Determination of Feed Speed

The calculation of the optimum feed is dependent on a number of factors and these must be taken into consideration in order to reach a satisfactory solution. The factors affecting the feed rate will be the size and rigidity of the cutter together with the chip space available. On very small cutters, the cutting edge has limited chip space and lower rates of feed are necessary otherwise breakage will occur.

On the other hand, too low a feed rate will cause the cutter to rub rather than cut.

Machine and job rigidity is another factor which must be considered. Parts must be adequately located and rigidly held down so that cutting forces cannot move the part. This will ensure a safe operation as well as allow maximum feed rates to be achieved commensurate with the required surface finish. Low feed rates will create a better finish than high feed rates.
The proposed feed rate can be easily calculated as shown below.

Suggested Chip Thickness

MATERIAL	CHIP THICKNESS (mm / Tooth)
Hardwood	0.2 - 0.7
Softwood	0.3 - 0.8
Chipboard	0.3 - 0.8
MDF	0.3 - 0.6
Plywood	0.3 - 0.6
Plastic laminated board	0.3 - 0.7

Let N = Rotational speed of cutter in R.P.M.
Z = number of wings on the cutter.
C = Chip thickness

$$\text{Then FEED RATE in Meters /Min} = \frac{N \times Z \times C}{1000}$$

For example.
For a 2 wing cutter, rotating at 9000 r.p.m, with a proposed chip thickness of 0.3 mm, the feed rate will be:

$$\text{Feed rate} = \frac{9000 \times 2 \times 0.3 \text{ Metres}}{1000} \text{ / min}$$

$$= 5.4 \text{ Metres/ min}$$

Spindle Speeds:

The majority of our tools are marked with a maximum tool r.p.m. Therefore before mounting the tools, it is always better to compare the tool's maximum r.p.m. with the machine's r.p.m. settings. The tool MUST NEVER be run above the specified r.p.m.
Please pay particular attention to worn or damaged tooling where the damaged tool could be out of balance and therefore dangerous. Remove and replace immediately.
If in doubt, below are some general r.p.m. rules:

1 Solid carbide routers to a maximum diameter of 20 mm ..... max 22,000 r.p.m.
2 Routers with 1/2 inch or 16 mm shank with a cut diameter of 25 mm or less. .... max 18,000 r.p.m.
3 Routers with a 20 or 25 mm shank with a cut diameter of 50 mm or less ..... max 16,000 r.p.m.
4 Routers with a 20 or 25 mm shank with a cut diameter of 125 mm or less ..... max 12,000 r.p.m.
5 Routers with 1/4 inch shank with a cut diameter of 20 mm or less ..... max 20,000 r.p.m.
Please note 1/4 inch shank routers are for hand trimming only and need extra special care when setting up and using.
6 All spindle moulder cutters with a cut diameter of 125 mm or less ..... max 12,000 r.p.m.
7 All spindle moulder cutters with a cut diameter of 180 mm or less ..... max 9,000 r.p.m.
8 All spindle moulder cutters with a cut diameter of 250 mm or less ..... max 6,000 r.p.m.
9 All spindle moulder cutters with a cut diameter of 270 mm or larger ..... max 4,200 r.p.m.

General Advice

Start Up:
Before using a tool for the first time, and prior to starting, check that the tool and inserts are running true to the spindle and that spindle nuts or collet chuck's are suitably tightened. Replace worn collets, spacers, nuts and clamping equipment. Replace all machine guarding and remove all loose tools before starting.

Protective Clothing:
Protective clothing and personal safety equipment MUST always be worn when using any router or spindle cutter.

No loose clothing should be worn near any machine; hair should be covered or tied well back; ear, eye, and face protection must always be worn.

Handling and Cleaning Tools:
Hand protection should be worn when handling tools during maintenance cleaning inspection, insert replacement, etc., by protecting hands with gloves.

Periodical tool cleaning should become a normal service operation. To do this, a light detergent with a soft cloth is adequate. Use a clean cloth with a light oil to protect surfaces from corrosion. Do not use harsh chemicals or solvents. Before using a tool for the first time, and prior to starting any spindle, the accuracy of the tool assembly should be inspected both visually and mechanically to ensure correct mounting of tools onto the machine and correct mounting of inserts.

Detail Instructions:

1) Fixing hardware.
Inserts for disposable tipped tooling are held in position by either clamps or Torx screws. Clamps are generally used in large diameter cutters whilst Torx screws are favoured for router bits and small spindle cutters.
The design choice depends on the size of the insert and the rotational speed of the cutter. All cutters should be periodically checked for damage or wear. This should include the screw threads on tool bodies, the associated fixing screws, as well as all other items on the tool body. Any damage found should be rectified or replaced immediately. Particular care should be taken to check that the socket on the Torx screw and the Torx driver is not damaged and that the key fits snugly.

Scribes are fixed by screws with straight screwdriver slots. These should be free of burrs and the slots undamaged, so that proper engagement with the correct size screwdriver will occur.

2) Tools.
The range of tools required to change inserts is minimal and will normally be restricted to the following:-
T15 Torx wrench, T12 Torx wrench, 4 A/F Tee handle Hex Key, Screwdriver with 10 x 1 mm blade.

The ends of these tools should be square to the axis of the tool and no rounding over should be present. Any minor damage can be removed by grinding back the key, but ensuring that the key does not become overly hot so that the hardness of the key is reduced. A number of very light grinds should be sufficient. Screwdriver ends can be treated in the same way. The objective is to ensure the correct fit of the tool at all times.

3) Changing Inserts.

Inserts should be changed when it is apparent that they are blunt. That inserts have become blunt generally shows itself as a degradation of surface finish on the component material and an increase in power needed to drive the cutter.

When inserts need to be changed, the cutter should be removed from the machine, and all dust and chips cleaned off with a suitable soft cloth, particularly around the insert seat area. Undo all clamping screws and remove inserts, paying particular attention to screws that are tight and could loosen suddenly, and without warning, cause injury. (Always wear protective gloves). Thoroughly clean all location faces and end stops. Fit new inserts and lightly clamp with fixing screws and wedges (as applicable) making sure that no dirt is behind the insert and that the insert is properly located in its seat and end stop. Tighten clamping screws by hand using the tools provided with the cutting tool. Do not use levers or anything that could over tighten the screws. Repeat until all inserts have been changed. Ensure that all replaced spare parts are original CROWN TOOLING spares. DO NOT USE SUBSITUTE SPARES.

For all cutter heads that have adjustable knife positions, ensure that knife protrusion is adjusted using the appropriate fixing gauge.
Carry out the following checks:

a) All inserts are facing the correct way;
b) All clamp screws are tight;
c) Cutter bores, shanks and location faces are clean; and that
d) Mating machine surfaces are clean and undamaged.

Once cutters have been replaced and locked into position, check that tool rotation is correct and replace all guards before restarting machine.

4) Speeds and Feeds.

Recommended speeds and feeds for various materials are shown in other data sheets contained in this publication. However, there may be times when the optimum cutting speed requires the cutter to be rotated at an unsafe spindle speed. On spindle cutters, safe working speeds are marked on the cutter body and should not be exceeded. For router bits, the maximum spindle speed is shown in the table in this publication.

Feed rates should be adjusted so that chips are of a reasonable size and thickness as indicated in the feed table shown in the specific section on speeds and feeds. Sufficient suction should be available to remove chips from the cutting area. Mechanical feed should be used wherever possible and on spindle cutters, the feed should always be against the rotation of the cutter, ***never with the rotation***.

5) Specific Notes for Spindle Cutters.

Hand-fed spindle moulders pose a particular safety hazard.
Although most modern spindle cutters have feed limiting capability, they do require care in their use. Material should be adequately guided and feed sticks used to push through small items. Generally the cutter configuration should be that the timber is over the cutter. The timber ***must*** be fed against the cutter rotation. Once the timber has fed past the cutter, some form of automatic guarding should come into play.

When setting up any form of moulding machine, it is important to check all spindles and tool location faces for damage. Any nicks or burrs, which may prevent proper seating of tools, should be carefully removed. In addition, tool location faces should be similarly checked. Prior to final fitting of tools to spindles, ensure that mating faces are clean. Clamp down with the appropriate nuts and ensure that they are tight. Correct fitting spanners or other tightening down tools are essential.
Before starting up, do a final check on spindle rotation. Replace all guards and remove loose tools.

6) Specific Notes for Routing Machines.

These notes are generally for overhead routing machines and do not refer to hand held routing machines, which normally have their own safety instructions.
Overhead routing machines have become very popular of the last few years and tend to use cutters up to 100 mm in diameter and in some cases even bigger.

Because of their open design, it is particularly important to ensure a safe working environment.
Tools should have the maximum size shank diameter possible, commensurate with the cutting diameter. Shanks should be free of damage, and the collet chuck in good condition.
The shank of the tool must engage the full length of the collet and the chuck fully tightened with the correct spanner provided with the chuck. The minimum 'hang out' of the tool is to be preferred.
Generally, feed of the tool will be against the rotation of the cutter. Feed with cutter rotation is sometimes used to prevent break out. In these cases, ensure that the board hold down system is adequate to prevent movement of the board.
With machines having automatic tool changers, it is recommended that only tools within the size limits of the changer be used. If a bigger cutter is required, it will require hand loading and may put unnecessary loads onto the machine spindle.

Where heavy material removal is required, ensure that the board holding system is adequate.
Inserts for router bits generally have 2 fixing screws and these must be in good condition.

The guidelines set out previously in Section 3 'Changing Inserts' should be rigorously applied.
In particular, dirt under the inserts should be avoided as this may cause cracking of the insert during the tightening of the fixing screws. Any insert with a crack should be discarded immediately.

Before starting the machine, ensure that all loose tools and other equipment are removed from the work area.

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