



MCR100 / F1 Router
CNC Machine
User's Manual

UK
CA | CE
approved



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1 : Notes



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1: Warning Notices

Warranty Disclaimer.

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

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

Maintenance Disclaimer.

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

Use of Machine.

Your Router is designed for machining F1 In Schools approved model blocks. The appropriate tooling, speeds and feeds should be used as recommended by Denford Limited. Information regarding the safety specification of the materials to be cut can be obtained from Denford Limited. Facility is provided for connecting a vacuum system for dust extraction. Always use the machine coupled to such a system.

Your Router is not intended for use with any metals, the machine is only designed to cut the F1 In Schools approved model blocks.

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

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

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

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

1: Warning Notices



Sound Level Disclaimer.

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

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

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

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

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

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



Portable Appliance Testing.

In-Service Testing

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

In-Service testing will involve the following:

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

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

1: Warning Notices

Portable Appliance Testing (continued).

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

Preliminary inspection

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

- Cables located so as to avoid damage
- Means of disconnection/isolation readily accessible
- Equipment positioned to avoid strain on cord
- Equipment is being operated with the covers in place
- Indiscriminate use of multi-way adaptors and trailing sockets is avoided
- Identify signs of overheating
- Identify signs of damage to insulation
- Check the correct size fuse is fitted (10A)
- Check the flexible cable connections and anchorage.

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

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

Earth continuity Test (Class 1 equipment)

The test should be carried out at 25A for a period of 5 – 10 Seconds
The reading should be less than $0.1 + R$ (where R is the resistance of the lead)

Insulation Resistance Test (Class 1 equipment)

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

The insulation Resistance should be greater than 1M Ohms

1: About this Manual

Using this manual	<p>This manual provides information describing how to transport, site, setup and operate the basic functions of your Denford Router CNC machine, including any operational features of hardware specific to the Denford Router series.</p> <p>This manual does not provide any information regarding the software packages used. Please refer to the help section within the appropriate software.</p> <p>Please note that the Electrical Diagrams for your Router are not included in this manual - they are delivered separately in the standard equipment box supplied with your CNC machine.</p> <p>If you have any doubts and/or questions regarding the specification, servicing, or features of your Router, 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.</p>
Disclaimer	<p>Please note that due to the nature of hardware and software developments, the specifications and features of this product can change without notice. The information contained in this manual is correct at the date of printing only - February 2023. No liability can be accepted by Denford Limited for loss, damage or injury caused by any errors in, or omissions from, the information supplied in this manual.</p>
Screenshots	<p>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 Router.</p>
Language	<p>This manual is written using European English.</p>
Contact	<p>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</p>

1: Introducing your MCR100 / F1 Router

Congratulations on your purchase of a MCR100 / F1 Router CNC machine. In this manual you will learn how to setup and use your Machine correctly and safely.



Your Router is a full three axes CNC router with a fixture specifically designed for machining F1 In Schools racing cars. Suitable for all levels of education and training, it is manufactured to meet industrial standards. Together with rapid traverse rates of up to 5000 mm/min your Router is the ideal partner for intensive 3D applications. Your MCR100 / F1 Router is designed with you in mind - making the processes involved both safe and easy to use.

Main Features:

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

1: Before Beginning to Setup

Before beginning to set up your MCR100 / F1 Router, please check your separate order documentation, making sure that all items have been delivered to your establishment. Any missing or damaged items should be reported to Denford Customer Services as soon as possible.

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

- MCR100 / F1 Router CNC machine. Note that the precise specification of your CNC machine will depend on any options selected at the time of ordering (see below).
- 1/4" Collet.
- 1 x Allen (hex) keys pack.
- 1 x 17mm A/F Spanner.
- 1/4"Dia. Ball Nose Cutter.
- 1 x MCR100 / F1 Router warranty pack (UK Machines only).
- 1 x CD-ROM containing Denford VR CNC Machine Control Software and manuals, and Machine user's manual
- 1 x CD-ROM containing VR CNC Machine Control Software Security Key.
- 1 x RJ45 Ethernet cable.
- 1 x USB to RJ45 adaptor.
- 1 x Mains Cable.
- 1 x Spare fuse pack.

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

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

2: Safety Features and Precautions

Safety Features Overview.

The following safety features are standard on your Machine:-

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

Safety Precautions.

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

General Safety Precautions :

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

2: Safety Features - Emergency Stop



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

A circular, red emergency stop button is located on the right front panel of your Router, as shown above. When pressed, it has the effect of stopping all axes movements and bringing the spindle to a controlled stop. 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 activate an emergency stop, press the button in until it clicks. The emergency stop button will continue to cut all power to the machine drives and keep the interlock switch closed, until the release sequence is performed.

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

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

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

2: Safety Features - Interlock Guard

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

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.

Under no circumstances must the safety switch actuator be removed (or a spare or replacement actuator, or other device be used) to defeat the safety interlocking system.

Note

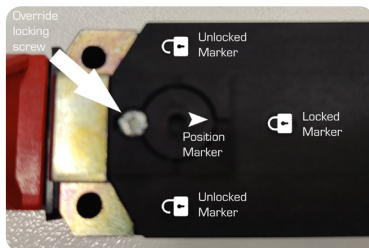
When the guard lock feature is disabled, the machine spindle will not operate. Ensure this is enabled before operation.

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. 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.



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

- 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.



Above: Looking directly at the face of the interlock guard switch

2: Dust Extraction & General Dust Precautions

If cutting known hazardous materials, the machine must be used with a suitable dust extraction system fitted and enabled.

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

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

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

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



General Dust Safety Precautions.

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

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

Never use a compressed airline for this purpose.

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

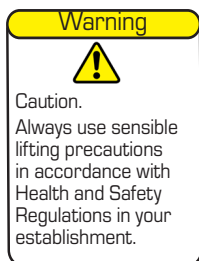
Dust particles on the floor can cause slipping. This should be monitored by the operator and removed before becoming a hazard.

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

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

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

3: Unpacking and Lifting your CNC Machine



If your CNC machine has been supplied inside a delivery box, cut the top of the box open and remove any packaging carefully. To obtain better access to the machine, remove all the sides from the delivery box. Your MCR100 / F1 Router weighs 45 kg and is designed for bench mounting.

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

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



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

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

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

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

3: Choosing a Site for your CNC Machine

Site your machine in a well ventilated room. If the Router is supplied for bench mounting 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.

If the Router is supplied with a Universal Machine Bench, the adjustable corner feet should be wound down to contact the floor to help minimise noise and vibration.

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 right hand side of the cabinet. Positioning the PC on a movable workstation may allow easier access to the various vents, connectors and switches on the machine cabinet, when required.

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

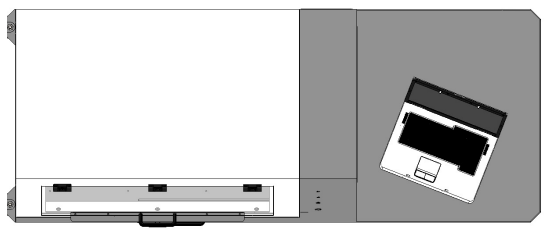
Do not place the machine in a position which allows any of the cabinet vents to be covered. Ensure all cables, pipes and flexes are routed to avoid the possibility of users tripping over them.

DENFORD®

- Dust extraction
- Ensure that any inlet/exhaust vents are not covered or blocked.
- Allow space to remove the electrical panel cover plate at the side of the cabinet.

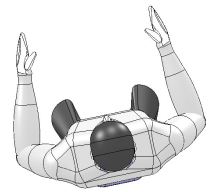
Dimensional Data.

- Machine Width (left to right) 540mm (21.25").
- Machine height (top to bottom 525mm (20.7").
- Machine depth (front to back) 445mm (17.5").



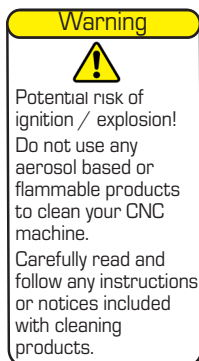
Computer angled towards Operator.

Plan View showing Ideal Machine Layout and Operating



Machine Operator.

3: Removing Protective Coatings and Packaging



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

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

4: Switching the Router On

Note

The safety guard cannot be opened until the Router 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 10 minutes before attempting to open the electrical panel cover plate.

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

Follow these instructions to switch on your Router:

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

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

4: Switching the Router 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.

Warning



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

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

Follow these instructions to switch off your Denford Router off:

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

4: Homing the Machine Axes (Home Mode)

Note

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

Immediately after establishing a communication link between the CNC control software and the Router, 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 router and the CNC machine control software, or when the CNC machine "loses" position, the software will not know the true position of the machine head in relation to the three machine axes.

Note

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

Homing the CNC machine defines:

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

Note

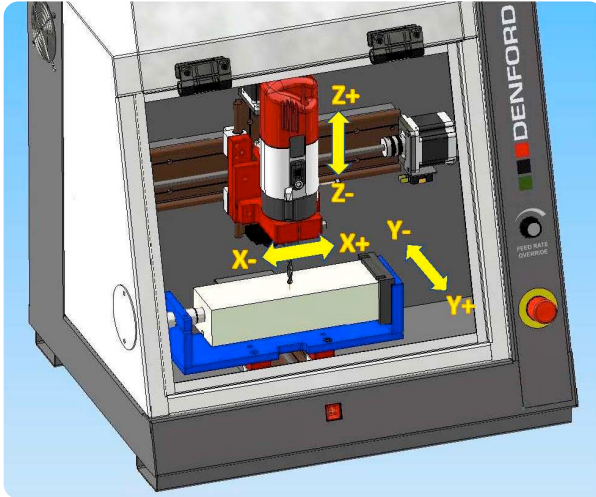
The machine datum position is set by Denford and can never be moved, since it defines the physical movement capability of the CNC

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

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

4: Manual Control - Axis Definitions (Jog Mode)

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



Axis Definitions.

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

Jog Keys to move axis - arrow keys left and right

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

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

Jog Keys to move axis - arrow keys up and down

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

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

Jog Keys to move axis -Page up and Page down

4: Machine Operators Panels

Note

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

Feedrate Override Controls.

The feedrate of the MCR100 / F1 Router can be manually overridden during a machining operation, using the potentiometer controls fitted to the operators panel.

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

To increase the feedrate, rotate the control clockwise.

To decrease the feedrate, rotate the control counterclockwise.

The degree of adjustment applied is displayed in the CNC control software.

Warning



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

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

Mains Power Switch.

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

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

Note

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

Emergency Stop Button.

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

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.

Note

When two or 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 a Manually Requested Tool Change.

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

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

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

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

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

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

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

5: Performing a Tool Change

Standard Tool Change System.

The tool change system, supplied as standard with your MCR100 / F1 Router, comprises four elements:

- i) The spindle motor with attached threaded shaft, configured to allow fitment of the cutting tool and collet assembly.
- ii) The collet and nut assembly - a tapered, tubular, split metal collet held inside the locking nut, which threads directly onto the 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. (See recommendations below).
- iv) Tooling - 1 off 17mm spanner is supplied with the machine.

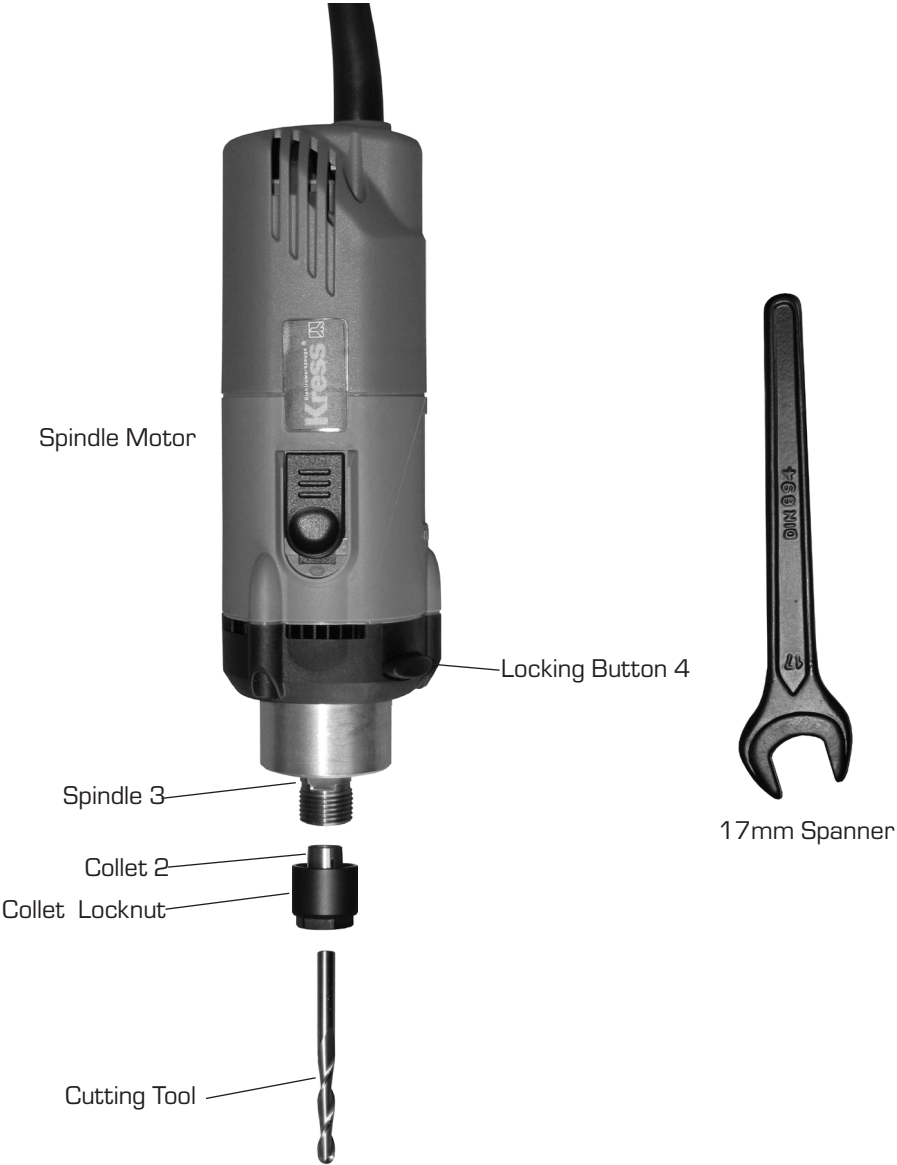
Bear in mind the following recommendations when choosing tools:

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

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

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

5: Performing a Tool Change



5: Setting Tools in the Router Motor

Tools required:

- 1 x 17mm Spanner [supplied].

Removing a Tool.

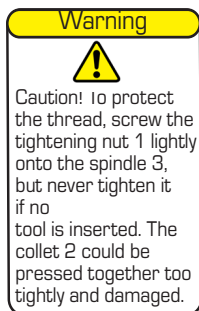
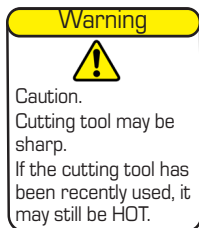
Lock the spindle 3 with spindle lock 4.
using the 17mm spanner unscrew the locking nut 1.
remove the nut and collet assembly.
then remove the cutting tool.

Refitting a Tool.

Select a tool to be fitted. If necessary also select a new collet according to the shank side of the new cutting tool, fit this into the locking nut - see porcedure for changing collets.

Lock the spindle 3 with spindle lock 4.
Hand thread the locking nut and collet assembly back onto the motor shaft, then insert the cutting tool.
with the spindle still locked, tighten the locking nut using the 17mm spanner.
check that the cutting tool is secure beofre putting the machine back into operation.

Changing a Collet



Lock the spindle 3 with spindle lock 4. Using the 17mm spanner unscrew and remove the locking nut 1 with the collet 2.



Using thumb and index finger, press the collet 2 together at the continuous slot.



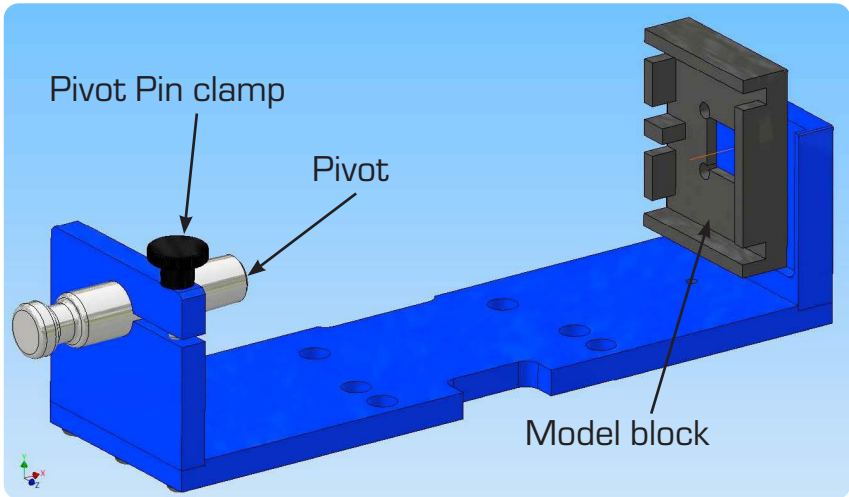
Tilt the collet 2 off and remove it from the locking nut 1. Push new collet into back of locking nut until it clicks into place.

6: F1 Model Block Manufacturing Fixture

Introducing the F1 Car Manufacturing Fixture.

The MCR100 / F1 Router is fitted with a bespoke F1 Car Manufacturing Fixture as standard, designed to hold the F1 In Schools approved model blocks.

The frame of the fixture shown in blue is clamped to the Y-Axis assembly and is not adjustable or need to be removed from the machine during normal machining operations.



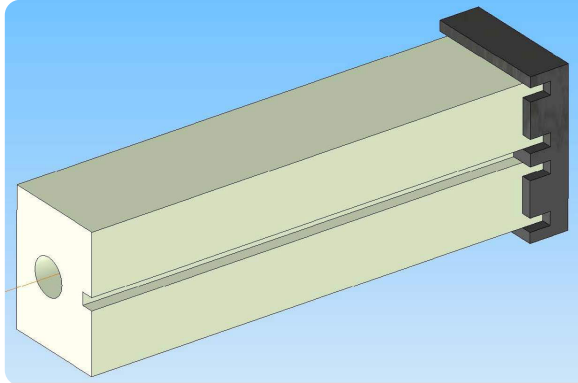
The parts identified above are the parts necessary to mount the F1 Model Block into the fixture.

Before mounting a model block remove the Model Block Clamp from the square spigot on the right hand fixture upright, slacken the pivot pin clamp screw and slide the pivot pin to the left to facilitate block mounting.

6: F1 Model Block Manufacturing Fixture

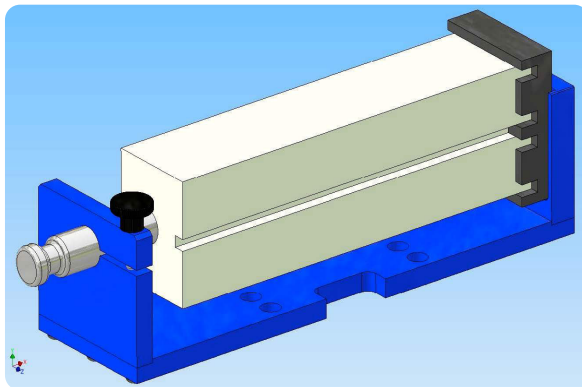
Mounting an F1 In Schools Approved Model Block.

Remove the authentication band with holographic sticker from the model block and retain it in a safe place as it will be required for inspection prior to racing. Position the model block in the block clamp as shown noting the location tab fits the slot in the block, its a tight fit but avoid excessive force as this may damage the block.



Position the block as shown below engaging the clamp block on the square spigot on the right hand upright of the fixture. Slide the pivot pin into the location hole in the F1 block until the taper securely engages in the hole. Tighten the pivot pin clamp screw to secure the pin in position.

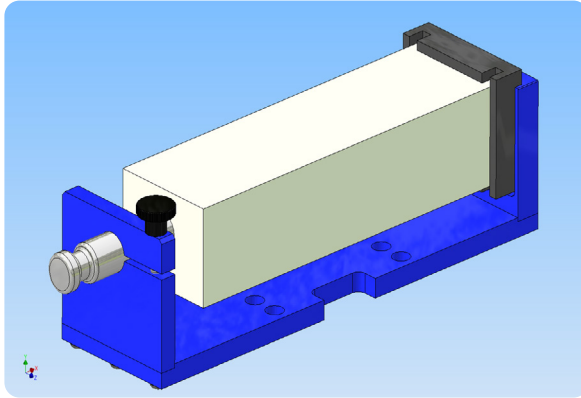
Depending on the design of the F1 car, machining would normally take place with the model block positioned in the fixture (with its smaller edges top and bottom as shown below) machining one side of the car then turning the block over 180 deg to machine the other side.



6: F1 Model Block Manufacturing Fixture

Rotating the Model Block in the Fixture.

When the machining of one side is completed the Pivot Clamp Screw can be loosened un-clamping the Pivot Pin and the Model Block with the Model Clamp Block still attached can be withdrawn just enough from the square location spigot to allow it to be rotated 90, 180 or 270 deg, then repositioned on the square spigot and re-clamped in the fixture to allowing further machining.



Alternative block mounting

7: Re-aligning the F1 manufacturing

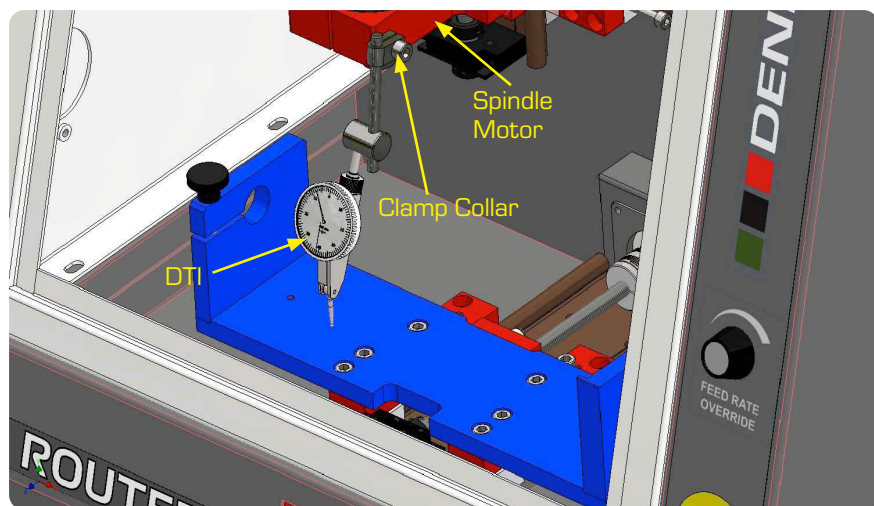
The machine is delivered from the factory with the F1 car manufacturing fixture mounted and aligned to the machine. Under normal operating conditions re-alignment of the fixture is not required.

However should a problem occur for example after a collision or in the case the fixture needs to be removed for maintenance reasons it will be necessary to re-align the fixture within the machine.

Re-alignment of the fixture can be carried out using a Dial Test Indicator (Finger Type) referred to as a DTI, or by using a composite setting block which is available from Denford Ltd as an accessory.

Re-aligning the fixture with a Dial Test Indicator

Firstly ensure the Z-Axis is raised so the DTI can be fitted to the spindle motor bracket as shown. This can be achieved by jogging the Z-Axis in an upwards direction.

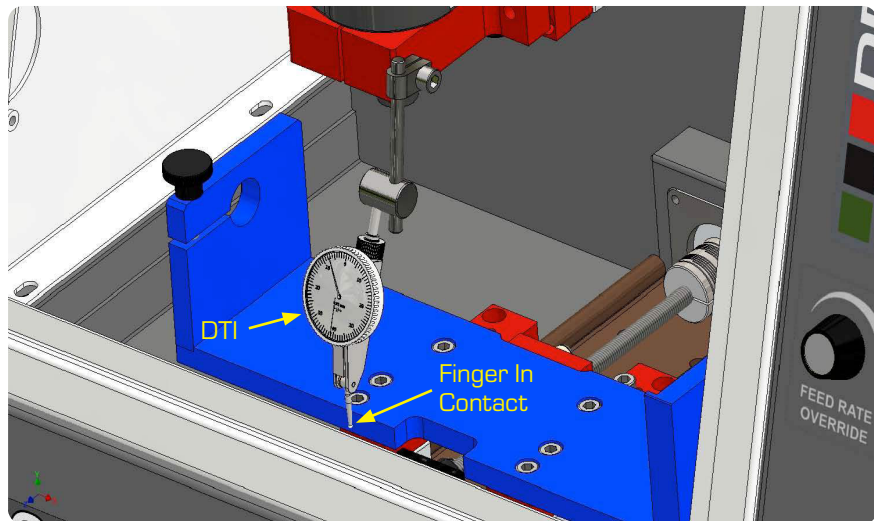


To mount the DTI to the spindle motor bracket remove the spindle motor clamp nut on the right hand side of the bracket and using a M6 screw of suitable length fix the clamp collar, normally supplied with DTI equipment as shown. Ensure that the DTI sensing finger is clear of the fixture at this stage to avoid damage.

7: Re-aligning the F1 manufacturing

Re-aligning the fixture with a Dial Test Indicator

To position the DTI sensing finger so it will contact the front face of the fixture (see below) move the Y-Axis using Jog Mode so the sensing finger is in an approximate position above the front edge of the fixture.

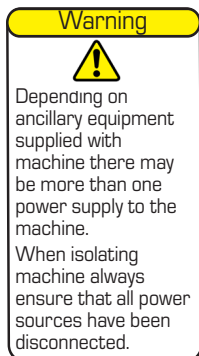
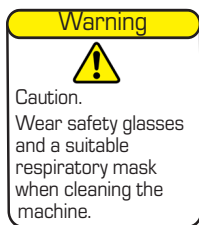


Lower the Z-Axis using Jog Mode so the sensing finger is just above the front edge of the fixture. Then with a combination of small jogs to both the Y-Axis and Z-Axis bring the sensing finger into contact with the front edge of the fixture. Jog the Y-Axis very carefully to just apply enough pressure to the sensing finger to rotate the DTI dial one revolution. Damage will occur to the DTI if this process is not followed.

Slacken the clamping screws which hold the fixture to the Z-Axis, depending on the design there will be either four or six screws, this allows a small amount of movement to the fixture. Now jog the X-Axis either clockwise or anticlockwise to move the DTI along the edge of the fixture as shown below.

As the DTI finger traverses along the edge of the fixture rotational movement of the DTI needle either clockwise or anti-clockwise will indicate the fixture is not in alignment. The aim is to run the DTI along the edge of the fixture making tiny adjustments to the fixture to achieve minimal fluctuation of the needle. Once this has been achieved tighten the clamping screws a little at a time in a diagonal pattern and re-check the readings. There is a cutout along the front edge of the fixture so alignment can be undertaken at either side of the cutout. Alignment can be checked along the entire edge of the fixture by carefully lifting the finger clear of the surface as the DTI is jogged over to cutout.

8: Planning Procedure for Maintenance



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

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

8: Maintenance Schedule

Every Day (and, if necessary between components)

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

Extra care must be exercised when changing from machining MDF, hardwood, foam etc. to machining metal, to avoid any risk of fire or explosion from ignition of dust particles by hot metal chips. Also after machining metal, thoroughly clean areas around leadscrews and guide rails to minimise risk of contamination from chips.

Every Week

- Clean the machine thoroughly.
- Clean dust from router motor - see p35.
- Lubricate the slideways and leadscrews - see p36.
- Check all exposed screws and nuts for tightness.
- Visually check door and window for signs of cracks or chips. Any damage should be reported immediately to Denford and a suitable replacement obtained without delay.

Door Part Number F1R/0602

Every Two Months

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

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

Denford part Number BI01229

Every Three Months

- Clean microswitches - see p35.
- Check security of Router motor mounting bolts.

8: Maintenance of the Router Motor

Maintenance of the spindle motor is limited to:-

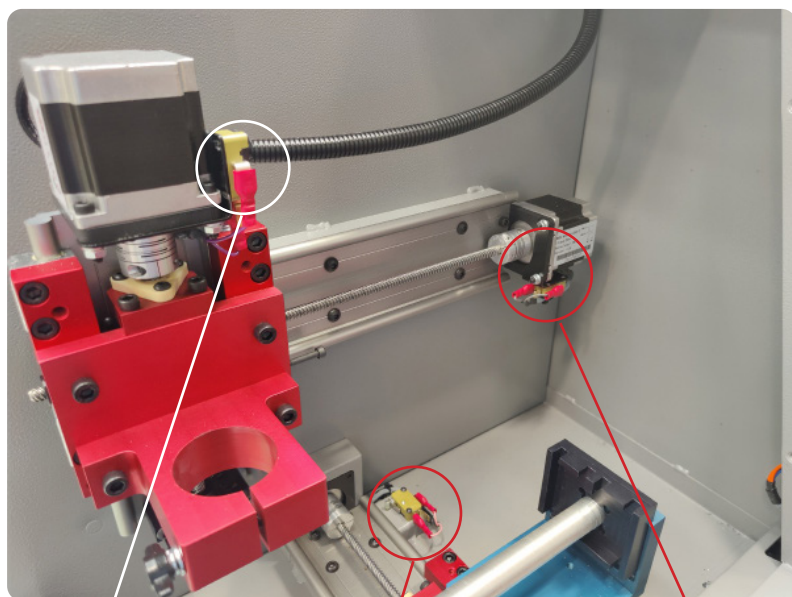
- i. Regularly (at least once a day if tools are changed frequently) checking that the surfaces of the router motor, tool housing and tool are clean.
- ii. Occasionally cleaning the grill of the cooling fan with a soft brush or vacuum (never use compressed air) and removing any objects blocking the air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

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

8: Cleaning the Microswitches

The X,Y Z axis all have microswitches

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



Z Axis Switch
located
top front corner

Y Axis Switch
located
middle rear corner

X Axis Switch
located
rear right corner

8: Lubricating the slideways & leadscrews

Use of Swansil Lubricant on Denford Routing Machines

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

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

Item 1 to be carried out daily or between components.

Items 2 – 6 to be carried out weekly.

Always adhere to general instructions and warnings on Swansil can.

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

Do not spray into confined areas.

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

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

8: Maintenance Log

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



8: Maintenance Log

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

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):

www.denfordata.com/bb

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

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

Address: Denford Limited,
Armytage Road,
Brighouse,
West Yorkshire,
HD6 1QF,
UK.

Telephone: +44 (0) 1484 728000

E-mail: technical@denford.co.uk

Times: Monday to Thursday 8.30am - 4.30pm GMT
Friday 8.30am - 1.00pm GMT

10: Specification of the MCR100 / F1

Safety Features:

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

Mechanical Details:

- Travel X axis 225mm [8.86"].
- Travel Y axis 86mm [3.38"].
- Travel Z axis 61mm [2.4"].

Dimensions:

- Machine width 540mm [21.25"].
- Machine height 525mm [20.67"].
- Machine depth - door closed 475mm [17.52"].

Weights:

- Machine weight 45 KG [99 lb].

Electrical Details:

- Mains supply required:
220/240V, 50Hz, 8 Amps. or 110V @ 50/60Hz 5A
- Spindle motor: 530W (220/240v) Or 800W (110V)
- Spindle Speeds: 0 - 29,000RPM.
- Axis stepper motors

Performance:

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



Declaration of Conformity

The responsible person and person
authorised to compile the Technical File

Mr Stephen Oddy

Business Name:

Denford Ltd

Address:

Armytage Road
Brighouse
W Yorkshire
HD6 1QF
United Kingdom

Declares that the Machinery Described:

Make:

Denford Ltd

Models:

MCR 100 / F1 Router, Compact 1000, Compact
1000PRO, Router 2600, Router 2600PRO, Router
6600 & Router 6600PRO.
Manufactured from January 1st 2023

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

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

Signature of responsible person

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

Position:

Managing Director

Date:

7th December 2022



Declaration of Conformity

The responsible person and person
authorised to compile the Technical File

Mr Stephen Oddy

Business Name:

Denford Ltd

Address:

Armytage Road
Brighouse
W Yorkshire
HD6 1QF
United Kingdom

Declares that the Machinery Described:

Make:

Denford Ltd

Models:

MCR 100 / F1 Router, Compact 1000, Compact
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6600 & Router 6600PRO.
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conformity refers to, is in conformity with
the essential requirements of the following
standards:

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

Signature of responsible person

Position:

Managing Director

Date:

7th December 2022

9: MCR100 / F1 Router Noise Level Test

NL-F1R-01

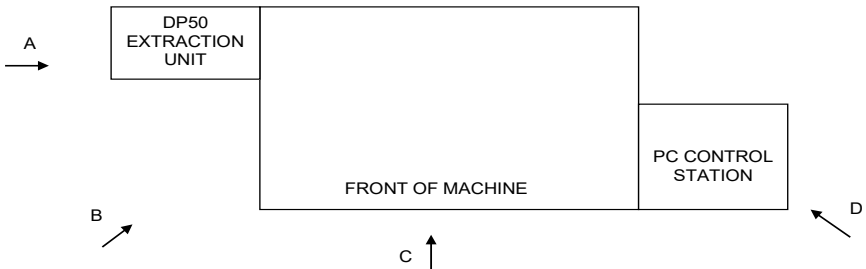
Noise Level test

Test Report No: NL-F1R-01
Machinery Manufacturer: Denford Limited.
Machinery Type/Model: MCR 100 / F1 Router

Equipment:
Meter Ref. Standard ST-805
Denford MCR 100 / F1 Router
DP50 Extraction Unit

Test Conditions:

Spindle speed: 0 - 29000 RPM.
Axis speed: 0 - 5000 mm/min
Ambient background noise: <50 dB(A).



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

Results;

All values are measured in dB(A)

Condition	A	B	C	D
Test Program	77	77	77	76
Test Program with Extraction	78	77	77	76






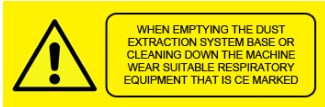



Test Program

Spindle speed 29000 RPM
Machine axes in combination 0 to 5000mm/min.
Extraction unit ran continuously during Test Program with Extraction.

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



9: Labels used in Manual or on Machine

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

10: Glossary

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

10: Glossary

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

10: Glossary

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

11: 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.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface. There is no handwriting or other markings on the paper.