergency stop button is a circular red push button. Pressing the emergency stop button has the effect of stopping all axes and spindle movements immediately. To activate an emergency stop, press the button in fully until it clicks. The emergency stop button will remain closed (continuing to cut all power to the machine drives) until the release sequence is performed. To release a closed emergency stop button, push and turn the button clockwise until it springs back out, then wait 10 seconds for the machine systems to reset.

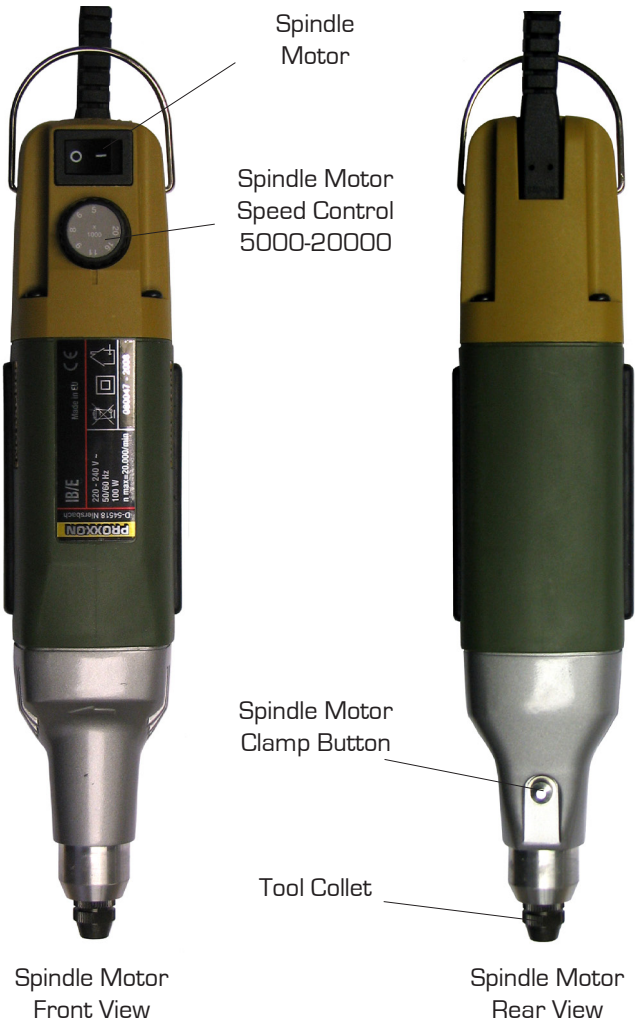
5: Spindle Motor Features and Controls

The spindle motor has an intermittent duty cycle - 100W S3-50 40min.

i.e. the motor can be run continuously at 100W for a maximum of 20 minutes in any 40 minute cycle. For the remainder of the cycle it must be allowed to cool before being used again.

If this duty cycle is likely to be exceeded, then it is highly recommended that a spare motor be purchased to alternate with the original motor.

A second motor also improves tool change times in that the tool change on one motor can be done in parallel with cutting on the other motor.



6: Performing a Tool Change

Warning



Never open the safety guard door and enter the working area when the spindle or machine axes are moving.

Note

When two or more tools are used in the same CNC file:

Your new tool **MUST** be refitted to Engraver motor and machine head in exactly the same position used when originally configuring its Z tool offset value.

Performing a Manually Requested Tool Change.

To ensure that the machine is always aware of which tool is fitted to the spindle at any one time, it is recommended that if you wish to change tool that this is done via the machine control software. When a tool change is requested the machine will automatically move to the tool change position as it would do in the Automatic tool change cycle detailed in the next chapter.

Performing an Automatically Requested Tool Change during the running of a CNC program.

On reading a tool change operation line in your CNC program, all three machine axes will move to their tool change positions, via an intermediate point, if programmed.

At this point, the software will pause the CNC program and a message window will be displayed, prompting you to manually change tools.

Always wait for the spindle and machine axes to stop moving, before attempting to open the safety guard door.

Replace the current tool number with the tool number specified in the software message window (the tool profiles allocated to each tool number may be listed at the beginning of your CNC program).

Close the safety guard door and clear the software message window to resume your machining.

6: Performing a Tool Change

Standard Tool Change System.

The tool change system, supplied as standard with your PCB Engraver, comprises four elements:

- i) The spindle motor with attached threaded shaft, configured to allow fitment of the cutting tool and collet assembly.
- ii) The collet and nut assembly - a tapered, tubular, split metal collet held inside the locking nut, which threads directly onto the Engraver motor threaded shaft. Different sized collets and collet adaptors are available to allow use of cutting tools with varying shank sizes.
- iii) The cutting tool. (See recommendations below).
- iv) Tooling - 1 off collet tool is supplied with the machine.
- v) Tool Setting Gauge

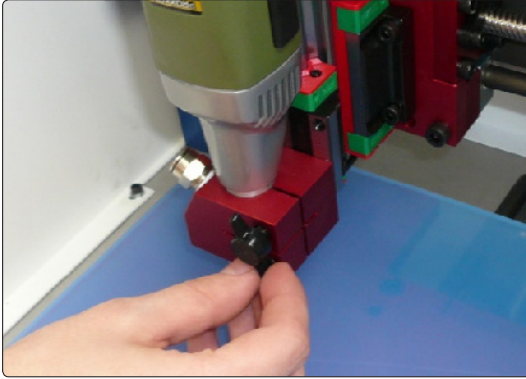
Bear in mind the following recommendations when choosing tools:

- a) Only use fully sharpened tools, and make sure that they are securely locked in the spindle.
- b) Never use bent or damaged tools, chipped tools, or tools that are not perfectly balanced.
- c) Always make sure that the mating surfaces of tools are perfectly clean and dent free before fitting the tool in the tool holder.
- d) Never use tools at speeds in excess of that punched on them or specified by their manufacturer.
- e) Always ensure that the following essential requisites are met before using any tool at high speed:
 - The tool must be of compact, short, and lightweight design.
 - The tool must be a precision instrument, and any inserts must be held in to a high degree of security.
 - The tool must be balanced and must mate symmetrically with the tool holder.
 - The cutting surfaces of the tool must be located near its centre of rotation.

In general, the recommended balance rating for tools run at speeds over 6000 RPM is G2.5 (ISO 1940 standard).

Maximum permissible values for vibrations measured on electrospindles must fall within classes I-K according to ISO 2372 - VDI 2056 standards.

6: Performing a Tool Change



Remove the Spindle Motor from the machine using the thumbscrew as shown.

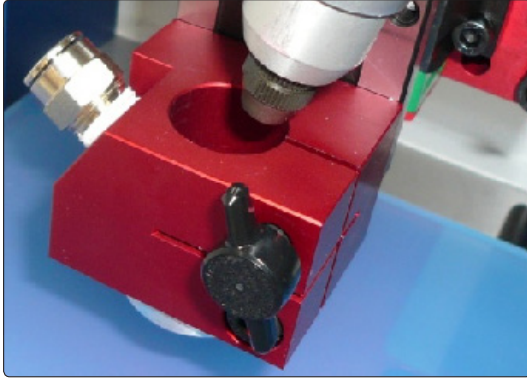


Release tool collet by pressing on the button and turning the spanner supplied. Insert engraving tool and very lightly tighten the collet.

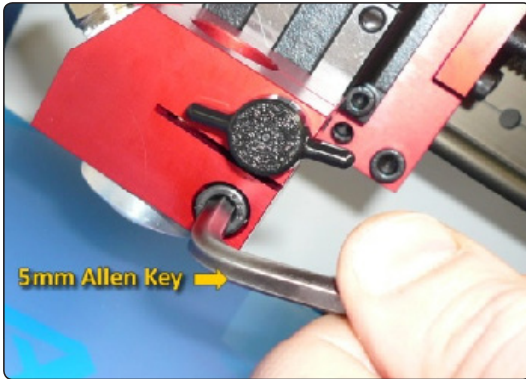


Using the tool setting gauge, push the tool into the spindle on the Z=0 setting. Now fully tighten the collet.

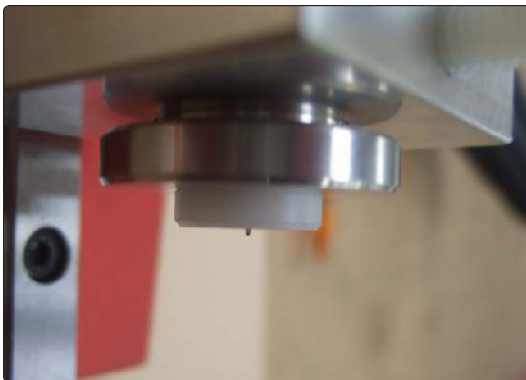
6: Performing a Tool Change



Place the spindle motor back into the floating assembly. Make sure the clamp is clean and free from debris. Retighten the thumb screw.

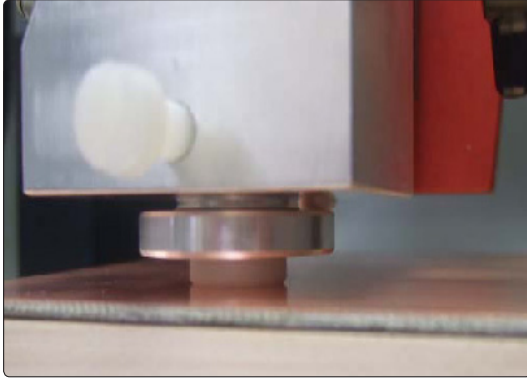


Loosen the cap screw and adjust the floating ring by turning until the tool tip protrudes...



The tool should protrude just enough to break the surface of the engraving material or PCB. Now tighten the cap screw.

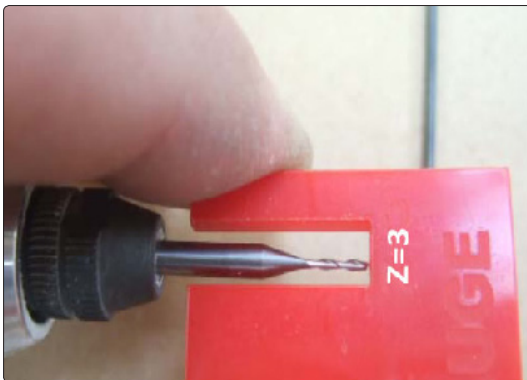
6: Performing a Tool Change



Check the setting of the collar by carrying out a cut on the material to ensure the depth is correct, adjust the ring as required.

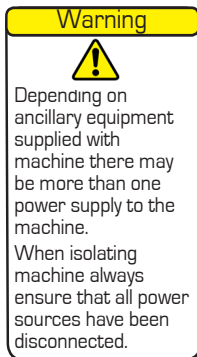
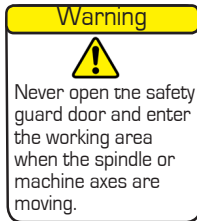
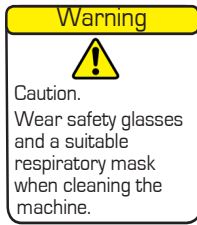


Changing to other tools is the same but you can set them to different heights using the supplied gauge.



This tool is set to $Z=3$, which will result in a drill depth of 3mm deeper than that of the track cutting tool setup to $Z=0$.

7: Planning Procedure for Maintenance



When carrying out any maintenance, pay special attention to the following items, ensuring safe and correct working procedures in accordance with Health and Safety Regulations in your establishment:

- Before starting any maintenance work, define the task and obtain the information relevant to carry out the maintenance. Also, define the time period needed to complete the task, to obtain the correct tools and order any spare parts, if required.
- During the maintenance work period, display a suitable notice stating that the machine is under maintenance and should not be used until the notice is removed.
- Safety must be a priority when carrying out any maintenance work. Covers and safety guards that are removed during the maintenance work must be replaced after the task is completed.
- All work must be carried out by suitably qualified personnel.
- Never attempt to access the electronic hardware systems of the machine with the mains power switched ON.
- Hazardous voltages can still exist immediately after switching off the power. If the machine has previously been switched on, wait at least 10 minutes before attempting to open the electrical panel access plate.
- When replacing electrical components, ensure the new parts are of suitable replacement specification.
- All work completed on the machine, whether progressive, or preventative, should be logged to ensure a complete service record is available for future referral. We recommend the maintenance logs at the end of the maintenance section are used to log any maintenance tasks undertaken.
- When maintenance work has been completed, check that the replaced or serviced parts work correctly, before allowing general operation of the machine.

7: Maintenance Schedule

Every Day (and, if necessary between components)

- Clear dust from working area of machine and ensure that the surfaces of the spindle, tool housing and tool are clean - do not use compressed air.

Every Week

- Clean the machine thoroughly.
- Clean dust from Engraver motor - see p30.
- Lubricate the slideways and leadscrews - see p31.
- Check all exposed screws and nuts for tightness.
- Visually check door and window for signs of cracks or chips. Any damage should be reported immediately to Denford and a suitable replacement obtained without delay.

Door Part Number PCB/0401D

Every Two Months

- Check the condition of any electrical connections.
- Check and thoroughly clean all components of the tooling system.
- Check all cables for kinks and breaks.
- Check door hinges for correct tension and adjust if necessary.

If, after fully hand tightening the centre screw of all hinges with an appropriate tool, the door falls when released from a position 15 degrees forward of vertical, new hinges should be obtained and fitted without delay.

Denford part Number B101229/A

Every Three Months

- Clean microswitches - see p30.

7: Maintenance of the Engraver Motor

Maintenance of the spindle motor is limited to:-

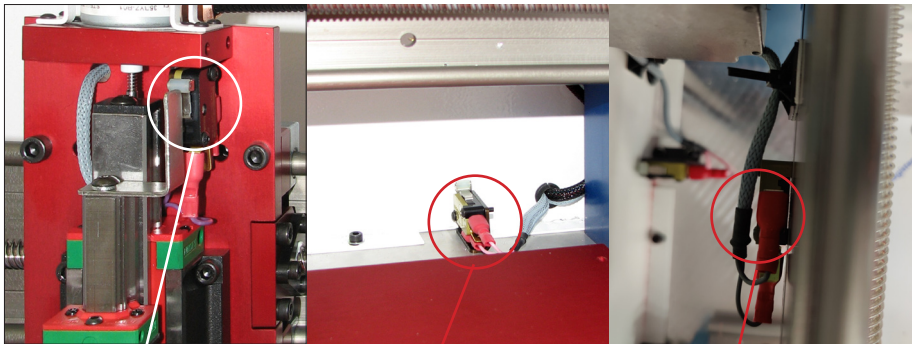
- i. Regularly (at least once a day if tools are changed frequently) checking that the surfaces of the Engraver motor, tool housing and tool are clean.
- ii. Occasionally cleaning the grill of the cooling fan with a soft brush or vacuum (never use compressed air) and removing any objects blocking the air ways.
- iii. Occasionally checking the security of the fixing of the motor to the machine.

For any maintenance beyond the above, the motor should be returned to Denford. This included replacement of worn carbon brushes.

7: Cleaning the Microswitches

The X,Y Z axis all have microswitches

Using a soft bristled brush, carefully clean dust and debris away from the microswitch, to an area where it can be removed using a vacuum cleaner.



The Z axis switch is located at the top R.H. corner of the head slide and is accessed by removing the white head cover.

The Y axis switch is mounted in front of the rear wall of the cabinet adjacent to the R.H. column.

The X axis switch is mounted on the rear face of the crossbeam and is located immediately above the Y axis switch.

7: Lubricating the slideways & leadscrews

Use of Swansil Lubricant on Denford Routing Machines

Swansil is the recommended lubricant for Denford equipment as it uses a non flammable propellant.

1. Clean down machine with brush and vacuum - do not use compressed air.
2. Position the Machine in mid-travel.
3. Open the guard.
4. Isolate machine from power supply.
5. Spray each lead screw and guide rail with a 2-3 second burst.
6. Leave 2-3 minutes for silicone to dry before operating the machine.

Item 1 to be carried out daily or between components.

Items 2 – 6 to be carried out weekly.

Always adhere to general instructions and warnings on Swansil can.

For full health and safety information visit <http://www.swantek.com/html/sds/136.pdf>

Do not spray into confined areas.

Any excessive over spray to be dried off with a dry, clean, lint-free cloth before operating the machine.

When cleaning down the machine, wear suitable respiratory protective equipment. Other personal protective equipment, such as eye protection, overalls and gloves should also be considered.

7: Maintenance Log

Date of maintenance work.	Name of personnel carrying out the maintenance.	Details of maintenance work completed.

7: Maintenance Log

Date of maintenance work.	Name of personnel carrying out the maintenance.	Details of maintenance work completed.

8: Technical Support

Denford Limited provides unlimited telephone and e-mail Technical Support on this CNC machine to registered users. On-site visits by our engineers may be chargeable. Please refer to the information held in your separate Warranty pack, for specific details.

Before contacting Denford for support, please read your hardware and software manuals and check the Denford websites for support.

Internet (access technical support and FAQ sections):

www.denfordata.com/bb

When you request support, please be at your CNC machine, with your hardware and software documentation to hand. To minimise delay, please be prepared to provide the following information:

- CNC Machine Serial Number (from the machine ID panel).
- Registered user's name / establishment name.
- The CNC machine control software name and version number (from the "Help/About" menu option).
- The wording of any error messages that appear on your computer screen, if applicable.
- A list of the steps that were taken to lead up to the problem.
- A list of any maintenance work that has been carried out on the CNC machine.

Address:	Denford Limited, Armytage Road, Brighouse, West Yorkshire, HD6 1QF, UK.
Telephone:	+44 (0) 1484 728000
E-mail:	technical@denford.co.uk
Times:	Monday to Thursday 8.30am - 4.30pm GMT Friday 8.30am - 1.00pm GMT



9: Specification of the PCB Engraver

Safety Features:

- Manual operation, totally enclosed, safety guard door.
- Emergency stop button.
- Toolpath graphics to verify part programs prior to machining.

Mechanical Details:

- Travel X axis 330mm [13"].
- Travel Y axis 210mm [8.3"].
- Travel Z axis 40mm [1.6"].
- Float Z axis 5mm [0.2"].

Dimensions:

- Machine width 570mm [22.5"].
- Machine height 385mm [15.2"].
- Machine depth - door closed 585mm [23"].

Weights:

- Machine weight 43 KG [95 lb].

Electrical Details:

- Mains supply required:
220/240V, 50Hz, 8 Amps. or 110V @ 50/60Hz 5A
- Spindle motor: 100W S3-50 40min
- Spindle Speeds: 5000 - 20,000RPM.
- Axis stepper motors

Performance:

- Rapid traverse rate up to 5000 mm/min [197 in./min]
- Max Feed traverse rate up to 5000 mm/min [197 in./min]





Declaration of Conformity

The responsible person and person
authorised to compile the Technical File

Mr Stephen Oddy

Business Name:

Denford Ltd

Address:

Armytage Road
Brighouse
W Yorkshire
HD6 1QF
United Kingdom

Declares that the Machinery Described:

Make:

Denford Ltd

Models:

PCB Engraver
Manufactured from January 1st 2023

We hereby declare that the product
described above, to which this declaration of
conformity refers to, is in conformity with
the essential requirements of the following
standards:

Supply of Machinery (Safety) Regulations 2008
BS EN 19085-1 :2021
BS EN 19085-3 :2021
The Electromagnetic Compatibility Regulations 2016
RoHS Directive:2011/65/EU
ISO 13849-1:2015(EN)

Signature of responsible person

A handwritten signature in black ink, appearing to read "S. Oddy".

Position:

Managing Director

Date:

7th December 2022



Declaration of Conformity

The responsible person and person
authorised to compile the Technical File

Mr Stephen Oddy

Business Name:

Denford Ltd

Address:

Armytage Road
Brighouse
W Yorkshire
HD6 1QF
United Kingdom

Declares that the Machinery Described:

Make:

Denford Ltd

Models:

PCB Engraver
Manufactured from January 1st 2023

We hereby declare that the product
described above, to which this declaration of
conformity refers to, is in conformity with
the essential requirements of the following
standards:

Machinery Directive: 2006/42/EC
EN 19085-1 :2021
EN 19085-3 :2021
EMC Directive:2014/30/EU
RoHS Directive:2011/65/EU
ISO 13849-1:2015(EN)

Signature of responsible person

Position:

Managing Director

Date:

7th December 2022

10: PCB Engraver Noise Level Test Results

NL-PCB-01S

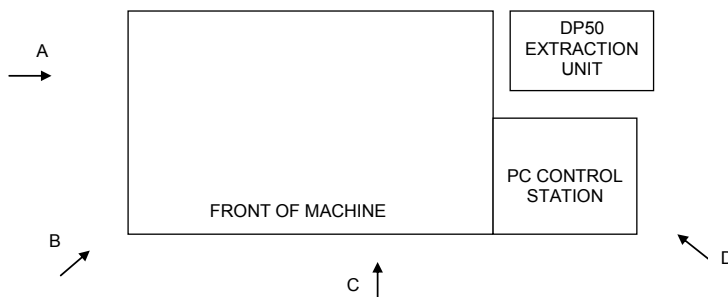
Noise Level test

Test Report No: NL-PCB-01S
Machinery Manufacturer: Denford Limited.
Machinery Type/Model: PCB Engraver

Equipment:
Meter Ref. Standard ST-805
Denford PCB Engraver
DP50 Extraction Unit

Test Conditions:

Spindle speed: 0 - 20000 RPM.
Axis speed: 0 - 5000 mm/min
Ambient background noise: <50 dB(A).



A, B, C, & D are measurement positions 1 metre from the machine and at height of 1.6 metres above floor level.

Results;

All values are measured in dB(A)






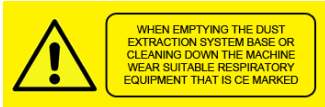



Condition	A	B	C	D
Test Program	72	72	73	74

Test Program

Spindle speed varying between 0 and 20000 RPM
Machine axes in combination 0 to 5000mm/min.
Extraction unit ran continuously during test.

The entire test cycle was run at each of the positions shown and the maximum figures registered at each position were recorded in the above table.

10: Labels used in Manual or on Machine

Label	Description & Location
	Description - Earth Label Location - Electrical Cabinet
	Description - Protected Earth label Location - Electrical Cabinet
	Description RJ45 / Ethernet Connection label Location - Right hand side of machine
	Description - Refers to an immediately impending danger. If the danger is not avoided, it could result in death or severe (crippling) injury. Please consult the manual where this symbol is displayed. Location - Machine
	Description Refers to a possibly dangerous situation. If it is not avoided, it could result severe injury. Location - Machine Manual and machine
	Description - PPE warning label Location - Right hand side of machine
	Description - Safety warning Location - Right hand side of machine
	Description - PAT Testing Label Location - Right hand side of machine
	Description - Hazardous Voltage Warning Location - Machine

11: Glossary

BILLET	A small, usually rectangular, bar of wood or metal in an intermediate stage of manufacture.
CAD	Computer Aided Design - the use of a wide range of computer based tools that assist engineers, architects and other design professionals in their design of "real world" objects.
CAM.....	Computer Aided Manufacture - software that is capable of creating tool cutter paths in a number of different axes for different CNC systems. Usually taking the design input from CAD system.
CNC.....	Computer Numerical Control - a computerised system of hardware and software, which controls the movement of a machine tool.
DRIVE	The controller unit for a disk system.
DRY RUN	An operation used to test how a CNC program will function without driving the machine itself.
DWELL	A programmed time delay.
EDIT	The mode used for altering the content of a CNC program via the Desktop Tutor or qwerty keyboard.
END OF BLOCK SIGNAL	The symbol or indicator (;)that defines the end of a block of data. The equivalent of the PC [return] key.
ERROR	The deviation of an attained value from a desired value.
G-CODE	The programming language understood by the machine controller.
FEEDRATE	The rate, in mm/min or in/min at which the cutting tool is advanced into the workpiece. For milling and drilling, the feedrate applies to the reference point on the end of the axis of the tool.
FILE	An arrangement of instructions or information, usually referring to work or control settings.
FORMAT	The pattern or way that data is organised.
FNC	FANUC Miller file, extension ".fnc". Contains G and M codes describing the machine and cutting operations.
G CODE	A preparatory code function in a CNC program that determines the control mode.
HARDWARE	Equipment such as the machine tool, the controller, or the computer.
HOME	Operation to send the axes of the CNC machine to their extreme limits of movement. Defines the co-ordinate based grid system of the CNC machine. Commonly referred to as homing the machine, or sending the machine to its home position.
INCREMENTAL	Incremental programming uses co-ordinate movements that are related from the previous programmed position. Signs are used to indicate the direction of movement.
INPUT	The transfer of external information [data] into a control system.
INTERFACE	The medium through which the control/computer directs the machine tool.

11: Glossary

JOG CONTROL	Manual movement mode for the machine axes, using very small pre-defined movements, called jog steps. One stepped movement is applied per movement using the machine offset facility. key/button press.
M CODE	A miscellaneous code function in a CNC program used to indicate an auxiliary function (ie, coolant on, tool change etc.).
MACHINE DATUM	A fixed zero reference point set by the machine manufacturer. The machine datum is used to define the co-ordinate based grid system of the CNC machine. All machining co-ordinates originate from this point. However, this point can be temporarily moved
MACHINE OFFSET	The workpiece offset file used with VR and real CNC machines.
MDI	Manual Data Input - A method used for manually inserting data into the control system (ie, Desktop Tutor, qwerty keyboard etc.).
MODAL	Modal codes entered into the controller by a CNC program are retained until changed by a code from the same modal group or cancelled.
NC	Numerical control.
OFFSET	Combination of two types of file, the workpiece offset and the tool offset. Used to describe the workpiece datum, a zero reference used on the CNC machine to ensure machining occurs in the correct place on the billet. Offsets are used to shift parts of the three dimensional co-ordinate based grid system, used by the CNC machine.
PART DATUM	Used as a zero reference point in a CNC file. All machining co-ordinates originate from this point.
PART PROGRAM	A list of coded instructions which describes how the designed part, or component, will be manufactured. The part program is also referred to as the CNC file, program, or G and M code program.
PC	Personal computer.
POST PROCESSOR	A file or setting that contains instructions for a CAM system, detailing how to create CNC code that can be understood by a particular CNC system (e.g. VR CNC Milling).
PROGRAM	A systematic arrangements of instructions or information to suit a piece of equipment.
RAPID TRAVERSE	Fast movement of the cutting tool through the 3 machine axes between cutting settings.
REFERENCE POINTS	The machine has 3 reference points used in setting the limits of movement for its slides (axes).
REMOVEABLE MEDIA	A computerised storage medium that is not permanently attached to the system, e.g. Floppy Disk, Flash Memory Card, USB Memory Key, CD/DVD disc.
SPINDLE MOTOR	The removable cutting head (motor). Also referred to as the machine head.
RPM	Revolutions per minute (rev/min) - a measure of spindle speed.
SLIDES	The 3 machine axes - see axis.
SPINDLE SPEED	The rate of rotation (velocity) of the machine head / cutting tool, measured in RPM.

11: Glossary

SOFTWARE	Programs, tool lists, sequence of instructions etc...
TOOL OFFSET	When machining, allowances must be made for the size of tools being used, since they all differ in length. The tool offset is the amount the Z value must be moved (or offset), so that all the different cutting tool tips used line up with each other, so they can all be used by one CNC file. See OFFSET.
TRAVERSE	Movement of the cutting tool through the 3 machine axes between cutting settings.
TXT	Standard Windows text only file, extension ".txt".
WORK (WORKPIECE)	The actual material being machined. The work is sometimes referred to as the billet or stock.
WORKPIECE DATUM	Used as a zero reference point on the real billet. All machining co-ordinates originate from this point, when offset files are used.
WORKPIECE OFFSET	A file containing X, Y and Z values that can shift the entire three dimensional co-ordinate based grid system, used by the CNC machine. See OFFSET.
WORD	A combination of a letter address and digits, used in a CNC program (ie, G42, M04 etc.).
VIRTUAL REALITY.....	A fully interactive, three dimensional, computer based simulation of a real world object or event.
Z TOOL OFFSET	See Tool Offset

12: Notes

Use this page to make a note of any parts of the software you have changed or configured, for example, common tooling set-ups, machine parameters, changes to installation paths or passwords etc.

[illegible]