DENFORD

Total Commitment to Education and Training WorldWide.

Microrouter CNC Machine User's Manual.

CE approved

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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.

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Warning Notices

Warranty Disclaimer.

The Warranty on your Microrouter CNC machine will be invalidated if any modifications, additional ancillary equipment is fitted, or any adjustments 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.
Do not carry out any portable appliance testing (PAT) on any of the supplied equipment.

Maintenance Disclaimer.

Always obtain permission from the person responsible for machinery in your establishment, before accessing the electrical control panel or Microrouter CNC 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 both the machine systems and the maintenance personnel. Denford Limited **cannot accept responsibility** for any damage and/or loss that may occur through incorrect maintenance of your Microrouter CNC machine.

Foreseen Use of Machine.

Your Microrouter CNC machine is designed for routing hard and soft woods, certain ceramics and plastics. In each case, the appropriate tooling, speeds and feeds should be used as recommended by the material supplier. Your Microrouter CNC machine is not intended for use with any ferrous or metallic materials.
Facility is provided for dust extraction. Always use the machine coupled to a vacuum system.
Do not attempt to use your Microrouter CNC machine for manual operations.
Do not remove the router head and attempt to use it independently of the machine.
If you have any doubts and/or questions regarding the 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.

About this Manual

Using this manual	This manual provides information describing how to transport, site, setup, operate and maintain the features of your Denford Microrouter CNC machine. This manual does not provide any information regarding the software packages used to control your Denford Microrouter CNC machine - please refer to your separate CNC machine control software manual. Please note that the Electrical Diagrams for your Microrouter CNC machine are not included in this manual - they are delivered separately in the standard equipment box supplied with your machine. If you have any doubts and/or questions regarding the 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.
Disclaimer	We take great pride in the accuracy of information given in this manual, but due to nature of hardware and software developments, be aware that specifications and features of this product can change without notice. The information contained in this manual is correct at the date of printing only - April, 2002. 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.
Language	This manual is written using European English.
Contact	Any comments regarding this manual should be referred to the following e-mail address: customerservices@denford.co.uk

1: Introducing your Microrouter CNC machine

Congratulations on your purchase of a Microrouter series CNC machine. In this manual you will learn how to setup and use your Microrouter.

The Microrouter is a compact three axes CNC machine, suitable for all levels of Education, Training and Prototyping. It has been designed with you in mind - making the processes involved both safe and easy to use.

Main Features:

- Designed specifically for Education, Training and Prototyping.
- Manufactured to industrial standards.
- Capable of cutting wood, MDF, foam, wax, plastics, acrylics and prototyping materials.
- Links to various CAD/CAM software packages, including Pro/Desktop, ArtCAM, MiniCam, Techsoft, Mill CAM Designer and AutoCAD.
- Totally enclosed high visibility interlocked guard.
- Feedrate and spindle speed override controls.
- CE approved for safety.
- Programming via International Standards Organisation format.
- Flexible workholding capabilities, including integrated vacuum pump for work holding.
- Dust extraction.
- Accepts A3 sized material - working envelope X 550mm (21 1/2”), Y 270mm (10 1/2”), Z 80mm (3 1/4”).
- Comes complete with powerful CNC Machine Contol operating software (Windows PC required).

1: What is CNC?

CNC (Computer Numerical Control) is the general term used for a system which controls the functions of a machine using coded instructions, processed by a computer. CNC machines are a very important part of the modern manufacturing process. Indeed, many of the different types of products you use everyday have been made using some sort of CNC machine.

The CNC Manufacturing Process - Example.

The sequence shown below defines the main steps involved in producing a component using a CNC system.

1) A part program is written using G and M codes. This describes the sequence of operations that the machine must perform, in order to manufacture the component.
2) The part program is loaded into the machines computer, called the controller. At this stage, the program can still be edited or simulated using the machine controller.
3) The machine controller processes the part program and sends signals to the machine components. These direct the machine through the required sequence of operations necessary to manufacture the component.

What are the advantages of CNC?

CNC systems are automated and very accurate. Once programmed, a CNC machine will perform repeat tasks until instructed to stop. Each component produced will be exactly the same size and shape, saving money on designing any jigs and fixtures that might have otherwise been required.

Using CNC machines can reduce waste material, since a CNC machine is much less likely to make an error than a human operated machine. CNC machines can also run 24 hours a day, if necessary, with no signs of fatigue.

Companies can estimate the manufacturing costs for CNC production much more accurately, compared to a production line with conventional production machines.

Jargon Buster

CNC refers to Computer Numerical Control, the automatic system used to control a machine tool.
A Part Program is 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.
A G and M code is a series of letters and numbers that make up the language used by CNC machinery.

1: Before Beginning to Setup...

Before beginning to setup your Microrouter CNC machine, 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.

Note

The standard equipment listed here is correct at the time of printing - April, 2002 - but is liable to change through continuous development of our products.

Please refer to your invoice for the definitive list of standard equipment shipped with your machine.

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

- Microrouter CNC machine. Note that the precise specification of your Microrouter will depend on any options selected at the time of ordering (see below).
- 1 x RS 232 serial link cable (25-9 pin connection)*.
- 1 x Metric allen/hex keys (2mm, 2.5mm, 3mm, 4mm, 5mm, 6mm).
- 2 x spanners.
- 1 x routing bit **.
- 1 x 6.3A fuse.
- 1 x silicone lubricant aerosol can.
- 1 x Microrouter CNC machine warranty pack.
- 1 x Microrouter CNC machine inspection certificate.
- 1 x Microrouter CNC machine manual (this book) plus additional OEM product manuals (as required).
- 1 x CNC Machine Control Software manual.
- 1 x CNC Machine Control Software CD-ROM and/or floppy disks.

*** Note**

* Short 9-25 pin serial link adaptor cables can be used to convert the RS232 connectors according to the type of COM port fitted to your computer.

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

- Additional Software: CAD/CAM, Offline CNC Machine Control.
- Machine work bench and/or PC & PC workstation.
- Vacuum table.
- Vacuum for dust collection.
- Additional work holding systems.
- Various tooling packages.
- Courseware, project books and project material packages.
- Video conferencing system.
- Additional and/or on-site training courses.

**** Note**

** Only use the Microrouter CNC machine with standard 1/4" or 1/8" shank routing bits, designed for operational speeds up to and including 26,500RPM.

2: Safety Features Overview and Precautions

Safety Features Overview.

The following safety features are standard on your Microrouter CNC machine:

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

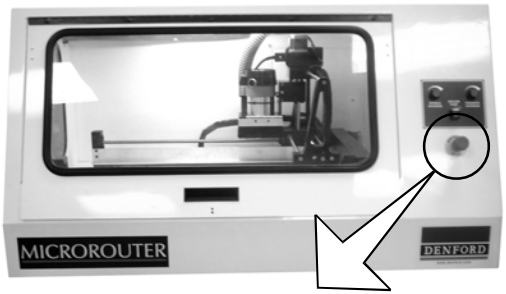
Safety Precautions.

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 Microrouter CNC machine.

General Safety Precautions :

- Wear clothing suitable for machine operation and follow the safe working procedures in place at your establishment.
- 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 preferably unplugged) before starting any maintenance work on the machine. Post a notice informing others not to use the machine since it is undergoing maintenance.
- Hazardous voltages can still exist immediately after switching the machine off. Always wait at least 5 minutes before accessing the electrical control panels.
- If power fails turn off the mains power switch immediately and unplug the machine from the mains power socket.
- Lubricate the required machine areas at the intervals specified in this manual, to prevent the axes from seizing (see the Maintenance section for further details).
- Observe caution when adding or removing machine tooling.
- When an emergency stop is required, press the circular red emergency stop button, located on the right front panel of the machine.

2: Safety Features - Emergency Stop Button



The emergency stop button is located on the right front panel of the machine.

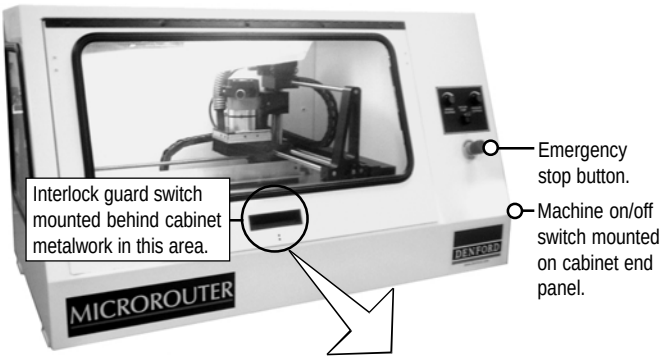
To active an emergency stop, press the button fully in until it clicks.

A circular, red emergency stop button is located on the right front panel of the machine. When pressed, it has the effect of stopping all axes and spindle movements immediately. The interlock switch will also close. When the safety guard door is in its closed position, this will prevent access to the working area of the machine.

To active an emergency stop, press the button in until it clicks. The emergency stop button will continue to cut all power to the machine drives and continue to keep the interlock switch closed, until the release sequence is performed.

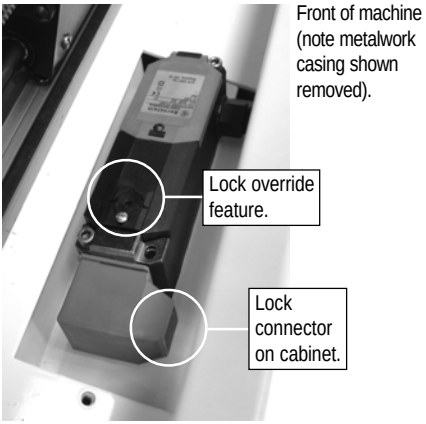
To release a closed emergency stop button, push in and turn the button clockwise until it springs back out.

2: Safety Features - Interlock Guard Switch



An interlock guard switch is fitted to the front machine door. The switch itself is hidden from view behind the cabinet metalwork. A closed machine door will remain locked when:

- The machine is switched off (ie, not in use). To release the lock, power up the machine, using the square red on/off button on the right cabinet end panel.
- The emergency stop button is fully pressed in. To release the lock, push in and turn the emergency stop button counterclockwise until it spring back out to its ready position.
- Machining is taking place. The lock will release when the machining operations have been completed and the CNC control software switched to operate in jog mode.



Front of machine (note metalwork casing shown removed).

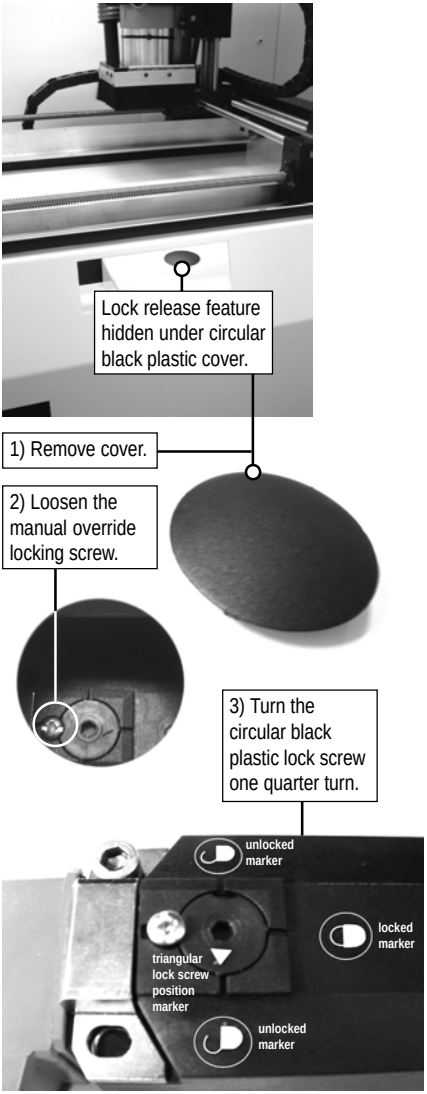
2: Safety Features - Interlock Guard Switch

An override facility is provided on the interlock guard switch, allowing **temporary** removal of the guard lock feature.

1) Using a flat blade, lift and remove the circular black plastic blanking plug.
2) Using a small flat or crosshead screwdriver, loosen the manual override locking screw until the circular black plastic lock screw can be turned.
3) Using a 3mm allen key, turn the circular black plastic lock screw one quarter turn to switch off the guard lock feature. If in doubt refer to the lock/unlock symbols embossed on the casing surface.
4) If necessary, tighten the manual override locking screw slightly, then replace the cover.
5) If you need to leave the machine, post a warning note on the machine informing users that the safety guard door lock is not operating.

Warning

Danger of serious injury!
Do not let unauthorised personnel use the machine when the guard lock feature is disabled. Ensure the guard lock feature is switched back on as soon as possible.



3: Unpacking & Lifting your Microrouter

Cut the top of the delivery box open and carefully remove any packaging, strengtheners and bracing struts, where fitted.

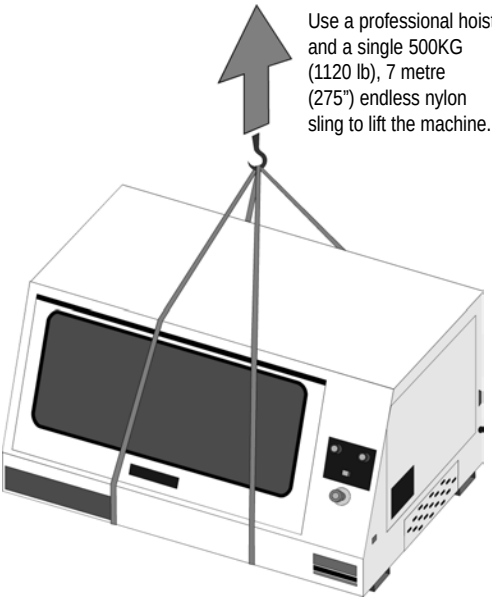
To obtain better access to the Microrouter, remove all the sides from the delivery box, leaving the machine standing on its wooden delivery pallet.

Remove any support packaging, used to help secure the Microrouter to its pallet. When fitted, these supporting struts are usually positioned between the machine feet sections.

Data Panel

Lifting Data.

Microrouter weight 150 KG (330 lb).



Use a professional hoist and a single 500KG (1120 lb), 7 metre (275") endless nylon sling to lift the machine.

Perform an assisted lift, whereby the hoist operator and at least one assistant can monitor the balance and security of the load.

Denford does NOT recommend direct lifting of the Microrouter. Use a professional hoist and a single 500KG (1120 lb), 7 metre (275") endless nylon sling to lift the Microrouter, arranged as shown in the diagram above.

Pass the sling around the middle of the machine casing, spreading the load around the area of the safety guard door handle. Note that the machine will be heavier at the righthand end of the cabinet, due the integrated electronic systems situated here. Perform an assisted lift, whereby the hoist operator and at least one assistant can manually monitor the balance and security of the load as is it moved. To transport the Microrouter over longer distances, use a suitably sized trolley. Always use sensible lifting precautions in accordance with Health and Safety Regulations in your establishment.

3: Deciding on a Site for your Microrouter

Site your Microrouter in a well ventilated room. The Microrouter is a bench mounted machine, so it should be sited on a bench of sturdy construction to take the weight of the machine 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, we recommend positioning the pc on a movable workstation, to allow easier access to the various vents and removable panels on the Microrouter cabinet, when required.

Position any vacuum pumps used with the dust extraction at the rear, or under, the machine table. 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.

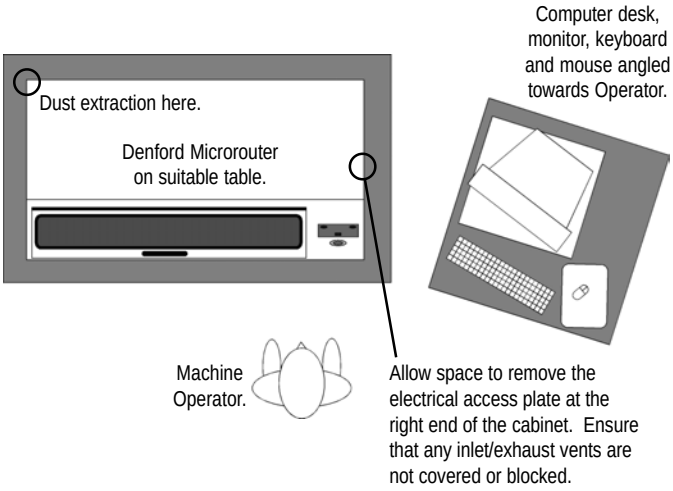
Data Panel

Dimensional Data.

Machine width (left to right end) 1356mm (54 3/8").

Machine height (top to bottom) 700mm (27 1/2").

Machine depth (front to back) 745mm (29 3/8").



Plan View showing Ideal Machine Layout and Operating Positions.

3: Levelling your Microrouter

Your Microrouter rests level on the two hollow sections which run beneath the machine cabinet. The machine itself has been levelled to the machine cabinet prior to dispatch, so it is only necessary to level the table on which the Microrouter is to be situated.

3: Connecting the Mains Supply

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.

The Microturn is delivered with standard mains specification cable connected directly into the isolator. The cable should be fitted with a standard 13 amp plug suitable for the mains power supply. All electrical connections should be completed by suitably qualified electrical engineers.

Mains supply required: 220/240Volts, 50Hz, 8Amps.
110/115Volts, 60Hz, 15Amps.
Cable required: 3 Core, 1.5mm^2 per core.
Spindle motor: 1.1kW, 1.5HP, 2.0 AMP.
Axis stepper motors: 200 steps/rev.

3: Accessing the Microrouter Electrical Panels

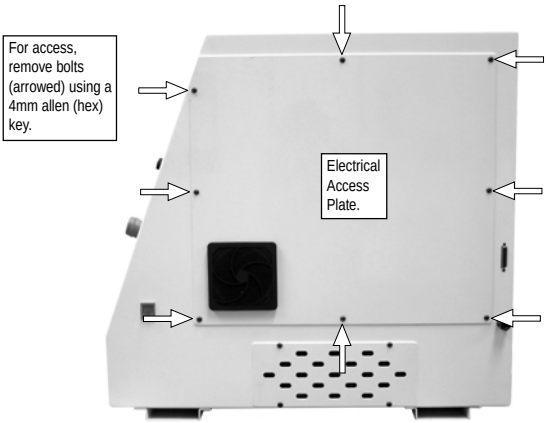
Warning

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 access plate.

The Microrouter electronics are loacted in the right end of the machine. Using a 4mm allen (hex) key, remove the eight bolts, then withdraw the cover plate, to gain access to the electrical panel, as shown below.



3: Electrical Diagrams

The Electrical Diagrams for your Microrouter are not included in this manual - they are delivered separately in the standard equipment box supplied with your machine.

3: Connecting your PC to the Microrouter

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.

Your Microrouter CNC machine is controlled using a standard IBM compatible PC (personal computer). In this role, the PC can be referred to as the machine controller computer.
Ideally, the PC you intend to use should be placed next to the Microrouter, in a position which will not interfere with routine maintenance and machine operation.

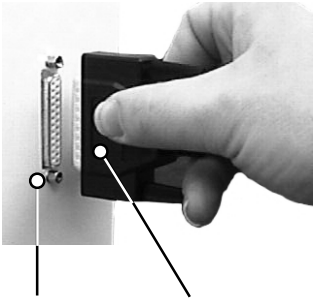
Your PC must be equipped with hardware that allows it to:
1) run the CNC Machine Control software.
2) be physically connected to the Microrouter.

The specification of PC required to control your Microrouter will depend upon the type of CNC machine controlling software being used. Please refer to your separate CNC machine controlling software manual for details regarding the exact PC specification required.

3: Connecting your PC to the Microrouter

To connect your PC to the Microrouter:

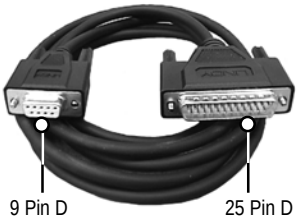
1) Connect the elements of your PC together as described in your original PC manufacturers operating manual. At this stage, your PC should not be switched on.
2) The PC must be physically connected to the Microrouter, using the supplied RS232 cable. This is the long, thin serial link cable fitted with a 25 pin D male connector at one end and a 9 pin D female connector at the opposite end, as shown below right.
3) Connect the 25 pin D male end of the RS 232 cable to the 25 pin D female port mounted on the righthand side panel of the Microrouter cabinet (when viewed from the front of the machine), as shown below left. The port is labelled **RS 232**.



25 pin D female connector fitted to electrical control box side panel.

25 pin D male connector fitted to RS232 cable.

RS232 Cable.



9 Pin D Female Connector.

25 Pin D Male Connector.

Note

PC Terminology:

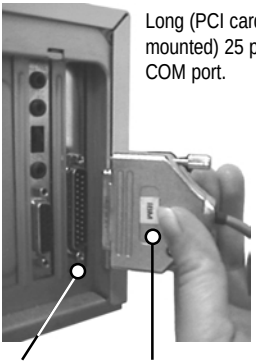
The COM ports on your PC may be labelled as Serial ports. Most COM ports have a 9 pin D MALE connector, though some older computers may be fitted with additional PCI COM cards having a 25 pin D MALE connection. In this case, a 9 to 25 pin adaptor cable can be added to the RS 232 cable supplied with your machine. The RS 232 cable supplied with your machine must always be used, since this cable features crossovers on some of the pin connections.

You must also configure the machine control software to recognise which numbered COM port is being used by the RS232 machine lead. Details on this procedure are outlined in your separate CNC machine control software manual.

The Parallel port on your PC may be labelled as the Printer port. The printer port has a 25 pin FEMALE connector.

3: Connecting your PC to the Microrouter

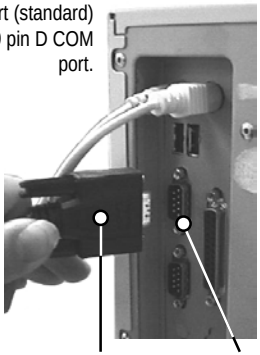
4) Connect the remaining 9 pin D female end of the RS 232 cable to the 9 pin D male **COM** port on your PC, ideally COM 2. Most computers usually have two COM ports situated on the back panel of your PC. If you cannot identify any of the ports on your PC, please refer to your original PC manufacturers operating manual for further guidance. Note that older computers may be fitted with a 25 pin D male COM port, which may require the fitting of an additional 9 to 25 pin adaptor to your RS 232 cable.



Long (PCI card mounted) 25 pin D COM port.

25 pin D male connector fitted to pc (back) panel.

25 pin D female connector fitted to RS232 cable (using a 9 to 25 pin adaptor).

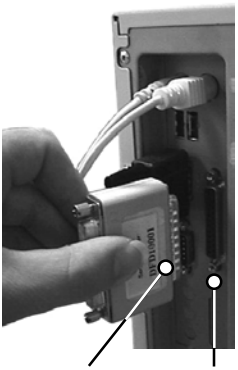


Short (standard) 9 pin D COM port.

9 pin D female connector fitted to RS232 cable.

9 pin D male connector fitted to pc (back) panel.

5) Do not confuse the 25 pin D female parallel (printer) port on your PC with the 25 or 9 pin male D COM ports. If your CNC machine control software is supplied with a security key, the 25 pin D male connector of this key must be fitted to the 25 pin D female parallel port, as shown right. Security keys are also referred to as dongles.



25 pin D male connector on security key (dongle).

25 pin D female connector fitted to pc (back) panel.

A schematic diagram illustrating these component connections is shown on page 22.

3: Removal of Protective Coatings

Once your Microrouter 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 windows should be removed and the glass and perspex cleaned with an anti-static cleaner.
2) Tie-wraps may be used in the working area of the machine, to prevent movement of X axis components during transit.

   To gain entry to the working area of the machine, power must be supplied to the machine, in order to release the switch that locks the safety guard door.

   Insert the mains supply plug into an available socket, then power up the machine using the square red on/off switch mounted on the righthand side panel of the Microrouter cabinet. The on/off switch will illuminate when power is being supplied to the machine.

   Cut and discard the tie-wraps.
3) Before using the machine, spray the slides and leadscrews with the silicone lubricant (aerosol can) provided.

Safety First!

Warning.

The silicone lubricant aerosol is extremely flammable. Never use the silicone lubricant aerosol near a naked flame, on any other machine, or for any other purpose. Carefully read and follow any instructions or notices included with the aerosol. Wear safety glasses and a suitable respiratory mask when using the aerosol.

3: Dust Extraction & General Wood Precautions

Dust Extraction Systems.

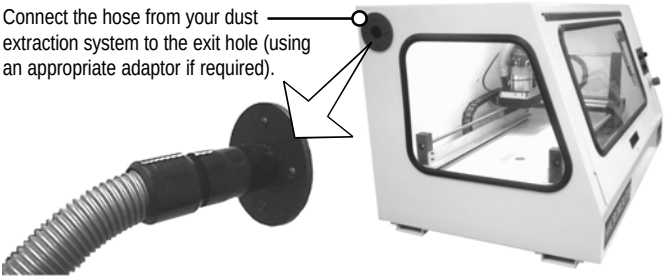
Your Microrouter is designed to run with a dust extraction system, used to remove any potentially harmful wood dust particles from within the working area of the machine.

The dust extraction system used should be independently tested to ensure that dust is kept well below the maximum exposure limits set by law. Denford can supply dust extraction systems for your Microrouter, or you may wish to connect your own existing system. The Microrouter should only be used with the dust extraction system enabled.

Connect the pipe from your dust extraction system to the exit hole, located in the top, rear corner of the left end of the Microrouter cabinet. An adapter may be required, in order to obtain an efficient seal.

3: Dust Extraction & General Wood Precautions

Dust Extraction Exit Hole Location.



General Wood Dust Safety Precautions.

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

Wood dust particles that remain inside the working area of the Microrouter, after a part has been machined, should be removed using the vacuum. The dust extraction pipe can be withdrawn from the end panel of the Microrouter and used for this purpose. NEVER USE A PRESSURISED AIRLINE for this purpose.

When emptying the dust extraction system base unit, wear suitable respiratory protective equipment that is CE marked. Other personal protective equipment, such as eye protection, overalls and gloves should also be considered.

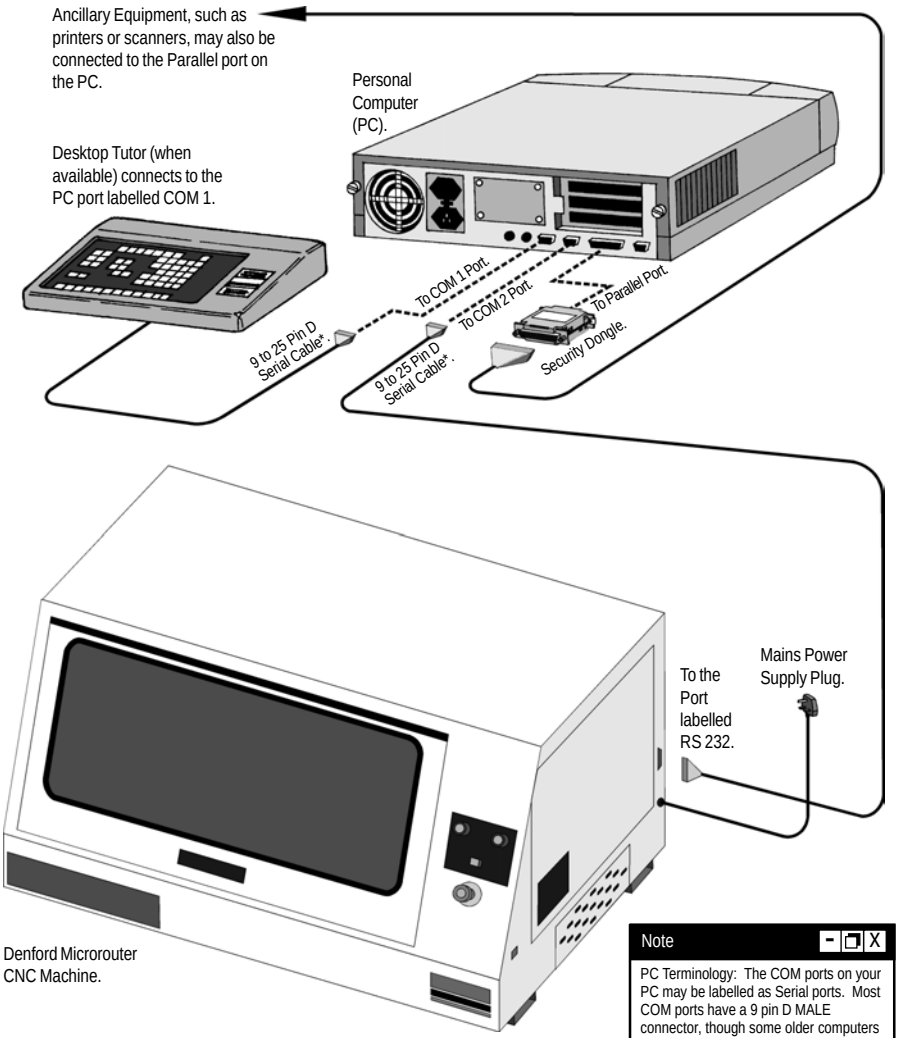
Wood dust particles on the floor can cause slipping. This should be monitored by the operator and removed before it becomes a hazard.

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

The following health problems are among the effects associated with exposure to wood dust particles:

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

3: Component Connection Schematic Diagram



Note

PC Terminology: The COM ports on your PC may be labelled as Serial ports. Most COM ports have a 9 pin D MALE connector, though some older computers may be fitted with 25 pin D MALE connectors. The Parallel port on your PC may be labelled as the Printer port. The printer port has a 25 pin FEMALE connector.

*** Note**

The RS232 serial cable connects the Microrouter to the PC port labelled COM 2. The RS232 cable is the long, thin cable fitted with a 9 pin D female connector at one end and a 25 pin D male connector at the opposite end. Connect the 25 pin D male end of the RS 232 cable to the 25 pin D female **RS 232** port on the righthand side panel of the Microrouter. Connect the remaining 9 pin D female end of the RS 232 cable to the 9 pin D male **COM2** port on your PC. Note - a 9 pin to 25 pin adapter may also be required if your COM port has a 25 pin connection.

4: Using your Microrouter - Overview

Several steps must be completed before the final manufacture of a part. The flowchart below lists the general steps that should be followed for CNC file creation, simulation and final part manufacture, in the recommended order. However, miscellaneous factors may warrant the user to complete the steps in a different order to that shown.

Note *

For more detailed information regarding these steps please refer to your separate CNC Machine Control Software User's Manual.

Note

Steps F and G are not required when working with a simulated CNC machine (for example, Virtual Reality).

Billet data is taken from Denford directives written in the CNC program - step B.

Tooling data is taken from the configuration of the software tooling - step C.

A: Switch on the Microrouter, then start the CNC Control Software
(see section 4: pages 27 to 28 and see Note * left)

B: Load or create the CNC program
(see Note * left)

C: Configure the tooling files in theCNC Control Software
(see Note * left)

D: Simulate the CNC program in 2D or 3D
(see Note * left)

E: Establish communications and home the Microrouter
(see Note * left)

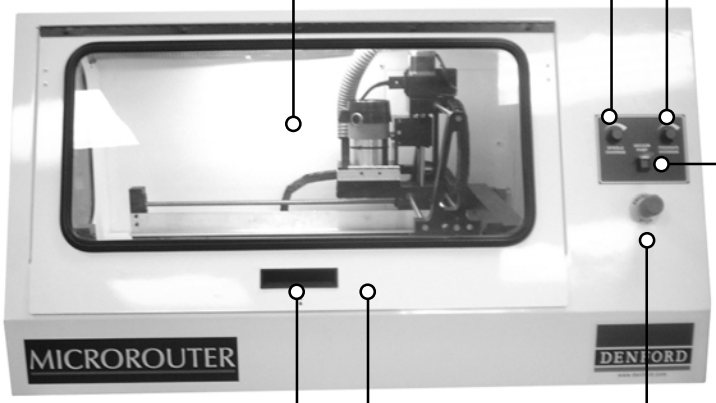
F: Prepare any tooling hardware for the Microrouter
(see section 5: pages 32 to 39)

G: Load the billet into the Microrouter
(see section 6: pages 40 to 47)

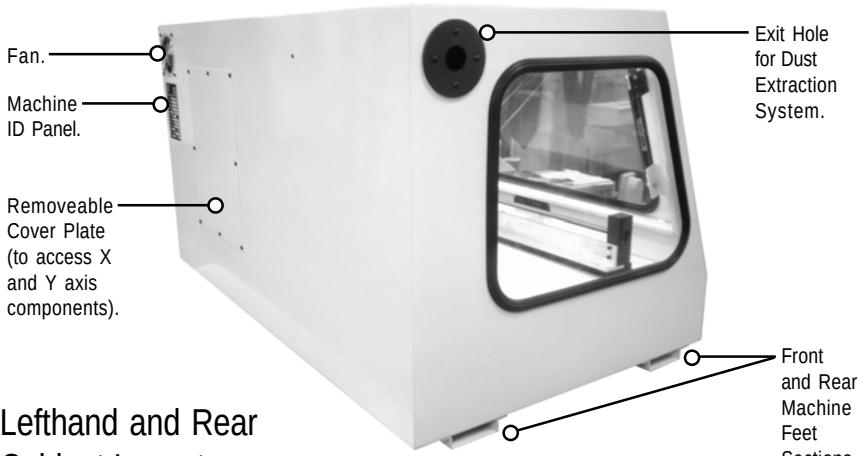
H: Configure the workpiece offset file and tool length offsets
(see Note * left)

I: Manufacture the part
(see section 4: pages 29 to 31 and see Note * left)

4: General Layout of Microrouter Components



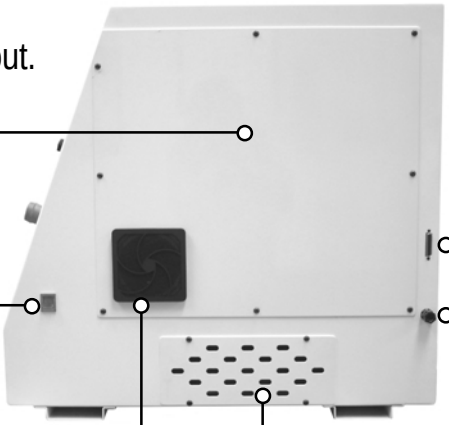
Front Cabinet Layout.



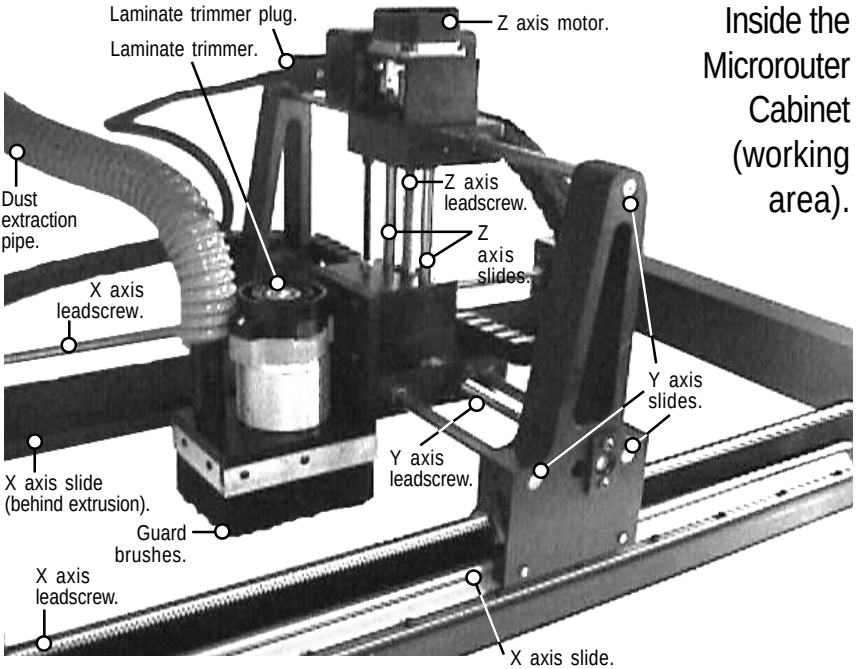
Lefthand and Rear Cabinet Layout.

4: General Layout of Microrouter Components

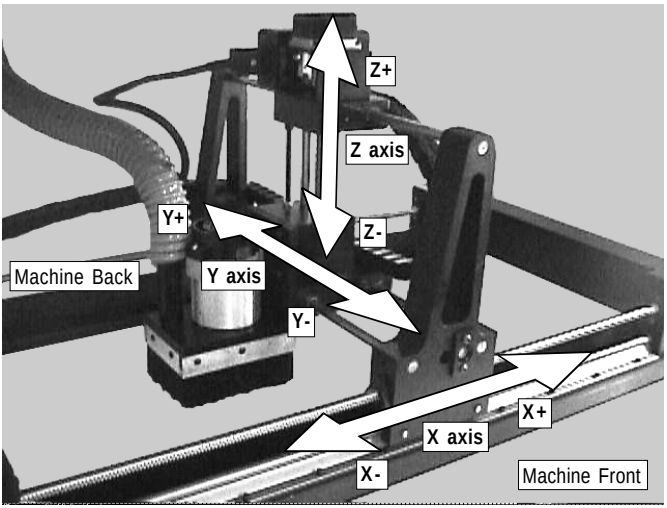
Righthand Cabinet Layout.



Inside the Microrouter Cabinet (working area).



4: Microrouter - 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.

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.

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.

4: Switching the Microrouter 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.

Follow these instructions to switch on your Microrouter:

1) Check the RS232 machine lead is fitted securely between the serial (COM) port socket on the machine controller PC and the RS232 socket, located on the righthand end panel of the Microrouter cabinet.
2) When fitted, check the RS232 controller lead is fitted securely between the serial (COM) port socket on the machine controller PC and the RS232 socket on the DeskTop Tutor controller keypad.
3) Check that all access panels are in position and securely fastened.
4) Check that all inlet/exhaust vents are clear from obstructions.
5) Check the flexible hose from your separate dust collection vacuum system is securely fitted to the connection hole, located on the lefthand end panel of the Microrouter cabinet.
6) Plug the Microrouter mains supply cable into an available power socket. Switch the power socket on.

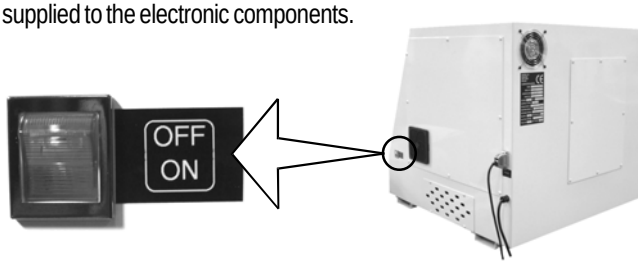
Warning

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 access plate.

7) The square, red, Microrouter on/off power switch is located on the righthand end panel of the cabinet. Press the switch to the down (on) position. The switch will illuminate when power is being supplied to the electronic components.



If the Microrouter does not begin its power-up routine, switch off the mains power supply to the CNC machine. Check all connections and fuses, referring to Section 8 - Machine Electronics, if necessary.

8) Switch on the machine controller PC and start the CNC control software. Establish a communication link with the Microrouter - please refer to your separate CNC Control Software User's Manual for details outlining this procedure.

   If a communication link cannot be established, recheck the connections on the RS232 machine lead, followed by the communication settings of your CNC control software, referring to Section 9 - Technical Support, if necessary.

4: Switching the Microrouter Off

Follow these instructions to switch off your Microrouter:

1) Wait for the Microrouter 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) To close down the communication link between the Microrouter and your PC, exit the CNC control software, as described in your separate CNC Control Software User's Manual.
4) To cut power to the Microrouter, press the square, red, Microrouter on/off power switch to the up (off) position.

   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 the Microrouter.

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 access plate.

4: Part Manufacture - Checklist and Tool Changing

Checklist.

Before beginning to manufacture your part, check to see that the following tasks have been completed:

- Billet mounted and secure.
- Tools prepared and numbered ready for use (according to your CNC file).
- Safety guard door closed.
- CNC file loaded and checked via simulation.
- Workpiece and Tool Offset files configured or loaded.
- Machine homed (datumed).

Safety First ! - ❐ X

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

Requesting a Tool Change.

The Miscellaneous Function M06 is used to program a manual tool change operation.

The M06 code activates the request for a tool change and is followed by the code T_ _ _ _, indicating the new tool number (the first two numerical digits) using the stated tool length offset file number (the last two numerical digits).

For example,
M06 T0305 ;
This command is read request a tool change, from the current tool number to tool number 3, using tool length offset file number 5.

Safety First ! - ❐ X

Caution.

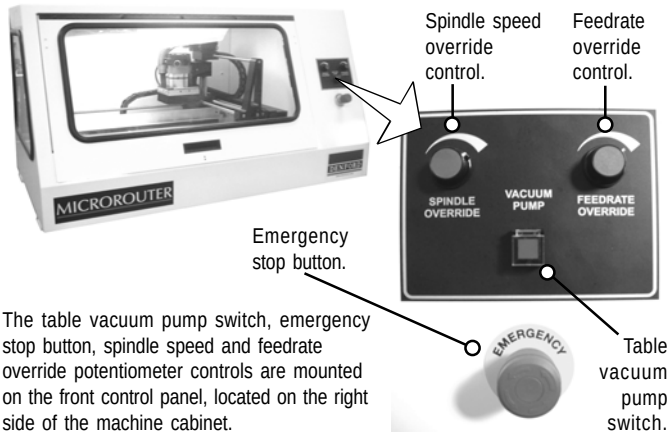
If the cutting tool has been recently used, it may still be HOT.

Using the Manual Tooling System.

When a manual tool change request is read by the CNC control software, a message window will be displayed. Wait for all machine movements to stop before opening the safety guard door, then change to the new tool number requested. Close the safety guard door and confirm via any CNC control software message windows that machining can be resumed.

Details regarding how to physically change the tool can be found in Section 5 - Preparing Tooling Hardware.

4: Part Manufacture - Overriding the Spindle Speed and Feedrate



The table vacuum pump switch, emergency stop button, spindle speed and feedrate override potentiometer controls are mounted on the front control panel, located on the right side of the machine cabinet.

Note

Spindle Speed and/or Feedrate override changes will only be registered when an actual spindle speed or feedrate is being applied by the CNC control software.

Spindle Speed and Feedrate Override Controls.

The spindle speed and feedrate of the Microrouter can be manually overridden during a machining operation, using the potentiometer controls fitted on the upper part of the panel illustrated above.

On machines where these controls are not fitted, or disabled, the spindle speed and feedrate must be overriden using the CNC control software (please refer to your separate CNC Control Software User's Manual for details regarding this feature).

The spindle speed can be overridden between 50% and 120%.

The feedrate can be overridden between 0% and 150%.

To increase the spindle speed or feedrate, rotate the appropriate control clockwise.

To decrease the spindle speed or feedrate, rotate the appropriate control anticlockwise.

4: Part Manufacture - Table Vacuum Pump & Emergency Stop

Note

Denford recommends that the vacuum cleaner used for dust extraction should have a minimum power rating of 500 watts.

Cyclonic models, such as the Dyson, are not suitable for use with the dust extraction system.

Table Vacuum Pump Control.

This switch (see photo p30) operates the integrated pump, used with the optional vacuum table, described in Section 6 - Work holding.

Switching the Pump On.

The switch becomes operational when a successful communication link is established between the Microrouter and the CNC machine controller PC. To switch on the vacuum pump, lift the cover and press the square, green, button once.

Switching the Pump Off.

To switch off an operating vacuum pump, lift the cover and press the square, green, button once. Note that a safety feature prevents the pump from being switched off when either the spindle is rotating or the CNC control software is operating in Auto mode (ie, automatically running the loaded CNC program). If you need to switch off the pump in these circumstances, you must stop the spindle and or CNC program, then switch the CNC control software to operate in Jog mode (ie, manual control of the machine).

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.

Pressing the emergency stop button (see photo p30) has the effect of stopping all axes and spindle movements immediately.

To active an emergency stop, press the button in until it clicks. The emergency stop button will remain closed (continuing to cut all power to the machine drives) until the button is released. To release, turn the button clockwise until it springs back out.

5: Performing a Tool Change

Standard Tool Change System.

The tool change system, supplied as standard with the laminate trimmer on your Microrouter, comprises of four elements:

i) The laminate trimmer threaded shaft, bored to allow fitment of the cutting tool and collet assembly.

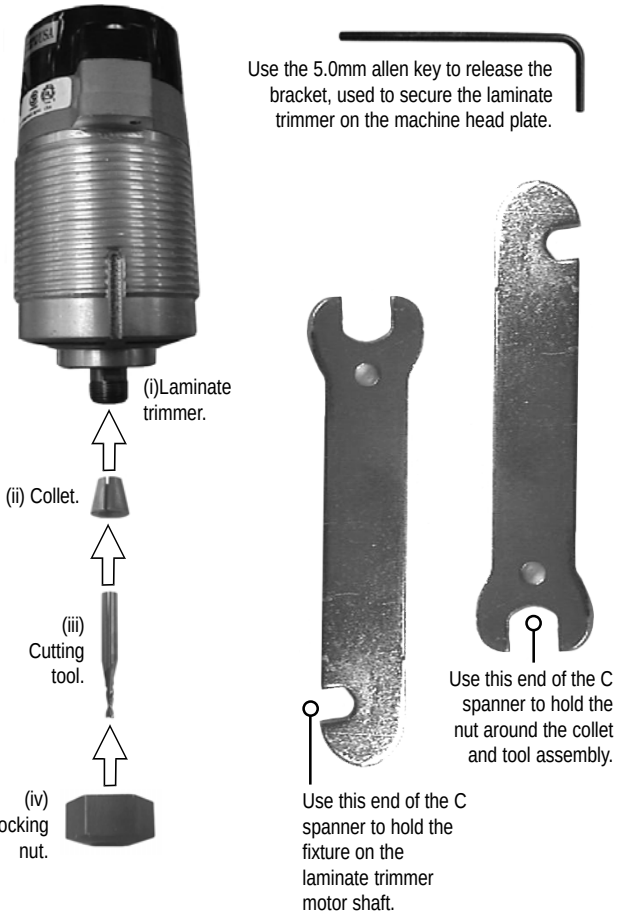
ii) The tapered, tubular, split metal collet, used to hold the cutting tool.

iii) The cutting tool. Your microrouter must only be used with standard 1/4" or 1/8" shank routing bits, capable of running safely at speeds of 26,500RPM.

iv) The locking nut, which threads directly onto the laminate trimmer threaded shaft, securing the cutting tool and collet assembly.

Note

Metric convertor collets are available as optional equipment, to allow fitment of metric tools.



5: Performing a Tool Change

Safety First !

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

Performing a Manually Requested Tool Change.

Before beginning a manual tool change operation, we recommend you home all three machine axes. When all three machine axes are at their home positions, the maximum amount of free space will be available in the working area, allowing easier access to the tool holder and the easy change collar.

Note

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

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

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 home 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.

5: Removing the Laminate Trimmer from the Machine Head

Safety First !

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

The easiest method of performing a tool change is to remove the laminate trimmer from the machine head, since the brush guards mounted around the base of the machine head prevent easy access to the laminate trimmer shaft.

Tools required:

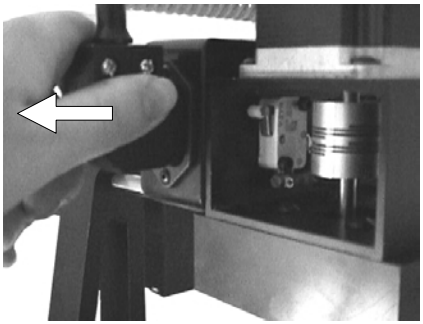
- 5mm allen key (supplied).

Safety First !

Caution.
If the cutting tool has been recently used, it may still be HOT.

To remove the laminate trimmer:

1) Following completion of any machining operations, open the safety guard door. Unplug the laminate trimmer power cable from the fixture at the top of the Z axis slide.

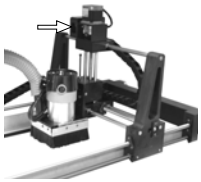


Left: Unplug power cable.

continued...

Location

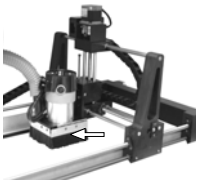
Look at left side of A slideframe assembly.



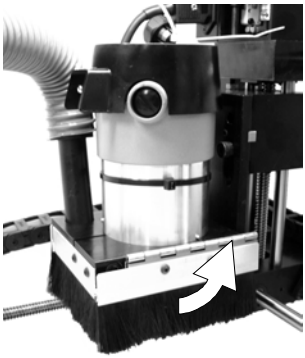
5: Removing the Laminate Trimmer from the Machine Head

Location

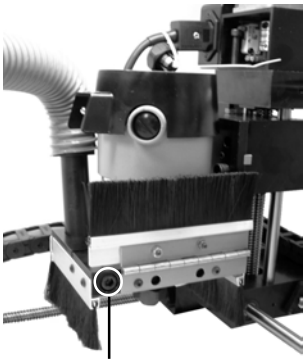
Look at front of machine head.



2) Lift up the front brush guard to gain access to the laminate trimmer clamping bracket allen bolt.



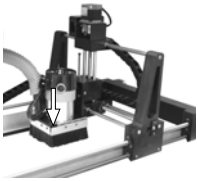
Above: Lift the front brush guard.



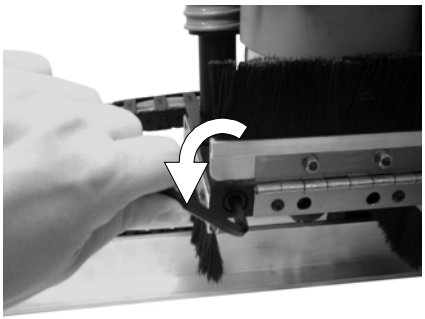
Above: Laminate trimmer clamping bracket allen bolt (circled).

Location

Look at front of machine head.



3) Release the laminate trimmer clamp, using the allen bolt located on the front left side of the clamping bracket. Using a 5mm allen key, loosen the clamping bracket bolt by turning it in an anticlockwise direction.



Left: Turn anticlockwise to release clamp.

4) Remove the laminate trimmer vertically from the clamping bracket, taking care not to hit any cutting tool on any machine fittings. Transfer the laminate trimmer assembly to a suitable workbench to carry out the tool change.

5: Setting Tools in the Laminate Trimmer

Safety First !

Your microrouter must only be used with standard 1/4" or 1/8" shank routing bits, capable of running safely at speeds of 26,500RPM.

Safety First !

Caution.
If the cutting tool has been recently used, it may still be HOT.

The easiest method of performing a tool change is to remove the laminate trimmer from the machine head. Transfer the laminate trimmer to a suitable workbench, where it can be held securely, since changing the tool is a two handed operation.

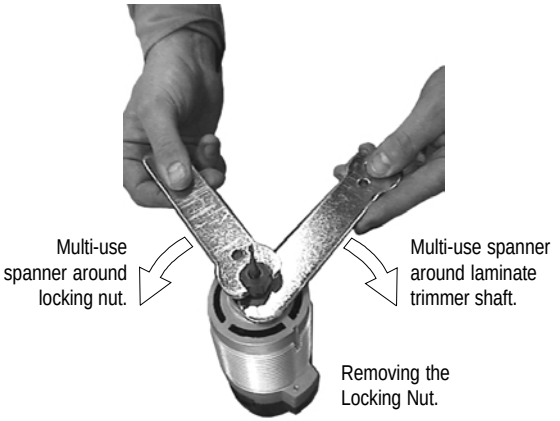
Tools required:

- 2 x Multi-use C Spanner (supplied).

Removing a Tool.

Position the first multi-use spanner around the locking nut on the end of the laminate trimmer shaft (use the conventional spanner end).

Position the second multi-use spanner around the fixture on the spindle motor shaft (use the C segment end). Position this spanner in the opposite direction to prevent the spindle from rotating as the locking nut is released (see below).



Removing the Locking Nut.

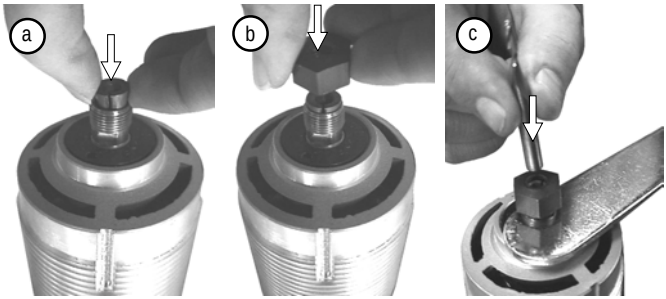
To loosen the locking nut, when directly viewing the end of the laminate trimmer shaft:

- Turn the multi-use spanner around the locking nut in an anticlockwise direction.
- Turn the multi-use spanner around the laminate trimmer shaft in a clockwise direction.

Refitting a Tool.

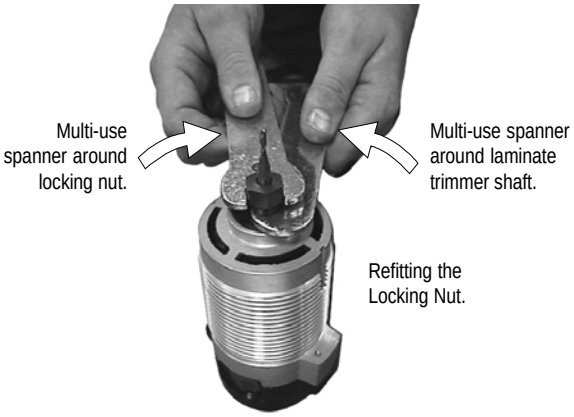
Place the appropriate collet into the end of the laminate trimmer shaft (a). The collet is the tapered, tubular, split metal casing. Hand thread the locking nut back onto the laminate trimmer shaft (b), then place the new cutting tool into this assembly (c). Refer to the diagrams on the next page...

continued...



Position the first multi-use spanner around the locking nut on the end of the laminate trimmer shaft (use the conventional spanner end).

Position the second multi-use spanner around the fixture on the spindle motor shaft (use the C segment end). Position this spanner in the opposite direction to prevent the spindle from rotating as the locking nut is refitted (see below).



To tighten the locking nut, when directly viewing the end of the laminate trimmer shaft:

- Turn the multi-use spanner around the locking nut in a clockwise direction.
- Turn the multi-use spanner around the laminate trimmer shaft in an anticlockwise direction.

Check that the cutting tool is secure before refitting the laminate trimmer to the machine head.

5: Refitting the Laminate Trimmer to the Machine Head

Safety First !

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

Tools required:

- 5mm allen key (supplied).

To refit the laminate trimmer:

1) Check that the clamping bracket hole is loose enough to accept the laminate trimmer body. After fitting the tool, carefully lower the laminate trimmer vertically into the clamping bracket, taking care not to hit any cutting tool on any machine fittings. Check that the laminate trimmer body is pushed fully into the clamping bracket.

Location

Look at front of machine head.

2) If necessary, lift up the front brush guard to gain access to the allen bolt, located on the front left side of the clamping bracket. Using a 5mm allen key, tighten the clamping bracket bolt by turning it in an clockwise direction. Check that the laminate trimmer is held securely.

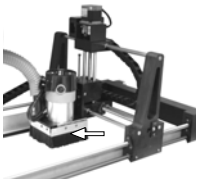
Left: Turn clockwise to tighten clamp.

continued...

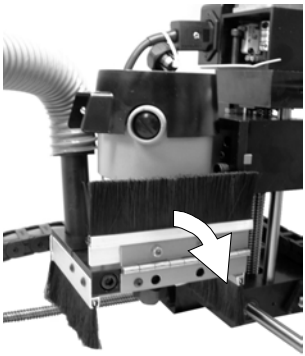
5: Refitting the Laminate Trimmer to the Machine Head

Location

Look at front of machine head.



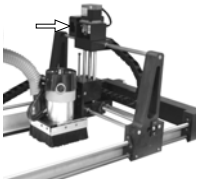
3) Close the front brush guard.



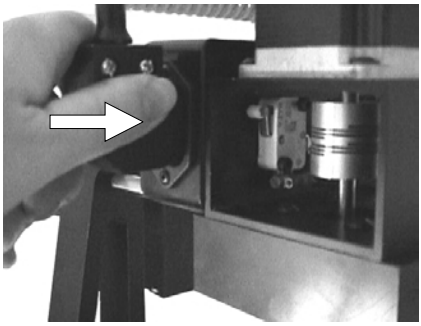
Above: Close the front brush guard.

Location

Look at left side of A slideframe assembly.



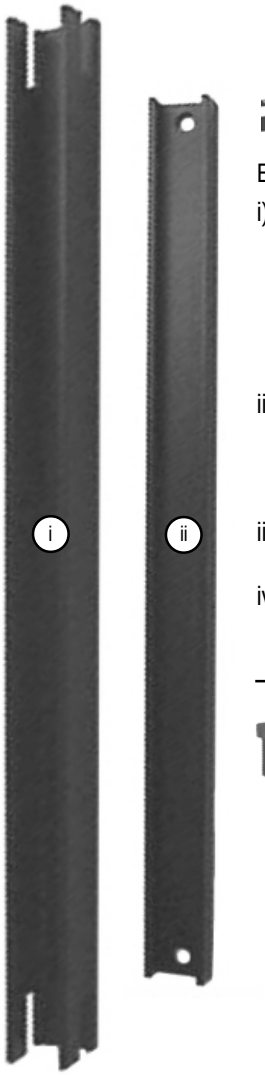
4) Push the laminate trimmer power cable into the socket on the fixture at the top of the Z axis slide. Check that the laminate trimmer power cable will not interfere with any moving part of the machine.

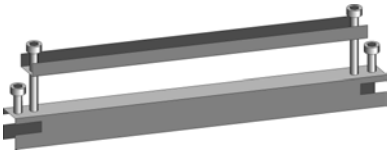


Left: Plug power cable into socket.

6: The Work Holding Clamp Rail Components

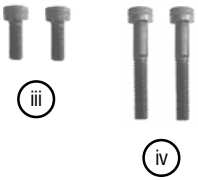
The easiest method of holding large, flat workpieces in the working area of the Microrouter is using a series of work holding clamp rails. Each clamp fits between the front and rear X axis sliderail frames and grips the workpiece in a similar way to a G-clamp or vice. Additional clamps can be fitted between the X axis sliderails to give support to longer or thinner workpieces.





Each clamp rail is constructed from:

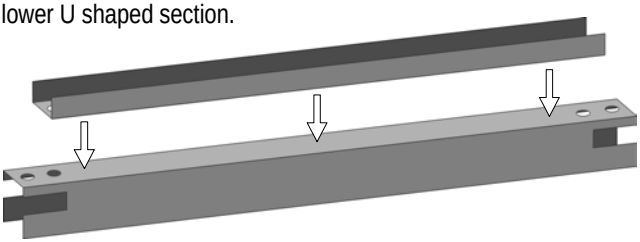
i) One long, deep, U shaped extruded metal section. Each end of this section contains two threaded holes on the flat surface of the channel, together with two slots cut into the channel sides.
ii) One short, shallow, U shaped extruded metal section. Each end of this section contains one hole on the flat surface of the channel.
iii) Two fully threaded M8 allen headed bolts approx. 30mm in length.
iv) Two part threaded M8 allen headed bolts approx. 60mm in length.



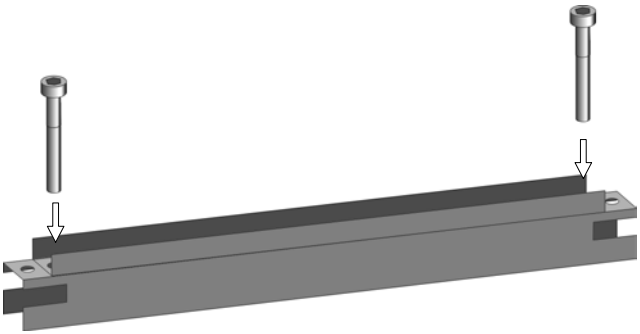
6: Assembling the Work Holding Clamp Rails

To assemble each clamp rail:

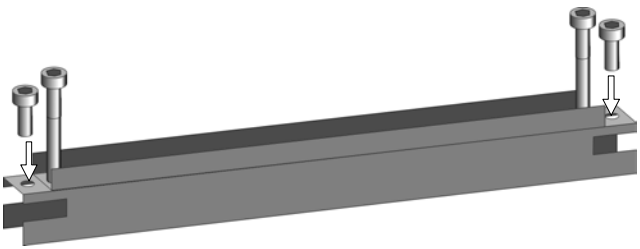
1) Place the long, deep, U shaped section upside down, on a flat workbench, so the bottom of its channel is facing upwards. Place the shorter, shallow, U shaped section on top, so the bottom of its channel is facing down. Position this U shaped section so the single holes at each end align with the inner thread holes of the lower U shaped section.



2) Insert the long part threaded M8 allen headed bolts through the two holes in the upper U shaped section and carefully fit them into the matching threaded holes in the lower U shaped section.



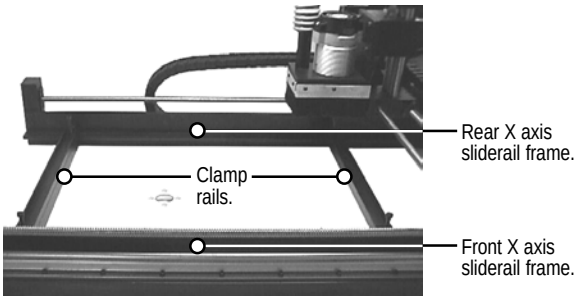
3) Carefully fit the short M8 allen headed bolts into the remaining threaded holes, one at each end of the lower U shaped section.



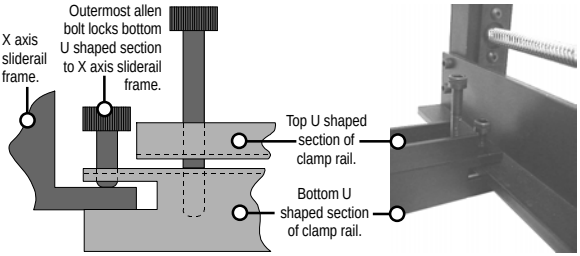
6: Assembling the Work Holding Clamp Rails

To fit the clamp rails in the Microrouter working area:

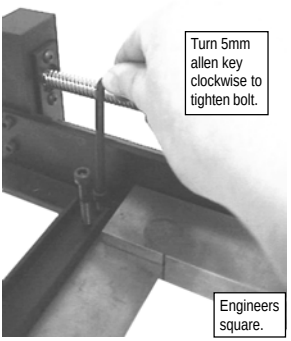
1) Position the clamp rails inside the machine, between the front and rear X axis sliderail frames. Align the clamp rails at right angles to the X axis sliderail frames.



2) Slide the bottom U shaped section of the clamp rail assembly onto both the front and rear X axis sliderail frames, using the two slots cut into the channel ends. Align the clamp rail so the outermost allen bolts are positioned over the X axis sliderail frames.



3) Check the clamp rails lie at right angles to the X axis sliderail frames using an engineers square. Using a 5mm allen key, tighten the outermost allen bolts (turning clockwise, when viewed from above) to lock the bottom U shaped sections to X axis sliderail frame.



6: Using the Work Holding Clamp Rails

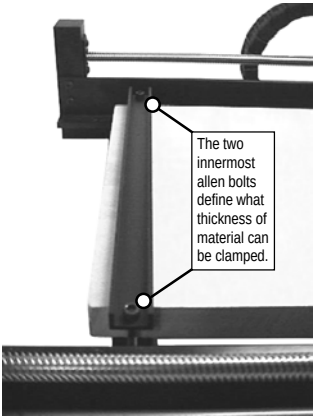
Note

Always use at least 2 clamp rails to clamp the workpiece.

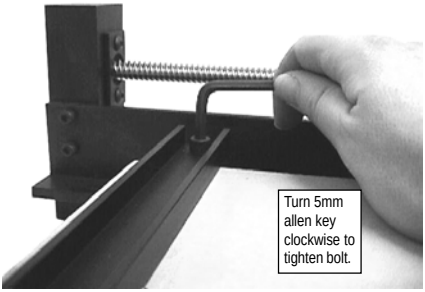
Additional clamps should be used to support longer or thinner workpieces (ensure these clamps are positioned in areas where no machining will occur).

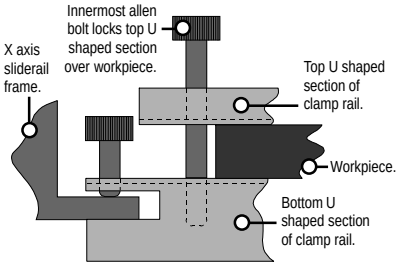
To clamp the workpiece:

1) Adjust the spacing between the upper and lower clamp rails, if necessary, so sufficient areas of the workpiece can be securely clamped. To increase the “gap” between the upper and lower clamp rails, loosen each of the two innermost allen bolts (turning anticlockwise, when viewed from above).



2) Position the workpiece under the top U shaped sections of each clamp rail. Using a 5mm allen key, tighten the innermost allen bolts (turning clockwise, when viewed from above) to lock the top U shaped sections onto the workpiece. Check that the workpiece is secure before commencing any machining operations.

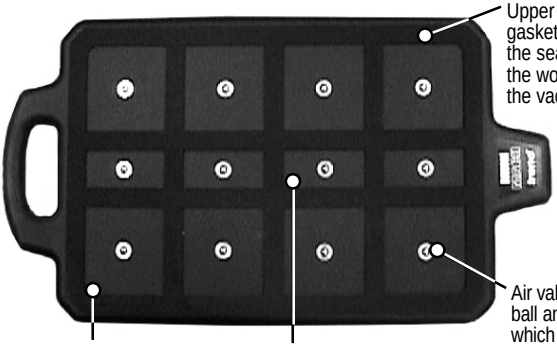




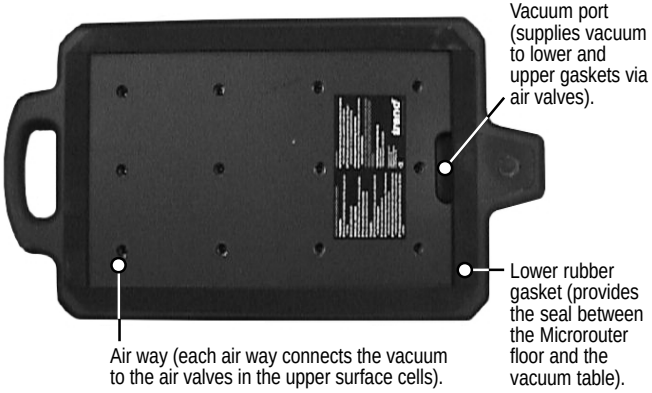
6: The Vacuum Table Components

The vacuum table is a fully assembled, self adjusting, lightweight vacuum clamping bed. The suction required for holding both the workpiece on the vacuum table and the vacuum table in position on the Microrouter floor, is provided by the pump located inside the base of the Microrouter cabinet.

The upper surface of the vacuum table has a rubber gasket surrounding a matrix of cells in two sizes, which when used in combination provide maximum holding area for small of awkward shaped workpieces. Each contains a ball valve in it's centre, connecting each cell to the vacuum.



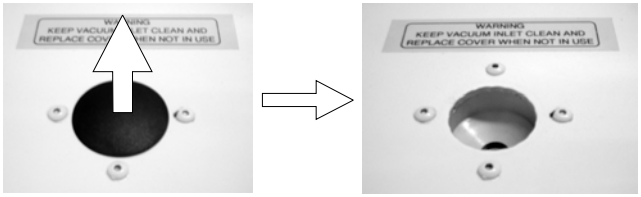
The lower surface of the vacuum table has a rubber gasket surrounding one large vacuum cell, used to clamp the vacuum table in position on the Microrouter floor.



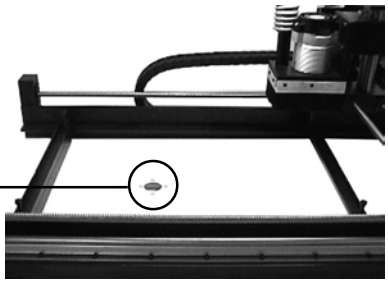
6: Preparing the Microrouter Working Area

Although the vacuum table itself is supplied fully assembled, the Microrouter must be prepared before the vacuum table can be used:

1) Ensure the microrouter floor is clean and free from any dust and debris. This will help ensure a strong vacuum can be created between the rubber gasket on the vacuum table and the Microrouter floor.
2) Using a flat blade, lift and remove the plastic blanking cover from the vacuum inlet hole, located in the centre of the Microrouter floor. Take care not to damage any of the retaining prongs fitted to the underside of the cover, during its removal. Do not leave the plastic cover inside the Microrouter working area - store it safely for refitting after machining has finished.



Remove the plastic cover fitted to the vacuum inlet hole in the centre of the Microrouter working area floor..

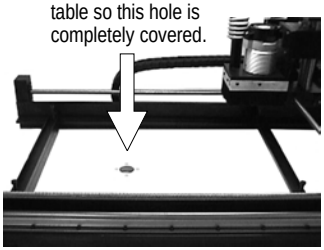


Vacuum inlet hole in Microrouter working area floor.

6: Fitting and Using the Vacuum Table

To operate the vacuum table:

1) Place the vacuum table on the Microrouter floor, with the multiple air valves and cells facing upwards, so the hole in the centre of the Microrouter floor is completely covered.

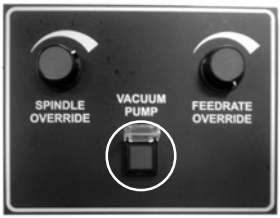


Note

Run the integrated vacuum pump only when using the vacuum table. Denford recommends a maximum continuous running time of 30 minutes, unless demanded otherwise due to the length of the CNC program in use, with a 10 minute break to ensure the optimum life for the vacuum pump motor.

2) The vacuum pump switch is fitted to the front control panel, located on the right side of the Microrouter cabinet. Switch on the vacuum pump by lifting the cover and pressing the square, green, button once.

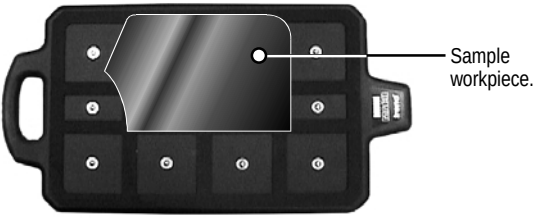
   The switch becomes operational when a successful communication link is established between the Microrouter and the CNC machine controller PC. A vacuum seal will be created between the lower surface of the vacuum table and the Microrouter floor, holding the vacuum table in position.



Left: Vacuum pump switch (circled) on the machine control panel.

continued...

3) Place the workpiece onto the upper surface of the vacuum table, to cover as many complete cells as possible. Push the workpiece down to open the ball valves in each of the covered cells, engaging the vacuum.



4) The vacuum suction will hold the workpiece securely on the vacuum table. Push the side of the workpiece to see if it is held firmly. Do not lift the workpiece, since this will break the vacuum seal. Once the machining operation has been completed, switch off the (running) vacuum pump by lifting the cover and pressing the square, green, button once. This will release both the workpiece and the vacuum table.

   Note that a safety feature prevents the pump from being switched off when either the spindle is rotating or the CNC control software is operating in Auto mode (ie, automatically running the loaded CNC program). If you need to switch off the pump in these circumstances, you must stop the spindle and or CNC program, then switch the CNC control software to operate in Jog mode (ie, manual control of the machine).

Vacuum Table Troubleshooting.

The vacuum table does not grip the Microrouter floor:

- Ensure the floor is clean and free from any dust or debris.
- Check the vacuum pump is functioning correctly, the hoses are not blocked or broken and the exhaust vents are not blocked or covered.
- Check the condition of the vacuum table lower surface rubber gasket.

The vacuum table will not hold the workpiece:

- Check the workpiece covers as many cells as possible.
- Check your workpiece is flat. The vacuum table will not hold rough sawn timber or materials which are seriously cupped or twisted.
- Check that the workpiece is not porous.
- The created vacuum is too weak. Check the performance of the vacuum pump.

7: Maintenance Schedule and Charts

Maintenance Schedule.

Daily	• Clean and remove any swarf. • Check that all the sliderails and leadscrews are lubricated. • Clean the tooling and laminate trimmer (machine head).
Weekly	• Clean the machine. • Check all exposed screws and nuts for tightness. • Lubricate all sliderails and leadscrews.
Biannually	• Check the condition of any electrical connections. • Check and clean tooling collets. • Check all cables for kinks and breaks. • Check the condition of any drive belts. • Clean the 3 axis datum microswitches.
Annually	• Check the slides for wear.

Note

If your CNC machine is used intensively, we recommend that the maintenance tasks listed in the above schedule are performed on a more regular basis.

Lubrication Chart.

Lubrication Point	Lubricating System	Frequency	Recommended Oil	Quantity
Slide ways, Leadscrews & Thrust Bearings.	Aerosol spray can	As required	Silicone based lubricant	As required

Note

The laminate trimmer motor has been lubricated with a sufficient amount of high grade lubricant for the life of the unit under normal operating conditions. No further lubrication is necessary.
Never use light machine oil, in place of the recommended silicone based spray, for machine lubrication. Always read the instructions supplied with any silicone based lubricant before use. Never use silicone based lubricant on any other type of machine unless specifically stated.

7: General Work Area Cleaning

Safety First !

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

Safety First !

Caution.

If the cutting tool has been recently used, it may still be HOT.

Safety First!

Warning.

The silicone lubricant aerosol is extremely flammable. Never use the silicone lubricant aerosol near a naked flame, on any other machine, or for any other purpose. Carefully read and follow any instructions or notices included with the aerosol. Wear safety glasses and a suitable respiratory mask when using the aerosol.

Vacuum the inside of the enclosure after each piece of work. In particular, ensure the build up of dust and debris in the following areas is prevented:

- The two X axis leadscrews, running longitudinal to the front edge of the machine casing.
- The single Y axis leadscrew, running transverse to the front edge of the machine casing.
- The single Z axis leadscrew, between the upper and lower box sections.
- The two horizontal supported sliderails on the X axis, running longitudinal to the front edge of the machine casing.
- The three supported sliderails, between the A frame assemblies, on the Y axis, running transverse to the front edge of the machine casing.
- The two vertical supported sliderails on the Z axis, between the upper and lower box sections.
- The X axis thrust bearing coupling and microswitch, in the casing at the right end of the rear X axis leadscrew.
- The Y axis thrust bearing coupling and microswitch, in the casing at the back of the Y axis leadscrew.
- The Z axis thrust bearing coupling and microswitch, in the casing at the top of the vertical Z axis leadscrew.

The photo at the base of the next page labels each area which requires cleaning. Please note that items requiring attention are encased in the machine cabinet. For illustration purposes, the photo shows a view of the working area without the machine cabinet.

7: Lubrication Areas on the Microrouter

Safety First!

Warning.

The silicone lubricant aerosol is extremely flammable. Never use the silicone lubricant aerosol near a naked flame, on any other machine, or for any other purpose. Carefully read and follow any instructions or notices included with the aerosol. Wear safety glasses and a suitable respiratory mask when using the aerosol.

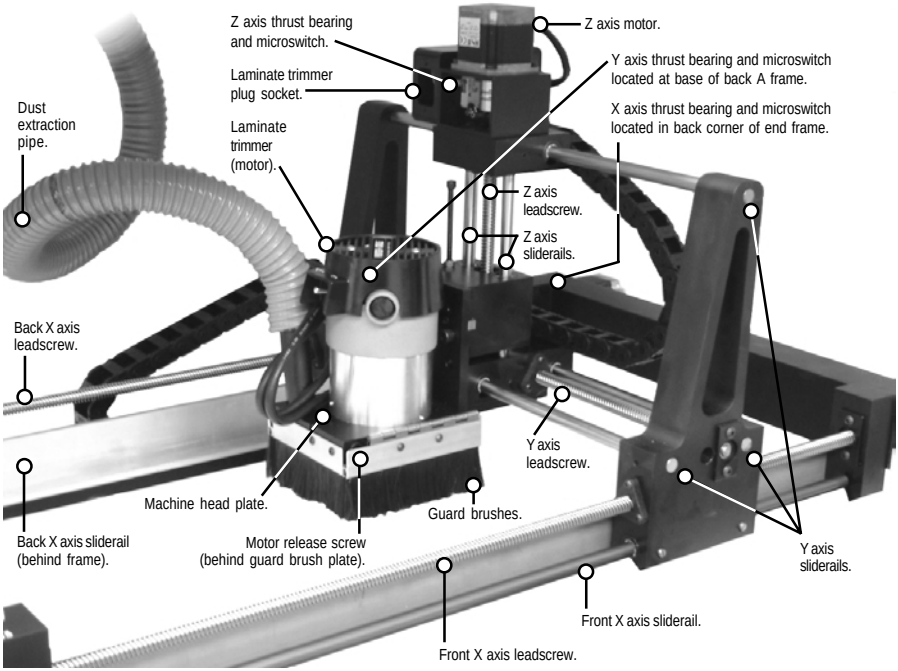
The following items should be lubricated daily, using a silicone based aerosol spray (DO NOT use light machine oil for this purpose):

- All sliderails (as listed on the previous page).
- All leadscrews (as listed on the previous page).

Note

Microrouter thrust bearings are sealed units that require no additional lubrication by the user.

The photo below labels each area which requires lubrication or cleaning. Please note that items requiring attention are encased in the machine cabinet. For illustration purposes, the photo shows a view of the working area without the machine cabinet.



7: Lubrication of Leadscrews

X Axis Leadscrew Lubrication.

The X axis has two leadscrews, fitted to the front and rear slideframe assemblies. The first leadscrew is visible on the front slideframe assembly. The second leadscrew is located at the back of the machine cabinet, partially hidden from view by the panel on the slideframe assembly.

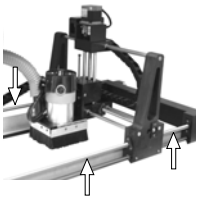
Run the machine head fully to the right, to gain access to the left end of both leadscrews. Spray lubrication directly onto the exposed surfaces of the leadscrews.

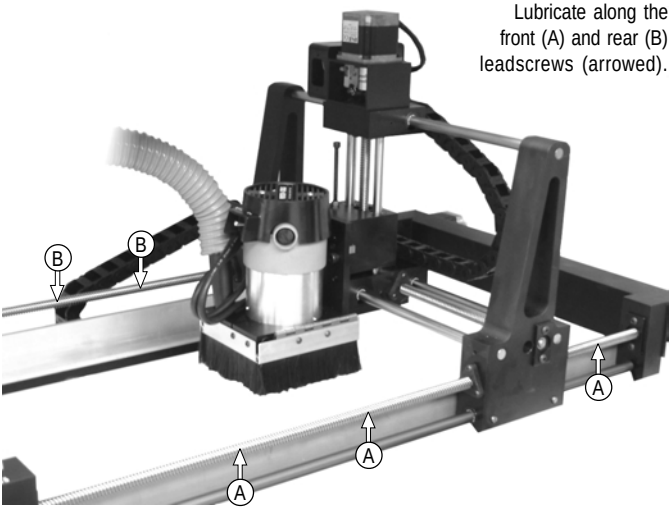
Run the machine head fully to the left, to gain access to the opposite end of the leadscrews. Spray lubrication directly onto the remaining surfaces of the leadscrews.

Finally, run the machine head left and right along the X axis, to distribute lubrication along the full length of the leadscrews.

Location

Look at front and rear slideframe assemblies.





Lubricate along the front (A) and rear (B) leadscrews (arrowed).

7: Lubrication of Leadscrews

Y Axis Leadscrew Lubrication.

The Y axis has one leadscrew, fitted between the bases of the front and rear A slideframe assemblies. Do not confuse the leadscrew with the two sliderails, which also lie along the same plane.

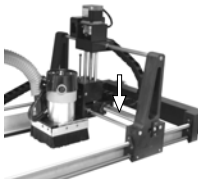
Run the machine head fully to the back, to gain access to the front end of the leadscrew. Spray lubrication directly onto the exposed surface of the leadscrew.

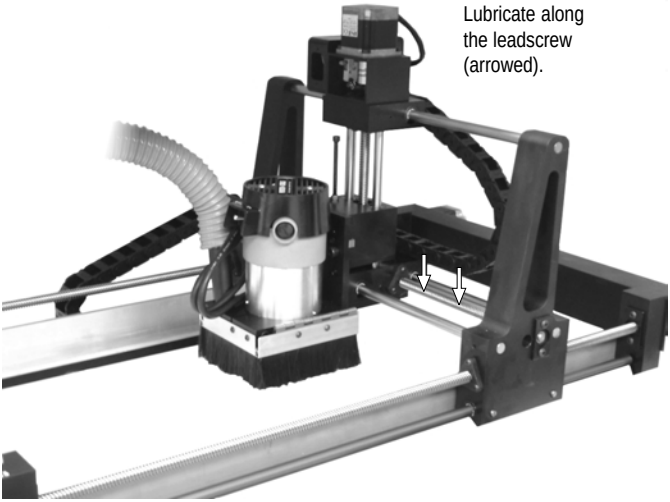
Run the machine head fully to the front, to gain access to the opposite end of the leadscrew. Spray lubrication directly onto the remaining surface of the leadscrew.

Finally, run the machine head forwards and backwards along the Y axis, to distribute lubrication along the full length of the leadscrew.

Location

Look between A slideframe assemblies.





Lubricate along the leadscrew (arrowed).

7: Lubrication of Leadscrews

Z Axis Leadscrew Lubrication.

The Z axis has one leadscrew, fitted between the upper and lower slideframe assemblies. Do not confuse the leadscrew with the two sliderails, which also lie along the same plane.

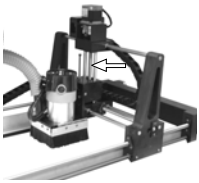
Run the machine head up fully, to gain access to the bottom end of the leadscrew. Spray lubrication directly onto the exposed surface of the leadscrew.

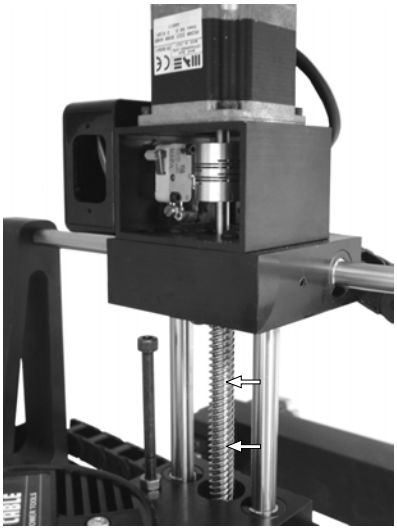
Run the machine head down fully, to gain access to the opposite end of the leadscrew. Spray lubrication directly onto the remaining surface of the leadscrew.

Finally, run the machine head up and down along the Z axis, to distribute lubrication along the full length of the leadscrew.

Location

Look between upper and lower slideframe assemblies.





Lubricate along the leadscrew (arrowed).

7: Lubrication of Sliderails

X Axis Sliderail Lubrication.

The X axis has two sliderails, fitted to the front and rear slideframe assemblies. Both sliderails are located directly under and running parallel to the leadscrews. The first sliderail is visible on the front slideframe assembly. The second sliderail is located at the back of the machine cabinet, partially hidden from view by the panel on the slideframe assembly.

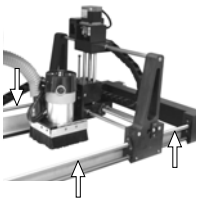
Run the machine head fully to the right, to gain access to the left end of both sliderails. Spray lubrication directly onto the exposed surfaces of the sliderails.

Run the machine head fully to the left, to gain access to the opposite end of the sliderails. Spray lubrication directly onto the remaining surfaces of the sliderails.

Finally, run the machine head left and right along the X axis, to distribute lubrication along the full length of the sliderails.

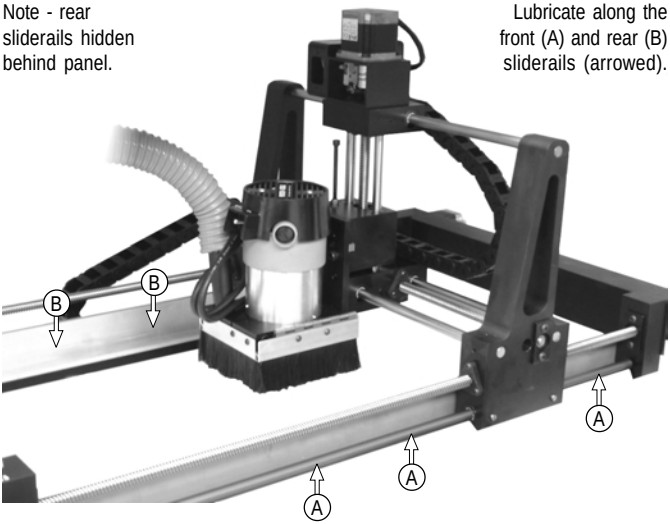
Location

Look at front and rear slideframe assemblies.



Note - rear sliderails hidden behind panel.

Lubricate along the front (A) and rear (B) sliderails (arrowed).



7: Lubrication of Sliderails

Y Axis Sliderail Lubrication.

The Y axis has three sliderails, fitted between the bases of the front and rear A slideframe assemblies. One sliderail is located at the top of the A slideframe assembly. The two remaining sliderails are located at the base of the A slideframe assembly, either side of the leadscrew, running parallel with the leadscrew in the same plane.

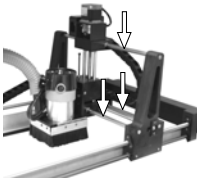
Run the machine head fully to the back, to gain access to the front end of the sliderails. Spray lubrication directly onto the exposed surface of the sliderails.

Run the machine head fully to the front, to gain access to the opposite end of the sliderails. Spray lubrication directly onto the remaining surface of the sliderails.

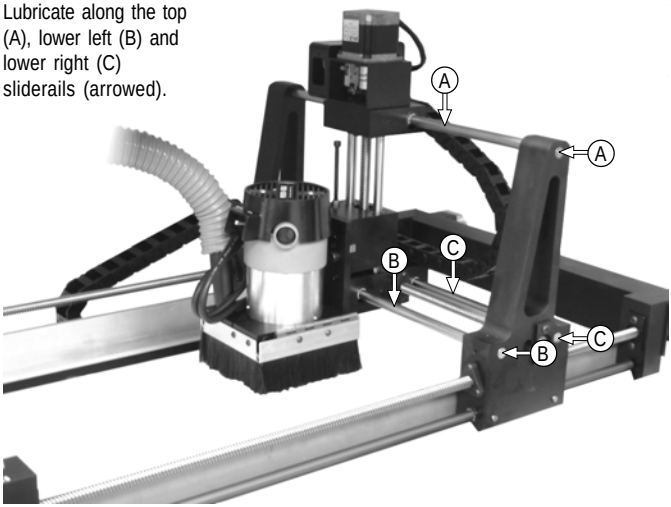
Finally, run the machine head forwards and backwards along the Y axis, to distribute lubrication along the full length of the sliderails.

Location

Look between A slideframe assemblies.



Lubricate along the top (A), lower left (B) and lower right (C) sliderails (arrowed).



7: Lubrication of Sliderails

Z Axis Sliderail Lubrication.

The Z axis has two sliderails, fitted between the upper and lower slideframe assemblies. The sliderails are located either side of the leadscrew, running parallel with the leadscrew in the same plane.

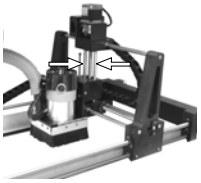
Run the machine head up fully, to gain access to the bottom end of the sliderails. Spray lubrication directly onto the exposed surface of the sliderails.

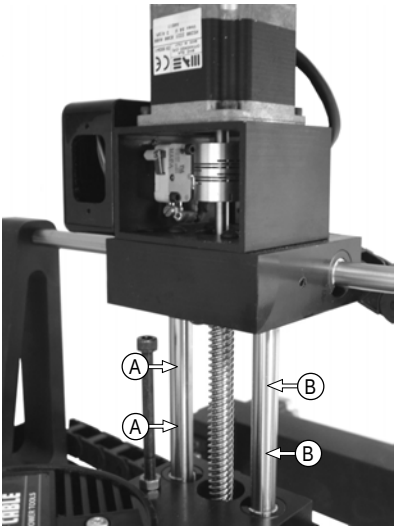
Run the machine head down fully, to gain access to the opposite end of the sliderails. Spray lubrication directly onto the remaining surface of the sliderails.

Finally, run the machine head up and down along the Z axis, to distribute lubrication along the full length of the sliderails.

Location

Look between upper and lower slideframe assemblies.





Lubricate along the left (A) and right (B) sliderails (arrowed).

7: Cleaning the Thrust Bearing Couplings

X Axis Thrust Bearing Coupling.

Location

Look at right end of rear slideframe assembly.

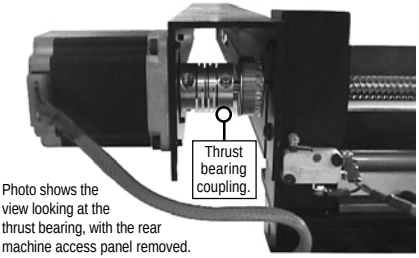


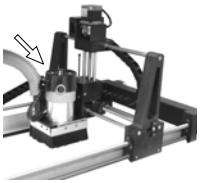
Photo shows the view looking at the thrust bearing, with the rear machine access panel removed.

Using a soft bristled brush, carefully clean dust and debris away from the thrust bearing coupling, to an area where it can be removed using a vacuum cleaner. Pay particular attention to debris that may have built up in the numerous coupling slots and any shaft holes.

Y Axis Thrust Bearing Coupling.

Location

Look behind rear A slideframe assembly.



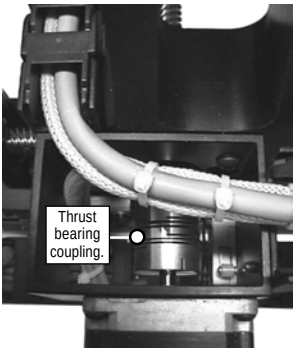


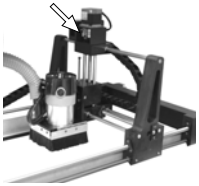
Photo shows the view looking directly down onto the thrust bearing, with the rear machine access panel removed.

Using a soft bristled brush, carefully clean dust and debris away from the thrust bearing coupling, to an area where it can be removed using a vacuum cleaner. Pay particular attention to debris that may have built up in the numerous coupling slots and any shaft holes.

Z Axis Thrust Bearing Coupling.

Location

Look inside upper slideframe assembly.



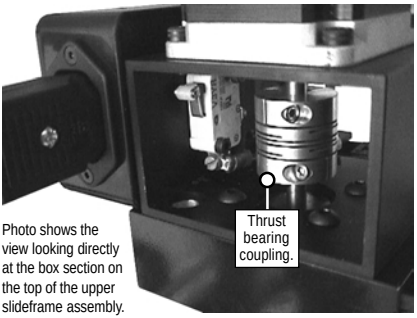


Photo shows the view looking directly at the box section on the top of the upper slideframe assembly.

Using a soft bristled brush, carefully clean dust and debris away from the thrust bearing coupling, to an area where it can be removed using a vacuum cleaner. Pay particular attention to debris that may have built up in the numerous coupling slots and any shaft holes.

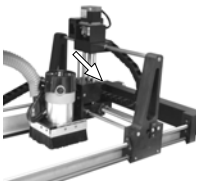
7: Cleaning the Datum Microswitches

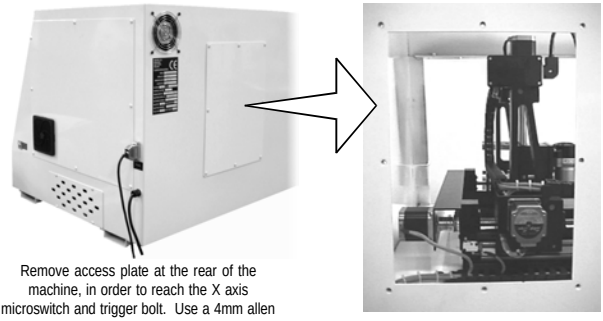
X Axis Datum Microswitch.

The microswitch defining the X axis datum is positioned on the right end of the rear X axis slideframe assembly, when viewed from the front of the machine. The microswitch itself is hidden from view by the extruded metal section, used to cover the drivebelt that connects the front and rear X axis leadscrews. In order to reach the X axis microswitch and trigger bolt, you must remove the access panel at the rear of the machine (see photo below).

Location

Look at right end of rear slideframe assembly.

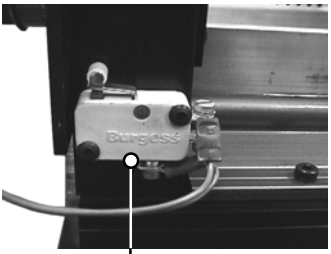




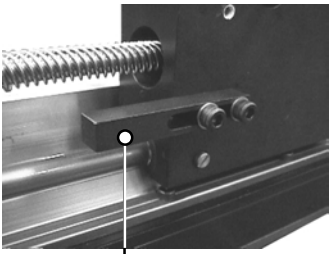
Remove access plate at the rear of the machine, in order to reach the X axis microswitch and trigger bolt. Use a 4mm allen (hex) key to remove the eight secxuring bolts.

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.

If the microswitch is being cleaned with the X axis at its datum position, take care not to disturb the position of the trigger bolt attached to the rear A frame assembly.



X axis microswitch.



X axis trigger bolt.

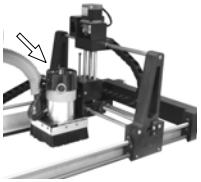
7: Cleaning the Datum Microswitches

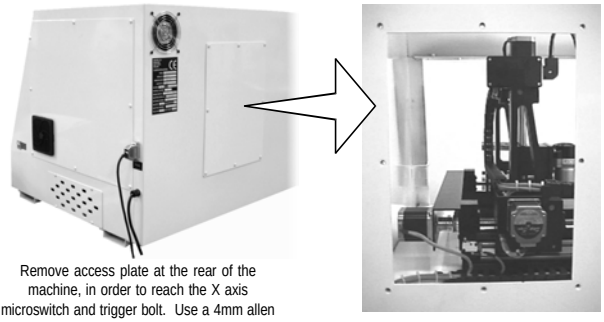
Y Axis Datum Microswitch.

The microswitch defining the Y axis datum is positioned at the base of the rear Y axis A slideframe assembly, when viewed from the front of the machine. The microswitch itself is hidden from view by the A frame itself. In order to reach the Y axis microswitch, you must remove the access panel at the rear of the machine (see photo below).

Location

Look behind rear A slideframe assembly.

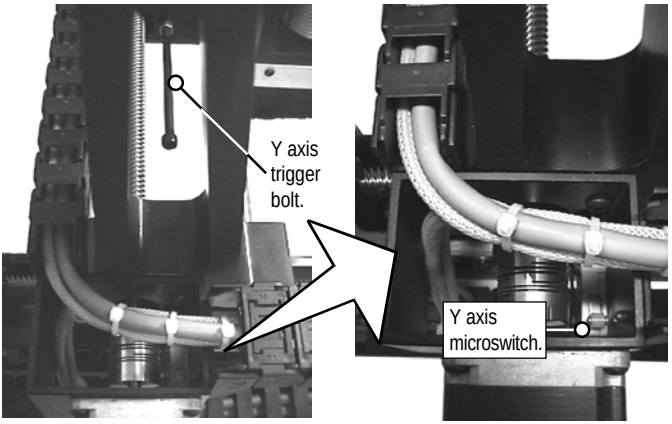




Remove access plate at the rear of the machine, in order to reach the X axis microswitch and trigger bolt. Use a 4mm allen (hex) key to remove the eight secxuring bolts.

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.

If the microswitch is being cleaned with the Y axis at its datum position, take care not to disturb the position of the trigger bolt attached to the rear of the machine head assembly.



7: Cleaning the Datum Microswitches

Z Axis Datum Microswitch.

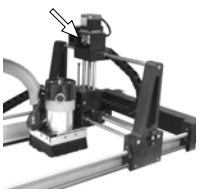
The microswitch defining the Z axis datum is positioned inside the box section, on the top of the upper slideframe assembly.

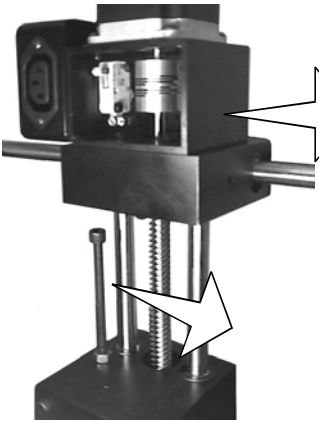
Using a soft bristled brush, carefully clean dust and debris away from the microswitch, to an area where it can be removed using a vacuum cleaner.

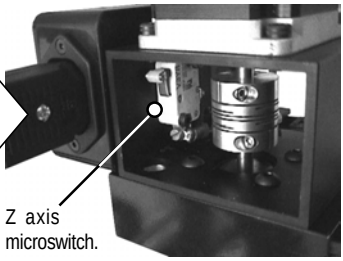
If the microswitch is being cleaned with the Z axis at its datum position, take care not to disturb the trigger bolt on the top of the machine head casing.

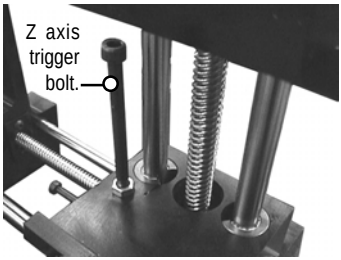
Location

Look inside upper slideframe assembly.









7: Laminate Trimmer Maintenance

Safety First !

Caution.

Wear safety glasses and a suitable respiratory mask whilst cleaning.

If the cutting tool has been recently used, it may still be HOT.

Daily.

Unplug the power lead from the laminate trimmer motor, at the junction on the upper slideframe box section. Open the clamp on the machine head, using a 5mm allen key, then remove the laminate trimmer to a suitable workbench for cleaning and inspection (see section 5 - Preparing Tooling Hardware, for further details on removing and replacing the laminate trimmer).

Carefully remove any dust and debris from all air passages, using a vacuum cleaner. DO NOT use compressed air for this purpose. Pay particular attention to any dust or debris that may have been drawn into the motor. Remove any buildup of grime resulting from working with green or sappy timber. This practice with extend the life of your motor and its brushes.

Failure to Start.

Should the motor fail to start, check that the prongs on the mains power cord plug are making good contact inside the outlet. Check for any blown fuses, replace them and recitify the cause.

Lubrication.

The laminate trimmer motor has been lubricated with a sufficient amount of high grade lubricant for the life of the unit under normal operating conditions. No further lubrication is necessary.

Brush Inspection.

At approximately 100 hours of use, Denford recommends you take or send your motor to your nearest authorised laminate trimmer service station or Denford agent to be thoroughly cleaned and inspected; worn parts replaced, where necessary; relubricated with fresh lubricant, if required; reassembled with new brushes; and performance tested.

Any loss of power before the above maintenance check may indicate the need for immediate servicing of your laminate trimmer. Do not continue to operate the laminate trimmer under these conditions.

8: Accessing the Electrical Panel

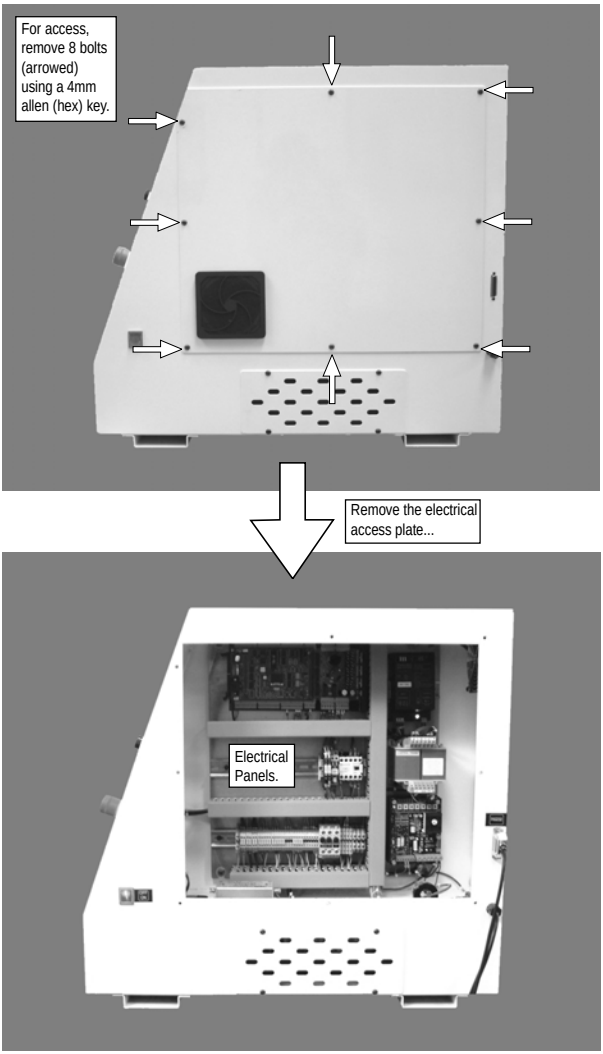
Warning

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 access plate.

The Microrouter electronics are located in the right end of the machine. Using a 4mm allen (hex) key, remove the eight bolts, then withdraw the cover plate, to gain access to the electrical panel, as shown below.



8: Layout of the Electrical Panel

Note

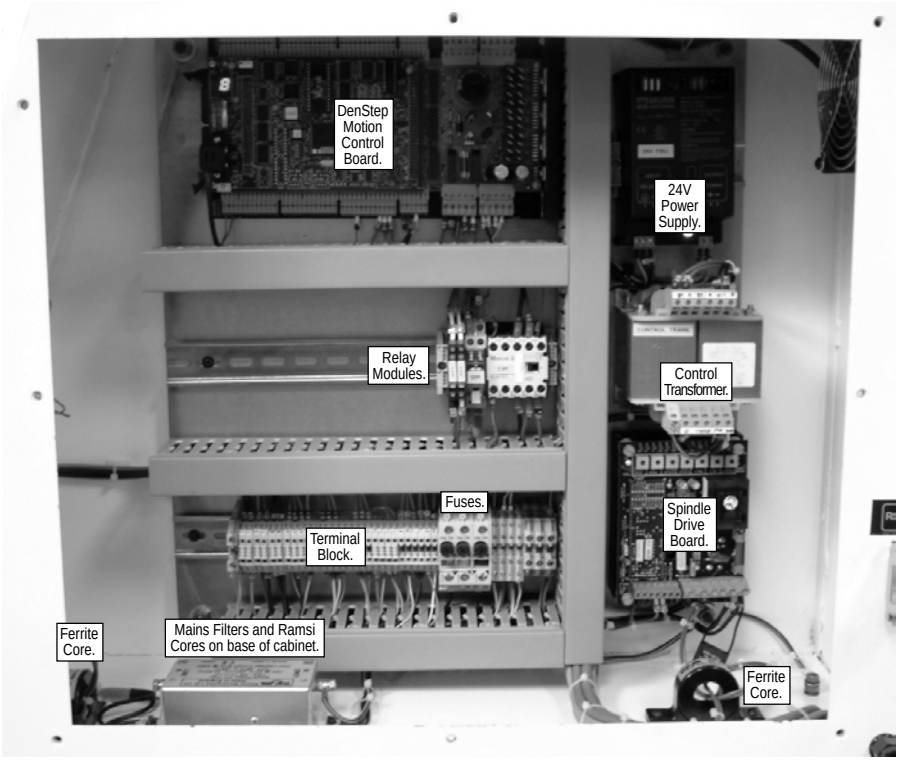
The Electrical Diagrams for your Microrouter are not included in this manual - they are delivered separately in the standard equipment box supplied with your machine. Further electrical schematics are available on request.

The photo below labels all important areas on the Microrouter electrical panel.

Please note that the layout of your electrical panel may differ from the photo, depending on components and options fitted to your Microrouter.

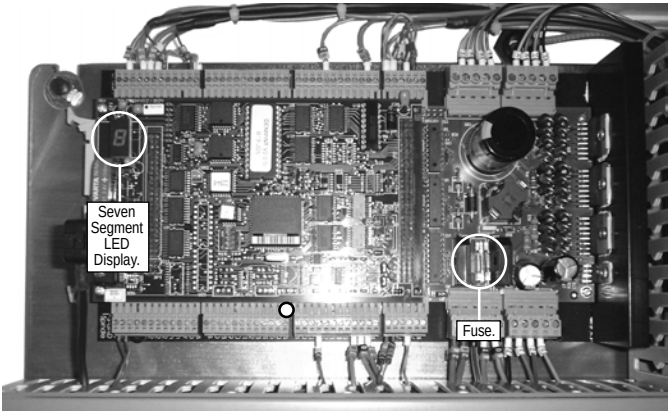
Before commencing any work, refer to the schematic diagram of the electrical panel, delivered separately in the standard equipment box supplied with your machine.

Microrouter Electrical Panel Layout.



8: The DenStep Motion Control Board

The DenStep motion control board is mounted in the top left-hand corner of the electrical panel. It controls the motors that drive the three CNC machine axes.



LED Status and Fault Display.

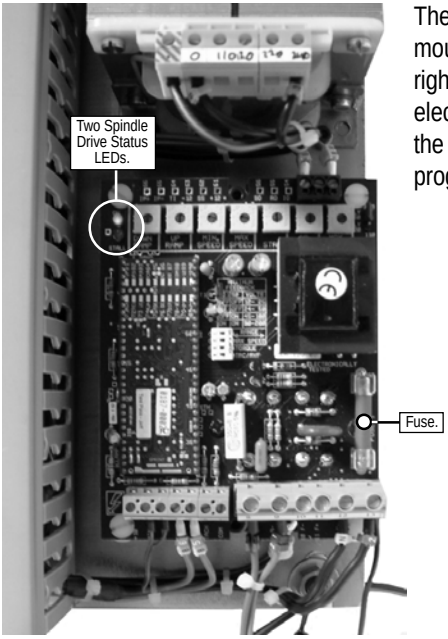
The LED display is mounted on the left side of the DenStep motion control board.

Display.	Meaning.
0	No comms board address fault.
-	Servo power off.
8	Servo power up and idle.
c	Cam profiling (subscript symbol).
C	Cam table (superscript symbol).
C	Circular interpolation.
E	Encoder following mode.
F	Flying shear (static symbol).
H	Homing (datuming).
J	Jogging (velocity) mode.
o	Offset mode.
P	Linear positional mode.
q	Torque control mode.
S	Stop asserted.
U	Pulse following mode.

Errors are all shown with a flashing dot.

Display.	Meaning.
E	External error.
E	Software abort or interpreter error.
F	Maximum servo following error exceeded.
L	Limit switch open.

8: The Spindle Drive Board



The spindle drive board, mounted in the bottom right-hand corner of the electrical panel, controls the motor for the programmable spindle.

Spindle Drive LED Status.

The two spindle drive status LEDs are mounted in the top left-hand corner of the spindle drive board.

Display.	**Meaning.**
ON LED	Spindle drive board operational. If this is not lit, check the spindle drive board fuse (shown in the diagram above) then the fuse labelled F1 on the main fuse rack (see the general layout photo on page 63).
STALL LED	Motor stall. This indicates a faulty motor or component on the spindle drive board.

9: 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 FAQ section on our website.

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 / company name.
- The CNC machine control software name and version number.
- 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.

Contact Details:

Denford Limited,

Birds Royd, Brighouse, West Yorkshire, HD6 1NB, UK.

Telephone: 01484 712264

Fax: 01484 722160

ISDN: 01484401157:01484401161

E-mail: service@denford.co.uk

Technical Support: Monday to Friday 8.30am - 4.30pm GMT

For USA please contact:

Denford Inc.

815 West Liberty Street, Medina, Ohio 44256, USA.

Telephone: 330 7253497

Fax: 330 7253297

E-mail: service@denford.com

Technical Support: Monday to Friday 8.30am - 4.30pm Eastern

Internet

http://www.denford.com

9: Troubleshooting

Note

Your screen may display the message "Error 50 Mint 3.28 Disconnect" (or similar, depending on the hardware fitted).

VR CNC Milling Software Communications Troubleshooting:

1) Your computer communicates with your Microrouter using an RS232 serial cable. Check the RS232 cable is securely plugged into a valid COM port on the computer. Note that COM ports are sometimes labelled as serial ports. Identify whether the COM port being used is labelled as COM1 or COM2. The opposite end of this cable is securely plugged into the RS232 port located on the right end panel of the Microrouter cabinet.
2) Check all mains power connections are correctly fitted and secure. Power up the Microrouter, using the square, red, on/off switch, located on the right end panel of the Microrouter cabinet. The switch illuminates when power is being supplied to the machine. If no power is present, switch off the mains supply, then wait at least 5 minutes before removing the electrical access plate. Check the condition of the on/off switch and fuses. For more information, refer to Section 8 - Machine Electronics.

Note

The password used to access the "Machine Properties" window can be changed by the user. Remember that the default password listed here will not be recognised if you have changed it.
If you change any passwords, we recommend you make a note of them in the Notes section in this manual.

3) Start the VR CNC Milling software. From the main menubar at the top of the VR CNC Milling software screen, click “Setup | Setup Machine Parameters”. You may be required to enter a password. The default password is “denny”. Type the password and click [OK]. The "Machine Properties" window will open. You can configure the type (name) of CNC machine attached to your pc and any COM port settings from this window.
4) The “Machine Properties” window will open with the name of the current (active) machine highlighted and its listing expanded. Note that there are a number of Microrouter versions to choose from. The active machine name in the software must match the name and version of your CNC machine - this information is printed on the CE identification panel, usually applied to the back panel of the Microrouter cabinet.

   For example, if “Microrouter Version 3” is printed on your CE identification panel, the VR CNC Milling software must have “RouterV3” set as the active machine. If the correct machine name is NOT listed as the active machine, right click over the required machine name title to display a pop-up menu. Click “Make Active”, then click [OK] and restart the VR CNC Milling software. Re-open the "Machine Properties" window to check that the changes have been applied.

VR CNC Milling Software Communications Troubleshooting continued...

5) In the “Machine Properties” window, click the “Communications” property title. Change the “COM Port” setting to match the number of the COM port being used by your pc. Note that the hardware resources (IRQ. etc.) are those specified in the Windows Control Panel. The “Baudrate” must be set to read “19200”. Baudrate is the speed at which data can be transferred through your COM ports. The “Stop Bits” must be set to read “2”. Stop Bits are the data signals sent after each data character has been transferred. Click the [OK] button to save and apply any changes made to the property listings.

6) Check the LED display status on your Microrouter control card (The Denstep Motion Control Board). The control card is the main electrical board in the Microrouter, located in the top left corner of the electrical panel. For more information, refer to Section 8 - Machine Electronics. A problem with this card can cause problems with communications. Look for the LED display mounted on the main control card. A blinking dot with an L or the number 8 should be shown. If the LED is not lit, check the control board fuse. If no display continues to be shown, call Denford Customer Services for assistance.

7) Check the COM port on your pc is functioning correctly. Consult your IT person or Computer Support Centre for help with these issues. Check the COM port settings in Windows by accessing the Device Manager. Check the com ports enabled and labelled properly in the computer BIOS. Check the physical COM port itself functional. For example, Windows and the BIOS may show that the COM ports are fine, but the port is not seen by any external devices.

8) When all else fails....

   a) Thoroughly check the condition of the RS232 cable. If the cable is bad, communication will not occur.

   b) Try using a different pc to connect to the CNC machine.

   c) Check for support on the Denford website (www.denford.com).

The part is being cut at an incorrect depth :

Check the validity of the following:

1) The Z value entered in the tool length offset.
2) The Z value entered in the workpiece offset file.
3) The number (size) used for defining the depth of cut used in your CNC program.
4) The sign (+ or -) used for defining the depth of cut used in your CNC program. If your workpiece datum is aligned with the upper surface of your billet, any Z values cutting into this billet will have a minus sign.

The machine begins cutting the part at the wrong location :

Check the X and Y values entered in the workpiece offset file.

Incorrect registration of tool offsets, when using multiple tools of the same diameter :

All tool offset data is saved in the tooling library according to the tool diameter, rather than the tool number used with the machine. This can present problems when you wish to use two or more tools of different lengths but identical tool diameters, for example, a 4mm roughing tool and a 4mm finishing tool. Only one tool offset can be registered, since the standard tooling library only contains one 4mm tool. In this example, separate entries must be created in the tooling library for both the 4mm roughing and finishing tools, then each tool added to the machine tooling window, to allow separate tool offset values to be registered.

Failure of the laminate trimmer motor to start :

Should the laminate trimmer motor fail to start, check that the prongs on the mains power cord plug are making good contact inside the outlet. Also, check for blown fuses or indications within your control software.

10: Specification of Microrouter CNC machine

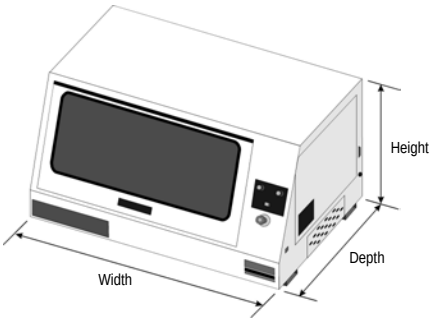
Standard Equipment:
- Microrouter CNC machine.
- Quick release interchangeable laminate trimmer.
- CNC machine control operating software.
- Installation, maintenance and instruction manuals.
- Set of maintenance tools and spare parts list.
- Machine commissioning and basic instruction.
- Worklight.
- Dust collection system (vacuum not included).
- Machine operation training (UK Only).

Extra Equipment:
- CAD/CAM software and manuals.
- Desk-top tutor and programming software.
- Courseware and project books.
- Various tooling packages.
- Training packages.
- Additional offline programming software.
- Machine work bench.
- Video conferencing system.
- PC & PC workstation.
- Vacuum table.
- Vacuum for dust collection.
- Additional work holding systems.

Safety Features:
- Manual operation, totally enclosed, interlocked, safety guard door.
- Emergency stop button.
- Toolpath graphics to verify part programs prior to machining.
- Automatic tool retraction & spindle stop for tool changing.

Mechanical Details:
- Accepts A3 sized material.
- Travel X axis 550mm (21 1/2”).
- Travel Y axis 270mm (10 1/2”).
- Travel Z axis 80mm (3 1/4”).

Dimensions:
- Total Machine width 1356mm (54 3/8”).
- Machine height 700mm (27 1/2”).
- Machine depth 745mm (29 3/8”).



Weights:
- Machine weight 150 KG (330 lb).

Electrical Details:
- Mains supply required:
  220/240Volts, 50Hz, 8Amps.
  110/115Volts, 60Hz, 15Amps.
- Spindle motor: 1.1kW, 1.5HP, 2.0 AMP.
- Spindle Speeds: 0 - 23,500RPM.
- Axis stepper motors: 200 steps/rev.

Performance:
- Rapid traverse rate up to 5000mm/min (197in./min).
- 3D profiling up to 2250mm/min (88in./min).

10: What is a Part Program?

A Part Program is a list of coded instructions which describes how the designed part, or component, will be manufactured. The part program is also called the CNC File.

These coded instructions are called data - a series of letters and numbers. The part program includes all the geometrical and technological data to perform the required machine functions and movements to manufacture the part.

The part program can be further broken down into separate lines of data, each line describing a particular set of machining operations. These lines, which run in sequence, are called blocks.

A block of data contains words, sometimes called codes. Each word refers to a specific cutting/movement command or machine function. The programming language recognised by the CNC, the machine controller, is an International Standards Organisation code, which includes the G and M code groups.

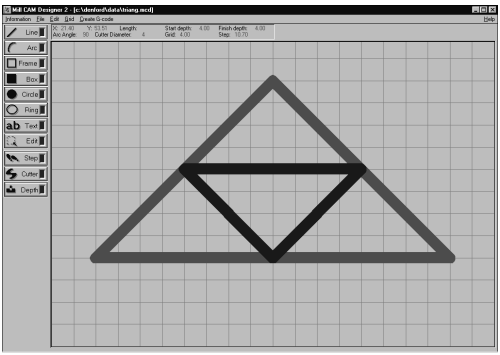
Each program word is composed from a letter, called the address, along with a number.

These terms are illustrated on the following pages.

10: Composition of a Part Program

A component is designed using a CAD/CAM software package, such as Mill CAM Designer.

The CAD/CAM software package automatically generates the part program, including all the G and M codes required to manufacture the component.



Part Program example -

(Mill CAM Designer - triang.MCD)
(3/3/1997)
(metric)
(Post fanucm:1.2Ø 24 June 1994)
G21
[BILLET X8Ø Y55 Z1Ø
[EDGEMOVE XØ YØ
[TOOLDEF T1 D2
NØØ1Ø G91G28XØYØZØ;
NØØ2Ø M6T1;
NØØ3Ø G43H1;
NØØ4Ø M3S15ØØ;
NØØ5Ø G9ØGØX4ØY48;
NØØ6Ø Z2;
NØØ7Ø G1Z-Ø.5F1ØØ;
NØØ8Ø X72Y16F15Ø;
NØØ9Ø X8;
NØ1ØØ X4ØY48;
NØ11Ø GØZ2;
NØ12Ø X24Y32;
NØ13Ø G1Z-1F1ØØ;
NØ14Ø X56F15Ø;
NØ15Ø X4ØY16;
NØ16Ø X24Y32;
NØ17Ø GØZ2;
NØ18Ø M5;
NØ19Ø G91G28XØYØZØ;
NØ2ØØ M3Ø;

Denford Directive Example - [BILLET

Address example - G

Word example - G1

Block example - NØ13Ø G1Z-1F1ØØ;

10: G Codes List

Note - Not all G codes may apply to your CNC machine.

G Code.	Group.	Function.
GØØ	1	Positioning (Rapid Traverse)
GØ1	1	Linear Interpolation (Cutting Feed)
GØ2	1	Circular Interpolation CW
GØ3	1	Circular Interpolation CCW
GØ4	Ø	Dwell, Exact Stop
G2Ø	6	Imperial Data Input (Inches)
G21	6	Metric Data Input (Millimetres)
G28	Ø	Reference Point Return
G4Ø	7	Cutter Compensation Cancel
G41	7	Cutter Compensation Left
G42	7	Cutter Compensation Right
G73	9	Peck Drilling Cycle
G74	9	Counter Tapping
G76	9	Fine Boring
G8Ø*	9	Canned Cycle Cancel
G81	9	Drilling Cycle, Spot Boring
G82	9	Drilling Cycle, Counter Boring
G83	9	Peck Drilling Cycle
G84	9	Tapping
G85	9	Boring Cycle
G86	9	Boring Cycle
G87	9	Back Boring Cycle
G89	9	Boring Cycle
G9Ø*	3	Absolute Zero
G91	3	Incremental Command
G94*	5	Feed per Minute
G95	5	Feed per Revolution
G98*	1Ø	Return to Initial Point in Canned Cycle
G99	1Ø	Return to R in Canned Cycle
G17Ø	Ø	Circular Pocket
G171	Ø	Circular Pocket
G172	Ø	Rectangular Pocket
G173	Ø	Rectangular Pocket

Code listing full and correct at the time of printing.

Note

G codes from group Ø are non-modal (they must be programmed into every program block when required). All other G codes are modal (they remain active through subsequent program blocks, until replaced or cancelled by a G code from their particular group).
The G codes indicated by an asterisk (*) are reactivated as defaults when the machine started.

10: M Codes List

Note - Not all M codes may apply to your CNC machine.

M code.	Function.
MØØ*	Program Stop
MØ1*	Optional Stop
MØ2*	Program Reset
MØ3	Spindle Forward (clockwise)
MØ4	Spindle Reverse (counter clockwise)
MØ5*	Spindle Stop
MØ6	Automatic Tool Change
MØ8	Coolant On
MØ9*	Coolant Off
M1Ø	Vice/Work Clamp Open
M11	Vice/Work Clamp Close
M13	Spindle Forward and Coolant On
M14	Spindle Reverse and Coolant On
M19	Spindle Orientation
M2Ø	ATC Arm In
M21	ATC Arm Out
M22	ATC Arm Down
M23	ATC Arm Up
M24	ATC Drawbar Unclamp
M25	ATC Drawbar Clamp
M27	Reset Carousel to Pocket One
M3Ø	Program Reset and Rewind
M32	Carousel CW
M33	Carousel CCW
M38	Guard Door Open
M39	Guard Door Close
M62	Auxiliary Output 1 On
M63	Auxiliary Output 2 On
M64	Auxiliary Output 1 Off
M65	Auxiliary Output 2 Off
M66*	Wait for Auxiliary Output 1 On
M67*	Wait for Auxiliary Output 2 On
M7Ø	Mirror in X On
M71	Mirror in Y On
M76	Wait for Auxiliary Output 1 Off
M77	Wait for Auxiliary Output 2 Off
M8Ø	Mirror in X Off
M81	Mirror in Y Off
M98	Sub Program Call
M99	Sub Program End and Return

Code listing full and correct at the time of printing.

Note

Not all M codes listed are available, all M codes marked with an asterisk (*) will be performed at the end of a program block (ie, after any axis movement).

10: List of Program Address Characters

N - Program Sequence (line) number.

X - Primary motion in X axis.

Y - Primary motion in Y axis.

Z - Primary motion in Z axis.

G - Preparatory functions.

I - Incremental distance parallel to X axis.

J - Incremental distance parallel to Y axis.

K - Incremental distance parallel to Z axis.

R - Radius.

M - Miscellaneous functions.

T - Tool numbers.

S - Spindle speeds.

F - Feed rates.

10: Denford Directives

Directives are program terms defined by Denford Limited.
They are used to help generate the 2D and 3D graphics used by the machine controlling software.

[BILLET
This directive allows a billet that appears in a simulation window to be given a size. The billet definition should be placed at the start of a program, after the units of measurement have been set.
Example:
G21
[BILLET X1ØØ.Ø Y9Ø.Ø Z2Ø.Ø
This sets the measure to metric (Note - if set to Imperial the units would be inches) and defines the billet as1ØØmm long by 9Ømm wide, with a depth of 2Ømm.

[SUBPROGRAM
This directive allows a program with a non-numeric name to be called as a subprogram.
Example:
[SUBPROGRAM Ø2ØØ FRED
M98 PØ2ØØ
This example assigns a subprogram number of Ø2ØØ to the program named FRED, then calls the subprogram Ø2ØØ.

[TOOLDEF
This directive sets the length and diameter of a cutting tool. The length of a tool is the distance from the spindle nose to the bottom of the cutter.
Example:
G21
[TOOLDEF T1 D8 Z65
This example defines tool number 1 as being 8mm in diameter, and 65mm long.

[STEP
This directive runs an on-screen program in single steps. This means the program will run one program line, then wait for the operator to prompt it to move to the next line; this continues until the program is instructed to stop this function.
The directive applies to both simulation and actual machining with a program.

[NO STEP
This directive runs an on-screen program without single steps. This means the program will run as originally intended with no pausing, unless a pause is requested from within the program itself.
The directive applies to both simulation and actual machining with a program.

[SHOW
This directive allows the machining operations to be graphically simulated on-screen.

[NOSHOW
This directive stops the machining operations from being graphically simulated on-screen.

10: Understanding Offsets

What are offsets?

Offsets are a collection of numerical values used to describe the location of the workpiece datum. The moveable workpiece datum defines the zero point on our workpiece (the material we want to machine). This is the starting point for any cutting co-ordinates supplied by the machine controller.

Two types of offset file are used, in combination, to describe this location:

i) The workpiece offset file - This file allows global offset values to be set for the X, Y and Z axes. In other words, every tool profile will use the workpiece offset values.

ii) The tool length offset files - Every tool has its own individual tool length offset file, containing a single Z offset value. They are used to compensate for the differences in length between tools.

How is a workpiece datum calculated?

The X position of the workpiece datum is defined by the X value entered into the workpiece offset file.

The Y position of the workpiece datum is defined by the Y value entered into the workpiece offset file.

The Z position of the workpiece datum is defined by the combination of the Z value entered into the workpiece offset file and the value entered into the tool length offset file belonging to the tool profile currently in use.

How is the workpiece datum used?

The software uses the workpiece datum as the starting point (zero reference) for any co-ordinate movements it receives. These co-ordinate movements are read from our loaded CNC file. In other words, the position of the workpiece datum will determine the place on the CNC machine where our part is manufactured.

What actually happens when I program my workpiece datum position?

Configuring the workpiece datum position shifts, or offsets, the entire three dimensional co-ordinate grid system used by the CNC machine. The workpiece datum will now be read by the CNC machine as its zero position, rather than the machine datum. The machine datum is a fixed point, defined when you first switch on and home the CNC machine.

Where should I position the workpiece datum on my billet?

This depends on the position of the part datum set in your CNC program. The part datum is the zero reference, or starting point, used when plotting all the co-ordinates that describe the shape of your design.

The part datum could have been set by the programmer, when manually writing the CNC program from a traditional engineering drawing, or automatically set by a CAD/CAM software package.

For example, if you used the CAD/CAM software package, Denford MillCAM Designer, your design would have been drawn within a fixed area, representing the size of the billet you intend to use. The software would then have generated the CNC program, automatically setting the front, left upper corner of this imaginary billet as the part datum. In this case, you would need to position the workpiece datum in the front, left upper corner of the real billet on the machine table.

What happens if I don't use any offsets with my CNC file?

If no offset is programmed, the machine controlling software will use the machine datum as the starting point (zero reference) for any co-ordinate movements it receives. Since it is unlikely that the position of the machine datum is the place where you want any machining to begin, your CNC machine will attempt to manufacture your design in the wrong place in its working area. Offsets are very important because without them, the CNC machine will not know where to begin cutting on your billet. Offsets must always be configured before manufacturing the part.

Are standard offset files supplied?

No, you must set your own. We DO NOT supply any standard offset files with your CNC machine controlling software. However, once you have configured and saved your offset files, the same files may be used over and over again, so long as the following holds true:

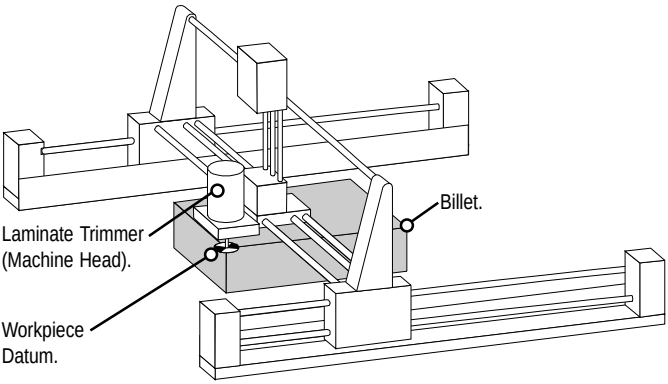
- The same cutting tools are used.
- The next billet to be machined is the same size as the last billet used.
- The next billet to be machined is placed in the working area in exactly the same position as the last billet used.

10: Configuring a Workpiece Offset

The workpiece offset file contains three values, used to describe the location of your workpiece datum. They determine how much you want to shift the zero reference position of the CNC machine along the X, Y and Z axes.

However, if your CNC file uses two or more tool profiles, the workpiece offset file will not account for the difference in length between the tools. To achieve this, you must also configure a tool offset value for each tool profile you intend to use (see the next page).

Before you can begin entering the workpiece offset values, you must position the tool over your workpiece datum. Move the tool so its cutting tip just touches your chosen workpiece datum position, as shown in the diagram below. Take care not to damage the cutting tip, when manoeuvring the tool.



In this example, the workpiece datum is set at the front left upper corner of the billet, held in place using the vacuum table. Alternatively, if the billet was a large, thin, flat piece of material, a small mark could be made on the surface to identify the proposed location of the workpiece datum.

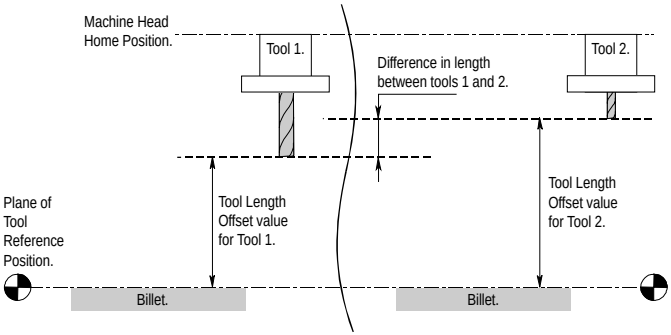
Tip

A clearer view of the cutting tool tip can be obtained by raising the front brush guard.

10: Configuring a Tool Length Offset

The tool length offset files each contain a single Z value. A separate tool length offset file must be configured for every tool we want to use. They allow us to establish a common workpiece datum position, no matter what length of tool is used with the CNC file.

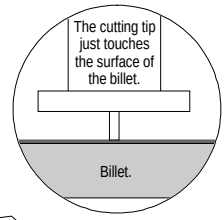
Select a point on your billet that can be reached by all the tools you intend to use. All tool length offsets are configured against this common tool offset reference point. When values are entered into each individual Z length tool offset file, each tool will use this reference point as their zero co-ordinate along the Z axis. It is this figure that compensates for the differences in length when various tools are used together on the same job, as shown in the diagram below.

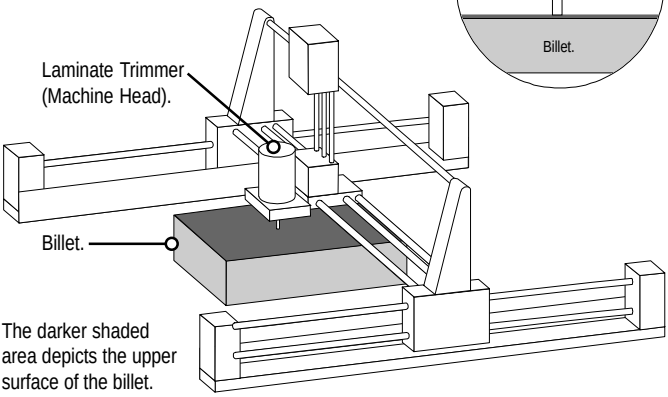


10: Configuring a Tool Length Offset

Move the Tool over the chosen Tool Offset Reference Position. Take care not to damage the cutting tip, when manoeuvring the tool.

In this example, the tool reference position has been chosen as the upper surface of the billet. This position can be easily reached by all the different tool profiles we intend to use with the CNC file.





The darker shaded area depicts the upper surface of the billet.

Tip

A clearer view of the cutting tool tip can be obtained by raising the front brush guard.

EC Declaration of Conformity

The responsible person ..... Mr J.M. Boyle.

Business Name ..... Denford Limited.

Address ..... Birds Royd,
Brighouse,
West Yorkshire,
HD6 1NB,
United Kingdom.

Declares that the machinery described:

Manufacturer ..... Denford Limited.

Model Name ..... Microrouter Series CNC Machine.

Serial Number ..... (please refer to warranty card and/or machine casing).

conforms to the following directives: .... The Machinery directive 98/37/EC
The LVD Directive 73/23/EEC

and the following standards .....
(where applicable) .....

and complies with the relevant .....
health and safety requirements. .....

Signature .....

Position within company ..... Senior Design Engineer.

Signed at ..... Denford Limited,
Birds Royd,
Brighouse,
West Yorkshire,
HD6 1NB,
United Kingdom.

Document: DC-NR 1-01.

Back of the EC Declaration of Conformity Certificate.

Microrouter Series Noise Level Test Results

Test Report No: NL - NR 1 - Ø1.

Machinery Manufacturer: Denford Limited.

Machinery Type/Model: Microrouter Series.

The Microrouter can be supplied with various options, including a vacuum table and dust extraction. In both cases, a “Yorkleen Woodvac WY1” is supplied for this purpose. The test was carried out with and without these options.

Equipment:

Meter ref. “Realistic” 42-3Ø19 (last calibrated 30/11/98) - 1 off.

Denford Microrouter CNC machine - 1 off.

Yorkleen Woodvac WY1 - 2 off.

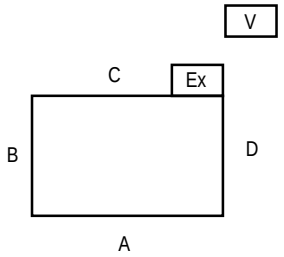


Diagram Key:

A, B, C and D are measurement positions 1 metre from the machine.

Ex: Vacuum for dust extraction.

V: Vacuum for vacuum table.

Test Conditions:

Spindle speed: 26,500 RPM.

Axis speed: 900 mm/min.

Ambient background noise: <60 dB (A).

Test Results:	Sound Levels dB (A) Position			
Condition	A	B	C	D
Spindle motor only	69	64	61	61
Spindle and drives	67	65	65	65
Vacuum table only	75	70	75	81
Spindle, drives and vacuum table	75	67	66	72
Extractor only	62	60	65	71
Spindle, drives and extractor	68	66	68	70
Spindle, drives, extractor and vacuum table	75	71	80	83

Back of the Microrouter Series Noise Level Test Results Certificate.

11: Glossary

ABSOLUTE ..... In absolute programming, zero is the point from which all other dimensions are described.

ALLEN HEAD ..... A hexagon shaped hole on the head (top) of a set screw. These are tightened and loosened using allen keys/wrenches.

ARC ..... A portion of a circle.

AUTOMATIC CYCLE ..... A mode of control operation that continuously runs a cycle or stored program until a program stop or end of program word is read by the controller.

AUXILIARY FUNCTION ..... The function of the CNC machine (ie, F, S, T, M codes etc.), other than co-ordinate based commands.

AXIS (AXES) ..... The planes of movement for the cutting tool, usually referred to as X (horizontal left and right, parallel to the front of the machine), Y (horizontal forward and backwards, parallel to the side of the machine) and Z (directly vertical). Combinations of all 3 allow precise co-ordinates to be described. Axes are also referred to as slides or slideways.

BILLET ..... The actual material being machined, sometimes referred to as the "workpiece" or "stock".

BLOCK ..... A collection of program words that collectively describe a machining operation. A single program line in the CNC file.

CHARACTER ..... A number, letter or symbol as entered into a CNC program.

CIRCULAR INTERPOLATION G-code term for a programmed arc movement.

COMMAND ..... A signal (or group of signals) instructing one step / operation to be carried out.

CONTEXT SENSITIVE ..... When the type of input signal of an event automatically changes the output signal.

CO-ORDINATES ..... Positions or relationships of points or planes. Co-ordinates are usually described using three numbers referring to the (X,Y,Z) axes, e.g. the co-ordinate (23,35,45) means X axis = +23 units, Y axis = +35 units and Z axis = +45 units.

CNC ..... Computer Numerical Control.

CNC FILE ..... The sequence of commands describing the manufacture of a part on a CNC machine, written using G and M codes, also called the CNC program.

CUTTER SPEED ..... The velocity of the cutting edge of the tool relative to the workpiece. With circular tools, the cutting speed is related to the tool when new (maximum cutting diameter). Usually the effect of feedrate is ignored.

CYCLE ..... A sequence of events or commands.

DATUM ..... The point (co-ordinate) from which a series of measurements are taken.

DESKTOP TUTOR ..... The input control keypad for the machine. Keypad overlays are interchangeable according to the type of controller required.

DIRECTORY ..... An area of a disk containing the names and locations of the files it currently holds.

DISK ..... A computer information storage device, examples, C: (drive) is usually the computers hard (internal) disk and A: (drive) is usually the floppy (portable 3.5" diskette) disk.

11: Glossary

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.

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 key/ button press.

LAMINATE TRIMMER ..... The removeable cutting head (motor). Also referred to as the machine head.

M CODE ..... A miscellaneous code function in a CNC program used to indicate an auxiliary function (ie, coolant on, tool change etc.).

MACHINE CODE ..... The code obeyed by a computer or microprocessor system with no need for further translation.

11: Glossary

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 using the machine offset facility.

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.

PRJ ..... Denford CNC Project file, extension ".prj". Project files contain global information about user defined settings in the VR CNC Milling software, such as toolpost setup, tooling library, offsets, toolbar and window positions etc.

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).

RPM ..... Revolutions per minute (rev/min) - a measure of spindle speed.

SIMULATION OFFSET ..... The workpiece offset file only used with VR CNC Milling software 2D and 3D graphics.

SLIDES ..... The 3 machine axes - see axis.

SPINDLE SPEED ..... The rate of rotation (velocity) of the machine head / cutting tool, measured in RPM.

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.

11: Glossary

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 milled. 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.

XNC ..... Denford Compiled CNC file, extension ".xnc". A compiled file is a FANUC Miller file that is formatted to allow 3D elements such as the 3D Viewer to run as quickly as possible. XNC files can also be used to drive an attached CNC machine when run through the VR CNC Milling software.

Z TOOL OFFSET ..... See Tool Offset

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12: Index

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.

12: Notes