DENFORD

Total Commitment to Education and Training WorldWide.

Microrouter Compact Series CNC Machine User's Manual.

CE approved

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See also Section 3 - CNC Machine Installation, page 18, for important information regarding general wood dust precautions.

Warranty Disclaimer.

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

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 Compact 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 Compact.

Foreseen Use of Machine.

Your Microrouter Compact 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 Compact 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 Compact 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 and operate the basic functions of your Denford Microrouter Compact CNC machine, including any operational features of hardware specific to the Microrouter Compact series. This manual does not provide any information regarding the software packages used to control your Microrouter Compact - please refer to your separate CNC machine control software manual. Please note that the Electrical Diagrams for your Microrouter Compact are not included in this manual - they are delivered separately in the standard equipment box supplied with your CNC machine. If you have any doubts and/or questions regarding the specification, servicing, or features of your Microrouter Compact, please contact Denford Customer Services. Denford Limited reserves the right to change the specification and/or operating features regarding this CNC machine without notice or documentation.
Disclaimer	Please note that due to the nature of hardware and software developments, the specifications and features of this product can change without notice. The information contained in this manual is correct at the date of printing only - April, 2003. No liability can be accepted by Denford Limited for loss, damage or injury caused by any errors in, or omissions from, the information supplied in this manual.
Screenshots	Please note that any screenshots are used for explanation purposes only. Any numbers, wording, window or button positions may be different for the configuration of the CNC machine control software being used to control your Microrouter Compact.
Language	This manual is written using European English.
Contact	Any comments regarding this manual should be marked for the attention of our technical authoring team and referred to the following e-mail address: customerservices@denford.co.uk

1: Introducing your Microrouter Compact

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

Your Microrouter Compact is a full three axes CNC router with a small footprint, yet remarkably allows machining of materials approaching A4 size. Suitable for all levels of education and training, it is manufactured to meet industrial standards. Together with rapid traverse rates of up to 5000mm/min (197in./min) and 3D profiling speeds up to 2250mm/min (88in./min) your Microrouter Compact is the ideal partner for intensive 3D applications, such as the F1 Team in Schools CAD/CAM Design Challenge (www.f1inschools.co.uk). Your Microrouter Compact is designed with you in mind - making the processes involved both safe and easy to use.

Main Features:

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

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 set up your Microrouter Compact, 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, 2003 - 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 (see note left):

- Microrouter Compact CNC machine. Note that the precise specification of your CNC machine will depend on any options selected at the time of ordering (see below).
- 1 x Denford machine link cable (25 to 9 pin connection)*.
- 1 x Allen (hex) keys pack.
- 2 x Router head spanners.
- 1 x Spare fuse pack.
- 1 x Microrouter Compact warranty pack.
- 1 x Microrouter Compact inspection certificate.
- 1 x User document pack (1 x Commissioning guide with CD-ROM, 1 x Microrouter Compact CNC Machine manual, 1 x CNC Machine Control Software manual, any additional OEM product manuals).
- 1 x Denford VR CNC Machine Control Software CD-ROM
- 1 x VR CNC Machine Control Software Security Key (dongle) or Flash screen software supplied on one floppy disk.

*** Note**

* If your controller PC is fitted with a 25 pin COM port connection, use a short 9 to 25 pin serial link adaptor cable (available from Denford) to allow connection of the Denford machine link cable.

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

- Additional Software: CAD/CAM, Offline CNC Machine Control.
- CNC Machine Control software security keys (dongles) or licence disks.
- Machine work bench and/or PC & PC workstation.
- Vacuum for dust collection.
- Additional work holding systems.
- Various tooling packages**.
- On-screen representation of industrial control systems (FANUC 21i) and optional link to industrial keypad.
- Courseware, project books and project material packages.
- Video conferencing system.
- Additional and/or on-site training courses.
- On-site CNC machine commissioning.

**** Note**

** Only use the Microrouter Compact 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 Compact:

- 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 and spindle stop for tool changing.

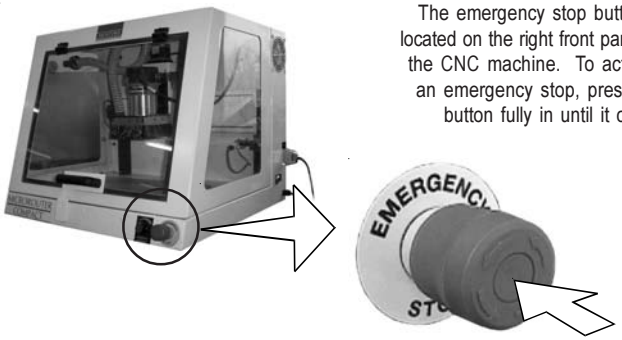
Safety Precautions.

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

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 CNC machine electronics.
- If power fails turn off the mains power switch immediately and unplug the machine from the mains power socket.
- Service the required areas at the intervals specified in this manual (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 side of the CNC machine front panel.

2: Safety Features - Emergency Stop Button



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

Note

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

A circular, red emergency stop button is located on the right front panel of your Microrouter Compact, as shown above. When pressed, it has the effect of stopping all axes and spindle movements immediately. The guard 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 CNC 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.

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

2: Safety Features - Interlock Guard Switch

Note

A closed safety guard door cannot be opened when:

- The machine is switched off (ie, not in use). To release the interlock guard switch, supply power to the machine.
- The emergency stop button is fully pressed in. To release the lock, push in and turn the emergency stop button counter-clockwise until it springs back out to its ready position.
- Machining is taking place. The interlock guard switch will release when the machining operations have been completed and the machine controlling software is operating in Jog Mode.

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.

Note

See also Section 3 - Installation, page 16.

An interlock guard switch is fitted to the front machine door. The switch unit itself is attached behind the lower machine panel, accessible from beneath the front of the machine. The lock must be manually released to enter the working area when the 24 volt circuit has failed and the door is clamped electrically.

Left: The interlock guard switch unit (circled) is located behind the lower front machine panel.

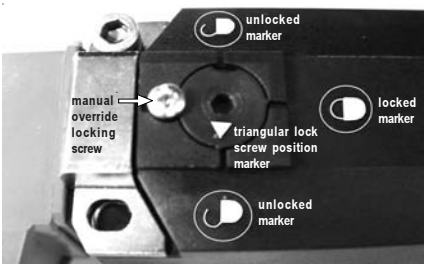
An override facility is provided on the interlock guard switch, allowing **temporary** removal of the guard lock feature. For manual interlock release, the power supply must be switched off.

1) Working beneath the front edge of the machine, locate the interlock guard switch unit.

2) Using a small flat or crosshead screwdriver, loosen the manual override locking screw until the circular black plastic lock screw can be turned (refer to photograph below).

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. If you need to leave the machine, post a warning note informing users that the safety guard door lock is not operating.



Left: Looking directly at the face of the interlock guard switch unit.

3: Unpacking and Lifting your CNC Machine

If your Microrouter Compact has been supplied inside a delivery box, cut the top of the box open and remove any packaging carefully. To obtain better access to the machine, remove all the sides from the delivery box. Your Microrouter Compact weighs 90 KG (198 lbs). Take suitable precautions when manually lifting the machine from the packaging (see text below).

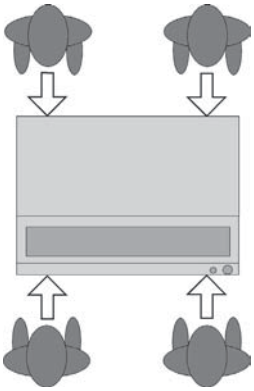
Denford recommends that four or more persons should be used to lift the Microrouter Compact, one at each corner of the machine, as illustrated in the diagram below. Always use sensible lifting precautions in accordance with Health and Safety Regulations in your establishment. Ensure that your Microrouter Compact is both secure and balanced before lifting. Do not tip the CNC machine whilst lifting.

Warning

Caution.
Always use sensible lifting precautions in accordance with Health and Safety Regulations in your establishment.

Data Panel

Machine Weight:
90 KG (198 lb).



Caution: The back of the machine is heavier than the front.

When lifting the Microrouter Compact manually, use one person at each corner of the machine.

Caution: Do not trap your fingers under the machine cabinet edges.

Points to Note.

The majority of the weight is situated at the back of the machine.

Due to the small clearance at the base of the machine, take precautions to ensure you do not trap your fingers under the edges of the machine cabinet, when lowering your Microrouter Compact onto a table top.

If necessary use two 100kg (220 lb) rated lifting bars to help raise the machine. Ensure the bars are fed between the four rubber feet, to reduce the chances of the machine sliding off the bars.

To transport your Microrouter Compact over longer distances, we recommend the use of a suitably sized wheeled trolley.

3: Choosing a Site for your CNC Machine

Site your machine in a well ventilated room. The Microrouter Compact 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, leave enough space for removal of the large plate covering the electronics at the rear of the cabinet. Positioning the PC on a movable workstation may allow easier access to the various vents, connectors and switches on the machine cabinet, when required.

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

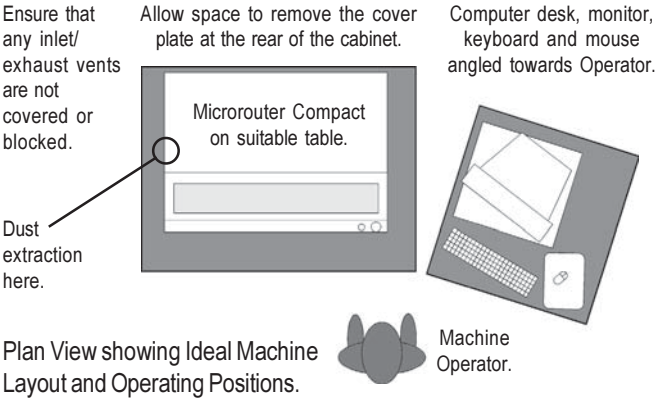
Dimensional Data.

Machine width (left to right end) 670mm (26 3/8").

Machine height (top to bottom) 578mm (22 3/4").

Machine depth (front to back) 690mm (27 3/16").

Machine height with guard door open 1005mm (39 9/16").



Plan View showing Ideal Machine Layout and Operating Positions.

3: Levelling your Microrouter Compact

Your Microrouter Compact rests level on the four rubber feet attached under the base of 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 machine 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 cause serious damage to components inside your CNC machine and/or service personnel.

Your Microrouter Compact 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: 220/240 Volts, 50 Hz, 8 Amps.

Cable required: 3 Core, 1.5mm^2 per core.

Spindle motor: 1.1 kW, 1.5HP, 23500 RPM.

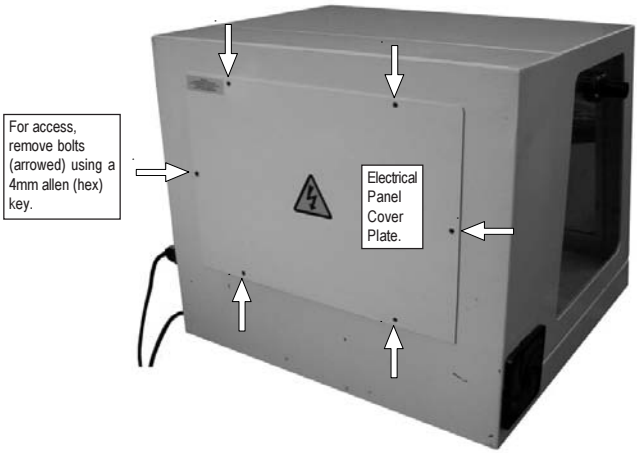
Axis stepper motors: 200 steps/rev.

3: Accessing the Microrouter 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 cover plate.

Your Microrouter Compact electronics are located in the back of the machine cabinet. Should you need to access the electrical panel, use a 4mm allen (hex) key to remove all the bolts, then withdraw the cover plate, as shown below.



3: Electrical Diagrams

Warning

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

The electrical diagrams for your Microrouter Compact are not included in this guide - they are delivered separately in the standard equipment box supplied with your machine.

Further electrical schematics are available on request - please contact Denford Customer Services.

3: Opening the Safety Guard Door

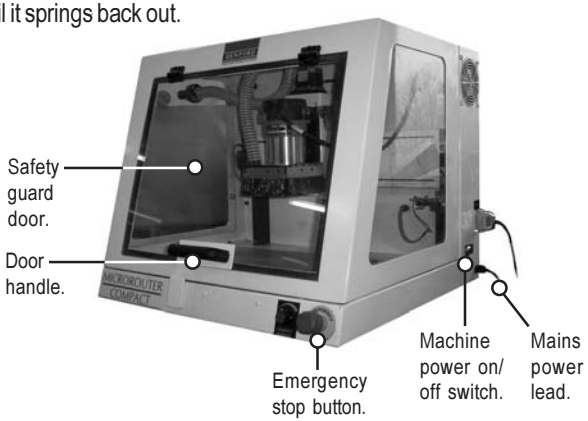
Note

See also Section 2 - Safety, page 12.

An interlock switch is fitted to the safety guard door. The switch unit itself is mounted behind the cabinet metalwork. In order to view the switch unit you must look under the front edge of the machine.

Please note that you may find the front machine door locked closed upon initial delivery of the machine. To release the interlock switch, insert the mains plug into an available power socket, then switch on the machine, using the on/off switch located on the right machine cabinet panel.

Check that the emergency stop button is not pressed in. To release a closed emergency stop button, push in and turn the button clockwise until it springs back out.



To open the guard door normally, pull the handle and swing the guard door upwards until it rests on the front upper section of the machine cabinet.

3: Removing Protective Coatings and Packaging

Warning

Potential risk of ignition / explosion!

Do not use any aerosol based or flammable products to clean your CNC machine.

Carefully read and follow any instructions or notices included with cleaning products.

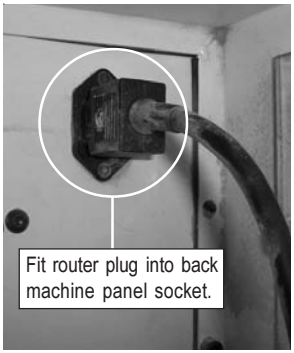
Once your Microrouter Compact has been sited and connected electrically, the protective coatings and transit packaging must be removed to prepare the machine for running:

1) The protective plastic sheeting on the guard windows must be removed and the glass and perspex cleaned with an antistatic cleaner.
2) Tie-wraps may be used in the working area of the machine, to prevent movement of components during transit. Additional items from your order may also be supplied packaged inside the working area.
3) To gain entry to the working area of the machine, power must be supplied to the machine, in order to release the switch unit that locks the safety guard door. Note that the switch unit will also remain locked when the emergency stop button is fully pressed in.

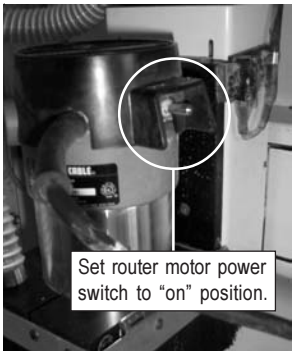
Warning - Aerosol based or flammable products must not be used to clean your CNC machine. To avoid the potential risk of ignition / explosion, ensure that any trapped solvent vapours can exit fully from any enclosed areas on the CNC machine. Wait at least 1 hour before attempting to operate the CNC machine.

3: Connecting the Router Motor

1) Items such as the collet adaptor, circled in the photo above, may be tie-wrapped to the router power lead upon delivery. Cut and discard any tie-wraps, together with any additional transit packaging and remove your additional items from the working area.



2) Fit the router motor plug into the socket fitted in the right, upper corner of the back panel, as shown in the photograph above.



3) Ensure the router motor power switch, circled in the photograph above, is set to the “on” position.

3: Dust Extraction & General Wood Precautions

Your Microrouter Compact 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 machine, or you may wish to connect your own existing system. The machine should only be used with the dust extraction system enabled.

Connect the pipe from your dust extraction system to the exit hole, located at the top of the left side viewing window. An adapter may be required, in order to obtain an efficient seal.

Connect the hose from your dust extraction system to the exit hole (using an appropriate adaptor if required).

⚠ 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 Compact, 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 Compact cabinet 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.

continued...

3: Dust Extraction & General Wood Precautions

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: Connecting your PC to your CNC Machine

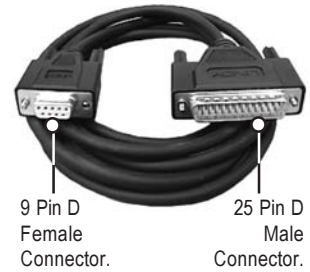
Warning

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

To connect your PC to the Microrouter Compact:

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 Compact, using the supplied Denford machine link 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 right.



continued...

3: Connecting your PC to your CNC Machine

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.

Note

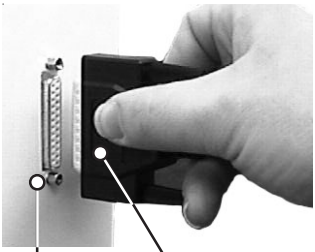
The Denford machine link cable supplied with your machine must always be used, since this cable features crossovers on some of the pin connections.

Do not confuse the 25 pin D female parallel (printer) port on your PC with the 25 or 9 pin male D COM ports.

Note

On computers fitted with older style 25 pin D male COM ports, an adaptor must be fitted to the Denford machine link cable. This will convert the standard 9 pin connection on the Denford machine link cable to a 25 pin connection suitable for your computer COM port. A 9 to 25 pin adaptor is not supplied as standard but can be ordered from Denford, if required.

3) Connect the 25 pin D male end of the Denford machine link cable to the 25 pin D female port mounted on the right-hand side panel of the machine cabinet, as shown right. The port is labelled **RS 232**.

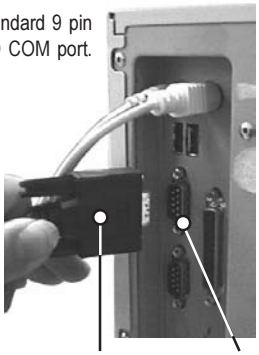


25 pin D female connector fitted to right panel of the machine cabinet.

25 pin D male connector fitted to Denford machine link cable.

4) Connect the remaining 9 pin D female end of the Denford machine link 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. Note that the COM ports on your PC may be labelled as Serial ports. If you cannot identify any of the ports on your PC, please refer to your original PC manufacturers operating manual for further guidance.

Standard 9 pin D COM port.

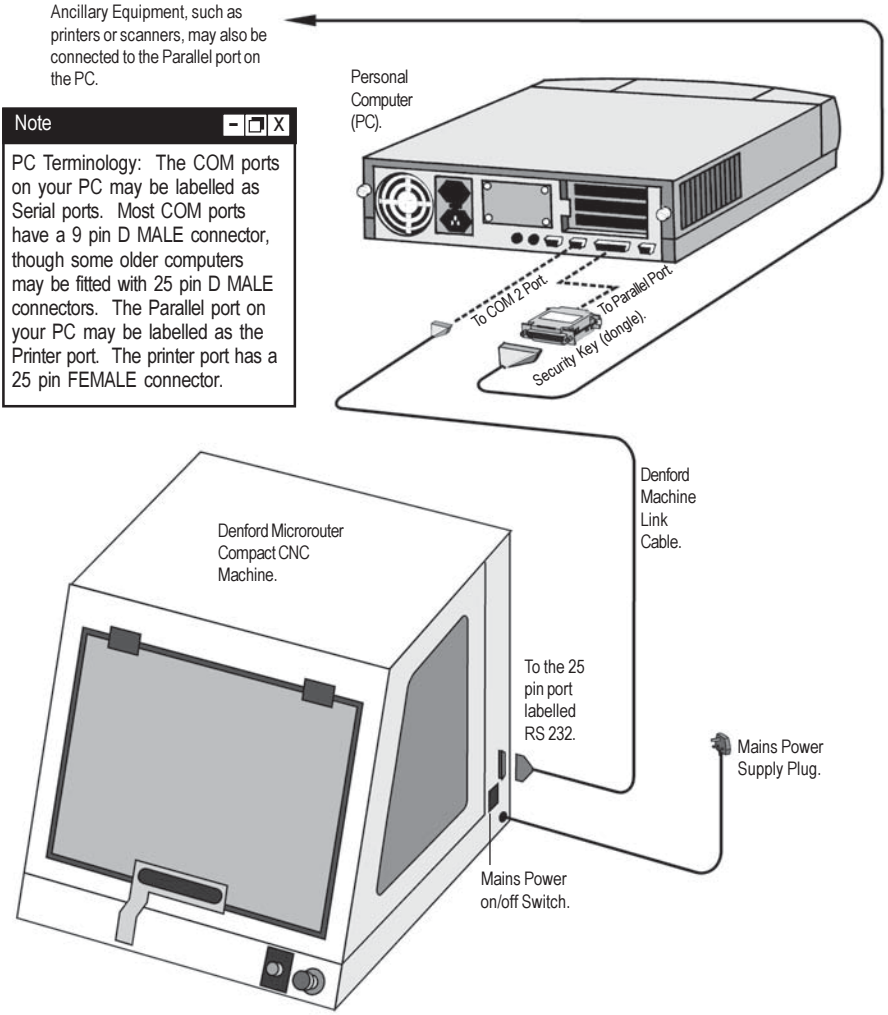


9 pin D female connector fitted to Denford machine link cable.

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

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

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 Denford machine link cable connects the Microrouter to the PC port labelled COM 2. The Denford machine link 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 right-hand side panel of the Microrouter Compact. 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 Compact - 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.

A: Switch on the Microrouter Compact, then start the CNC Control Software
(see section 4 : page 25 and see Note * left)

B: Establish communications and home the Microrouter Compact
(see section 4: page 27 and see Note * left)

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

D: Configure the tooling files in the CNC Control Software
(see Note * left)

E: Prepare any tooling hardware for the Microrouter Compact
(see section 4: pages 28 to 30 and section 5: pages 38 to 43)

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

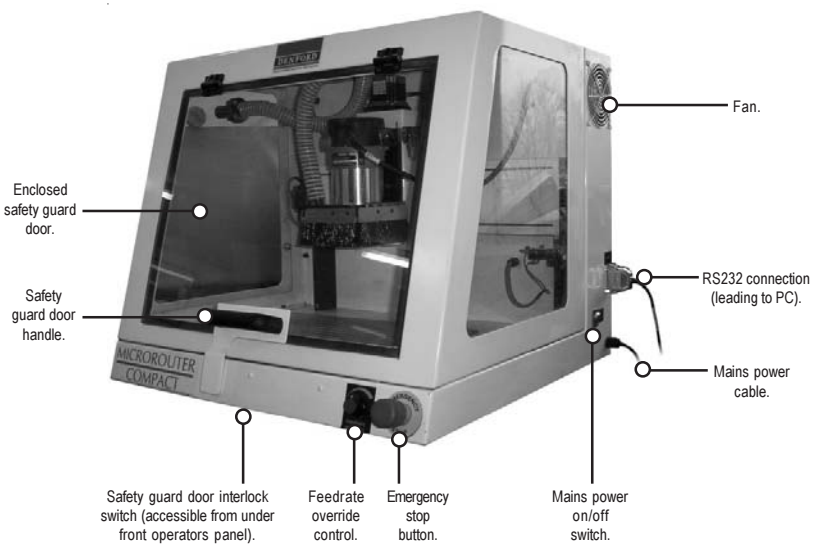
G: Load the billet onto the machine table
(see section 6: pages 44 to 52)

H: Configure the workpiece offset file and tool length offsets
(see section 4: pages 28 to 34 and see Note * left)

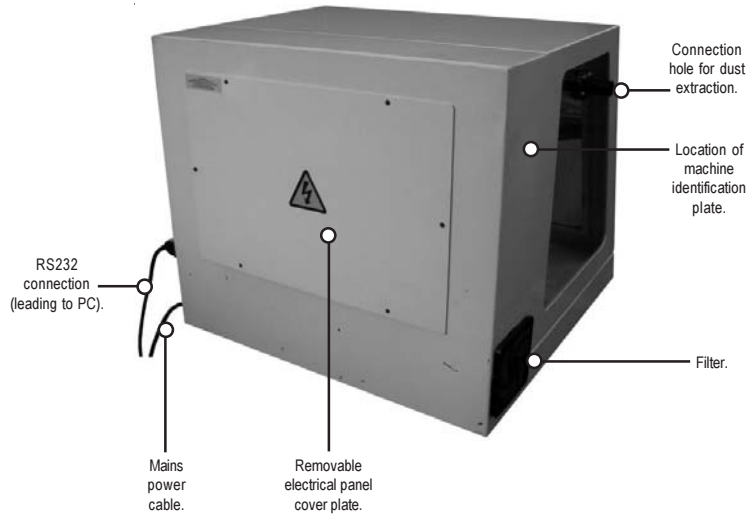
I: Manufacture the part
(see section 4: page 35 to 37 and see Note * left)

4: Microrouter Compact Component Locations

Front 3/4 View.

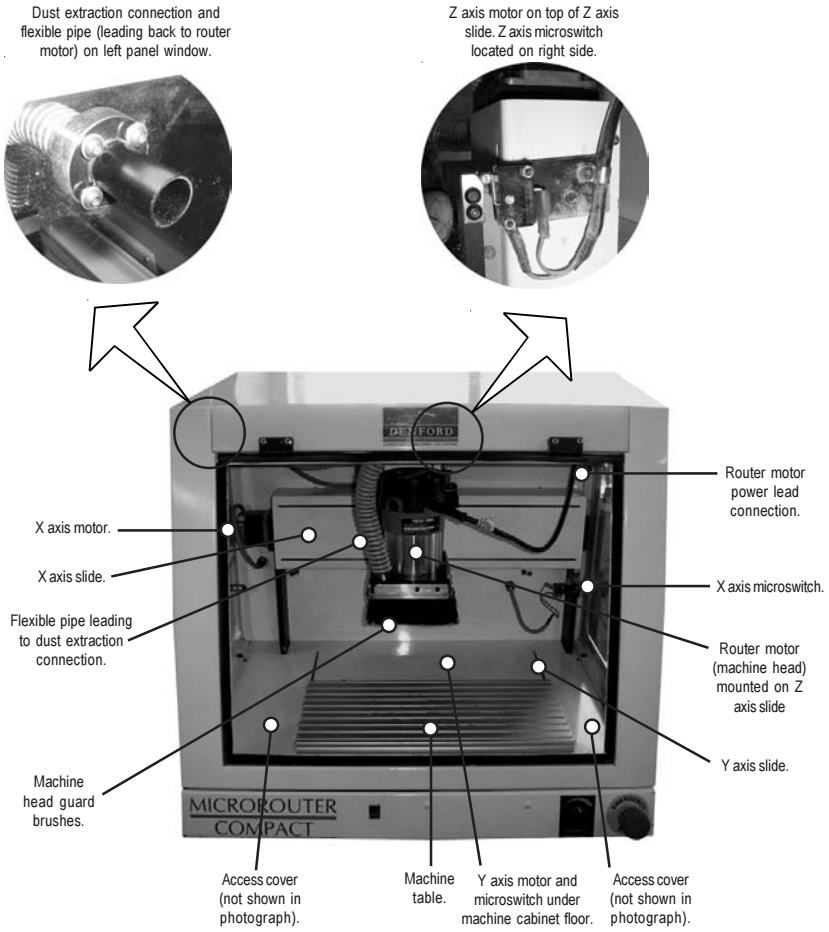


Rear 3/4 View.



4: Working Area Component Locations

Front View.



4: Switching the Microrouter Compact On

Note

The safety guard cannot be opened until the Microrouter Compact is powered up to release the interlock guard switch.

Warning

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

Warning

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

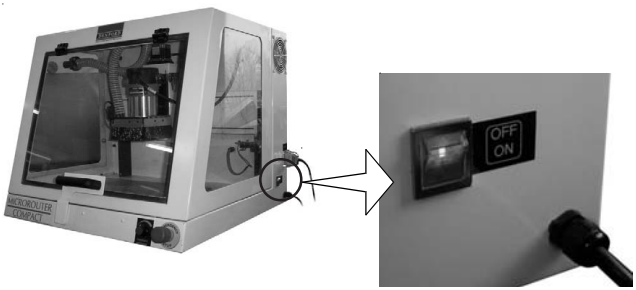
Note that hazardous voltages can still exist immediately after switching off the power.

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

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

Follow these instructions to switch on your Microrouter Compact:

1) Check the Denford machine link cable is fitted securely between the serial (COM) port socket on the machine controller PC and the RS232 socket, located on the right-hand panel of the Microrouter Compact cabinet.
2) Check that all access panels are in position and securely fastened.
3) Check that all inlet/exhaust vents are clear from obstructions.
4) Check the flexible hose from your separate dust collection vacuum system is securely fitted to the connection hole, located at the top of the left side viewing window.
5) Plug the Microrouter Compact mains supply cable into an available power socket. Switch the power socket on.
6) The square, red, on/off power switch is located on the right-hand panel of the Microrouter Compact cabinet. Press the switch to the down (on) position (as shown below). The switch will illuminate when power is being supplied to the machine.



If the Microrouter Compact does not begin its power-up routine, switch off the mains power and check all connections and fuses, referring to section 8 - Machine Electronics, if necessary.

7) Switch on the machine controller PC and start the CNC machine control software. Establish a communication link between your machine controller PC and your Microrouter Compact - please refer to your separate CNC Machine 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 machine control software, referring to Section 9 - Technical Support, if necessary.

4: Switching the Microrouter Compact Off

Warning

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

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

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

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

Follow these instructions to switch off your Microrouter Compact:

1) Wait for the Microrouter Compact to fully complete any machining or processing of any operational instructions.
2) Open the safety guard door and remove any finished parts from the working area.
3) Close down the communication link between the CNC control software and the Microrouter Compact, then exit the CNC control software, as described in your separate CNC Control Software User's Manual.
4) Shut down and switch off the machine controller personal computer.
5) Power down the Microrouter Compact by pressing the square, red, on/off mains power switch to the up (off) position. The on/off switch is mounted on the right-hand cabinet panel, towards the back of the CNC machine. Note that cutting the machine power will trigger the closing of the interlock guard switch. This will lock a closed safety guard door in position, preventing access to the machine working area. The interlock guard switch will automatically reopen when power is next supplied to your Microrouter Compact.
6) Switch off the mains power socket.

4: Homing the Machine Axes (Home Mode)

Note

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

Note

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

Note

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

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

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

Homing the CNC machine defines:

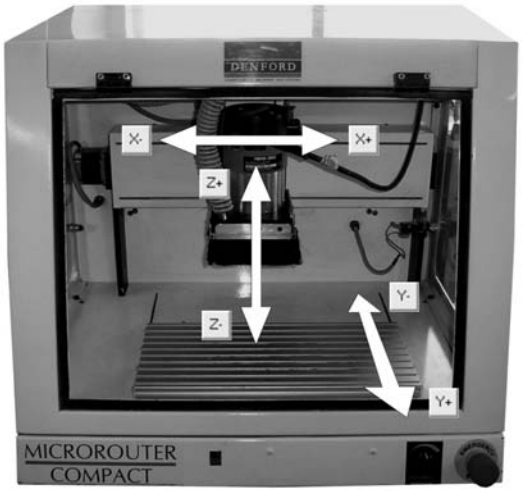
- The machine datum, by physically driving the machine head to a fixed zero reference point.
- The constraints of three dimensional co-ordinate grid system used for plotting any programmed movements, effectively the working envelope of the CNC machine.

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

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

4: Manual Control - Axis Definitions (Jog Mode)

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



Axis Definitions.

Note

The keys for manual axis movement will depend on the type of CNC control software being used - please refer to your separate CNC Control Software User's Manual for specific details.

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 back of the machine and positive (+) Y movements run towards the front of the machine.

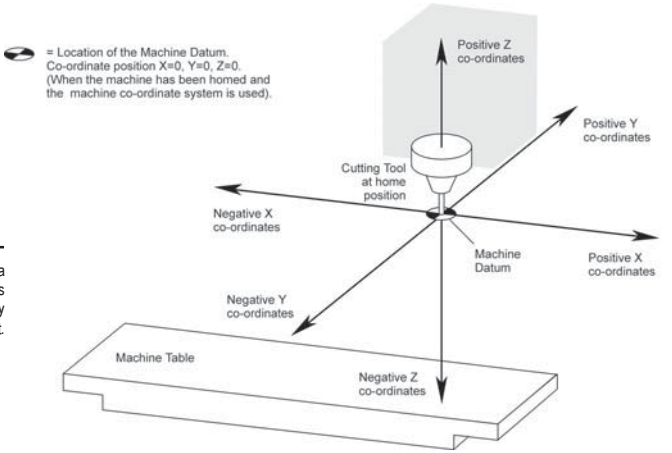
Z Axis - The Z axis slides runs at 90 degrees to the X and Y axes, vertically up and down, when viewed from the front of the machine.
Minus (-) Z movements run down, towards the floor of the machine and positive (+) Z movements run up, away from the floor of the machine.

4: Co-ordinate Display Systems (All Modes)

The co-ordinate display can be changed, according to datum (zero position) required:

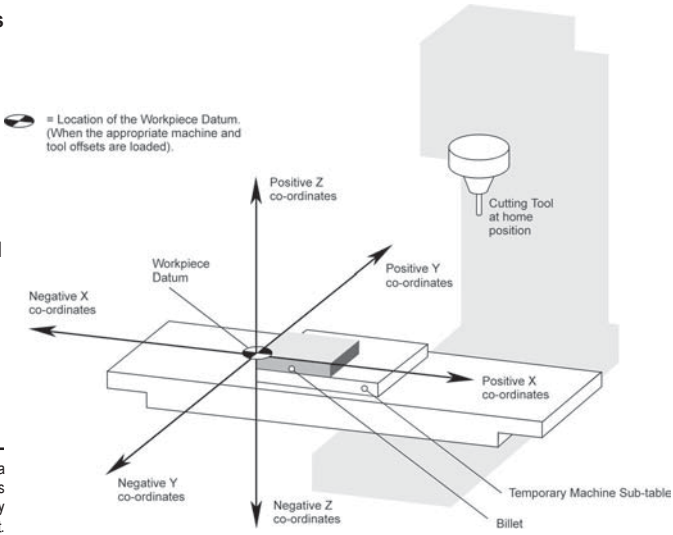
Machine Co-ordinates Display System.
The co-ordinate position values are displayed relative to the fixed machine datum. The co-ordinate display always shows the true position of the machine.

Note: Although the graphic depicts a Triac CNC machine, the principles shown in the diagram apply equally to the Microrouter Compact.



Work Piece Co-ordinates Display System.
The co-ordinate position values are displayed relative to the programmed (moveable) workpiece datum, described through use of the offset facility. Offsets temporarily shift the entire co-ordinate based grid system of the machine. It is common to configure the workpiece datum as the location from which all machining co-ordinates will be taken.

Note: Although the graphic depicts a Triac CNC machine, the principles shown in the diagram apply equally to the Microrouter Compact.



4: Manual Control - M Codes (Jog Mode)

Note

The sequence of events required to manually enter an M code will depend on the type of CNC control software being used. In addition, many of these miscellaneous functions may be controlled directly using buttons and commands available in your CNC machine control software.
Please refer to your separate CNC Machine Control Software User's Manual for specific details.

M codes can be manually entered for control of miscellaneous functions, such as switching the spindle on and off.

M03 - Spindle forward

M05 - Spindle stop

4: Requesting a Tool Change (Jog Mode)

Safety First !

Never attempt to 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.

Programming 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.

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: Understanding Offsets

Note

Further information regarding configuration of workpiece and tool length offsets can be found in your separate CNC Machine Control Software User's Manual.

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 the billet (the material you 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 the loaded CNC file. In other words, the position of the workpiece datum will determine the place on the CNC machine where the 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.

4: Understanding Offsets

Note

Further information regarding configuration of workpiece and tool length offsets can be found in your separate CNC Machine Control Software User's Manual.

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 control 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.

4: Configuring a Workpiece Offset

Note

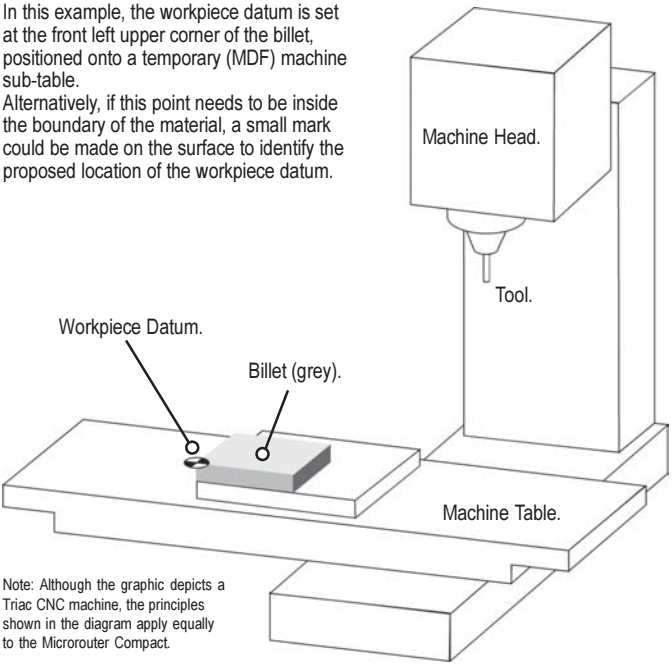
Further information regarding configuration of workpiece and tool length offsets can be found in your separate CNC Machine Control Software User's Manual.

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, positioned onto a temporary (MDF) machine sub-table.
Alternatively, if this point needs to be inside the boundary of the material, a small mark could be made on the surface to identify the proposed location of the workpiece datum.



Note: Although the graphic depicts a Triac CNC machine, the principles shown in the diagram apply equally to the Microrouter Compact.

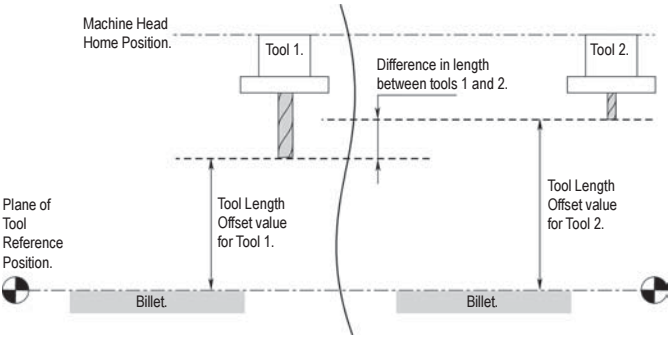
4: Configuring a Tool Length Offset

Note

Further information regarding configuration of workpiece and tool length offsets can be found in your separate CNC Machine Control Software User's Manual.

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.



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

4: Running a CNC Program (Auto Mode)

Note

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

Auto mode is used for controlling the CNC machine when running a CNC program.

Part Manufacture Checklist.

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

- The billet is mounted and secure on the machine table.
- All cutting tools are prepared and numbered ready for use, according to the tool numbers defined in your CNC file.
- The safety guard door is closed.
- Your CNC file is loaded and has been checked via simulation.
- The workpiece and tool length offset files have been configured or loaded.
- The CNC machine has been homed (datumed).
- The CNC machine control software is operating in Auto mode.

4: Front Machine Operators Panel

Warning

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

Location of Components on the Front Machine Operators Panel.

Mains power on/off switch.

Feedrate override potentiometer control.

Emergency stop button.

4: Front Machine Operators Panel

Feedrate Override Control.

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.

The feedrate of the Microrouter Compact can be manually overridden during a machining operation, using the potentiometer control dial fitted to the right end of the front machine operators panel.

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

To increase the feedrate, rotate the control dial clockwise.

To decrease the feedrate, rotate the control dial counter-clockwise.

The degree of adjustment applied to the feedrate value is displayed in the CNC machine control software.

Note

The spindle speed must be overridden using the CNC machine control software (please refer to your separate CNC Machine Control Software User's Manual for details regarding this feature). The spindle speed can be overridden between 50% and 120%.

Mains Power Switch.

The square, red, on/off power switch is located on the right-hand panel of the Microrouter Compact cabinet.

To supply power to the CNC machine, press the switch to the down (on) position. The switch will illuminate when power is being supplied to the machine.

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

Note

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

Emergency Stop Button.

The emergency stop button is a circular red push button. Pressing the emergency stop button has the effect of stopping all axes and spindle movements immediately. To active an emergency stop, press the button in fully until it clicks. The emergency stop button will remain closed (continuing to cut all power to the machine drives) until the release sequence is performed. To release a closed emergency stop button, push and turn the button counter-clockwise until it springs back out, then wait 6 seconds for the machine systems to reset, unlocking the safety guard door.

5: Performing a Tool Change

Standard Tool Change System.

The tool change system, supplied as standard with your Microrouter Compact, comprises of four elements:

i) The router motor with attached threaded shaft, bored to allow fitment of the cutting tool and collet assembly.

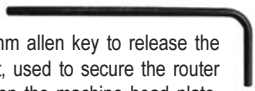
ii) The collet and nut assembly - a tapered, tubular, split metal collet held inside the locking nut, which threads directly onto the router motor threaded shaft. Different sized collets and collet adaptors are available to allow use of cutting tools with varying shank sizes.

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

(i) Router Motor.

(ii) Collet and Nut Assembly.

(iii) Cutting tool.



Use a 6mm allen key to release the bracket, used to secure the router motor on the machine head plate.

Use the two C spanners to tighten the locking nut onto the threaded shaft - one around the nut, the other around the shaft.

Note

Metric convertor collets (to allow fitment of metric shank tools) and various tooling packages are available as options.

5: Performing a Tool Change

Warning

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 the Y and Z machine axes and drive the X axis to roughly the mid point on its axis. When the axes are in this position, the maximum amount of free space will be available in the working area, allowing easier access to the tooling.

Note

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

Your new tool MUST be refitted to router motor 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: Adding and Removing the Router Motor

Warning

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

Warning

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

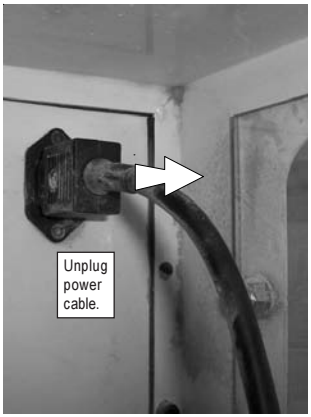
The easiest method of performing a tool change is to remove the router motor from the clamping plate, since the brush guards mounted around the base of the machine head prevent easy access to the router motor shaft.

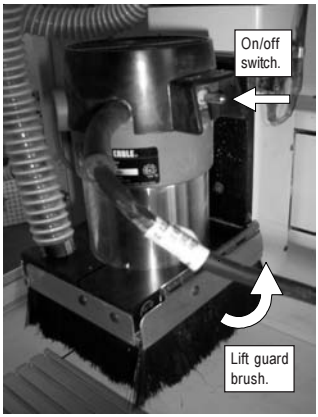
Tools required:

- 6mm allen key (supplied).

To remove the router motor:

1) Following completion of any machining operations, open the safety guard door. Turn off the mains power to the router motor, using the on/off switch mounted on the side of the motor body. Unplug the router motor power cable from the socket, mounted in the top, right corner of the machine back panel.





continued...

5: Adding and Removing the Router Motor

Warning

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

Warning

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

2) Lift up the side brush guard to gain access to the router motor clamping bracket allen bolt. Using a 6mm allen key, loosen the clamping bracket bolt by turning it in an anticlockwise direction.

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

To refit the router motor:

Refitting is the reverse of the removal procedure.
Check that:

- you do not hit the new cutting tool on any part of the machine when positioning the router motor back in the clamping plate.
- the router motor body is pushed fully into the clamping bracket before tightening the clamping bolt.
- once fitted, the router motor power cable will not interfere with any moving parts of the machine.

5: Setting Tools in the Router Motor

Warning

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

Warning

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

Although cutting tools can be changed with the router motor clamped inside the machine working area, it is safer and easier to perform the tool change with the router motor removed, as described in the previous two pages. Transfer the router motor to a suitable workbench, where it can be held securely, since changing the tool is a two handed operation.

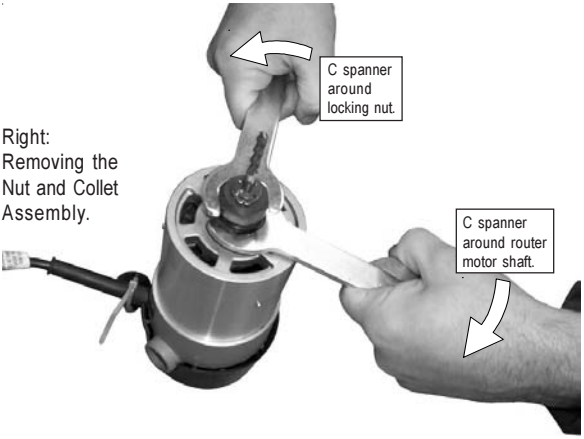
Tools required:

- 2 x C Spanners (supplied).

Removing a Tool.

Position the first C spanner around the locking nut on the end of the router motor shaft. Position the second C spanner around the locating fixture on the router motor spindle.

To loosen the locking nut, when directly viewing the end of the router motor shaft, turn the C spanner around the locking nut in an counter-clockwise direction. Turn the C spanner around the router motor shaft in a clockwise direction, as shown in the photograph below.



Right:
Removing the Nut and Collet Assembly.

Remove the nut and collet assembly, then remove the cutting tool.

continued...

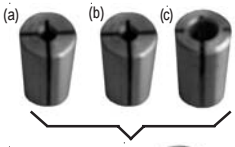
5: Setting Tools in the Router Motor

Note

Metric convertor collets (to allow fitment of metric shank tools) and various tooling packages are available as options.

Refitting a Tool.

Select the correct nut and collet assembly, according to the shank size of your new cutting tool, as shown in the photograph below.



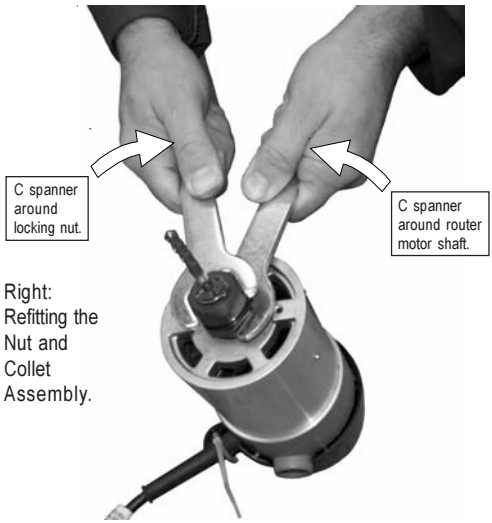
Right: From left to right, collets to convert from 1/2" to (a) 1/8" shank tools, (b) 3mm shank tools and (c) 6mm shank tools. The convertor collets fit inside the 1/2" nut and collet assembly.

Right: 1/2" shank nut and collet assembly.

Left: 1/4" shank nut and collet assembly.

Hand thread the locking nut back onto the router motor shaft, then insert the cutting tool into the nut and collet assembly. Position the first C spanner around the locking nut on the end of the router motor shaft. Position the second C spanner around the locating fixture on the router motor spindle.

To tighten the locking nut, when directly viewing the end of the router motor shaft, turn the C spanner around the locking nut in a clockwise direction. Turn the C spanner around the router motor shaft in an counter-clockwise direction, as shown in the photograph below.



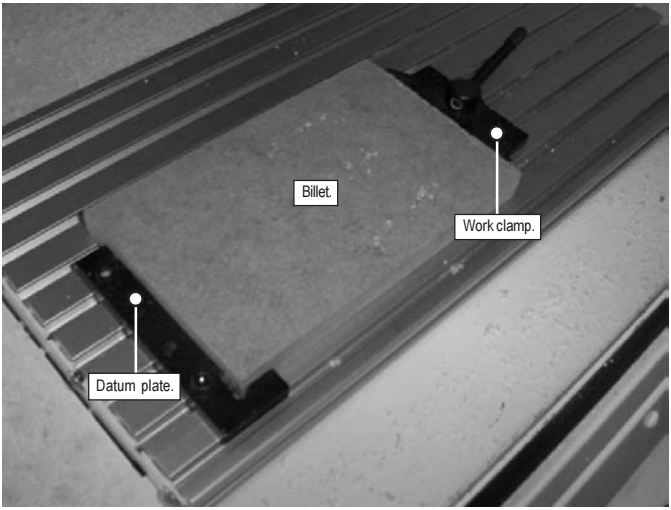
Right: Refitting the Nut and Collet Assembly.

Check that the cutting tool is secure before refitting the router motor to the machine head.

6: Option - The Datum Plate and Work Clamp

The datum plate is an L shaped bracket used to help accurately position the workpiece, or billet, on the machine table. The plate is clamped against the machine table using two tee nut assemblies. The work clamp is fitted to the opposite end of the machine table. It operates using a cam style arrangement, allowing billets to be continually removed and replaced.

Used in combination, the datum plate and work clamp allow projects to be configured that use the same workpiece and tool offsets, since identical billets can be placed in identical positions on the machine table time after time.



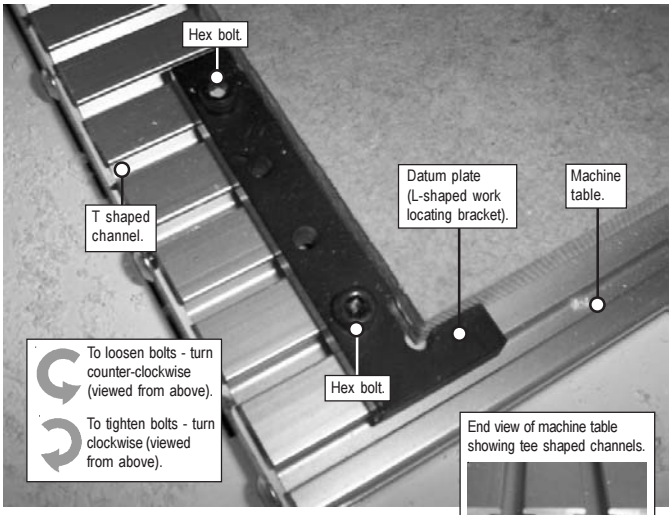
6: Fitting and Removing the Datum Plate

Removing the Datum Plate.

Using a 4mm allen (hex) key, loosen the two hex bolts clamping the datum plate to the machine table. Do not completely remove the bolts at this stage, since this will make removal of the individual tee nuts more difficult. Slide the entire datum plate assembly to a free end of the machine table, release the tee nuts from their respective channels and withdraw the datum plate assembly.

Fitting the Datum Plate.

Loosely assemble the two hex bolts and tee nuts on the datum plate. Four holes are provided on the plate for the tee nut assemblies - we recommend using the two outermost holes, as shown in the photograph below. Move the datum plate assembly to a free end of the machine table, then carefully align each tee nut with the respective channels in the machine table. Slide the assembly to the approximate position required. Using a 4mm allen (hex) key, tighten each of the hex bolts, by turning each bolt in a clockwise direction until they just begin to grip the datum plate to the table surface. It must still be possible to move the datum plate, since final adjustments will be required to align the plate exactly "square" with respect to the edges of the machine table - exactly parallel to the direction of the X and Y machine axes. After adjusting the position of the datum plate, fully tighten the two hex bolts.

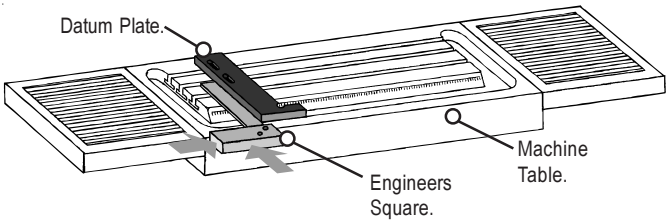


6: Setting the Datum Plate

The following diagrams illustrate the various methods that can be used when positioning the datum plate square with respect to the machine table (ie. the edges of the datum plate run exactly parallel with the X and Y machine axes). Each method varies according to the level of position accuracy required.

Datum Plate Setting Method 1.

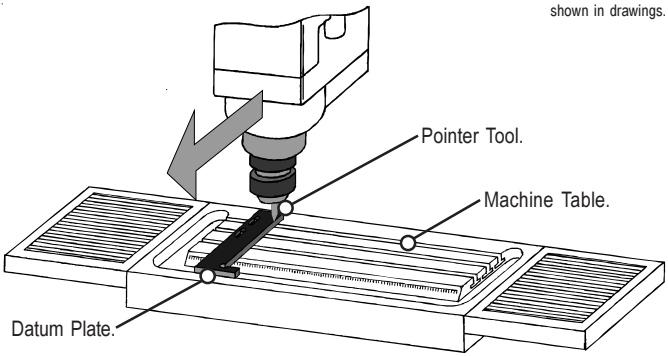
Note - Triac machine table shown in drawings.



To obtain a better degree of accuracy, use an engineers square lined up against the front edge of the machine table. Adjust the datum plate so it touches the engineers square. Finally, tighten the hex bolts to clamp the datum plate firmly in place.

Datum Plate Setting Method 2.

Note - Triac machine table shown in drawings.



Set up the machine so a pointer is held in place of a cutting tool. Align the pointing tool so it is positioned slightly above one of the 2 edges of the datum plate, which run parallel with the Y axis.

continued...

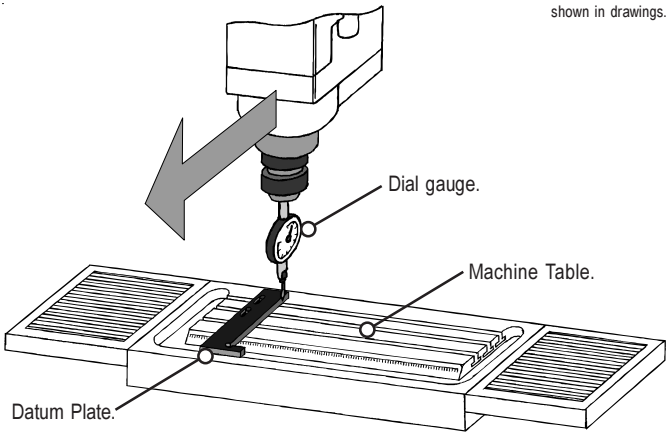
Datum Plate Setting Method 2 continued...

Start with the pointer near the back of the datum plate edge you have chosen. Move the pointer towards the front of the datum plate, checking that the tip of the pointer is still lined up exactly over the edge you have chosen. If the pointer does not align, readjust the position of the datum plate. Keep repeating these steps, moving the pointer forwards and backwards along the datum plate edge, until a suitable degree of accuracy has been obtained.

For a final check, the pointer can be moved above and along one of the datum plate edges which run parallel to the X axis. Finally, tighten the hex bolts to clamp the datum plate firmly in place.

Datum Plate Setting Method 3.

Note - Triac machine table shown in drawings.



Set up the machine so a dial gauge is held in place of the cutting tool. Align the dial gauge so it is positioned along one of the 2 sides of the datum plate, which run parallel with the Y axis.

Start with the dial gauge near the back of the datum plate edge you have chosen. Move the dial gauge towards the front of the datum plate, checking that the values indicated on the dial gauge do not alter. If the values do alter, readjust the position of the datum plate until the values are constant. Keep repeating these steps, moving the dial gauge forwards and backwards along the datum plate edge, until a suitable degree of accuracy has been obtained.

Finally, tighten the hex bolts to clamp the datum plate firmly in place.

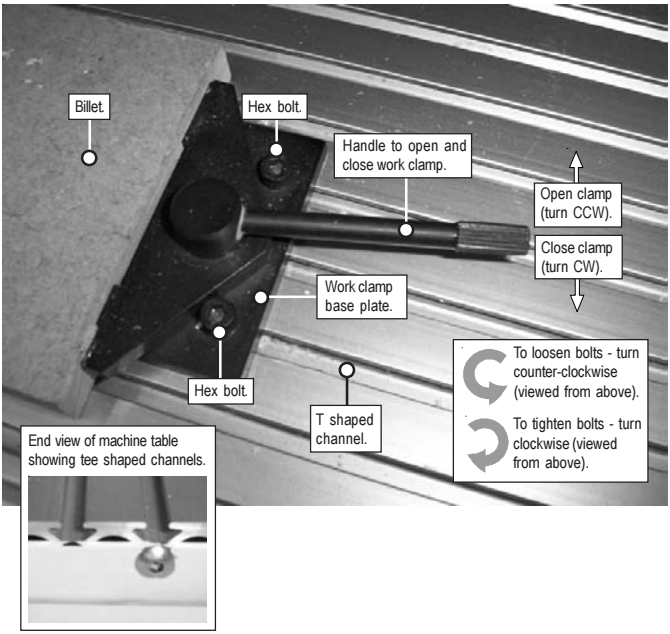
6: Fitting and Removing the Work Clamp

Removing the Work Clamp.

Using a 4mm allen (hex) key, loosen the two hex bolts clamping the work clamp to the machine table. Do not completely remove the bolts at this stage, since this will make removal of the individual tee nuts more difficult. Slide the entire work clamp assembly to a free end of the machine table, release the tee nuts from their respective channels and withdraw the work clamp assembly.

Fitting the Work Clamp.

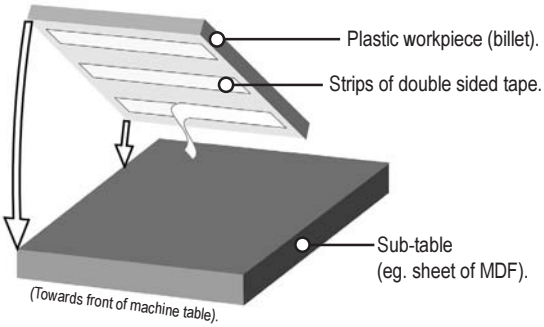
Fit, align and clamp the datum plate as described on page 45. Loosely assemble the two hex bolts and tee nuts through the two holes in the work clamp base plate. Move the work clamp assembly to a free end of the machine table, then carefully align each tee nut with the respective channels in the machine table and slide the clamp onto the table. Before fully tightening the hex bolts, adjust the position of the clamp against your chosen billet, as described on the next two pages.



6: Using the Work Clamp

The work clamp, when used in combination with the datum plate, is a quick and versatile method of securing most pieces of work to the machine table.

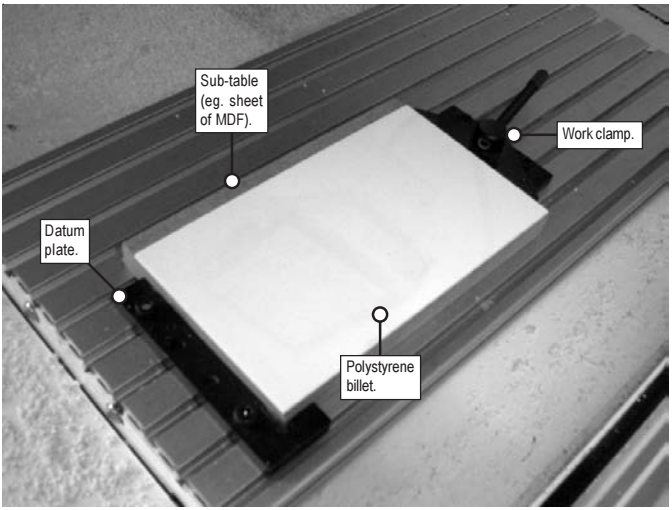
In the example shown below, a polystyrene billet is taped onto a sheet of MDF (medium density fibreboard), with its front and left-hand edges aligned with the front and left-hand edges of the MDF - this front, left upper corner will be configured as the workpiece datum for the machine offsets. The MDF is used as a sub-table - a safety measure to prevent damage occurring to the machine table itself, should a problem occur when milling.



Tape Tip

Use plastic type double sided tape, which can be removed from your billet without tearing. If your billet material comes supplied with a protective film, affix the tape to this film, then simply tear off the film once machining has been completed. Avoid using tissue type double sided tape, which is a strip of tissue with a thin coating of glue each side - this type is very difficult to remove from your billet once it has been machined.

The polystyrene/MDF block can then be added or removed from the machine table without having to reconfigure the machine offsets.



continued...

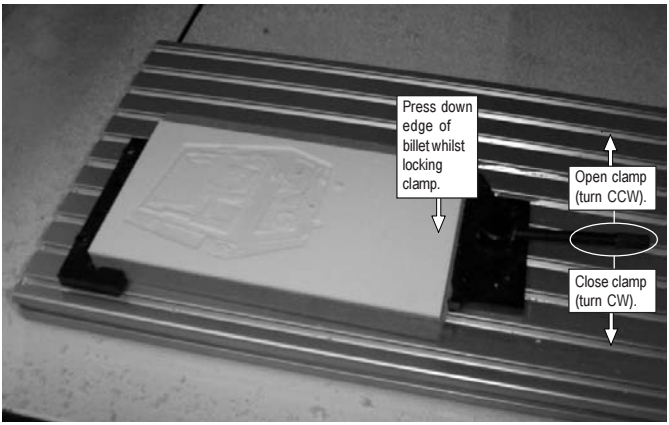
6: Using the Work Clamp

Setting the Position of the Work Clamp.

Place the billet onto the machine table, so it is located correctly against the inside edges of the datum plate. Set the work clamp in the open (unlocked) position. If you have fitted the work clamp to the right end of the machine table, you must push the handle back.

Slide the work clamp assembly along the machine table until the two flats on the clamp plate are just touching the billet. Fully tighten the two hex bolts to firmly fix the work clamp base plate in position on the machine table. At this stage, it should still be possible to remove the billet.

To close (lock) the work clamp, pull the handle forwards. Press the end of the billet down against the machine table, whilst locking the work clamp - this will prevent the end of the billet from lifting. The handle should only need to be turned about one quarter of a revolution before locking the billet firmly in position. If the billet can still be moved, you must loosen the two hex bolts and reposition the work clamp base plate so it is closer to the billet.



Now that the work clamp position has been set, the billet can be continually withdrawn from the machine table, then replaced, always to the same position. This is an advantage for jobs involving the repeat milling of pieces of work, such as a small production run or a college class/group project.

7: Planning Procedure for Maintenance Work

Warning

Caution.

Wear safety glasses and a suitable respiratory mask when cleaning the machine.

Warning

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

Warning

Caution.

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

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

- Before starting any maintenance work, define the task and obtain the information relevant to carry out the maintenance. Also, define the time period needed to complete the task, to obtain the correct tools and order any spare parts, if required.
- During the maintenance work period, display a suitable notice stating that the machine is under maintenance and should not be used until the notice is removed.
- Safety must be a priority when carrying out any maintenance work. Covers and safety guards that are removed during the maintenance work must be replaced after the task is completed.
- All work must be carried out by suitably qualified personnel.
- Never attempt to access the electronic hardware systems of the machine with the mains power switched ON.
- Hazardous voltages can still exist immediately after switching off the power. If the machine has previously been switched on, wait at least 5 minutes before attempting to open the electrical panel access plate.
- When replacing electrical components, ensure the new parts are of suitable replacement specification.
- All work completed on the machine, whether progressive, or preventative, should be logged to ensure a complete service record is available for future referral. We recommend the following two pages are used to log any maintenance tasks undertaken.
- When maintenance work has been completed, check that the replaced or serviced parts work correctly, before allowing general operation of the machine.

7: Maintenance Log

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

7: Maintenance Log

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

7: Maintenance Schedule

Daily	• Clean and remove any swarf inside the machine (the working area). • Clean the tooling and laminate trimmer (the machine head).
Weekly	• Clean the outside surfaces, vents and under the machine base. • Check all exposed screws and nuts for tightness. • Clean the X and Z axis datum microswitches. • Clean under the working area floor (via the two access covers).
Biannually	• Check the condition of any electrical connections. • Check all cables for kinks and breaks. • Check the condition of any drive belts.
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.
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 user maintenance or lubrication is required.
The bearings in the machine are lifetime lubricated bearings, therefore require no periodic lubrication.
Under normal operating conditions, no user maintenance or lubrication is required on the slides and ballscrews.
If you have any doubts concerning any of the routine maintenance checks, please contact Denford Customer Services for clarification and/or assistance.

Warning

Risk of Ignition or Explosion!
Denford recommends that aerosol based cleaning products should NOT be used directly on machine parts, since these products may cause potentially explosive vapours to build-up in enclosed areas of the working area.

7: General Work Area Cleaning

Warning

Caution.

Wear safety glasses and a suitable respiratory mask when cleaning the machine.

Warning

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

Warning

Caution.

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

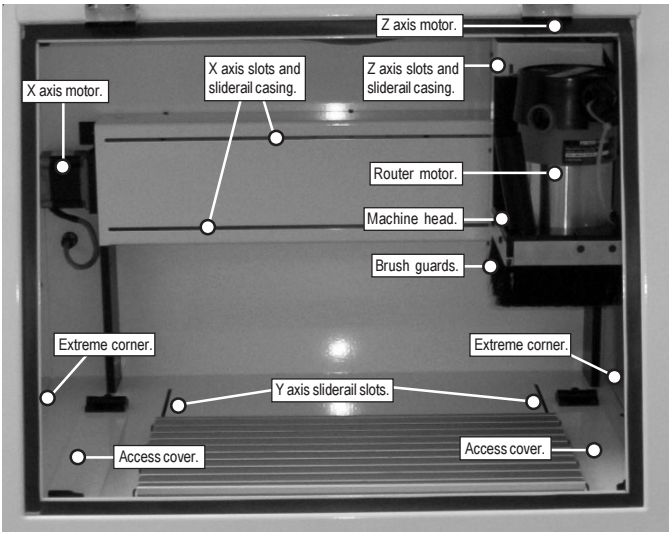
Warning

Risk of Ignition or Explosion!

Denford recommends that aerosol based cleaning products should NOT be used directly on machine parts, since these products may cause potentially explosive vapours to build-up in enclosed areas of the working area.

We recommend that you 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 slots and sliderail casing, running horizontally, left to right, at the back of the machine (see photo below).
- The X axis motor on the left end of the X axis sliderail casing (see photo below).
- The X axis microswitch, mounted under the right end of the sliderail casing (see page 56).
- The two Y axis sliderail slots, cut into the working area floor
- The two Z axis slots and sliderail casing, above the router motor (see photo below).
- The Z axis motor above the Z axis sliderail casing (see photo below).
- The Z axis microswitch, mounted on the right side of the sliderail casing (see page 57).
- Under the working area floor, via the two long access covers at either side of the machine table (see page 58).
- Around the router motor power lead connection plug and socket, in the top, right corner of the back panel (see page 59).
- Above and under the machine head, the brush guards and the router motor clamping bolt on the machine head plate (see page 59).
- Around the router motor vents (see page 59).
- The extreme corners of the machine working area (see photo below).

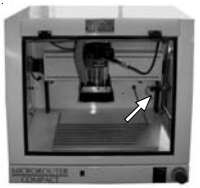


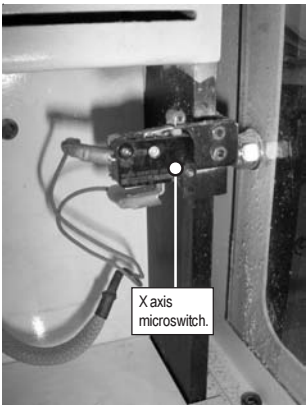
7: Cleaning the X Axis Microswitch

The X axis microswitch is positioned on the bracket under the right end of the X axis sliderail casing, when viewed from the front of the machine. In order to gain better access to the microswitch, drive the machine head towards the left end of the machine.

Location

Look under the right end of the X axis sliderail casing.





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.

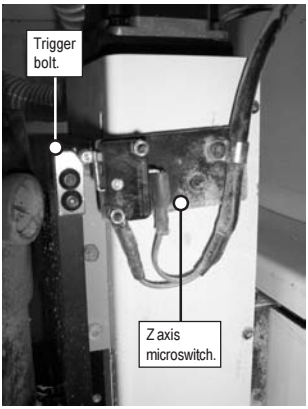
Dust and debris should also be cleaned from the bolt/bracket used to trigger the microswitch. The bolt/bracket is mounted at the bottom of the X axis slideway plate, onto which the Z axis slideway is attached.

7: Cleaning the Z Axis Microswitch

The Z axis microswitch is positioned on the right side of the Z axis sliderail casing, when viewed from the front of the machine. In order to gain better access to the microswitch, drive the machine head towards the left end of the machine.

Location

Look at the right side of the Z axis sliderail casing.



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.

Dust and debris should also be cleaned from the bolt used to trigger the microswitch. The bolt is mounted on the right side of the Z axis slideway plate, onto which the machine head clamp plate (the router motor) is attached.

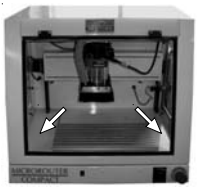
7: Cleaning under the Work Area Floor

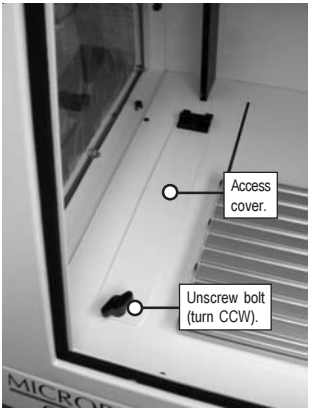
During the normal operation of your machine, some dust and debris will fall beneath the work area floor, usually through the Y axis slideway slots. Most of this dust and debris accumulates towards the left and right ends of the machine.

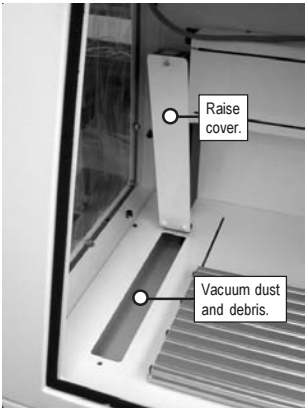
Two access covers are located to the left and right of the machine table. Unscrew (turning counter-clockwise to loosen the bolt) and raise each of the covers. Using a vacuum cleaner, remove any dust and debris, then close and secure the covers, as shown in the photographs below.

Location

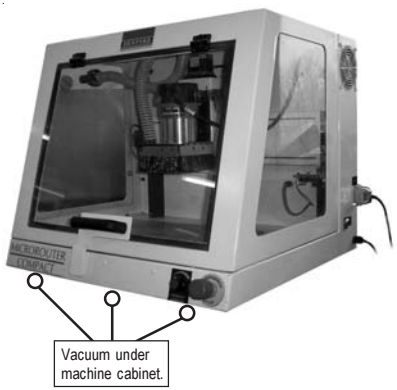
Look to the left and right of the machine table.







A series of holes is also provided in the machine cabinet base under the work area floor, to allow any central dust and debris to exit the machine. Using a suitable long nose tool on a vacuum cleaner, or a brush, reach under the front of the machine and remove any dust and debris that may have accumulated here.

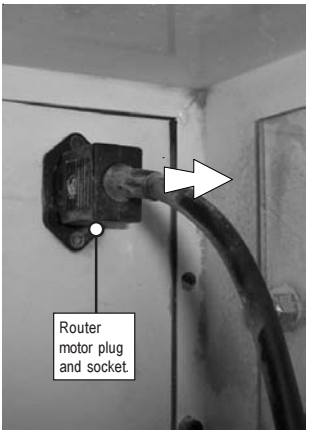


7: Cleaning the Router Motor

Location

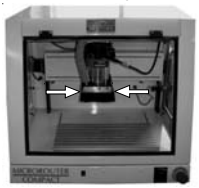
Look in the top, right corner of the machine back panel.

Using a vacuum or a soft brush, clean and dust and debris away from the router motor plug and socket connection, located in the top, right corner of the machine back panel. Remove the power lead plug from the socket, as shown in the photograph right.

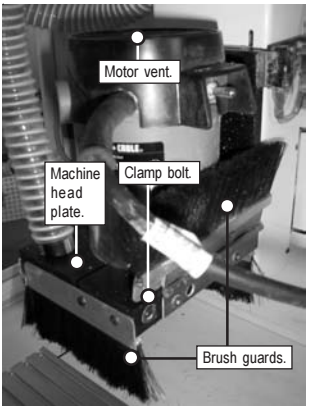


Location

Look around the machine head plate.



Using a vacuum or a soft brush, clean and dust and debris away from the top and bottom of the machine head plate. Clean the brush guards. To remove the router motor, lift the right brush guard and release the clamp on the machine head plate, using a 6mm allen key. Turn counter-clockwise to loosen the hex bolt.



Remove and transfer the router motor to a suitable workbench for cleaning and inspection. Carefully remove any dust and debris from all air passages and vents using a vacuum cleaner or soft brush. 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. Maintenance procedures for the router motor are outlined on the next page.

7: Maintenance of the Router Motor

Warning

Caution.

Wear safety glasses and a suitable respiratory mask when cleaning the machine.

Warning

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

Warning

Caution.

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

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 machine back panel socket. Check the on/off switch on the router motor is set to the “on” position. Check for any blown fuses (referring to the electrical diagrams delivered separately with your machine), replace them and rectify the cause.

Lubrication.

The router 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 router motor service station or Denford agent to be thoroughly cleaned and inspected; worn parts replaced, where necessary; recharged 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 router motor. Do not continue to operate the motor under these conditions.

8: Accessing the Electrical Panel

Warning

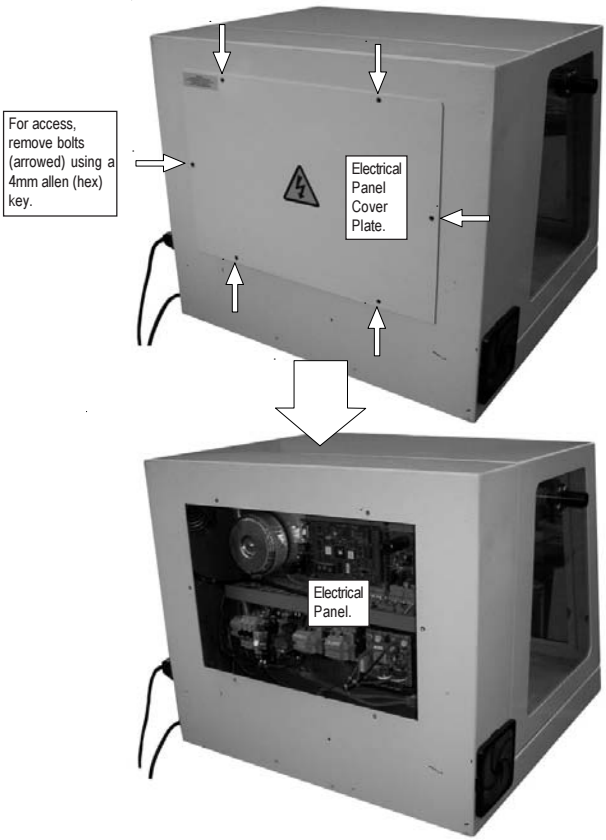
Never attempt to access the electronic hardware systems of the machine with the mains power switched ON.

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 cover plate.

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

Your Microrouter Compact electronics are located in the back of the machine cabinet. Should you need to access the electrical panel, use a 4mm allen (hex) key to remove all the bolts, then withdraw the cover plate, as shown below.



8: Electrical Diagrams

The electrical diagrams for your Microrouter Compact are not included in this guide - they are delivered separately in the standard equipment box supplied with your machine.

Further electrical schematics are available on request - please contact Denford Customer Services.

8: Layout of the Electrical Panel

Note

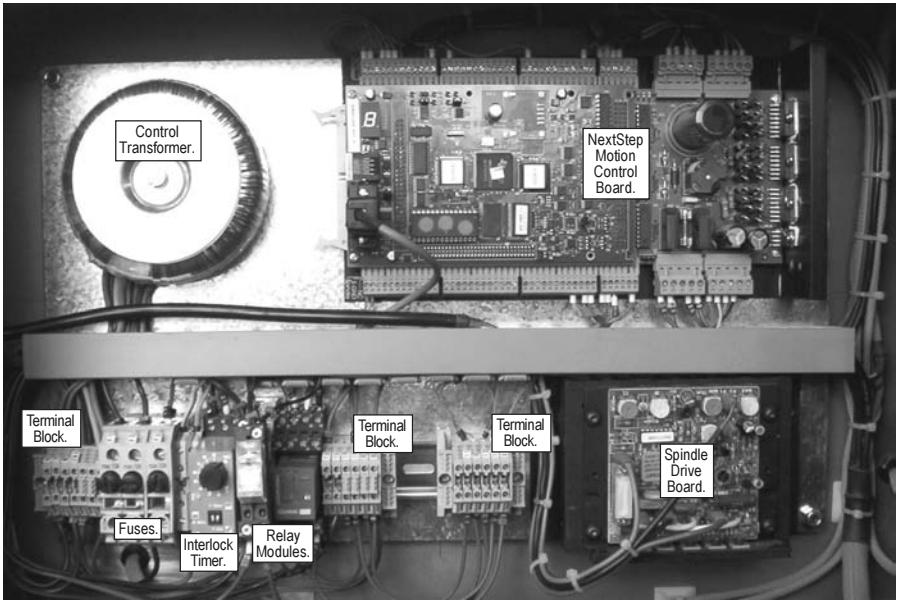
The Electrical Diagrams for your Microrouter Compact are not included in this manual - they are delivered separately in the standard equipment box supplied with your machine. Further electrical schematics are available on request.

The photo below labels all important areas on the Microrouter Compact 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 Compact.

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 Compact Electrical Panel Layout.

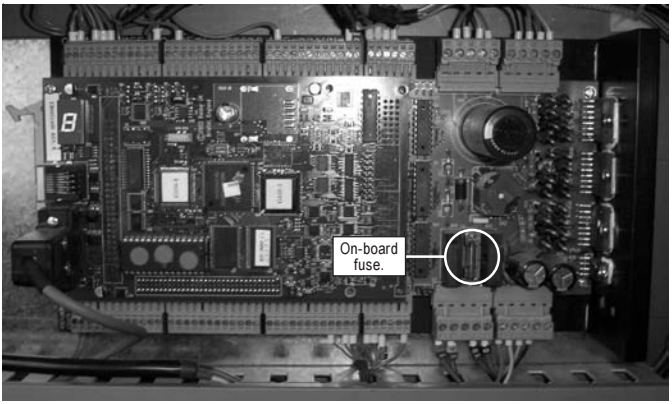


8: The NextStep Motion Control Board

Warning

Hazard Voltages exist within the machine - when removing the electrical panel cover plate always isolate the power and leave all electronic components untouched for at least 5 minutes.

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



The NextStep motion control board processes the step and direction signals, which are then passed to the drive units used to control the three machine axes.

The NextStep motion control board is mounted in the top right corner of the electrical panel (as shown in the panel layout on page 62). Note the position of the on-board fuse, mounted on the right-hand side.

Motion Control / Axis Drive Troubleshooting.

Check the validity of the following:

1) Check the emergency stop button is not depressed.
2) Check the machine has not triggered any overtravel limit switches.
3) Check the NextStep on-board fuse (shown in the photograph above).
4) Check the control transformer input fuse - labelled F2 and the control transformer output fuse - labelled F3. Both of these fuses are mounted on the main fuse rack.

   In addition, refer to the electrical schematic diagrams for specific fuse details and labelling.

8: The NextStep Motion Control Board

Warning

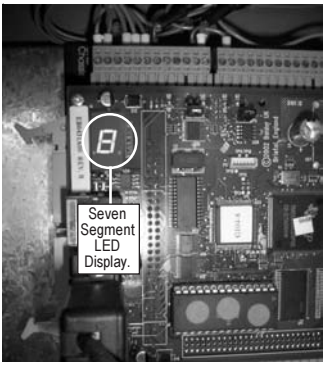
Hazard Voltages exist within the machine - when removing the electrical panel cover plate always isolate the power and leave all electronic components untouched for at least 5 minutes.

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

LED Status and Fault Display Codes.

The status of the motion control can be determined from the LED display, mounted on the left side of the NextStep board.

Errors are all shown with a flashing dot in the bottom right corner of the LED display.



Whilst NextStep is powering up:

..... Indicates FPGA has booted successfully.

..... Indicates FPGA 'walking ones' test on FPGA scratchpad has failed. HALT.

..... Indicates pseudo random number test on all of RAM has failed. HALT.

..... Indicates CAN controller reset has failed. HALT.

..... Indicates 'walking ones test' on the CAN controller has failed. HALT.

..... Indicates that power up test did not find any valid Firmware in Flash device.

. Indicates that new firmware is being loaded into the NextStep control.

When NextStep has powered up:

..... Normal indication that card is powered up. Figure '2' is the default card NODE number.

..... Axes disabled, normally after downloading Mint (MEX file) for the first time, before starting Denford S/W.

..... Flashing E whilst Flash memory is being erased and mint (MEX) file is being downloaded.

When Mint is running and Denford Software is connected:

Note that these figures relate to axis 0 specifically (ie, the X axis).

..... Axis is enabled.

..... Flashing E. A general error has occurred (possible Mint failure).

..... A SPLINE move is being executed.

..... A circular move is being executed.

..... A Flying shear (used in lathe threading moves) is being executed.

..... Axis is in homing sequence.

..... Axis is performing a positional linear move.

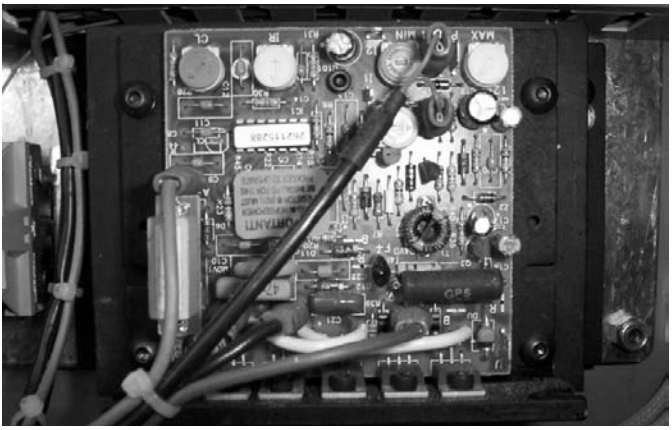
. Flashing sequence. Emergency Stop has been pressed. On Denford S/W this is a solid S symbol.

8: The Spindle Drive Board

Warning

Hazard Voltages exist within the machine - when removing the electrical panel cover plate always isolate the power and leave all electronic components untouched for at least 5 minutes.

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



The spindle drive board controls the motor for the programmable spindle. The board is mounted in the bottom right corner of the electrical panel (as shown in the panel layout on page 62).

Spindle Drive Troubleshooting.

Check the validity of the following:

1) Check the emergency stop button is not depressed.
2) Check the spindle drive fuse - labelled F1. This fuse is mounted on the main fuse rack.
3) Check the control transformer input fuse - labelled F2 and the control transformer output fuse - labelled F3. Both of these fuses are mounted on the main fuse rack.

   In addition, refer to the electrical schematic diagrams for specific fuse details and labelling.

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 Denford websites for support.
Internet (access technical support and FAQ sections):
Denford UK: http://www.denford.co.uk
Denford USA: http://www.denford.com

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 (from the “Help|About” menu option).
- The wording of any error messages that appear on your computer screen, if applicable.
- A list of the steps that were taken to lead up to the problem.
- A list of any maintenance work that has been carried out on the CNC machine.

Contact Details:
Denford Limited,
Birds Royd, Brighouse, West Yorkshire, HD6 1NB, UK.
Telephone: 01484 722733
Fax: 01484 722160
ISDN: 01484401157:01484401161
E-mail: customerservices@denford.co.uk
Technical Support: Monday to Friday 8.30am - 4.30pm GMT
For international dialling: +44 and remove first 0 in each city code.

9: Troubleshooting - VR CNC Milling Software

Note

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

1) Your computer communicates with your Microrouter Compact using the Denford Machine Link cable. Check the Denford Machine Link 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 machine cabinet.
2) Check all mains power connections are correctly fitted and secure. Power up the Microrouter Compact, using the red on/off switch, mounted on the right end panel of the machine cabinet. If no power is present, switch off the mains supply, then wait at least 5 minutes before attempting to access the Microrouter Compact electronics. The Microrouter Compact electrical panel is mounted at the back of the machine cabinet, behind the removable cover plate. Check the condition of the on/off switch and any 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 either this or your CNC Control Software manual.

3) Start the VR CNC Milling software (from the default installation, click “Start | Programs | Denford | VR Milling”). The name of CNC machine that can be directly controlled by the VR CNC Milling software is displayed on the main program titlebar. 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. The name of the active machine in the software must match the name and version of your real CNC machine - this information is printed on the CE identification panel, usually applied to one of the machine cabinet end panels. 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. Reopen the "Machine Properties" window to check that the changes have been applied.

continued...

> **Note**
>
> Any optional equipment fitted to your Microrouter Compact can be configured using the options available in the "Machine Properties" window.

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. Set the "Baudrate" to the highest value possible, according to the specifications outlined in your computer or motherboard manual. Baudrate is the speed at which data can be transferred through your COM ports. Set the "Stop Bits" 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 the NextStep Motion Control Board, referring to the descriptive list to determine the condition of the board. A problem with this card can cause problems with communications. The board is located in the top, left corner of the electrical panel. For more information, refer to Section 8 - Machine Electronics. If no display is shown, call Denford Customer Services for assistance.

   Warning - Risk of electric shock. Note that in order to check the readout, the CNC machine must be powered up with the electrical panel exposed. Exercise extreme caution - do not touch any live electrical components since damage may occur to the hardware or technician inspecting the equipment. Remember to shutdown the CNC machine, then replace the electrical panel cover plate, on completion of this step.

7) Check the COM port on your computer 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...

   Thoroughly check the condition of the Denford Machine Link cable. If the cable is bad, communication will not occur. Try using a different computer to connect to the Microrouter Compact. Check for help on the technical support, FAQ and download sections of the Denford websites and/or contact Denford Customer Services for further assistance.

9: Troubleshooting - VR CNC Milling Tool Offsets

Incorrect registration of tool offsets, when using multiple tools of the same diameter with VR CNC Milling Software:

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.

9: Troubleshooting - Mechanical Problems

The safety guard door cannot be opened :

In most cases, this is because the interlock guard switch has locked the door in the closed position. The interlock guard switch is mounted behind the front, lower machine panel, accessible from beneath the front of the machine.

Check the following:

1) Mains power is reaching the CNC machine. Check the mains plug is fitted to an available power socket and the socket is switched on. Check the Microrouter Compact on/off keyswitch, mounted on the right end panel of the machine cabinet, has been turned to the on “I” position.
2) The emergency stop button is not pressed in. To release, push and turn the button clockwise until it springs back out to its ready position.
3) No CNC program is running. Wait for all machining operations to finish, then switch the software to operate in jog mode.

9: Troubleshooting - Cutting Problems

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 following:

1) The workpiece and tool offset files have been configured and applied successfully. If no offsets have been configured, the CNC machine will use the machine datum as the starting point for any machining co-ordinates read.
2) The X and Y values entered in the workpiece offset file are correct.

Poor surface finishes are obtained :

Check the following:

1) The correct feedrates and spindle speeds are being used, appropriate for the cutting tool profile and type of material being machined. Recommended feed and speed values should be available from your tool and material supplier. Note that running incorrect feeds and speeds can severely shorten the life expectancy of your tools.
2) The billet being machined is securely clamped.
3) The correct tool profile, appropriate to the finish required, is being used. Check that the cutting edges are sharp and undamaged.
4) Any machine drive belts are correctly tensioned and not slipping.
5) The tool profile is held securely in the tool holder or collet, which in turn is held securely in the machine spindle.

When using double sided tape, the billet keeps lifting from the sub-table (sheet of MDF) :

Check the surface of the sub-table is clean and smooth before attempting to add the billet. Routinely clean tape adhesive residue from the sub-table. Check tape adequately covers all parts of the billet. Check the sequence in which the various parts of your design are machined. For example, machine any small or etched surfaces before cutting pieces completely out from the billet. If you keep the largest solid area of the billet attached to the sub-table for as long as possible, you reduce the likelihood of the billet moving during machining.

9: Troubleshooting - Electrical Problems

Warning

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

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

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

Warning

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

Note

Always refer to your electrical schematic diagrams for the definitive labelling and placement of components and fuses. Information contained on this page is correct at the time of printing - April 2003 - but is liable to change through continuous development of our products.

The spindle drive is not working :

Check the validity of the following:

1) Check the spindle drive fuse, labelled F1.
2) Check the control circuit fuse, labelled F3.

   All fuses are mounted on the main fuse rack. In addition, refer to the electrical schematic diagrams for specific fuse details and labelling.

The axis drives do not respond :

Check the validity of the following:

1) Check the emergency stop button is not depressed.
2) Check the machine has not triggered any overtravel limit switches.
3) Check the axis drive transformer input fuse - labelled F2, the axis drive control fuse - labelled F3 and the axis drive transformer output fuse - labelled F4.

   All fuses are mounted on the main fuse rack. In addition, refer to the electrical schematic diagrams for specific fuse details and labelling.

The router motor fails to start :

Should the router motor fail to start, check that the prongs on the mains power cord plug are making good contact inside the socket outlet. The socket is mounted in the top, right corner of the cabinet back panel, when looking at the front of the machine. Also, check for any blown fuses or indications within your CNC machine control software.

10: Specification of Microrouter Compact

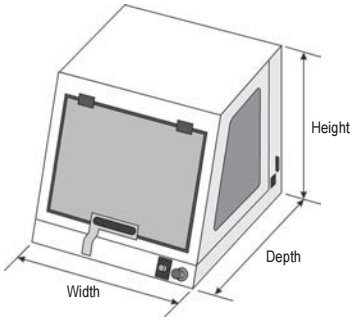
Standard Equipment:
- Microrouter Compact CNC machine.
- Quick release interchangeable router motor (laminate trimmer).
- CNC machine control operating software.
- Installation, commissioning, maintenance and instruction manuals.
- Set of maintenance tools and spare parts list.
- Dust collection system (vacuum not included).

Extra Equipment:
- CAD/CAM software and manuals.
- On-screen representation of industrial control systems (FANUC 21i) and optional link to industrial keypad.
- Courseware and project books.
- Various tooling packages.
- Additional and/or on-site training courses.
- On-site CNC machine commissioning.
- Additional offline programming software.
- Portable machine work bench.
- Video conferencing system.
- PC and workstation.
- 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.

Mechanical Details:
- Table size: 400mm x 200mm (15 3/4" x 7 7/8").
- Travel X axis 400mm (15 3/4").
- Travel Y axis 200mm (7 7/8").
- Travel Z axis 100mm (3 15/16").

Dimensions:
- Machine width 670mm (26 3/8").
- Machine height 578mm (22 3/4").
- Machine depth 690mm (27 3/16").
- Machine height with guard door open 1005mm (39 9/16").



Weights:
- Machine weight 90 KG (198 lb).

Electrical Details:
- Mains supply required:
  220/240Volts, 50Hz, 8Amps.
  110/120Volts, 60Hz, 15Amps.
- Spindle motor: 1.1 kW, 1.5HP.
- 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.

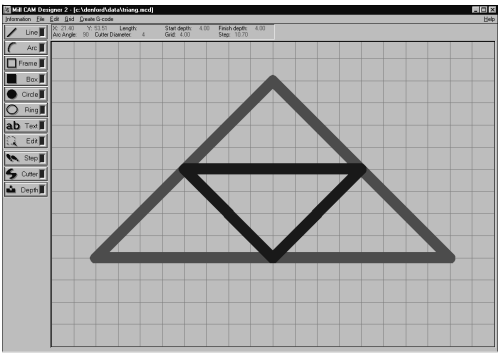
Each program word is composed from a letter, called the address, along with a number.

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 X100.0 Y90.0 Z20.0
This sets the measure to metric (Note - if set to Imperial the units would be inches) and defines the billet as100mm long by 90mm wide, with a depth of 20mm.

[SUBPROGRAM
This directive allows a program with a non-numeric name to be called as a subprogram.
Example:
[SUBPROGRAM 0200 FRED
M98 P0200
This example assigns a subprogram number of 0200 to the program named FRED, then calls the subprogram 0200.

[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.

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 Compact 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-RC 1-01.

Back of the EC Declaration of Conformity Certificate.

Microrouter Compact Series Noise Level Test Results

Test Report No: NL - RC 1 - Ø1.

Machinery Manufacturer: Denford Limited.

Machinery Type/Model: Microrouter Compact Series.

The Microrouter Compact can be supplied with dust extraction. The test was carried out with and without this option, using a "Yorkleen Woodvac WY1" vacuum.

Equipment:

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

Denford Microrouter Compact CNC machine - 1 off.

Yorkleen Woodvac WY1 - 1 off.

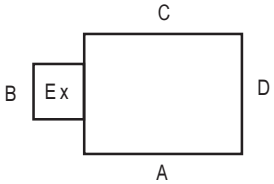


Diagram Key:

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

Ex: Vacuum for dust extraction.

Test Conditions:

Spindle speed: 10,000 to 24,000 RPM.

Axis speed: 900 mm/min.

Ambient background noise: <60 dB (A).

Test Results:	Sound Levels dB (A) Position			
Condition	A	B	C	D
24,000 RPM + Vacuum ON	78	77	76	75
20,000 RPM + Vacuum ON	78	77	76	75
20,000 RPM + NO Vacuum	78	75	75	75
10,000 RPM + NO Vacuum	70	68	70	70
Vacuum ONLY	70	71	65	69

Back of the Microrouter Compact Series Noise Level Test Results Certificate.

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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.

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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.

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.

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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 tooling 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).

ROUTER MOTOR ..... The removable cutting head (motor). Also referred to as the machine head.

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.

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SOFTWARE ..... Programs, tool lists, sequence of instructions etc...

TOOL OFFSET ..... When machining, allowances must be made for the size of tools being used, since they all differ in length. The tool offset is the amount the Z value must be moved (or offset), so that all the different cutting tool tips used line up with each other, so they can all be used by one CNC file. See OFFSET.

TRAVERSE ..... Movement of the cutting tool through the 3 machine axes between cutting settings.

TXT ..... Standard Windows text only file, extension ".txt".

WORK (WORKPIECE) ..... The actual material being 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: 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