

Key Cutters Speeds & Feeds		
Material	Grades	SFM
<b>P - Steels</b>		
High Strength Tool Steel	A2, D2, P20, H11, H13, S2, O1	80-90
Low Carbon	A36, 12L14, 12L15, 1005, 1018, 1020, 1108-1119, 1213-1215, 1513-1518, 4012, 5015, 9310	180
Medium Carbon	1040-1095, 1140-1151, 1330-1345, 1520-1572, 4023-4063, 4120-4161, 4330-4340, 4620-4640, 8620-8660, 8740-8750, 6150, 51000, 52100	170
<b>M- Stainless Steels</b>		
Austenitic	301-304L, 310, 316L, 321, 347	100
Martensitic	403, 410, 416, 420, 430, 431, 440	110
Precipitation Hardening	12/8, 15/5, 17/4, AM-350/355/363, PH13-8MO, PH14-8/MO	120
<b>K - Cast Irons</b>		
Ductile	A536, J434, 60-40-18	180
Gray	A48, A436, A319, Class 20, G4000	140
Malleable	A220, A602, J158	100
<b>N - Non-Ferrous</b>		
Aluminum Alloys	2014, 2024, 6061, 7075	300
Aluminum High Silicon	A380, A390	300
Brass/Bronze	Aluminum Bronze, Low Silicon Bronze	230-250
Composites	G-10, Fiberglass, Graphite, Graphite Epoxy, Plastics	180-200
Copper		100-200
Magnesium		300
<b>S - High Temp Alloys</b>		
Cobalt Base	Stellite, HS-21, Haynes 25/188, X40, L605	80
Iron Base	Incoloy 800-802, Multmet N-155, Timkin 16-25-6, Carpenter 22-b3	80
Nickel Base	Inconel 625/718, Inco 700, 713C, 718, Monel 400-401, 404, K401, Rene, Rene 41 & 95 Hastelloy, Waspoly, Udimet 500 & 700	80
Titanium	Commercially Pure, 6Al-4V, ASTM 1/2/3, 6Al-25N-4Zr-2Mo-Si, Ti-8Al-1Mo, Ti-8Al-4Mo	90

**NOTE:** Speeds and Feeds listed are estimated and will vary by application.

These tools can be found on pages 417-441.

Speeds Formula for Calculating RPM
$\frac{\text{SFM} \times 4 = F}{\text{Diameter of Cutter}} = \text{RPM}$
<b>EXAMPLE: 1/2" ø Cutter in Aluminum</b>
$\frac{\text{SFM (300)} \times 4 = 1200 (F)}{.500} = 2400 \text{ RPM}$

Feeds Formula for Calculating IPM
$.001 \times \# \text{ of Teeth in Cutter} \times \text{RPM} = \text{IPM}$
<b>EXAMPLE: 1/2" ø Cutter in Aluminum</b>
$.001 \times 6 \times 2400 = 14.4 \text{ IPM}$

### Dovetail Cutters Speeds & Feeds

Material	Grades	SFM	Feed by Dovetail Cutter Diameter (IPT)						
			1/8	1/4	3/8	1/2	5/8	3/4	1
			(.1250)	(.2500)	(.3750)	(.5000)	(.0625)	(.7500)	(1.000)
<b>P - Steels</b>									
High Strength Tool Steel	A2, D2, P20, H11, H13, S2, O1	200-350	.0002-.0006	.0005-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0035-.0050	.0050-.0060
High Strength Tool Steel >32 HRC		100-300	.0002-.0006	.0005-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0035-.0050	.0050-.0060
Low Carbon	A36, 12L14, 12L15, 1005, 1018, 1020, 1108-1119, 1213-1215, 1513-1518, 4012, 5015, 9310	250-550	.0002-.0006	.0005-.0010	.0010-.0020	.0020-.0030	.0035-.0045	.0045-.0060	.0060-.0070
Low Carbon >32HRC		80-150	.0003-.0005	.0005-.0007	.0006-.0008	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030
Medium Carbon	1040-1095, 1140-1151, 1330-1345, 1520-1572, 4023-4063, 4120-4161, 4330-4340, 4620-4640, 8620-8660, 8740-8750, 6150, 51000, 52100	100-250	.0004-.0008	.0008-.0015	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0040-.0050
Medium Carbon >32 HRC		80-150	.0003-.0005	.0005-.0007	.0006-.0008	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030
<b>M - Stainless Steels</b>									
Austenitic	301-304L, 310, 316L, 321, 347	250-400	.0002-.001	.0002-.0010	.0010-.0020	.0010-.0020	.0020-.0060	.0020-.0060	.0020-.0060
Austenitic >32 HRC		50-250	.0002-.001	.0002-.0010	.0010-.0020	.0010-.0020	.0010-.0060	.0010-.0060	.0010-.0060
Martensitic	403, 410, 416, 420, 430, 431, 440	250-400	.0002-.001	.0002-.0010	.0010-.0020	.0010-.0020	.0020-.0060	.0020-.0060	.0020-.0060
Martensitic >32 HRC		50-250	.0002-.001	.0002-.0010	.0010-.0020	.0010-.0020	.0010-.0060	.0010-.0060	.0010-.0060
Precipitation Hardening	12/8, 15/5, 17/4, AM-350/355/363, PH13-8MO, PH14-8/MO	250-400	.0002-.001	.0002-.0010	.0010-.0020	.0010-.0020	.0020-.0060	.0020-.0060	.0020-.0060
Precipitation Hardening >32 HRC		50-250	.0002-.001	.0002-.0010	.0010-.0020	.0010-.0020	.0010-.0060	.0010-.0060	.0010-.0060
<b>K - Cast Irons</b>									
Ductile	A536, J434, 60-40-18	80-400	.0002-.0006	.0006-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0035-.0045	.0045-.0060
Gray	A48, A436, A319, Class 20, G4000	200-500	.0003-.0015	.0015-.0020	.0015-.0020	.0020-.0030	.0030-.0040	.0040-.0050	.0050-.0060
Malleable	A220, A602, J158	250-600	.001-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0035-.0040	.0040-.0045	.0050-.0060
<b>N - Non-Ferrous</b>									
Aluminum Alloys		900-1300	.0002-.0010	.0010-.0020	.0020-.0030	.0030-.0040	.0050-.0060	.0060-.0070	.0070-.0080
Aluminum High Silicon		600-900	.0002-.0010	.0010-.0020	.0020-.0030	.0030-.0040	.0050-.0060	.0060-.0070	.0070-.0080
Brass/Bronze	Aluminum Bronze, Low Silicon Bronze								
Composites	G-10, Fiberglass, Graphite, Graphite Epoxy, Plastics								
Copper		350-900	.0005-.0010	.0010-.0015	.0015-.0020	.0020-.0025	.0030-.0040	.0040-.0050	.0050-.0060
Magnesium		800-1400	.0005-.0010	.0010-.0020	.0020-.0030	.0030-.0040	.0050-.0070	.0060-.0080	.0080-.0100
<b>S - High Temp Alloys</b>									
Cobalt Base	Stellite, HS-21, Haynes 25/188,	150-300	.0002-.0006	.0005-.0010	.0010-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0040
Cobalt Base >32HRC	X40, L605	20-130	.0003-.0006	.0005-.0008	.0007-.0009	.0008-.0010	.0010-.0014	.0013-.0018	.0016-.0020
Iron Base	Incoloy 800-802, Multmet N-155	20-130	.0002-.0006	.0005-.0010	.0010-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0040
Iron Base >32HRC	Timkin 16-25-6, Carpenter 22-b3	15-80	.0003-.0006	.0005-.0008	.0007-.0009	.0008-.0010	.0010-.0014	.0013-.0018	.0016-.0020
Nickel Base	Inconel 625/718, Inco 700, 713C, 718	150-300	.0002-.0006	.0005-.0010	.0010-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0040
Nickel Base >32HRC	Monel 400-401, 404, K401, Rene, Rene 41 & 95 Hastelloy, Waspoloy, Udimet 500 & 700	20-130	.0003-.0006	.0005-.0008	.0007-.0009	.0008-.0010	.0010-.0014	.0013-.0018	.0016-.0020
Titanium	Commercially Pure, 6Al-4V, ASTM 1/2/3, 6Al-25N-4Zr-2Mo-Si, Ti-8Al-1Mo, Ti-8Al-4Mo	30-350	.0002-.0005	.0005-.0010	.0008-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0040-.0050

**NOTE:** Speeds and Feeds listed are estimated and will vary by application. These tools can be found on pages 442-445.

### Chamfer Mills Speeds & Feeds

Material	Grades	SFM			Feed by Chamfer Mill Diameter (IPT)						
					1/8	1/4	3/8	1/2	5/8	3/4	1
		Uncoated	AlTiN	TiCN	(.1250)	(.2500)	(.3750)	(.5000)	(.0625)	(.7500)	(1.000)
<b>P - Steels</b>											
High Strength Tool Steel	A2, D2, P20, H11, H13, S2, 01	150-225	210-315	185-310	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
High Strength Tool Steel >32 HRC		60-125	85-175	75-155	.0003-.0005	.0004-.0005	.0005-.0008	.0008-.0015	.0015-.0022	.0020-.0025	.0025-.0035
Low Carbon	A36, 12L14, 12L15, 1005, 1018, 1020, 1108-1119, 1213-1215, 1513-1518, 4012, 5015, 9310	200-250	280-350	250-310	.0007-.0015	.0010-.0015	.0015-.002	.0020-.0025	.0025-.0030	.0030-.0035	.0040-.0050
Low Carbon >32HRC		125-175	175-245	155-215	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
Medium Carbon	1040-1095, 1140-1151, 1330-1345, 1520-1572, 4023-4063, 4120-4161, 4330-4340, 4620-4640, 8620-8660, 8740-8750, 6150, 51000, 52100	200-250	280-350	250-310	.0007-.0015	.0010-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0035	.0040-.0050
Medium Carbon >32 HRC		125-175	175-245	155-215	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
<b>M - Stainless Steels</b>											
Austenitic	301-304L, 310, 316L, 321, 347	200-250	280-350	250-310	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
Austenitic >32 HRC		150-200	210-350	185-250	.0003-.0005	.0004-.0005	.0005-.0008	.008-.0015	.0015-.0022	.0020-.0025	.0025-.0035
Martensitic	403, 410, 416, 420, 430, 431, 440	150-250	210-350	185-310	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
Martensitic >32 HRC		125-175	175-245	155-215	.0003-.0005	.0004-.0005	.0005-.0008	.008-.0015	.0015-.0022	.0020-.0025	.0025-.0035
Precipitation Hardening	12/8, 15/5, 17/4, AM-350/355/363, PH13-8MO, PH14-8/MO	150-250	210-350	185-310	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
Precipitation Hardening >32 HRC		125-175	175-245	155-215	.0003-.0005	.0004-.0005	.0005-.0008	.008-.0015	.0015-.0022	.0020-.0025	.0025-.0035
<b>K - Cast Irons</b>											
Ductile	A536, J434, 60-40-18	300-400	420-560	375-500	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0040-.0060	.0080-.0120	.0100-.0120
Gray	A48, A436, A319, Class 20, G4000	250-350	350-490	310-435	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0040-.0060	.0060-.0080	.0080-.0100
Malleable	A220, A602, J158	275-375	375-515	340-465	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0040-.0060	.0060-.0080	.0080-.0100
<b>N - Non-Ferrous</b>											
Aluminum Alloys		>500	>500	>500	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0040-.0060	.0060-.0080	.0080-.0100
Aluminum High Silicon		450	450	560	.0010-.0015	.0015-.002	.0020-.0030	.0030-.0040	.0040-.0060	.0060-.0080	.0080-.0100
Brass/Bronze	Aluminum Bronze, Low Silicon Bronze	250-350	350-490	310-435	.0007-.0015	.0010-.0015	.0015-.0020	.0020-.0025	.0025-.0050	.0050-.0080	.0080-.0100
Composites	G-10, Fiberglass, Graphite, Graphite Epoxy, Plastics	250-1000	350-1400	310-435	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0040-.0060	.0060-.0080	.0080-.0100
Copper		300-400	420-560	375-500	.0007-.0015	.0010-.0015	.0015-.0020	.0020-.0025	.0025-.0050	.0050-.0080	.0080-.0100
Magnesium		>500	>500	>500	.0010-.0015	.0015-.002	.0020-.0030	.0030-.0040	.0040-.0060	.0060-.0080	.0080-.0100
<b>S - High Temp Alloys</b>											
Cobalt Base	Stellite, HS-21, Haynes 25/188,	175-225	245-315	215-280	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
Cobalt Base >32HRC	X40, L605	125-175	175-245	155-215	.0003-.0005	.0004-.0005	.0005-.0008	.0080-.0015	.0015-.0022	.0020-.0025	.0025-.0035
Iron Base	Incoloy 800-802, Multmet N-155	175-225	245-315	215-280	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
Iron Base >32HRC	Timkin 16-25-6, Carpenter 22-b3	125-175	175-245	155-215	.0003-.0005	.0004-.0005	.0005-.0008	.0080-.0015	.0015-.0022	.0020-.0025	.0025-.0035
Nickel Base	Inconel 625/718, Inco 700, 713C, 718	125-175	175-245	155-215	.0005-.0010	.0008-.0010	.0010-.0015	.0015-.0020	.0020-.0030	.0030-.0040	.0035-.0045
Nickel Base >32HRC	Monel 400-401, 404, K401, Rene, Rene 41 & 95 Hastelloy, Wasp-oloy, Udimet 500 & 700	70-115	100-160	85-140	.0003-.0005	.0004-.0005	.0005-.0008	.0080-.0015	.0015-.0022	.0020-.0025	.0025-.0035
Titanium	Commercially Pure, 6Al-4V, ASTM 1/2/3, 6Al-25N-4Zr-2Mo-Si, Ti-8Al-1Mo, Ti-8Al-4Mo	200-300	280-420	250-375	.0007-.0015	.0010-.0015	.0015-.002	.0020-.0025	.0025-.0030	.0030-.0035	.0040-.0050

- NOTES:** (1) Speeds and Feeds listed are estimated and will vary by application.  
 (2) Maximize rigidity to reduce chatter and increase tool life by applying the following tips.  
 • Choose the largest diameter possible  
 • Use the shortest LOC (Length of Cut) available  
 • Use the toolholder which offers the shortest gage length  
 (3) To control chatter, increase feed or reduce speed.  
 (4) For extra long endmills, reduce SFM by 25%.  
 (5) Keep to a minimum at all times. As runout increases, the tools' performance decreases and tool life will be reduced.  
 (6) Use a coolant or air blast to evacuate chips to avoid premature damage to your carbide cutting tool, which may occur if chips are recut.

These tools can be found on pages 446-451.

Specialty Tools - Technical Info

## Edge Breakers & Angle Cutters Speeds & Feeds

Material	Grades	SFM
<b>P - Steels</b>		
High Strength Tool Steel	A2, D2, P20, H11, H13, S2, O1	80-90
Low Carbon	A36, 12L14, 12L15, 1005, 1018, 1020, 1108-1119, 1213-1215, 1513-1518, 4012, 5015, 9310	180
Medium Carbon	1040-1095, 1140-1151, 1330-1345, 1520-1572, 4023-4063, 4120-4161, 4330-4340, 4620-4640, 8620-8660, 8740-8750, 6150, 51000, 52100	170
<b>M- Stainless Steels</b>		
Austenitic	301-304L, 310, 316L, 321, 347	100
Martensitic	403, 410, 416, 420, 430, 431, 440	110
Precipitation Hardening	12/8, 15/5, 17/4, AM-350/355/363, PH13-8MO, PH14-8/MO	120
<b>K - Cast Irons</b>		
Ductile	A536, J434, 60-40-18	180
Gray	A48, A436, A319, Class 20, G4000	140
Malleable	A220, A602, J158	100
<b>N - Non-Ferrous</b>		
Aluminum Alloys	2014, 2024, 6061, 7075	300
Aluminum High Silicon	A380, A390	300
Brass/Bronze	Aluminum Bronze, Low Silicon Bronze	230-250
Composites	G-10, Fiberglass, Graphite, Graphite Epoxy, Plastics	180-200
Copper		100-200
Magnesium		300
<b>S - High Temp Alloys</b>		
Cobalt Base	Stellite, HS-21, Haynes 25/188, X40, L605	80
Iron Base	Incoloy 800-802, Multmet N-155, Timkin 16-25-6, Carpenter 22-b3	80
Nickel Base	Inconel 625/718, Inco 700, 713C, 718, Monel 400-401, 404, K401, Rene, Rene 41 & 95 Hastelloy, Waspoly, Udimet 500 & 700	80
Titanium	Commercially Pure, 6Al-4V, ASTM 1/2/3, 6Al-25N-4Zr-2Mo-Si, Ti-8Al-1Mo, Ti-8Al-4Mo	90

**NOTE:** Speeds and Feeds listed are estimated and will vary by application.

These tools can be found on pages 452-457.

### Speeds Formula for Calculating RPM

$$\text{SFM} \times 4 = F$$

$$\frac{F}{\text{Diameter of Cutter}} = \text{RPM}$$

**EXAMPLE:** 1/2" ø Cutter in Aluminum

$$\text{SFM (300)} \times 4 = 1200 (F)$$

$$\frac{1200 (F)}{.500} = 2400 \text{ RPM}$$

### Feeds Formula for Calculating IPM

$$.001 \times \# \text{ of Teeth in Cutter} \times \text{RPM} = \text{IPM}$$

**EXAMPLE:** 1/2" ø Cutter in Aluminum

$$.001 \times 6 \times 2400 = 14.4 \text{ IPM}$$