

Speeds and Feeds



- 1) Select your material in the ISO colored chart with respect to material description.
- 2) Start with a middle/average value for cutting speed, V_c (m/min) and feed, f_n (mm/rev). Adjust the cutting speed and/or feed based on your cutting conditions.

| Material | | | | | Recommended Cutting Values | | | | | | | | | | | | | | |
|----------|----------------------|-----------|-----------|------|----------------------------|-----------|-----------|------------|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-------|--------|-------|-------|
| Group | Material Description | HB | HRC | SMM | Drill Diameter | | | SMM | Drill Diameter | | | | | | | | | | |
| | | | | | METRIC | 1.0 | 2.0 | | METRIC | 3.0 | - | 4.0 | - | 5.0 | 6.0 | - | - | 8.0 | |
| ISO | VDI 3323 | | | | FRACTIONAL | - | - | FRACTIONAL | - | 1/8 | - | 3/16 | - | - | 1/4 | 5/16 | - | | |
| | | | | | DECIMAL | .0394 | .0787 | DECIMAL | .1181 | .1250 | .1575 | .1875 | .1969 | .2362 | .2500 | .3125 | .3150 | | |
| P | 2 | 190 | 13 | ⊙ | 70 | RPM | 22,280 | 11,140 | 100 | RPM | 10,610 | 7,960 | 6,370 | 5,310 | 3,980 | | | | |
| | | | | | | FEED | 0.03-0.05 | 0.05-0.07 | | FEED | 0.06-0.12 | 0.08-0.14 | 0.14-0.20 | 0.16-0.22 | 0.18-0.24 | | | | |
| | | | | | | 3 | 250 | 25 | | ⊙ | 70 | RPM | 22,280 | 11,140 | 100 | RPM | 10,610 | 7,960 | 6,370 |
| | FEED | 0.03-0.05 | 0.05-0.07 | FEED | 0.06-0.12 | | | | 0.08-0.14 | | | 0.14-0.20 | 0.16-0.22 | 0.18-0.24 | | | | | |
| | 4 | 270 | 28 | ⊙ | 70 | RPM | 22,280 | 11,140 | 100 | RPM | 10,610 | 7,960 | 6,370 | 5,310 | 3,980 | | | | |
| | | | | | | FEED | 0.03-0.05 | 0.05-0.07 | FEED | 0.04-0.10 | 0.07-0.13 | 0.10-0.16 | 0.12-0.18 | 0.14-0.20 | | | | | |
| | 5 | 300 | 32 | ○ | 60 | RPM | 19,100 | 9,550 | 80 | RPM | 8,490 | 6,370 | 5,090 | 4,240 | 3,180 | | | | |
| | | | | | | FEED | 0.03-0.05 | 0.05-0.07 | | FEED | 0.04-0.10 | 0.07-0.13 | 0.10-0.16 | 0.12-0.18 | 0.14-0.20 | | | | |
| | 6 | 180 | 10 | ⊙ | 70 | RPM | 22,280 | 11,140 | 100 | RPM | 10,610 | 7,960 | 6,370 | 5,310 | 3,980 | | | | |
| | | | | | | FEED | 0.03-0.05 | 0.05-0.07 | | FEED | 0.06-0.12 | 0.08-0.14 | 0.14-0.20 | 0.16-0.22 | 0.18-0.24 | | | | |
| | 7 | 275 | 29 | ⊙ | 60 | RPM | 19,100 | 9,550 | 80 | RPM | 8,490 | 6,370 | 5,090 | 4,240 | 3,180 | | | | |
| FEED | | | | | | 0.03-0.05 | 0.05-0.07 | FEED | | 0.06-0.12 | 0.08-0.14 | 0.14-0.20 | 0.16-0.22 | 0.18-0.24 | | | | | |
| 8 | 300 | 32 | ○ | 60 | RPM | 19,100 | 9,550 | 80 | RPM | 8,490 | 6,370 | 5,090 | 4,240 | 3,180 | | | | | |
| | | | | | FEED | 0.02-0.04 | 0.03-0.05 | | FEED | 0.04-0.10 | 0.07-0.13 | 0.10-0.16 | 0.12-0.18 | 0.14-0.20 | | | | | |
| 9 | 350 | 38 | ○ | 30 | RPM | 9,550 | 4,770 | 40 | RPM | 4,240 | 3,180 | 2,550 | 2,120 | 1,590 | | | | | |
| | | | | | FEED | 0.02-0.04 | 0.03-0.05 | | FEED | 0.03-0.08 | 0.05-0.11 | 0.08-0.14 | 0.10-0.16 | 0.12-0.18 | | | | | |
| 10 | 200 | 15 | ⊙ | 50 | RPM | 15,920 | 7,960 | 70 | RPM | 7,430 | 5,570 | 4,460 | 3,710 | 2,790 | | | | | |
| | | | | | FEED | 0.03-0.05 | 0.05-0.07 | | FEED | 0.04-0.10 | 0.07-0.13 | 0.10-0.16 | 0.12-0.18 | 0.14-0.20 | | | | | |
| 11 | 325 | 35 | ○ | 30 | RPM | 9,550 | 4,770 | 40 | RPM | 4,240 | 3,180 | 2,550 | 2,120 | 1,590 | | | | | |
| | | | | | FEED | 0.02-0.04 | 0.03-0.05 | | FEED | 0.03-0.08 | 0.05-0.11 | 0.08-0.14 | 0.10-0.16 | 0.12-0.18 | | | | | |
| M | 12 | 200 | 15 | ○ | 50 | RPM | 15,920 | 7,960 | 70 | RPM | 7,430 | 5,570 | 4,460 | 3,710 | 2,790 | | | | |
| | | | | | | FEED | 0.03-0.05 | 0.05-0.07 | | FEED | 0.06-0.12 | 0.08-0.14 | 0.14-0.20 | 0.16-0.22 | 0.18-0.24 | | | | |
| 13 | 240 | 23 | ○ | 35 | RPM | 11,140 | 5,570 | 45 | RPM | 4,770 | 3,580 | 2,860 | 2,390 | 1,790 | | | | | |
| | | | | | FEED | 0.02-0.04 | 0.03-0.05 | | FEED | 0.04-0.10 | 0.07-0.13 | 0.10-0.16 | 0.12-0.18 | 0.14-0.20 | | | | | |
| K | 15 | 180 | 10 | ⊙ | 70 | RPM | 22,280 | 11,140 | 100 | RPM | 10,610 | 7,960 | 6,370 | 5,310 | 3,980 | | | | |
| | | | | | | FEED | 0.04-0.06 | 0.04-0.06 | | FEED | 0.08-0.14 | 0.12-0.18 | 0.15-0.22 | 0.20-0.26 | 0.22-0.28 | | | | |
| | 16 | 260 | 26 | ○ | 65 | RPM | 20,690 | 10,350 | 80 | RPM | 8,490 | 6,370 | 5,090 | 4,240 | 3,180 | | | | |
| | | | | | | FEED | 0.04-0.06 | 0.04-0.06 | | FEED | 0.06-0.12 | 0.08-0.14 | 0.14-0.20 | 0.16-0.22 | 0.18-0.24 | | | | |
| | 17 | 160 | 3 | ⊙ | 70 | RPM | 22,280 | 11,140 | 100 | RPM | 10,610 | 7,960 | 6,370 | 5,310 | 3,980 | | | | |
| | | | | | | FEED | 0.04-0.06 | 0.04-0.06 | | FEED | 0.08-0.14 | 0.12-0.18 | 0.15-0.22 | 0.20-0.26 | 0.22-0.28 | | | | |
| | 18 | 250 | 25 | ○ | 50 | RPM | 15,920 | 7,960 | 70 | RPM | 7,430 | 5,570 | 4,460 | 3,710 | 2,790 | | | | |
| | | | | | | FEED | 0.04-0.06 | 0.04-0.06 | | FEED | 0.06-0.12 | 0.08-0.14 | 0.14-0.20 | 0.16-0.22 | 0.18-0.24 | | | | |
| | 19 | 130 | | ⊙ | 60 | RPM | 19,100 | 9,550 | 80 | RPM | 8,490 | 6,370 | 5,090 | 4,240 | 3,180 | | | | |
| | | | | | | FEED | 0.04-0.06 | 0.04-0.06 | | FEED | 0.08-0.14 | 0.12-0.18 | 0.15-0.22 | 0.20-0.26 | 0.22-0.28 | | | | |
| 20 | 230 | 21 | ○ | 50 | RPM | 15,920 | 7,960 | 70 | RPM | 7,430 | 5,570 | 4,460 | 3,710 | 2,790 | | | | | |
| | | | | | FEED | 0.03-0.05 | 0.05-0.07 | | FEED | 0.06-0.12 | 0.08-0.14 | 0.14-0.20 | 0.16-0.22 | 0.18-0.24 | | | | | |



Speeds and Feeds



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- 2) Start with a middle/average value for cutting speed, V_c (m/min) and feed, f_n (mm/rev). Adjust the cutting speed and/or feed based on your cutting conditions.

| Material | | | | | Recommended Cutting Values | | | | | | | | | | | | | | | | | | | |
|----------|----------------------|-----|-----|-----|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------|-------|-------|
| Group | Material Description | HB | HRC | SMM | Drill Diameter | | | | | | | | | | | | | | | | | | | |
| | | | | | METRIC | - | 10.0 | 12.0 | - | 14.0 | - | - | 16.0 | 18.0 | - | 20.0 | | | | | | | | |
| ISO | VDI 3323 | | | | FRACTIONAL | 3/8 | - | - | - | 1/2 | - | 9/16 | 5/8 | - | - | 3/4 | - | | | | | | | |
| | | | | | DECIMAL | .3750 | .3937 | .4724 | .5000 | .5512 | .5625 | .6250 | .6299 | .7087 | .7500 | .7874 | | | | | | | | |
| P | 2 | 190 | 13 | ⊙ | 100 | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 |
| | | | | | | FEED | 0.19-0.27 | | 0.21-0.29 | | 0.21-0.29 | | 0.23-0.31 | | 0.25-0.33 | | 0.28-0.38 | | 0.28-0.38 | | 0.30-0.40 | | | |
| | | | | | | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 |
| | 3 | 250 | 25 | ⊙ | 100 | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 |
| | | | | | | FEED | 0.19-0.27 | | 0.21-0.29 | | 0.21-0.29 | | 0.23-0.31 | | 0.25-0.33 | | 0.28-0.38 | | 0.28-0.38 | | 0.30-0.40 | | | |
| | | | | | | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 |
| | 4 | 270 | 28 | ⊙ | 100 | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 |
| | | | | | | FEED | 0.15-0.23 | | 0.17-0.25 | | 0.17-0.25 | | 0.18-0.26 | | 0.19-0.27 | | 0.20-0.30 | | 0.20-0.30 | | 0.22-0.32 | | | |
| | | | | | | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 |
| | 5 | 300 | 32 | ○ | 80 | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 |
| | | | | | | FEED | 0.15-0.23 | | 0.17-0.25 | | 0.17-0.25 | | 0.18-0.26 | | 0.19-0.27 | | 0.20-0.30 | | 0.20-0.30 | | 0.22-0.32 | | | |
| RPM | | | | | | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 | |
| 6 | 180 | 10 | ⊙ | 100 | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 | |
| | | | | | FEED | 0.19-0.27 | | 0.21-0.29 | | 0.21-0.29 | | 0.23-0.31 | | 0.25-0.33 | | 0.28-0.38 | | 0.28-0.38 | | 0.30-0.40 | | | | |
| | | | | | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 | |
| 7 | 275 | 29 | ⊙ | 80 | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 | |
| | | | | | FEED | 0.19-0.27 | | 0.21-0.29 | | 0.21-0.29 | | 0.23-0.31 | | 0.25-0.33 | | 0.28-0.38 | | 0.28-0.38 | | 0.30-0.40 | | | | |
| | | | | | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 | |
| 8 | 300 | 32 | ○ | 80 | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 | |
| | | | | | FEED | 0.15-0.23 | | 0.17-0.25 | | 0.17-0.25 | | 0.18-0.26 | | 0.19-0.27 | | 0.20-0.30 | | 0.20-0.30 | | 0.22-0.32 | | | | |
| | | | | | RPM | 1,270 | | | 1,060 | | | 1,010 | | | 910 | | 800 | | 710 | | 670 | | 640 | |
| 9 | 350 | 38 | ○ | 40 | RPM | 1,270 | | | 1,060 | | | 1,010 | | | 910 | | 800 | | 710 | | 670 | | 640 | |
| | | | | | FEED | 0.13-0.19 | | 0.14-0.20 | | 0.14-0.20 | | 0.15-0.21 | | 0.16-0.22 | | 0.17-0.25 | | 0.17-0.25 | | 0.18-0.28 | | | | |
| | | | | | RPM | 2,230 | | | 1,860 | | | 1,760 | | | 1,590 | | 1,390 | | 1,240 | | 1,170 | | 1,110 | |
| 10 | 200 | 15 | ⊙ | 70 | RPM | 2,230 | | | 1,860 | | | 1,760 | | | 1,590 | | 1,390 | | 1,240 | | 1,170 | | 1,110 | |
| | | | | | FEED | 0.15-0.23 | | 0.17-0.25 | | 0.17-0.25 | | 0.18-0.26 | | 0.19-0.27 | | 0.20-0.30 | | 0.20-0.30 | | 0.22-0.32 | | | | |
| | | | | | RPM | 1,270 | | | 1,060 | | | 1,010 | | | 910 | | 800 | | 710 | | 670 | | 640 | |
| 11 | 325 | 35 | ○ | 40 | RPM | 1,270 | | | 1,060 | | | 1,010 | | | 910 | | 800 | | 710 | | 670 | | 640 | |
| | | | | | FEED | 0.13-0.19 | | 0.14-0.20 | | 0.14-0.20 | | 0.15-0.21 | | 0.16-0.22 | | 0.17-0.25 | | 0.17-0.25 | | 0.18-0.28 | | | | |
| | | | | | RPM | 2,230 | | | 1,860 | | | 1,760 | | | 1,590 | | 1,390 | | 1,240 | | 1,170 | | 1,110 | |
| M | 12 | 200 | 15 | ○ | 70 | RPM | 2,230 | | | 1,860 | | | 1,760 | | | 1,590 | | 1,390 | | 1,240 | | 1,170 | | 1,110 |
| | | | | | | FEED | 0.19-0.27 | | 0.21-0.29 | | 0.21-0.29 | | 0.23-0.31 | | 0.25-0.33 | | 0.28-0.38 | | 0.28-0.38 | | 0.30-0.40 | | | |
| | | | | | | RPM | 1,430 | | | 1,190 | | | 1,130 | | | 1,020 | | 900 | | 800 | | 750 | | 720 |
| 13 | 240 | 23 | ○ | 45 | RPM | 1,430 | | | 1,190 | | | 1,130 | | | 1,020 | | 900 | | 800 | | 750 | | 720 | |
| | | | | | FEED | 0.15-0.23 | | 0.17-0.25 | | 0.17-0.25 | | 0.18-0.26 | | 0.19-0.27 | | 0.20-0.30 | | 0.20-0.30 | | 0.22-0.32 | | | | |
| | | | | | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 | |
| K | 15 | 180 | 10 | ⊙ | 100 | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 |
| | | | | | | FEED | 0.25-0.33 | | 0.27-0.35 | | 0.27-0.35 | | 0.29-0.37 | | 0.31-0.39 | | 0.32-0.42 | | 0.32-0.42 | | 0.34-0.44 | | | |
| | | | | | | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 |
| 16 | 260 | 26 | ○ | 80 | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 | |
| | | | | | FEED | 0.19-0.27 | | 0.21-0.29 | | 0.21-0.29 | | 0.23-0.31 | | 0.25-0.33 | | 0.28-0.38 | | 0.28-0.38 | | 0.30-0.40 | | | | |
| | | | | | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 | |
| 17 | 160 | 3 | ⊙ | 100 | RPM | 3,180 | | | 2,650 | | | 2,510 | | | 2,270 | | 1,990 | | 1,770 | | 1,680 | | 1,590 | |
| | | | | | FEED | 0.25-0.33 | | 0.27-0.35 | | 0.27-0.35 | | 0.29-0.37 | | 0.31-0.39 | | 0.32-0.42 | | 0.32-0.42 | | 0.34-0.44 | | | | |
| | | | | | RPM | 2,230 | | | 1,860 | | | 1,760 | | | 1,590 | | 1,390 | | 1,240 | | 1,170 | | 1,110 | |
| 18 | 250 | 25 | ○ | 70 | RPM | 2,230 | | | 1,860 | | | 1,760 | | | 1,590 | | 1,390 | | 1,240 | | 1,170 | | 1,110 | |
| | | | | | FEED | 0.19-0.27 | | 0.21-0.29 | | 0.21-0.29 | | 0.23-0.31 | | 0.25-0.33 | | 0.28-0.38 | | 0.28-0.38 | | 0.30-0.40 | | | | |
| | | | | | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 | |
| 19 | 130 | | ⊙ | 80 | RPM | 2,550 | | | 2,120 | | | 2,010 | | | 1,820 | | 1,590 | | 1,410 | | 1,340 | | 1,270 | |
| | | | | | FEED | 0.25-0.33 | | 0.27-0.35 | | 0.27-0.35 | | 0.29-0.37 | | 0.31-0.39 | | 0.32-0.42 | | 0.32-0.42 | | 0.34-0.44 | | | | |
| | | | | | RPM | 2,230 | | | 1,860 | | | 1,760 | | | 1,590 | | 1,390 | | 1,240 | | 1,170 | | 1,110 | |
| 20 | 230 | 21 | ○ | 70 | RPM | 2,230 | | | 1,860 | | | 1,760 | | | 1,590 | | 1,390 | | 1,240 | | 1,170 | | 1,110 | |
| | | | | | FEED | 0.19-0.27 | | 0.21-0.29 | | 0.21-0.29 | | 0.23-0.31 | | 0.25-0.33 | | 0.28-0.38 | | 0.28-0.38 | | 0.30-0.40 | | | | |



Speeds and Feeds



**Penetration Rate
(mm/min)**

$$v_f = f_n \cdot n$$

**Feed Per Revolution
(mm/rev)**

$$f_n = \frac{v_f}{n}$$

**Cutting Speed
(m/min)**

$$v_c = \frac{\pi \cdot D_{tool} \cdot n}{1000}$$

**Spindle Speed
(rev/min)**

$$n = \frac{v_c \cdot 1000}{\pi \cdot D_{tool}}$$

**Material Removal Rate
(cm³/min)**

$$MRR = \frac{D_{tool} \cdot f_n \cdot v_c}{4}$$

Metric

| Symbol | Definition | Unit |
|------------|-----------------------|------------------------|
| v_f | Penetration rate | mm/min |
| f_n | Feed per revolution | mm/rev |
| v_c | Cutting speed | m/min (SMM) |
| n | Spindle speed | rev/min (RPM) |
| D_{tool} | Tool cutting diameter | mm |
| MRR | Material removal rate | (cm ³ /min) |