# **Material Cutting Speeds**

Recommended Cutting Speeds using High-Speed Steel Tools. For Reamers use 1/2 to 2/3 speed given in this Table. For Carbide tools double the speeds.

Material	Hardness, Bhn	Cutting Speed, sfpm	Material	Hardness, Bhn	Cutting Speed, sfpm
Carbon Steel AISI-1019, 1020, 1030, 1050, 1060, 1070, 1090	120-150 150-170 170-190 190-220 220-280 280-350 350-425	80-120 70-90 60-80 50-70 40-50 30-40 15-30	Tool Steel Water Hardening Cold Work Shock Resisting Mold High-Speed Steel	150-250 200-250 175-225 100-200 200-250 250-275	70-80 20-40 40-50 50-70 30-40 15-30
Alloy Steel AISI-1320, 3120, 4012, 4120, 4720, 4820, 5020, 6120, 8720, 9315, etal	125-175 175-225 225-275 275-325 325-375 375-425	60-80 50-70 45-60 35-55 30-40 15-30	Gray Cast-Iron  Malleable Iron Ferritic Pearlitic	110-140 150-190 190-220 220-260 260-320 110-160 160-200 200-240 240-280	90-140 80-100 60-80 50-70 30-40 120-140 90-110 60-90 50-60
Stainless Steel Standard	135-185 225-275 135-185 135-175	40-50 30-40 50-60 55-70	Bearing Bronze	210 230	30-100
Austenitic (annealed) Cold-Drawn Ferritic Martensitic	175-225 275-325 375-425	50-60 30-40 15-30	Brass & Bronze Aluminum		150-300 200-300
(annealed) Tempered	135-185 225-275 135-185 135-185	80-100 60-90 100-120 100-130	Cast Heat Treated Wrought Cold Drawn Wrought Heat Treated		150-250 150-300 140-300
Free Machining Austenitic (annealed) Cold-Drawn Ferritic Martensitic (annealed)	275-325 375-425	50-60 30-40	Plastics		600-1000
Tempered					

stolen from http://its.foxvalley.tec.wi.us/MachShop1/drillpress/cutspeeds.htm

### **Basic Spindle RPM for Drilling and Milling**

Spindle RPM for Cutter Diameter											
Material	SFPM	1/8"	1/4"	1/2"	3/4"	1''	2''	3"	4''	5''	6''
Tool & SS Steel	30	900	450	220	150	110	60	40	30	45	20
Cast Steel	35	1000	530	260	180	130	70	45	33	27	22
Cast Iron	50	1500	760	380	250	190	95	64	48	38	32
Carbon Steel	60	1800	910	450	300	230	115	76	57	46	38
Mild Steel	70	2100	1000	530	350	260	130	90	67	53	44
Bronze	100	3000	1500	760	500	380	190	130	95	76	64
Brass	200	6000	3000	1500	1000	760	380	250	190	150	130
Aluminum	300	9100	4560	2280	1500	1140	570	380	280	220	190
Plastic	1000	30000	15000	7600	5000	3800	1900	1200	950	760	640

Speeds in Surface Feet per Minute are specified for High-Speed Steel drill bits, and are approximate for normal drilling operations.

Speeds should be halved when using Carbon Steel bits and can be doubled for Carbide bits. Use coolant judiciously.

For Milling operations speeds may be increased by 50%. Lathe turning speeds may be increased by 100%.

The best rule of thumb for proper cutting speed is the color of the chip when cutting steel.

- Using a high-speed steel drill bit the chips should never be turning brown or blue.
- Straw colored chips indicate that you are on the maximum edge of the cutting speed for your cutting conditions.
- When using Carbide bits, chip colors can range from amber to blue, but never black.
- A dark purple color will indicate that you are on the maximum edge of your cutting conditions.

# **Calculation of Spindle RPM**

the formula for Spindle RPM, given Cutting Speed in feet-per-minute and Cutter Diameter in inches is:

(Cutting-speed x 12inches) / (Cutter-diameter x Pi)

### **Simplified Calculation of Spindle RPM**

conveniently enough the above formula approximately reduces to this:

(Cutting-speed x 4) / Cutter-diameter)

## **Depth of Cut**

**FLYCUTTING** -- Depth of cut on flat surfaces with H.S.S. cutters.

- Mild steel -- .030 in.
- Brass -- .045 in.
- Alluminum -- .060 in.

#### **END MILLING** -- Spiral flute H.S.S. endmills.

Maximum depth of cut and tool offset into material when cutting along one edge. The amount of material removed per pass is a box of this size in both directions.

- Cutters up to 1/4" diameter -- 1/8 of diameter
  - 1/8" cutter -- 1/64 or .016"
  - o 3/16" cutter -- .024"
- Cutters 1/4" and over -- 1/4 of diameter
  - 1/4" cutter -- 1/16 or .063"
  - 1/2" cutter -- 1/8 or .125"

### **SLOT CUTTING** -- H.S.S. spiral fluted endmills.

Incrimental depth of cut when all edges of the cutter are in contact with material. Spindle speed should be halved from that recommended for drilling.

Slotting Depth for Cutter Diameter									
Material	1/8''	3/16"	1/4"	3/8"	1/2"	5/8''	3/4"		
Mild Steel	.025	.030	.045	.070	.100	.200	.250		
Brass	.027	.040	.060	.100	.140	.250	.300		
Aluminum	.030	.045	.065	.110	.150	.300	.350		

#### **KEYWAY CUTTING** -- H.S.S. disc cutters (i.e. saw blades).

Spindle speed for Cisc Cutter Diameter								
Material	2''	2.5"	3"	3.5"	4''			
Mild Steel	65	55	45	38	33			
Brass	115	95	75	65	55			
Aluminum	190	155	125	110	95			