

## Data for Ordering

### Standard Tools in Catalogue

Part number

Dimensions

### Custom Tools

Bore or shank size

Machine rpm and required feedrate

Direction of rotation

Drawing showing dimensions of cut or a workpiece sample giving orientation to machine table and fence.

Type of material to be cut including (if appropriate) wood species and moisture content.

### Main Specifications

Tool Diameter x Width of Cut x Bore (or Shank) Diameter

Number of Teeth

Direction of Rotation

Maximum RPM (n max)

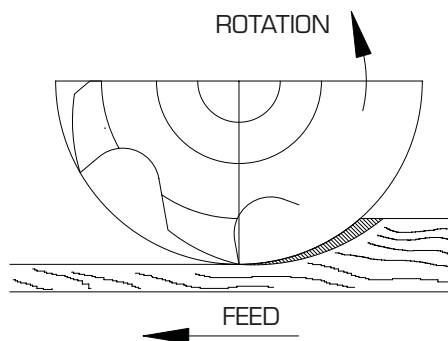
Keyway Size

Tooth Material: Tungsten Carbide, HSS, Stellite or Diamond

## Working Method

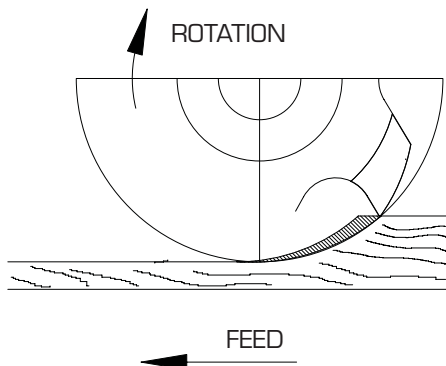
### Against Feed Direction (Up Cut)

Usual method of operation. The cutting motion of the tool and the feed direction work counter to one another. The cutting force exerted on the workpiece resists the direction of feed. Only the Up Cut method is suitable for hand feeding.



### With Feed Direction (Climb Cut)

The cutting motion of the tool and the feed direction are in the same direction. The cutting force exerted on the workpiece works in the same direction as the feed. The Climb Cut method is suitable only for mechanical feed.

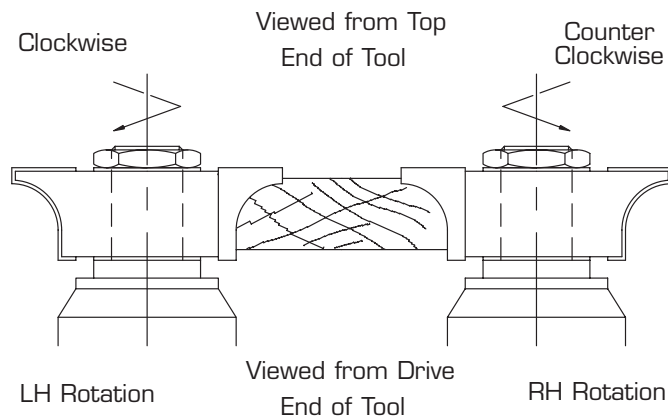


## Direction of Rotation

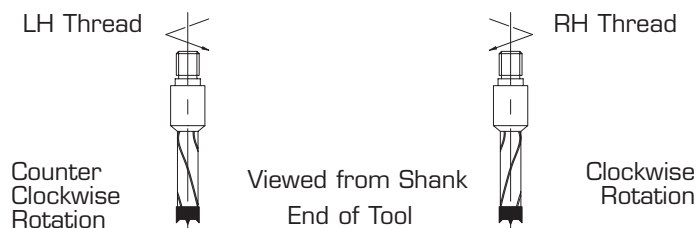
Left Hand Cutting

Right Hand Cutting

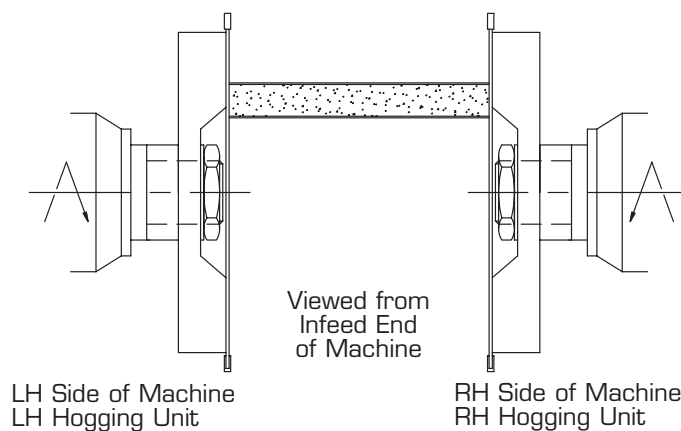
### Bore Mounted Tools



### Shank Mounted Tools

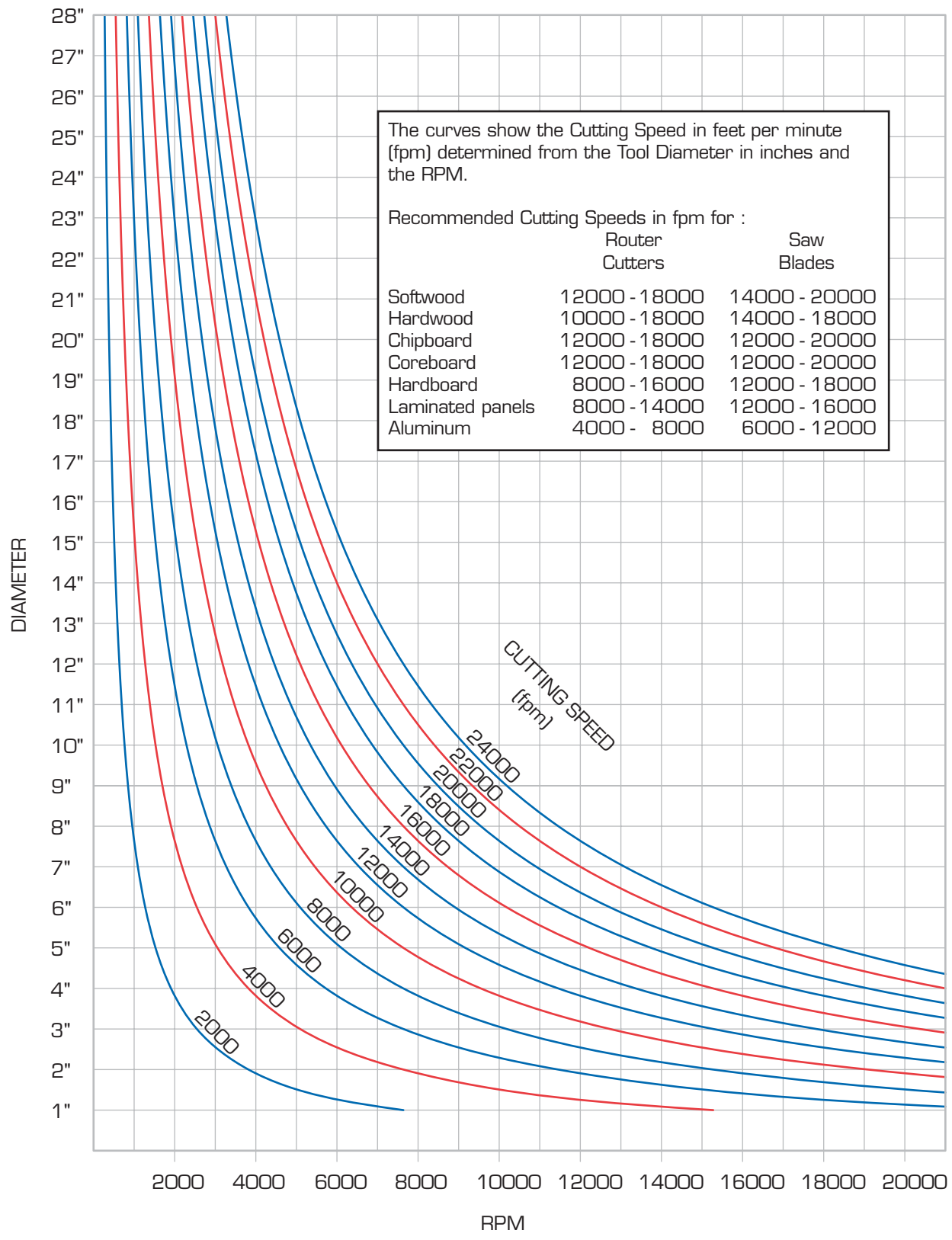


### Hogging Units



## Determination of Cutting Speed

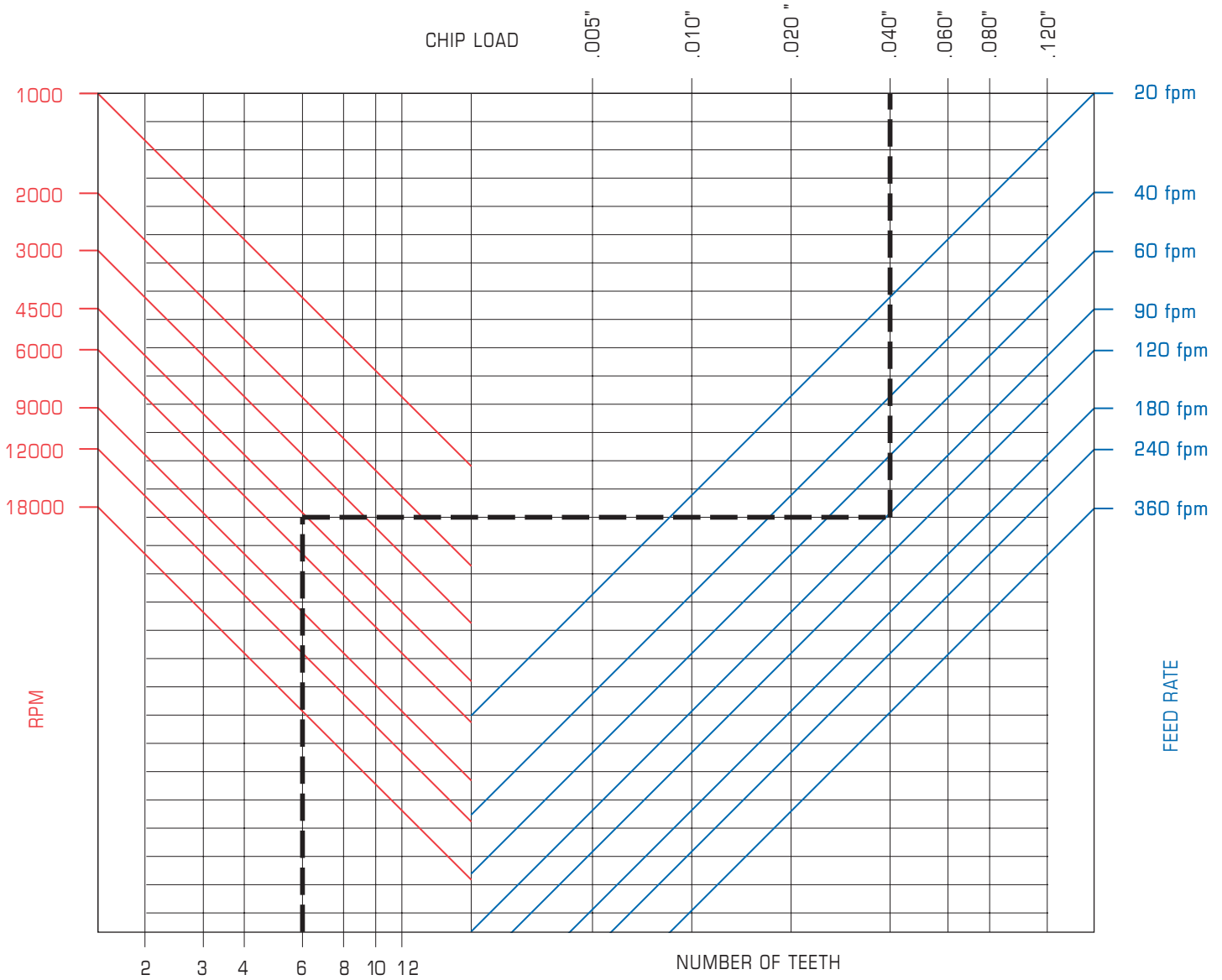
In relation to rpm and tool diameter



# Technical Information

## Determination of Operation Parameters for Cutters

Chipload, Feed Rate, R.P.M., Number of Teeth



**Recommended Chiploads (inch / tooth)**

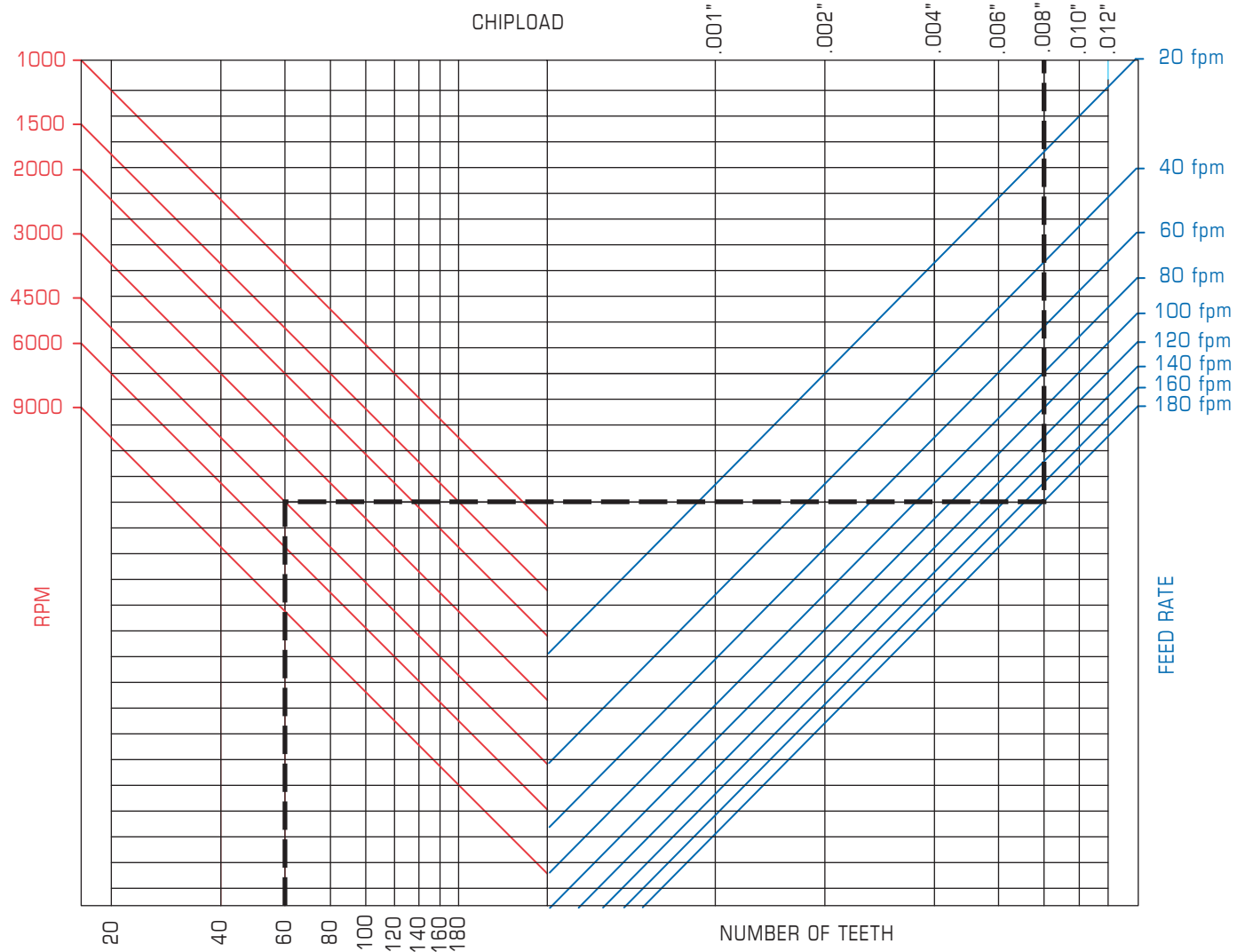
Fine finish	.010" - .030"
Medium finish	.030" - .100"
Course finish	.100" - .200"

**Example** - - - - -

6 tooth cutter rotating at 4,500 rpm, feeding at 90 fpm has a chipload of .040"/tooth

## Determination of Operation Parameters for Circular Saw Blades

Chipload, Feed Rate, R.P.M., Number of Teeth



### Recommended Chiploads (inch / tooth)

Softwood:	
Along grain	.008" - .035"
Cross grain	.004" - .008"
Hardwood	.002" - .006"
Chipboard	.004" - .010"
Veneered panels	.001" - .004"
Plastic laminated panels	.001" - .002"
Aluminum	.001" - .003"

### Example — — — —

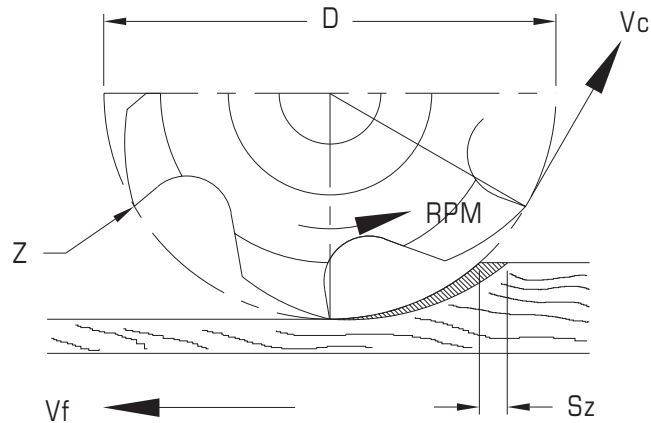
60 Tooth saw blade rotating at 4,500 rpm, feeding at 180 fpm has a chipload of .008"/tooth

## Formulas

For calculating chipload, cutter marks per inch, feed rate, and cutting speed

## Symbols

- D = Diameter (inches)
- Z = Number of Teeth
- RPM = Spindle Speed
- Vf = Feed Rate (fpm)
- Vc = Cutting Speed (fpm)
- Sz = Chipload (inch/tooth)
- MPI = Cutter Marks per Inch



## Chipload

$$S_z = \frac{V_f \times 12}{RPM \times Z}$$

Example

- Vf = 90 fpm
- RPM = 4500
- Z = 6

$$S_z = \frac{90 \times 12}{4500 \times 6}$$

$$= .040" / \text{tooth}$$

## Cutter Marks Per Inch

$$MPI = \frac{1}{S_z}$$

Example

- Sz = .040" / tooth

$$MPI = \frac{1}{.040}$$

$$= 25$$

## Feed Rate

$$V_f = \frac{S_z \times RPM \times Z}{12}$$

Example

- Sz = .040" / tooth
- RPM = 4500
- Z = 6

$$V_f = \frac{.040 \times 4500 \times 6}{12}$$

$$= 90 \text{ fpm}$$

## Cutting Speed

$$V_c = \frac{D \times \pi \times RPM}{12}$$

Example

- D = 6"
- $\pi$  = 3.14
- RPM = 6000

$$V_c = \frac{6 \times 3.14 \times 6000}{12}$$

$$= 9420 \text{ fpm}$$

## Operating Instructions

### Handling (Packing/unpacking)

Use special care when unpacking and packing tools, as well as in handling (e.g. mounting onto the machine) due to the danger of injury from sharp cutting edges.

### Transport

Due to the risk of injury, transport tool only in suitable packing. Use the original packaging where possible.

### Use

Exclusively for the cutting and machining of wood materials, laminates, plastics and non-ferrous materials as described in the product pages of this catalogue.

### RPM

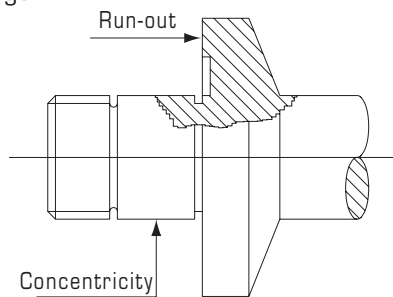
The maximum permissible speed (n max) stated on the tool must not be exceeded. This speed should not be adopted as the operating speed, as the optimum speed for the tool will be dependant upon the application of use.

### Machine

Secure the machine against accidental starting before mounting or changing the tool. Use appropriate lock-out procedures.

Check that machine spindle speed does not exceed maximum permissible speed stated on the tool. Check direction of rotation.

Check spindle for concentricity and flange for run-out using a dial gauge.



Use only precision ground spacers and flanges, otherwise the spindle can become distorted.

Check that workpiece is securely clamped and that feed is correctly aligned to spindle.

### Operation

All tools should be handled with care. Placing tools against each other or on hard surfaces such as machine tables may damage the cutting edges. Tools must be protected when not in use and when being moved to and from the machine.

Mount and secure the tool as specified by the machine manufacturers' instructions. Do not block the tool to assist in tightening the tool onto the machine spindle as this may cause damage to the tool. Similarly, do not jam material against the tool to assist in slowing down the tool when stopping the spindle.

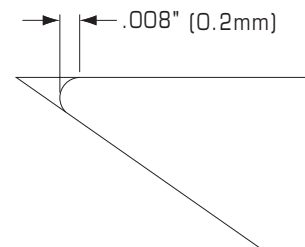
Observe all instructions and warnings included with the tool. The tool may only be mounted by trained and qualified personnel. Never operate tool without appropriate guarding in place. Always wear correct eye, ear and breathing protection which complies with current standards. All machine specifications must be adhered to. Never leave a running machine unattended. All valid safety regulations must be adhered to. Incorrect use for purposes not intended is prohibited.

### Tool Maintenance

Proper care and maintenance of tooling is paramount to ensure long tool life and economic overall tool costs. Never let any tool become blunt because teeth could break if production continues. A good method of monitoring tool wear is to install an ammeter which will show the increase in power consumption on the machine as the tool wears.

Tools should be re-sharpened or knives changed when:

- Surface finish of workpiece is no longer acceptable.
- Cutting edges become rounded more than .008"



- Machine power consumption becomes too high.
- Cutting edges are chipped or broken.

The servicing of tooling should be performed by competent personnel using suitable equipment. To ensure continued high performance of your tooling throughout its service life, tools must be maintained to the manufacturers' specifications. The people best able to do this are your local FS Tool Distributors who have been selected for their ability to provide a Sharpening Service which will maintain your tools to our specifications.

## Carbide Tipped Circular Saw Blades

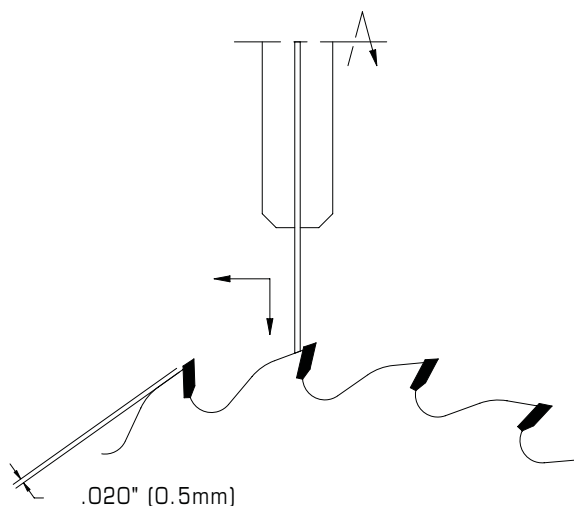
### Safety

Circular saw blades which are cracked or which have been deformed may not be used. Welding or soldering of cracked saw blades is not permissible. The saw blade should not be stopped with side pressure during run down. Use of loose rings or bushings to 'make-up' bore sizes is not permitted. Reduction of the bore may only be done by the use of a fixed bushing, e.g. pressed or held by adhesive fixing. Saw blades where tips have been reduced to a minimum of .040" (1mm) will have reached the end of their regrind life and shall be taken out of service.

### Cleaning and Steel Relieving

The saw blade should be cleaned to remove all build up of material (resin, gum, dust etc) from the saw plate and sides of the carbide teeth. Effective cleaning of the saw blade will increase service life by minimizing friction of the saw plate and thereby preventing overheating and loss of saw plate tension. Cleaning of the sides of the teeth will maintain the effectiveness of side clearances originally ground on the saw blade when it was manufactured. The sides of the teeth are not reground during resharpener but the face and top geometry is reground. Cleaning is best done using an ultrasonic cleaning tank or else a propriety cleaning solution. Do not scrape or use an abrasive wheel to clean the sides of the saw plate. Such action can affect the tension of the saw plate.

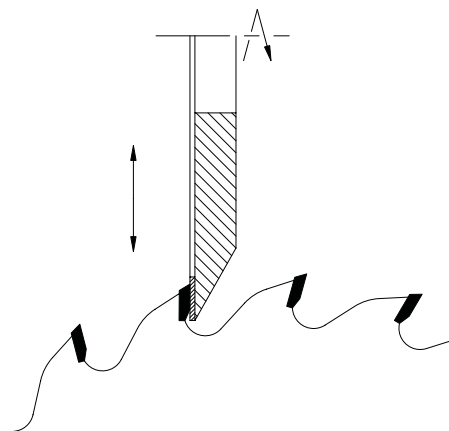
As the saw blade progresses through its regrind life it will periodically be necessary to relieve the steel body behind the top geometry of the teeth. This is necessary to ensure optimal chip clearance and to allow effective regrinding of the top geometry using diamond abrasive wheels.



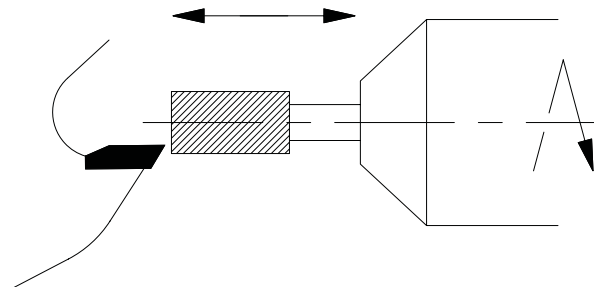
### Face Grinding

Align the face of the tooth to the grinding wheel linear axis. Adjust the tooth so that the face remains parallel during regrinding. If the tooth is not ground parallel then the radial side clearance and rake angle will be adversely affected. The amount to be removed from the face is dependent upon the wear on the tooth. Typically .008" (0.2mm) is removed. When top grinding is also to be performed then not all of the wear should be removed by face grinding as the remainder will be ground from the top geometry. Take care to ensure that the tip thickness is equal on all teeth. Variations in tip thickness will cause variations in tip kerf which may lead to chipping of workpiece material.

We recommend the use of coolant when grinding with diamond abrasive wheels.



Hollow face tooth saw blades are resharpener on their face using a diamond abrasive rod operating at high speed. Particular care is required to make sure that the abrasive rod is centered accurately. Failure to center accurately will adversely affect tooth geometry and may lead to chipping of material being cut.



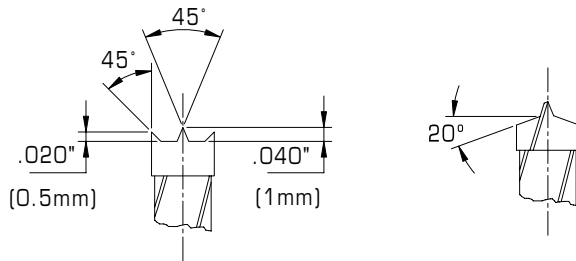
### Top Grinding

Top grinding is used to sharpen the periphery of the saw blade and regenerate the original tooth geometry. Care must be taken to reproduce the original FS Tool tooth specifications.

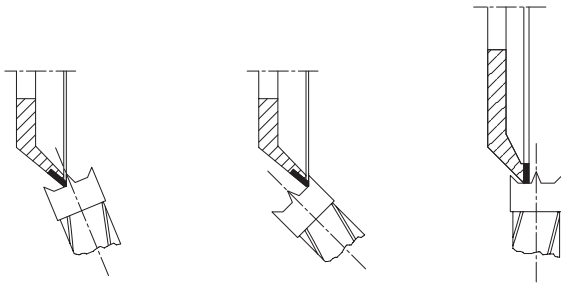
## Carbide Tipped Dowel Drills

### Sharpening

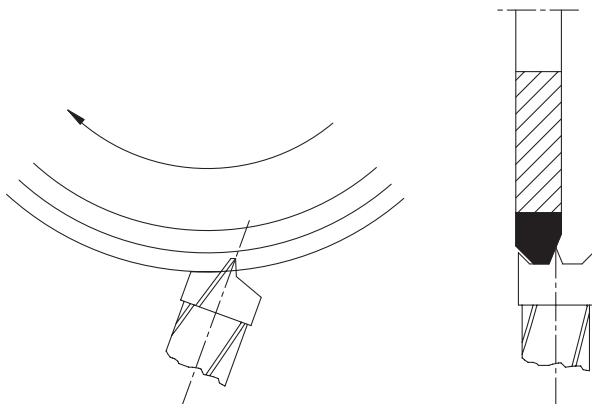
Clamp drill bits in a holder or collet and check for concentricity. Sharpen spurs and brad point maintaining projection from rakers. To avoid chipping of spurs only grind with very light grinding pressure.



Small quantities can be sharpened using standard grinding wheels using three setups. The brad point and spurs are ground using the end face of a cup wheel as shown. Next the rakers are sharpened using the periphery of a suitable wheel.



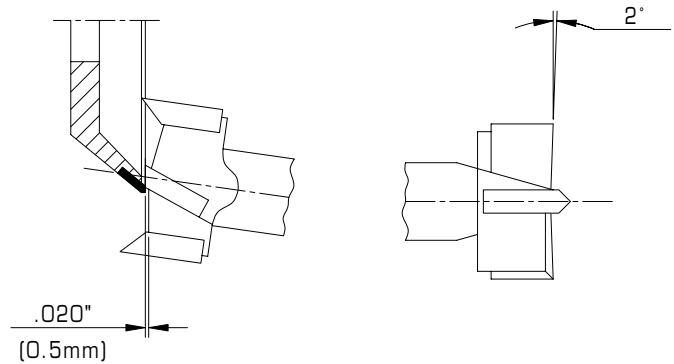
Larger quantities are best sharpened using a formed grinding wheel. With a 45 degree angle dressed on both sides of a suitable 1A1 style wheel the spur, brad point and rakers can be sharpened in one setup. Different widths of rakers are accommodated by shifting sideways. After sharpening one cutting edge the bit is rotated and the process repeated.



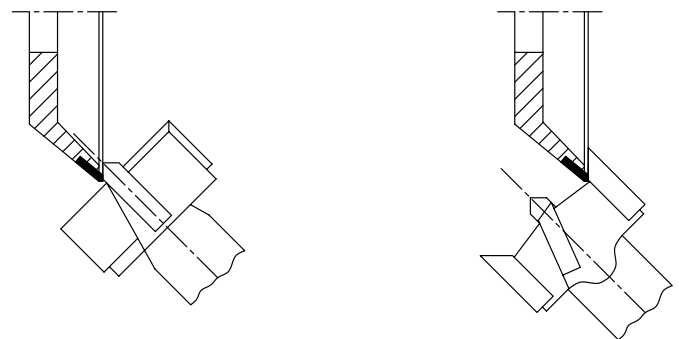
## Carbide Tipped Cylinder Boring Bits

### Sharpening

Clamp boring bits in a holder or collet and check for concentricity. Relieve steel body behind rakers to maintain .020" (0.5mm) protrusion of cutting edges above body. Sharpen rakers by regrinding end clearance. Maintain 2 degree end dish angle. If rakers are heavily worn then also grind rake face.



Sharpen spurs and brad point to maintain .012" to .020" (0.3 to 0.5mm) protrusion above rakers. Grind 45 degree angles on inside edge of spurs and on all edges of brad point. Spurs also require leading and trailing edges to be sharpened to ensure correct cutting action.



Always index tool using a precision dividing head or mechanical stop to make sure equal amounts are taken from cutting edges.



## Carbide Tipped Router Bits

### Safety

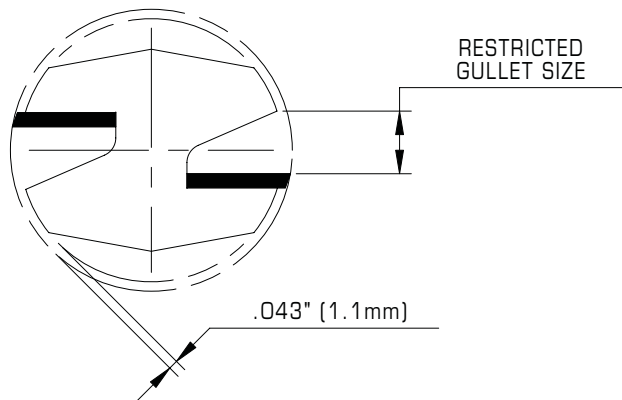
The most progressive safety standards for woodworking tooling exist in Europe. There, a harmonized European Standard has been developed and adopted by all members of the EU. Unfortunately, here in North America, there are no similar safety standards but to promote the best safe working practices and tool design, FS Tool Corporation has utilized this European Standard number EN 847-1 in the router bits we supply.

According to the Standard there are two distinct methods of working with router bits. The first is working by hand, or **MAN**ual feed, where the workpiece is held or guided by hand. This also includes use of a hand operated carriage on which the workpiece is held manually or clamped and the use of a demountable power feed unit. The second is working with integrated feed where the feed mechanism for the workpiece or tool is integrated with the machine and where the workpiece or tool are held and controlled **MEC**hanically during the machining operation.

These two methods of working have lead to two different requirements for tool safety.

### MANual

With manual feed there is greater risk of injury to operators due to accidental kickback of the workpiece and contact with the tool.



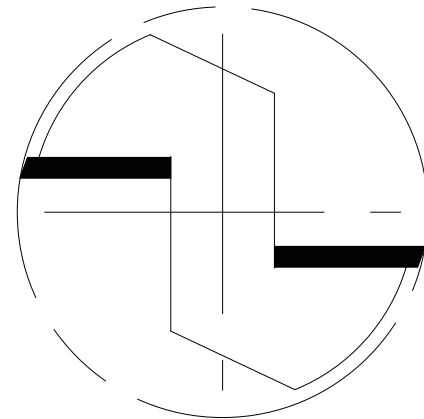
For this reason, tools for manual feed are designed with additional safety features. These include a limited projection of the cutting edges beyond the tool body and, for tools greater than 5/8" (16mm), a restricted gullet width.

Both of these safety features have the effect of minimizing the severity of kickback and injury caused by physical contact with a rotating tool.

Router bits designed for manual feed are marked **MAN**.

### MEC

Fully automated machines, for example CNC routers, do not pose the same hazards to operators as manual fed machines. For this reason, restrictions of tip to body clearances and gullet sizes do not apply and allow greater flexibility in tool design. Tools that are intended only for use with mechanically controlled feed are marked **MEC**.



### Sharpening

Router bits for jointing and rebating are to be resharpened on the face. If the teeth are excessively worn or chipped then they can also be ground on the outer cutting diameter.

Any router bits for **MAN**ual feed with chip thickness limiters will require reduction of the limiters as the router bit progresses through its regrind life. The teeth must protrude above the limiters by a maximum of .043" (1.1mm).

Profiled router bits are to be resharpened parallel to the face only.

## Carbide Tipped Cutters

### Sharpening

Tools must be cleaned before sharpening to remove resin and dust. Inspect the cutting edges to determine the extent of wear and to identify any edges that are more heavily worn.

Cutters can be sharpened on either universal tool and cutter grinders or else purpose built CNC cutter grinders using diamond grinding wheels.

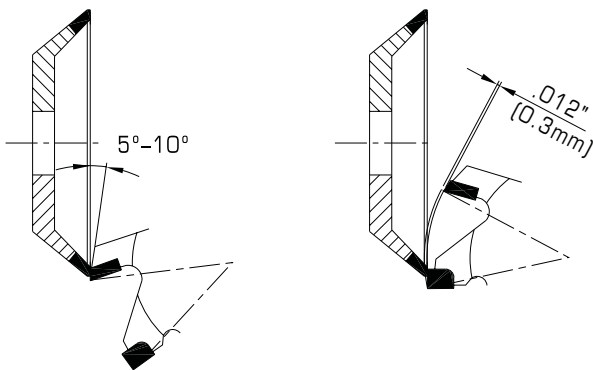
Sharpening should be performed using coolant to avoid overheating and possible damage to either the grinding wheel or the carbide teeth.

Sharpen all teeth by the same amount to remove all wear and to ensure good concentricity. Check concentricity using a dial gauge.

The sharpening method employed is dependant on the type of cutter as follows:

### Grooving Cutters with or without spurs

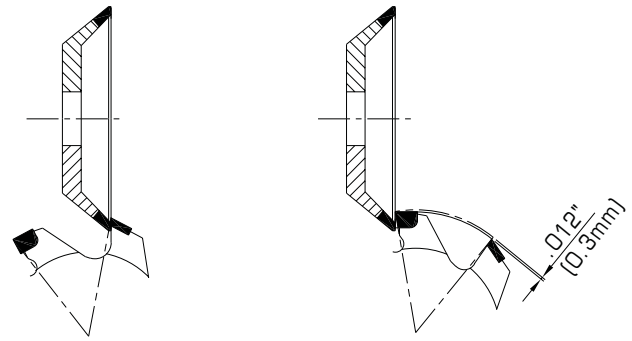
These tools are face tipped and therefore are to be sharpened on the top of the teeth. Spurs must protrude raker teeth by .012" (0.3mm) radially and .008" (0.2mm) laterally.



As the diameter of the cutter is reduced it may become necessary to relieve the steel body as shown. To relieve the steel increase the top clearance angle ground on the body by 5° to 10° using a carborundum or CBN grinding wheel.

### Rebating and Jointing Cutters

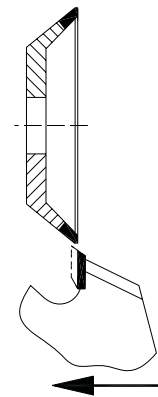
These tools are top tipped and therefore are to be sharpened on the face of the teeth. Spurs must protrude raker teeth by .012" (0.3mm) radially and .008" (0.2mm) laterally.



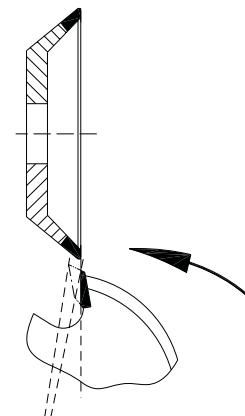
### Profile Cutters

There are two different methods to sharpen profile cutters dependant upon how the profile shape has been ground.

For profile cutters with straight back relief the cutting edges are sharpened by face grinding parallel to the original face.



For profile cutters with radial back relief the cutting edges are not sharpened parallel to the original face but by rotating the tool onto the grinding wheel. This will ensure that the original cutting angle of the tool and profile shape are maintained.



# CONVERSION OF MILLIMETERS TO INCHES

1MM = 0.03937 INCHES

MM	0	1	2	3	4	5	6	7	8	9
0	-	3/64"	5/64	1/8"	5/32"	13/64"	15/64"	9/32"	5/16"	23/64"
10	25/64"	7/16"	15/32"	33/64"	35/64"	19/32"	5/8"	43/64"	45/64"	3/4"
20	25/32"	53/64"	55/64"	29/32"	15/16"	63/64"	1-1/32"	1-1/16"	1-7/64"	1-9/64"
30	1-3/16"	1-7/32"	1-17/64"	1-19/64"	1-11/32"	1-3/8"	1-27/64"	1-29/64"	1-1/2"	1-17/32"
40	1-37/64"	1-39/64"	1-21/32"	1-11/16"	1-47/64"	1-49/64"	1-13/16"	1-27/32"	1-57/64"	1-59/64"
50	1-31/32"	2-1/64"	2-3/64"	2-3/32"	2-1/8"	2-11/64"	2-13/64"	2-1/4"	2-9/32"	2-21/64"
60	2-23/64"	2-13/32"	2-7/16"	2-31/64"	2-33/64"	2-9/16"	2-19/32"	2-41/64"	2-43/64"	2-23/32"
70	2-3/4"	2-51/64"	2-53/64"	2-7/8"	2-29/32"	2-61/64"	2-63/64"	3-1/32"	3-5/64"	3-7/64"
80	3-5/32"	3-3/16"	3-15/64"	3-17/64"	3-5/16"	3-11/32"	3-25/64"	3-27/64"	3-15/32"	3-1/2"
90	3-35/64"	3-37/64"	3-5/8"	3-21/32"	3-45/64"	3-47/64"	3-25/32"	3-13/16"	3-55/64"	3-57/64"
100	3-15/16"	3-31/32"	4-1/64"	4-1/16"	4-3/32"	4-9/64"	4-11/64"	4-7/32"	4-1/4"	4-19/64"
110	4-21/64	4-3/8"	4-13/32"	4-29/64"	4-31/64"	4-17/32"	4-9/16"	4-39/64"	4-41/64"	4-11/16"
120	4-23/32"	4-49/64"	4-51/64"	4-27/32"	4-7/8"	4-59/64"	4-61/64"	5"	5-3/64"	5-5/64"
130	5-1/8"	5-5/32"	5-13/64"	5-15/64"	5-9/32"	5-5/16"	5-23/64"	5-25/64"	5-7/16"	5-15/32"
140	5-33/64"	5-35/64"	5-19/32"	5-5/8"	5-43/64"	5-45/64"	5-3/4"	5-25/32"	5-53/64"	5-55/64"
150	5-29/32"	5-15/16"	5-63/64"	6-1/32"	6-1/16"	6-7/64"	6-9/64"	6-3/16"	6-7/32"	6-17/64"
160	6-19/64"	6-11/32"	6-3/8"	6-27/64"	6-29/64"	6-1/2"	6-17/32"	6-37/64"	6-39/64"	6-21/32"
170	6-11/16"	6-47/64"	6-49/64"	6-13/16"	6-27/32"	6-57/64"	6-59/64"	6-31/32"	7-1/64"	7-3/64"
180	7-3/32"	7-1/8"	7-11/64"	7-13/64"	7-1/4"	7-9/32"	7-21/64"	7-23/64"	7-13/32"	7-7/16"
190	7-31/64"	7-33/64"	7-9/16"	7-19/32"	7-41/64"	7-43/64"	7-23/32"	7-3/4"	7-51/64"	7-53/64"
200	7-7/8"	7-29/32"	7-61/64"	7-63/64"	8-1/32"	8-5/64"	8-7/64"	8-5/32"	8-3/16"	8-15/64"
210	8-17/64"	8-5/16"	8-11/32"	8-25/64"	8-27/64"	8-15/32"	8-1/2"	8-35/64"	8-37/64"	8-5/8"
220	8-21/32"	8-45/64"	8-47/64"	8-25/32"	8-13/16"	8-55/64"	8-57/64"	8-15/16"	8-31/32"	9-1/64"
230	9-1/16"	9-3/32"	9-9/64"	9-11/64"	9-7/32"	9-1/4"	9-19/64"	9-21/64"	9-3/8"	9-13/32"
240	9-29/64"	9-31/64"	9-17/32"	9-9/16"	9-39/64"	9-41/64"	9-11/16"	9-23/32"	9-49/64"	9-51/64"
250	9-27/32"	9-7/8"	9-59/64"	9-61/64"	10"	10-3/64"	10-5/64"	10-1/8"	10-5/32"	10-13/64"
260	10-15/64"	10-9/32"	10-5/16"	10-23/64"	10-25/64"	10-7/16"	10-15/32"	10-33/64"	10-35/64"	10-19/32"
270	10-5/8"	10-43/64"	10-45/64"	10-3/4"	10-25/32"	10-53/64"	10-55/64"	10-29/32"	10-15/16"	10-63/64"
280	11-1/32"	11-1/16"	11-7/64"	11-9/64"	11-3/16"	11-7/32"	11-17/64"	11-19/64"	11-11/32"	11-3/8"
290	11-27/64"	11-29/64"	11-1/2"	11-17/32"	11-37/64"	11-39/64"	11-21/32"	11-11/16"	11-47/64"	11-49/64"
300	11-13/16"	11-27/32"	11-57/64"	11-59/64"	11-31/32"	12-1/64"	12-3/64"	12-3/32"	12-1/8"	12-11/64"
310	12-13/64"	12-1/4"	12-9/32"	12-21/64"	12-23/64"	12-13/32"	12-7/16"	12-31/64"	12-33/64"	12-9/16"
320	12-19/32"	12-41/64"	12-43/64"	12-23/32"	12-3/4"	12-51/64"	12-53/64"	12-7/8"	12-29/32"	12-61/64"
330	12-63/64"	13-1/32"	13-5/64"	13-7/64"	13-5/32"	13-3/16"	13-15/64"	13-17/54"	13-5/16"	13-11/32"
340	13-25/64"	13-27/64"	13-15/32"	13-1/2"	13-35/64"	13-37/64"	13-5/8"	13-21/32"	13-45/64"	13-47/64"
350	13-25/32"	13-13/16"	13-55/64"	13-57/64"	13-15/16"	13-31/32"	14-1/64"	14-1/16"	14-3/32"	14-9/64"
360	14-11/64"	14-7/32"	14-1/4"	14-19/64"	14-21/64"	14-3/8"	14-13/32"	14-29/64"	14-41/64"	14-17/32"
370	14-9/16"	14-39/64"	14-41/64"	14-11/16"	14-23/32"	14-49/64"	14-51/64"	14-27/32"	14-7/8"	14-59/64"
380	14-61/64"	15"	15-3/64"	15-5/64"	15-1/8"	15-5/32"	15-13/64"	15-15/64"	15-9/32"	15-5/16"
390	15-23/64"	15-25/64"	15-7/16"	15-15/32"	15-33/64"	15-35/64"	15-19/32"	15-5/8"	15-43/64"	15-45/64"
400	15-3/4"	15-25/32"	15-53/64"	15-55/64"	15-29/32"	15-15/16"	15-63/64"	16-1/32"	16-1/16"	16-7/64"
410	16-9/64"	16-3/16"	16-7/32"	16-17/64"	16-19/64"	16-11/32"	16-3/8"	16-27/64"	16-29/64"	16-1/2"
420	16-17/32"	16-37/64"	16-39/64"	16-21/32"	16-11/16"	16-47/64"	16-49/64"	16-13/16"	16-27/32"	16-57/64"
430	16-59/64"	16-31/32"	17-1/64"	17-3/64"	17-3/32"	17-1/8"	17-11/64"	17-13/64"	17-1/4"	17-9/32"
440	17-21/64"	17-23/64"	17-13/32"	17-7/16"	17-31/64"	17-33/64"	17-9/16"	17-19/32"	17-41/64"	17-43/64"
450	17-23/32"	17-3/4"	17-51/64"	17-53/64"	17-7/8"	17-29/32"	17-61/64"	17-63/64"	18-1/32"	18-5/64"
460	18-7/64"	18-5/32"	18-3/16"	18-15/64"	18-17/64"	18-5/16"	18-11/32"	18-25/64"	18-27/64"	18-15/32"
470	18-1/2"	18-35/64"	18-37/64"	18-5/8"	18-21/32"	18-45/64"	18-47/64"	18-25/32"	18-13/16"	18-55/64"
480	18-57/64"	18-15/16"	18-31/32"	19-1/64"	19-1/16"	19-3/32"	19-9/64"	19-11/64"	19-7/32"	19-1/4"
490	19-19/64"	19-21/64"	19-3/8"	19-14/32"	19-29/64"	19-31/64"	19-17/32"	19-9/16"	19-39/64"	19-41/64"
500	19-11/16"	19-23/32"	19-49/64"	19-51/64"	19-27/32"	19-7/8"	19-59/64"	19-61/64"	—	—

# CONVERSION OF INCHES TO MILLIMETERS

1 INCH = 25.4 MM

INCHES	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0.00	25.40	50.80	76.20	101.60	127.00	152.40	177.80	203.20	228.60	254.00	279.40	304.80
1/64	0.40	25.80	51.20	76.60	102.00	127.40	152.80	178.20	203.60	229.00	254.40	279.80	305.20
1/32	0.79	26.19	51.59	76.99	102.39	127.79	153.19	178.59	203.99	229.39	254.79	280.19	305.59
3/64	1.19	26.59	51.99	77.39	102.79	128.19	153.59	178.99	204.39	229.79	255.19	280.59	305.99
1/16	1.59	26.99	52.39	77.79	103.19	128.59	153.99	179.39	204.79	230.19	255.59	280.99	306.39
5/64	1.98	27.38	52.78	78.18	103.58	128.98	154.38	179.78	205.18	230.58	255.98	281.38	306.78
3/32	2.38	27.78	53.18	78.58	103.98	129.38	154.78	180.18	205.58	230.98	256.38	281.78	307.18
7/64	2.78	28.18	53.58	78.98	104.38	129.78	155.18	180.58	205.98	231.38	256.78	282.18	307.58
1/8	3.18	28.58	53.98	79.38	104.78	130.18	155.58	180.98	206.38	231.78	257.18	282.58	307.98
9/64	3.57	28.97	54.37	79.77	105.17	130.57	155.97	181.37	206.77	232.17	257.57	282.97	308.37
5/32	3.97	29.37	54.77	80.17	105.57	130.97	156.37	181.77	207.17	232.57	257.97	283.37	308.77
11/64	4.37	29.77	55.17	80.57	105.97	131.37	156.77	182.17	207.57	232.97	258.37	283.77	309.17
3/16	4.76	30.16	55.56	80.96	106.36	131.76	157.16	182.56	207.96	233.36	258.76	284.16	309.56
13/64	5.16	30.56	55.96	81.36	106.76	132.16	157.56	182.96	208.36	233.76	259.16	284.56	309.96
7/32	5.56	30.96	56.36	81.76	107.16	132.56	157.96	183.36	208.76	234.16	259.56	284.96	310.36
15/64	5.95	31.35	56.75	82.15	107.55	132.95	158.35	183.75	209.15	234.55	259.95	285.35	310.75
1/4	6.35	31.75	57.15	82.55	107.95	133.35	158.75	184.15	209.55	234.95	260.35	285.75	311.15
17/64	6.75	32.15	57.55	82.94	108.35	133.75	159.15	184.55	209.95	235.35	260.75	286.15	311.55
9/32	7.14	32.54	57.94	83.34	108.74	134.14	159.54	184.94	210.34	235.74	261.14	286.54	311.94
19/64	7.54	32.94	58.34	83.74	109.14	134.54	159.94	185.34	210.74	236.14	261.54	286.94	312.34
5/16	7.94	33.34	58.74	84.14	109.54	134.94	160.34	185.74	211.14	236.54	261.94	287.34	312.74
21/64	8.33	33.73	59.13	84.53	109.93	135.33	160.73	186.13	211.53	236.93	262.34	287.74	313.14
11/32	8.73	34.13	59.53	84.93	110.33	135.73	161.13	186.53	211.93	237.33	262.73	288.13	313.53
23/64	9.13	34.53	59.93	85.33	110.73	136.13	161.53	186.93	212.33	237.73	263.13	288.53	313.93
3/8	9.53	34.93	60.33	85.73	111.13	136.53	161.93	187.33	212.73	238.13	263.53	288.93	314.33
25/64	9.92	35.32	60.72	86.12	111.52	136.92	162.32	187.72	213.12	238.52	263.92	289.32	314.72
13/32	10.32	35.72	61.12	86.52	111.92	137.32	162.72	188.12	213.52	238.92	264.32	289.72	315.12
27/64	10.72	36.12	61.52	86.92	112.32	137.72	163.12	188.52	213.92	239.32	264.72	290.12	315.52
7/16	11.11	36.51	61.91	87.31	112.71	138.11	163.51	188.91	214.31	239.71	265.11	290.51	315.91
29/64	11.51	36.91	62.31	87.71	113.11	138.51	163.91	189.31	214.71	240.11	265.51	290.91	316.31
15/32	11.91	37.31	62.71	88.11	113.51	138.91	164.31	189.71	215.11	240.51	265.91	291.31	316.71
31/64	12.30	37.70	63.10	88.50	113.90	139.30	164.70	190.10	215.50	240.90	266.30	291.70	317.10
1/2	12.70	38.10	63.50	88.90	114.30	139.70	165.10	190.50	215.90	241.30	266.70	292.10	317.50
33/64	13.10	38.50	63.90	89.30	114.70	140.10	165.50	190.90	216.30	241.70	267.10	292.50	317.90
17/32	13.49	38.89	64.29	89.69	115.09	140.49	165.89	191.29	216.69	242.09	267.49	292.89	318.29
35/64	13.89	39.29	64.69	90.09	115.49	140.89	166.29	191.69	217.09	242.49	267.89	293.29	318.69
9/16	14.29	39.69	65.09	90.49	115.89	141.29	166.69	192.09	217.49	242.89	268.29	293.69	319.09
37/64	14.68	40.08	65.48	90.88	116.28	141.68	167.08	192.48	217.88	243.28	268.68	294.08	319.48
19/32	15.08	40.48	65.88	91.28	116.68	142.08	167.48	192.88	218.28	243.68	269.08	294.48	319.88
39/64	15.48	40.88	66.28	91.68	117.08	142.48	167.88	193.28	218.68	244.08	269.48	294.88	320.28
5/8	15.88	41.28	66.68	92.08	117.48	142.88	168.28	193.68	219.08	244.48	269.88	295.28	320.68
41/64	16.27	41.67	67.07	92.47	117.87	143.27	168.67	194.07	219.47	244.87	270.27	295.67	321.07
21/32	16.67	42.07	67.47	92.87	118.27	143.67	169.07	194.47	219.87	245.27	270.67	296.07	321.47
43/64	17.07	42.47	67.87	93.27	118.67	144.07	169.47	194.87	220.27	245.67	271.07	296.47	321.87
11/16	17.46	42.86	68.26	93.66	119.06	144.46	169.86	195.26	220.66	246.06	271.46	296.86	322.26
45/64	17.86	43.26	68.66	94.06	119.46	144.86	170.26	195.66	221.06	246.46	271.86	297.26	322.66
23/32	18.26	43.66	69.06	94.46	119.86	145.26	170.66	196.06	221.46	246.86	272.26	297.66	323.06
47/64	18.65	44.05	69.45	94.85	120.25	145.65	171.05	196.45	221.85	247.25	272.65	298.05	323.45
3/4	19.05	44.45	69.85	95.25	120.65	146.05	171.45	196.85	222.25	247.65	273.05	298.45	323.85
49/64	19.45	44.85	70.25	95.65	121.05	146.45	171.85	197.25	222.65	248.05	273.45	298.85	324.25
25/32	19.84	45.24	70.64	96.04	121.44	146.85	172.24	197.64	223.04	248.44	273.84	299.24	324.64
51/64	20.24	45.64	71.04	96.44	121.84	147.24	172.64	198.04	223.44	248.84	274.24	299.64	325.04
13/16	20.64	46.04	71.44	96.84	122.24	147.64	173.04	198.44	223.84	249.24	274.64	300.04	325.44
53/64	21.03	46.43	71.83	97.23	122.63	148.03	173.43	198.83	224.23	249.64	275.04	300.44	325.84
27/32	21.43	46.83	72.23	97.63	123.03	148.43	173.83	199.23	224.63	250.03	275.43	300.83	326.23
55/64	21.83	47.23	72.63	98.03	123.43	148.83	174.23	199.63	225.03	250.43	275.83	301.23	326.63
7/8	22.23	47.63	73.03	98.43	123.83	149.23	174.63	200.03	225.43	250.83	276.23	301.63	327.03
57/64	22.62	48.02	73.42	98.82	124.22	149.62	175.02	200.42	225.82	251.22	276.62	302.02	327.42
29/32	23.02	48.42	73.82	99.22	124.62	150.02	175.42	200.82	226.22	251.62	277.02	302.42	327.82
59/64	23.42	48.82	47.22	99.62	125.02	150.42	175.82	201.22	226.62	252.02	277.42	302.82	328.22
15/16	23.81	49.21	74.61	100.01	125.41	150.81	176.21	201.61	227.01	252.41	277.81	303.21	328.61
61/64	24.21	49.61	75.01	100.41	125.81	151.21	176.61	202.01	227.41	252.81	278.21	303.61	329.01
31/32	24.61	50.01	75.41	100.81	126.21	151.61	177.01	202.41	227.81	253.21	278.61	304.01	329.41
63/64	25.00	50.40	75.80	101.20	126.60	152.00	177.40	202.80	228.20	253.60	279.00	304.40	329.80