# Speeds and Feeds

HAAS TOOLING.COM

| ISO | VDI 3323 | Material Description | Composition / Structure / Heat Treatment | | HB | HRC | SFM (ft/min) | Countersink Diameter IPR(inch/rev) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | METRIC | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 |
| | | | | | | | | DECIMAL | .1969 | .3937 | .5906 | .7874 | .9843 | 1.1811 | 1.5748 | 1.9685 |
| P | 1 | Non-alloy steel | About 0.15% C | Annealed | 125 | | 66 | FEED | .0047-.0063 | .0063-.0079 | .0079-.0091 | .0091-.0102 | .0102-.0114 | .0114-.013 | .013-.0146 | .0146-.0161 |
| P | 2 | | About 0.45% C | Annealed | 190 | 13 | 66 | FEED | .0047-.0063 | .0063-.0079 | .0079-.0091 | .0091-.0102 | .0102-.0114 | .0114-.013 | .013-.0146 | .0146-.0161 |
| P | 3 | | About 0.45% C | Quenched & tempered | 250 | 25 | 43 | FEED | .0039-.0055 | .0055-.0071 | .0071-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 | .0122-.0138 | .0138-.0154 |
| P | 4 | | About 0.75% C | Annealed | 270 | 28 | 33 | FEED | .0024-.0039 | .0039-.0055 | .0055-.0067 | .0067-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 | .0122-.0138 |
| P | 5 | | About 0.75% C | Quenched & tempered | 300 | 32 | 33 | FEED | .0024-.0039 | .0039-.0055 | .0055-.0067 | .0067-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 | .0122-.0138 |
| P | 6 | Low alloy steel | | Annealed | 180 | 10 | | | | | | | | | | |
| P | 7 | | | Quenched & tempered | 275 | 29 | | | | | | | | | | |
| P | 8 | | | Quenched & tempered | 300 | 32 | | | | | | | | | | |
| P | 9 | | | Quenched & tempered | 350 | 38 | | | | | | | | | | |
| P | 10 | High alloyed steel, and tool steel | | Annealed | 200 | 15 | | | | | | | | | | |
| P | 11 | | | Quenched & Tempered | 325 | 35 | | | | | | | | | | |
| M | 12 | Stainless steel | Ferritic / Martensitic | Annealed | 200 | 15 | 20 | FEED | .0024-.0031 | .0024-.0031 | .0031-.0039 | .0031-.0039 | .0039-.0047 | .0039-.0047 | .0047-.0059 | .0047-.0059 |
| M | 13 | | Martensitic | Quenched & Tempered | 240 | 23 | 16 | FEED | .0024-.0031 | .0024-.0031 | .0031-.0039 | .0031-.0039 | .0039-.0047 | .0039-.0047 | .0047-.0059 | .0047-.0059 |
| M | 14 | | | Austenitic | 180 | 10 | 13 | FEED | .0024-.0031 | .0024-.0031 | .0031-.0039 | .0031-.0039 | .0039-.0047 | .0039-.0047 | .0047-.0059 | .0047-.0059 |
| | | Duplex | | | 180 | 10 | | | | | | | | | | |
| K | 15 | Grey cast iron | Pearlitic / ferritic | | 180 | 10 | 72 | FEED | .0035-.0043 | .0043-.0051 | .0051-.0063 | .0063-.0075 | .0075-.0087 | .0087-.0098 | .0098-.011 | .011-.0126 |
| K | 16 | | Pearlitic (Martensitic) | | 260 | 26 | 56 | FEED | .0031-.0039 | .0039-.0047 | .0047-.0059 | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 |
| K | 17 | Nodular cast iron | Ferritic | | 160 | 3 | **56** | FEED | .0035-.0043 | .0043-.0051 | .0051-.0063 | .0063-.0075 | .0075-.0087 | .0087-.0098 | .0098-.011 | .011-.0126 |
| K | 18 | | Pearlitic | | 250 | 25 | 49 | FEED | .0031-.0039 | .0039-.0047 | .0047-.0059 | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 |
| K | 19 | Malleable cast iron | Ferritic | | 130 | | 56 | FEED | .0035-.0043 | .0043-.0051 | .0051-.0063 | .0063-.0075 | .0075-.0087 | .0087-.0098 | .0098-.011 | .011-.0126 |
| K | 20 | | Pearlitic | | 230 | 21 | 49 | FEED | .0031-.0039 | .0039-.0047 | .0047-.0059 | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 |
| N | 21 | Aluminum-wrought alloy | Not Curable | | 60 | | 138 | FEED | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 | .0122-.0138 | .0138-.0157 | .0157-.0177 |
| N | 22 | | Curable | Hardened | 100 | | 138 | FEED | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 | .0122-.0138 | .0138-.0157 | .0157-.0177 |
| N | 23 | Aluminum-cast, alloyed | ≤ 12% Si, Not Curable | | 75 | | 128 | FEED | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 | .0122-.0138 | .0138-.0157 | .0157-.0177 |
| N | 24 | | ≤ 12% Si, Curable | Hardened | 90 | | 121 | FEED | .0047-.0059 | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.011 | .011-.0122 | .0122-.0146 | .0146-.0165 |
| N | 25 | | > 12% Si, Not Curable | | 130 | | 115 | FEED | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.0106 | .0106-.0122 | .0122-.0138 | .0138-.0157 | .0157-.0177 |
| N | 26 | Copper and Copper Alloys (Bronze / Brass) | Cutting Alloys, PB>1% | | 110 | | 92 | FEED | .0047-.0059 | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.011 | .011-.0122 | .0122-.0146 | .0146-.0165 |
| N | 27 | | CuZn, CuSnZn (Brass) | | 90 | | 82 | FEED | .0047-.0059 | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.011 | .011-.0122 | .0122-.0146 | .0146-.0165 |
| N | 28 | | CuSn, lead-free copper and electrolytic copper | | 100 | | 49 | FEED | .0047-.0059 | .0059-.0071 | .0071-.0083 | .0083-.0094 | .0094-.011 | .011-.0122 | .0122-.0146 | .0146-.0165 |
| N | - | High strngth Bronze | | | | | | | | | | | | | | |
| N | 29 | Non Metallic Materials | Duroplastic, Fiber Reinforced Plastic | | | | | | | | | | | | | |
| N | 30 | | Rubber, Wood, etc. | | | | | | | | | | | | | |
| N | - | CFRP, Graphite Composite | | | | | | | | | | | | | | |
| S | 31 | Heat Resistant Super Alloys | Fe Based | Annealed | 200 | 15 | | | | | | | | | | |
| S | 32 | | | Cured | 280 | 30 | | | | | | | | | | |
| S | 33 | | Ni or Co Based | Annealed | 250 | 25 | | | | | | | | | | |
| S | 34 | | | Cured | 350 | 38 | | | | | | | | | | |
| S | 35 | | | Cast | 320 | 34 | | | | | | | | | | |
| S | 36 | Titanium Alloys | Pure Titanium | | 400 Rm | | | | | | | | | | | |
| S | 37 | | Alpha + Beta Alloys | Hardened | 1050 Rm | | | | | | | | | | | |
| H | 38 | Hardened steel | | Hardened | 550 | 55 | | | | | | | | | | |
| H | 39 | | | Hardened | 630 | 60 | | | | | | | | | | |
| H | 40 | Chilled Cast Iron | | Cast | 400 | 42 | | | | | | | | | | |
| H | 41 | Hardened Cast Iron | | Hardened | 550 | 55 | | | | | | | | | | |

# Speeds and Feeds

| Penetration Rate (in/min) |
| --- |
| $v_f = f_n \cdot n$ |

| Feed Per Revolution (in/rev) |
| --- |
| $f_n = \frac{v_f}{n}$ |

| Cutting Speed (ft/min) |
| --- |
| $v_c = \frac{\pi \cdot D_{tool} \cdot n}{12}$ |

| Spindle Speed (rev/min) |
| --- |
| $n = \frac{v_c \cdot 12}{\pi \cdot D_{tool}}$ |

| Material Removal Rate ($in^3$/min) |
| --- |
| $MRR = D_{tool} \cdot f_n \cdot v_c \cdot 3$ |

**Inch**

| Symbol | Definition | Unit |
| --- | --- | --- |
| $v_f$ | Penetration rate | *in/min* |
| $f_n$ | Feed per revolution | *in/rev* |
| $v_c$ | Cutting speed | *ft/min (SFM)* |
| $n$ | Spindle speed | *rev/min (RPM)* |
| $D_{tool}$ | Tool cutting diameter | *in* |
| $MRR$ | Material removal rate | *($in^3$/min)* |