# FEEDS & SPEEDS

## I. FEEDRATES & RPM

One of the most important factors when cutting material is the 'chip load'. The chip load is the thickness of the chip being created by the cutter.

[Chipload] x [# of flutes] x [RPM] = [feedrate].

If the chipload is too small, the cutter will heat up. This can result in burning, melting or premature wear of the cutter.

A good starting point to find the chipload is about 2% of the cutter diameter. Softer materials and materials that melt should have a thicker chip closer to 4% of the cutter diameter.

2% Hard material:
Brass, hardwood, cast acrylic, solid surface
4% Soft material:
Aluminum, MDF, particle board, extruded acrylic, sintra, polycarbonate

[2%-4%] x [cutter dia] x [#flutes] x [RPM] = [feedrate].

1/4" 2 flute endmill
.02 x .25 x 2 x 18000=180
.02 x .25 x 2 x 12000=120
.02 x .25 x 2 x 6000=60

1/8" 2 flute endmill
.02 x .125 x 2 x 18000=90
.02 x .125 x 2 x 12000=60
.02 x .125 x 2 x 6000=30

1/4" 1 flute endmill
.02 x .25 x 1 x 18000=90
.02 x .25 x 1 x 12000=60
.02 x .25 x 1 x 6000=30

1/8" 1 flute endmill
.02 x .125 x 1 x 18000=45
.02 x .125 x 1 x 12000=30
.02 x .125 x 1 x 6000=15

1/4" 4 flute endmill
.02 x .25 x 4 x 18000=360
.02 x .25 x 4 x 12000=240
.02 x .25 x 4 x 6000=120

Note that for each cutter, there is a feedrate range that corresponds to the RPM range. The number of flutes determine the range at which a cutter should be fed at. The number of flutes should be taken into consideration when cutting material. 3 and 4 flute cutters are best for high feedrates, while 1 and 2 flute cutters are best at lower feedrates. Also keep in mind that spindles have peak power at the higher RPMs. It is better to use a 2 flute cutter at 18000RPM than a 4 flute at 9000RPM.

When dealing with material that melts, a thicker chip will reduce melting. When cutting deep into these materials, it becomes important to remove the chips from the cut. Cutters with less flutes are better capable of removing these chips. Also, larger cutters are better for dealing with melting.

***See Tables on Next Page ...***

# Feedrates & RPMs

[Chipload] x [Cutter Dia] x [# flutes] x [RPM] = [Feedrate]

2% chipload for hard materials---------- Hardwood, solid surface, cast acrylic, brass
4% chipload for soft materials and materials that melt------- Polycarbonate, Sintra, MDF, extruded acrylic, aluminum

| Cutter Dia | 1/2 | | | | |
|---|---|---|---|---|---|
| Chipload | 2% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 60 | 120 | 180 | 240 |
| 7000 | | 70 | 140 | 210 | 280 |
| 8000 | | 80 | 160 | 240 | 320 |
| 9000 | | 90 | 180 | 270 | 360 |
| 10000 | | 100 | 200 | 300 | 400 |
| 11000 | | 110 | 220 | 330 | 440 |
| 12000 | | 120 | 240 | 360 | 480 |
| 13000 | | 130 | 260 | 390 | 520 |
| 14000 | | 140 | 280 | 420 | 560 |
| 15000 | | 150 | 300 | 450 | 600 |
| 16000 | | 160 | 320 | 480 | 640 |
| 17000 | | 170 | 340 | 510 | 680 |
| 18000 | | 180 | 360 | 540 | 720 |
| 19000 | | 190 | 380 | 570 | 760 |
| 20000 | | 200 | 400 | 600 | 800 |
| 21000 | | 210 | 420 | 630 | 840 |
| 22000 | | 220 | 440 | 660 | 880 |
| 23000 | | 230 | 460 | 690 | 920 |
| 24000 | | 240 | 480 | 720 | 960 |

| Cutter Dia | 3/8 | | | | |
|---|---|---|---|---|---|
| Chipload | 2% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 45 | 90 | 135 | 180 |
| 7000 | | 53 | 105 | 158 | 210 |
| 8000 | | 60 | 120 | 180 | 240 |
| 9000 | | 68 | 135 | 203 | 270 |
| 10000 | | 75 | 150 | 225 | 300 |
| 11000 | | 83 | 165 | 248 | 330 |
| 12000 | | 90 | 180 | 270 | 360 |
| 13000 | | 98 | 195 | 293 | 390 |
| 14000 | | 105 | 210 | 315 | 420 |
| 15000 | | 113 | 225 | 338 | 450 |
| 16000 | | 120 | 240 | 360 | 480 |
| 17000 | | 128 | 255 | 383 | 510 |
| 18000 | | 135 | 270 | 405 | 540 |
| 19000 | | 143 | 285 | 428 | 570 |
| 20000 | | 150 | 300 | 450 | 600 |
| 21000 | | 158 | 315 | 473 | 630 |
| 22000 | | 165 | 330 | 495 | 660 |
| 23000 | | 173 | 345 | 518 | 690 |
| 24000 | | 180 | 360 | 540 | 720 |

| Cutter Dia | 1/4 | | | | |
|---|---|---|---|---|---|
| Chipload | 2% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 30 | 60 | 90 | 120 |
| 7000 | | 35 | 70 | 105 | 140 |
| 8000 | | 40 | 80 | 120 | 160 |
| 9000 | | 45 | 90 | 135 | 180 |
| 10000 | | 50 | 100 | 150 | 200 |
| 11000 | | 55 | 110 | 165 | 220 |
| 12000 | | 60 | 120 | 180 | 240 |
| 13000 | | 65 | 130 | 195 | 260 |
| 14000 | | 70 | 140 | 210 | 280 |
| 15000 | | 75 | 150 | 225 | 300 |
| 16000 | | 80 | 160 | 240 | 320 |
| 17000 | | 85 | 170 | 255 | 340 |
| 18000 | | 90 | 180 | 270 | 360 |
| 19000 | | 95 | 190 | 285 | 380 |
| 20000 | | 100 | 200 | 300 | 400 |
| 21000 | | 105 | 210 | 315 | 420 |
| 22000 | | 110 | 220 | 330 | 440 |
| 23000 | | 115 | 230 | 345 | 460 |
| 24000 | | 120 | 240 | 360 | 480 |

| Cutter Dia | 3/16 | | | | |
|---|---|---|---|---|---|
| Chipload | 2% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 23 | 45 | 68 | 90 |
| 7000 | | 26 | 53 | 79 | 105 |
| 8000 | | 30 | 60 | 90 | 120 |
| 9000 | | 34 | 68 | 101 | 135 |
| 10000 | | 38 | 75 | 113 | 150 |
| 11000 | | 41 | 83 | 124 | 165 |
| 12000 | | 45 | 90 | 135 | 180 |
| 13000 | | 49 | 98 | 146 | 195 |
| 14000 | | 53 | 105 | 158 | 210 |
| 15000 | | 56 | 113 | 169 | 225 |
| 16000 | | 60 | 120 | 180 | 240 |
| 17000 | | 64 | 128 | 191 | 255 |
| 18000 | | 68 | 135 | 203 | 270 |
| 19000 | | 71 | 143 | 214 | 285 |
| 20000 | | 75 | 150 | 225 | 300 |
| 21000 | | 79 | 158 | 236 | 315 |
| 22000 | | 83 | 165 | 248 | 330 |
| 23000 | | 86 | 173 | 259 | 345 |
| 24000 | | 90 | 180 | 270 | 360 |

| Cutter Dia | 1/8 | | | | |
|---|---|---|---|---|---|
| Chipload | 2% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 15 | 30 | 45 | 60 |
| 7000 | | 18 | 35 | 53 | 70 |
| 8000 | | 20 | 40 | 60 | 80 |
| 9000 | | 23 | 45 | 68 | 90 |
| 10000 | | 25 | 50 | 75 | 100 |
| 11000 | | 28 | 55 | 83 | 110 |
| 12000 | | 30 | 60 | 90 | 120 |
| 13000 | | 33 | 65 | 98 | 130 |
| 14000 | | 35 | 70 | 105 | 140 |
| 15000 | | 38 | 75 | 113 | 150 |
| 16000 | | 40 | 80 | 120 | 160 |
| 17000 | | 43 | 85 | 128 | 170 |
| 18000 | | 45 | 90 | 135 | 180 |
| 19000 | | 48 | 95 | 143 | 190 |
| 20000 | | 50 | 100 | 150 | 200 |
| 21000 | | 53 | 105 | 158 | 210 |
| 22000 | | 55 | 110 | 165 | 220 |
| 23000 | | 58 | 115 | 173 | 230 |
| 24000 | | 60 | 120 | 180 | 240 |

| Cutter Dia | 1/2 | | | | |
|---|---|---|---|---|---|
| Chipload | 4% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 120 | 240 | 360 | 480 |
| 7000 | | 140 | 280 | 420 | 560 |
| 8000 | | 160 | 320 | 480 | 640 |
| 9000 | | 180 | 360 | 540 | 720 |
| 10000 | | 200 | 400 | 600 | 800 |
| 11000 | | 220 | 440 | 660 | 880 |
| 12000 | | 240 | 480 | 720 | 960 |
| 13000 | | 260 | 520 | 780 | ### |
| 14000 | | 280 | 560 | 840 | ### |
| 15000 | | 300 | 600 | 900 | ### |
| 16000 | | 320 | 640 | 960 | ### |
| 17000 | | 340 | 680 | ### | ### |
| 18000 | | 360 | 720 | ### | ### |
| 19000 | | 380 | 760 | ### | ### |
| 20000 | | 400 | 800 | ### | ### |
| 21000 | | 420 | 840 | ### | ### |
| 22000 | | 440 | 880 | ### | ### |
| 23000 | | 460 | 920 | ### | ### |
| 24000 | | 480 | 960 | ### | ### |

| Cutter Dia | 3/8 | | | | |
|---|---|---|---|---|---|
| Chipload | 4% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 90 | 180 | 270 | 360 |
| 7000 | | 105 | 210 | 315 | 420 |
| 8000 | | 120 | 240 | 360 | 480 |
| 9000 | | 135 | 270 | 405 | 540 |
| 10000 | | 150 | 300 | 450 | 600 |
| 11000 | | 165 | 330 | 495 | 660 |
| 12000 | | 180 | 360 | 540 | 720 |
| 13000 | | 195 | 390 | 585 | 780 |
| 14000 | | 210 | 420 | 630 | 840 |
| 15000 | | 225 | 450 | 675 | 900 |
| 16000 | | 240 | 480 | 720 | 960 |
| 17000 | | 255 | 510 | 765 | ### |
| 18000 | | 270 | 540 | 810 | ### |
| 19000 | | 285 | 570 | 855 | ### |
| 20000 | | 300 | 600 | 900 | ### |
| 21000 | | 315 | 630 | 945 | ### |
| 22000 | | 330 | 660 | 990 | ### |
| 23000 | | 345 | 690 | ### | ### |
| 24000 | | 360 | 720 | ### | ### |

| Cutter Dia | 1/4 | | | | |
|---|---|---|---|---|---|
| Chipload | 4% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 60 | 120 | 180 | 240 |
| 7000 | | 70 | 140 | 210 | 280 |
| 8000 | | 80 | 160 | 240 | 320 |
| 9000 | | 90 | 180 | 270 | 360 |
| 10000 | | 100 | 200 | 300 | 400 |
| 11000 | | 110 | 220 | 330 | 440 |
| 12000 | | 120 | 240 | 360 | 480 |
| 13000 | | 130 | 260 | 390 | 520 |
| 14000 | | 140 | 280 | 420 | 560 |
| 15000 | | 150 | 300 | 450 | 600 |
| 16000 | | 160 | 320 | 480 | 640 |
| 17000 | | 170 | 340 | 510 | 680 |
| 18000 | | 180 | 360 | 540 | 720 |
| 19000 | | 190 | 380 | 570 | 760 |
| 20000 | | 200 | 400 | 600 | 800 |
| 21000 | | 210 | 420 | 630 | 840 |
| 22000 | | 220 | 440 | 660 | 880 |
| 23000 | | 230 | 460 | 690 | 920 |
| 24000 | | 240 | 480 | 720 | 960 |

| Cutter Dia | 3/16 | | | | |
|---|---|---|---|---|---|
| Chipload | 4% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 45 | 90 | 135 | 180 |
| 7000 | | 53 | 105 | 158 | 210 |
| 8000 | | 60 | 120 | 180 | 240 |
| 9000 | | 68 | 135 | 203 | 270 |
| 10000 | | 75 | 150 | 225 | 300 |
| 11000 | | 83 | 165 | 248 | 330 |
| 12000 | | 90 | 180 | 270 | 360 |
| 13000 | | 98 | 195 | 293 | 390 |
| 14000 | | 105 | 210 | 315 | 420 |
| 15000 | | 113 | 225 | 338 | 450 |
| 16000 | | 120 | 240 | 360 | 480 |
| 17000 | | 128 | 255 | 383 | 510 |
| 18000 | | 135 | 270 | 405 | 540 |
| 19000 | | 143 | 285 | 428 | 570 |
| 20000 | | 150 | 300 | 450 | 600 |
| 21000 | | 158 | 315 | 473 | 630 |
| 22000 | | 165 | 330 | 495 | 660 |
| 23000 | | 173 | 345 | 518 | 690 |
| 24000 | | 180 | 360 | 540 | 720 |

| Cutter Dia | 1/8 | | | | |
|---|---|---|---|---|---|
| 0.04 | 4% | | | | |
| | Feedrate | | | | |
| RPM | Flutes: | 1 | 2 | 3 | 4 |
| 6000 | | 30 | 60 | 90 | 120 |
| 7000 | | 35 | 70 | 105 | 140 |
| 8000 | | 40 | 80 | 120 | 160 |
| 9000 | | 45 | 90 | 135 | 180 |
| 10000 | | 50 | 100 | 150 | 200 |
| 11000 | | 55 | 110 | 165 | 220 |
| 12000 | | 60 | 120 | 180 | 240 |
| 13000 | | 65 | 130 | 195 | 260 |
| 14000 | | 70 | 140 | 210 | 280 |
| 15000 | | 75 | 150 | 225 | 300 |
| 16000 | | 80 | 160 | 240 | 320 |
| 17000 | | 85 | 170 | 255 | 340 |
| 18000 | | 90 | 180 | 270 | 360 |
| 19000 | | 95 | 190 | 285 | 380 |
| 20000 | | 100 | 200 | 300 | 400 |
| 21000 | | 105 | 210 | 315 | 420 |
| 22000 | | 110 | 220 | 330 | 440 |
| 23000 | | 115 | 230 | 345 | 460 |
| 24000 | | 120 | 240 | 360 | 480 |