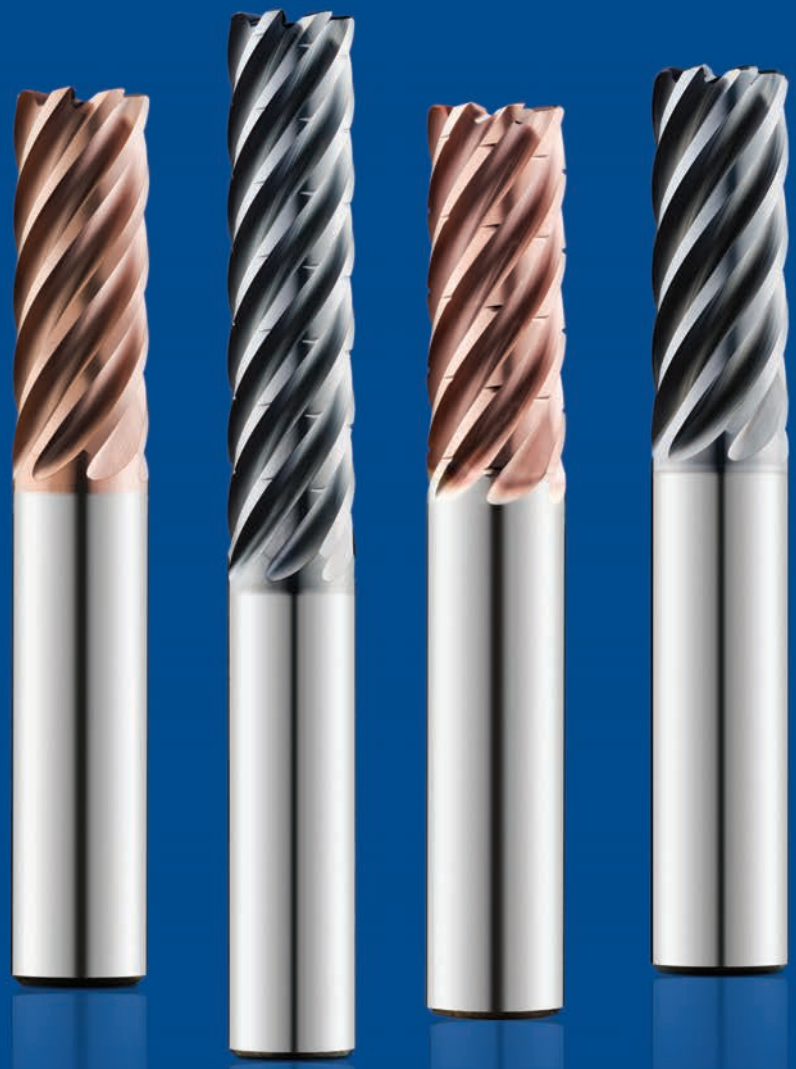
SGS®
Solid Carbide Tools

VALUE AT THE SPINDLE®

H-Carb High Efficiency Endmills

77
H-CARB



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ISO 9001:2015 Certified

KYOCERA

7 7 H-CARB

INTRODUCING THE H-CARB SEVEN FLUTE HIGH EFFICIENCY ENDMILL

The H-Carb Seven Flute High Efficiency Endmill specializes in deep axial trochoidal and high-speed machining applications offered at various lengths of cut. The specialized core and flute design improves rigidity and chip flow while reducing deflection. The seven-flute design allows for superior finishes at high rates over 5 and 6 flute tools. The series is offered in a variety of cut lengths and end configurations with two cutting edge styles. The H-Carb is available with either Ti-NAMITE®-M or Ti-NAMITE®-A coatings for superior tool life and performance in a variety of ferrous materials and high temp alloys.

THE H-CARB IS IDEAL FOR HIGH-EFFICIENCY ROUGHING AND FINISHING IN THE FOLLOWING TARGET MATERIALS:

- Titanium
- High-Temperature Alloys
- Stainless Steels
- Carbon and Alloyed Steels
- Cast Iron
- Hardened Steels

EXPANSIVE OFFERING

- Over 500 items in portfolio
- Available in 3 lengths of cut
- Full complement of corner radii available
- Specials and alterations are available upon request
- Available coatings are suitable for dry machining in ferrous based materials such as cast irons and many carbon steels
- Chip Breaker profile standard in portfolio

Ti-NAMITE-M

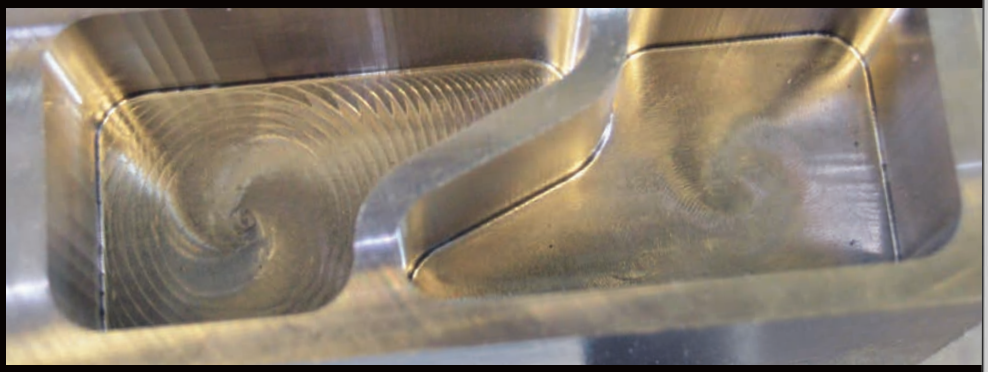
Features of Ti-NAMITE®-M include high wear resistance, reduced friction, and excellent prevention of cutting edge build up. The coating provides superior material removal rates and tool life when used in high performance operations in cast iron and steel and with difficult to machine materials like titanium.

Hardness (HV): 3600
Oxidation Temperature: 1150°C / 2100°F
Coefficient of Friction: 0.45
Thickness: 1 – 5 Microns (based on tool diameter)

Ti-NAMITE-A

The H-Carb is available with an abrasive resistant and hard coating. The coating has a high hardness giving ultimate protection against abrasive wear and erosion. Ideal for high temperature alloys and stainless-steel applications.

Hardness (HV): 3700
Oxidation Temperature: 1100°C / 2010°F
Coefficient of Friction: 0.30
Thickness: 1 – 5 Microns (based on tool diameter)



FEATURES

END WORK

- Open center design delivers efficiency during entry movements into the workpiece
- Specially engineered gash provides increased strength at the end of the tool

CHIP BREAKER

- Breaks up the chips formed by the long flute length allowing for better chip flow and evacuation in deep pocketing operations
- Specialized design enhances edge strength and reduces load

FLUTING & HELIX ANGLE

- The innovative seven flute design allows for higher feed rates, decreasing cycle time and improving productivity
- An optimized core improves rigidity, chip flow and reduced deflection
- The variable flute indexing provides advanced chatter suppression
- Optimized Helix angle provides enhanced shearing capabilities

CAPABILITIES

ROUGHING

- 2.5xD length of cut is capable of 20% radial engagement at full axial depth of cut
- 3xD length of cut is capable of 15% radial engagement at full axial depth of cut
- 4xD length of cut is capable of 10% radial engagement at full axial depth of cut

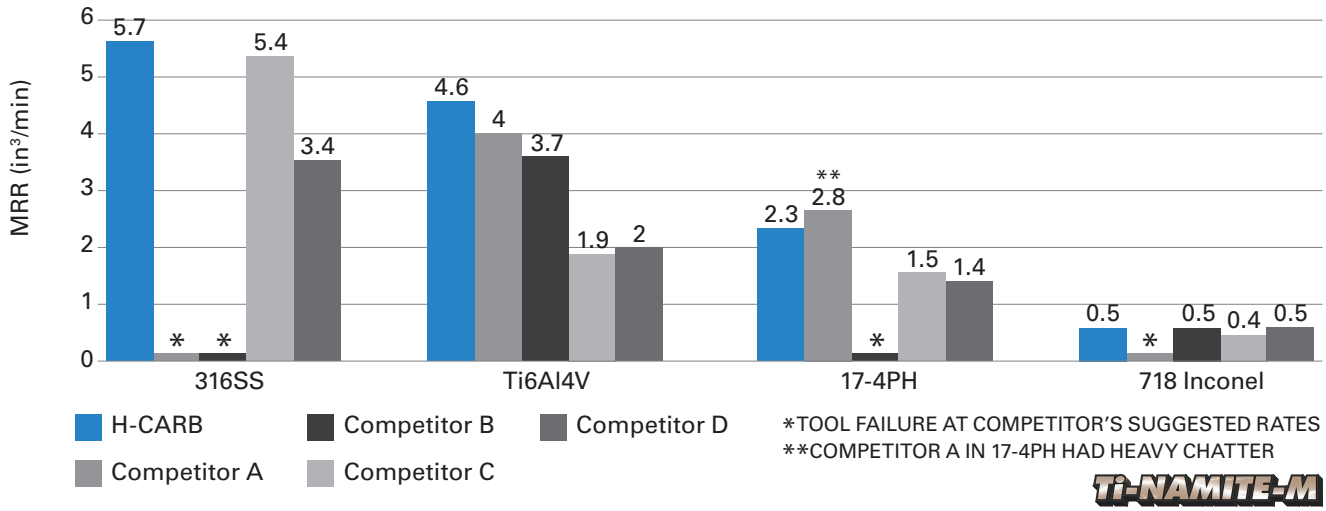
FINISHING

- Varying length of cuts available to attain an optimal surface finish
- The seven-flute design allows for superior finishes at higher rates over 5 and 6 flute tools, allowing for superior finishes in a shorter cycle time

HIGH-SPEED MACHINING

- Long flute length enables deep axial cuts at high speeds and feeds, enhancing material removal rate in a wide range of difficult to machine materials
- Exclusive TI-NAMITE®-M coating for high heat resistance to enhance tool life in difficult to machine materials like titanium
- Available with TI-NAMITE®-A coating for superior wear, edge build-up resistance and extended tool life in difficult to machine materials like stainless steel

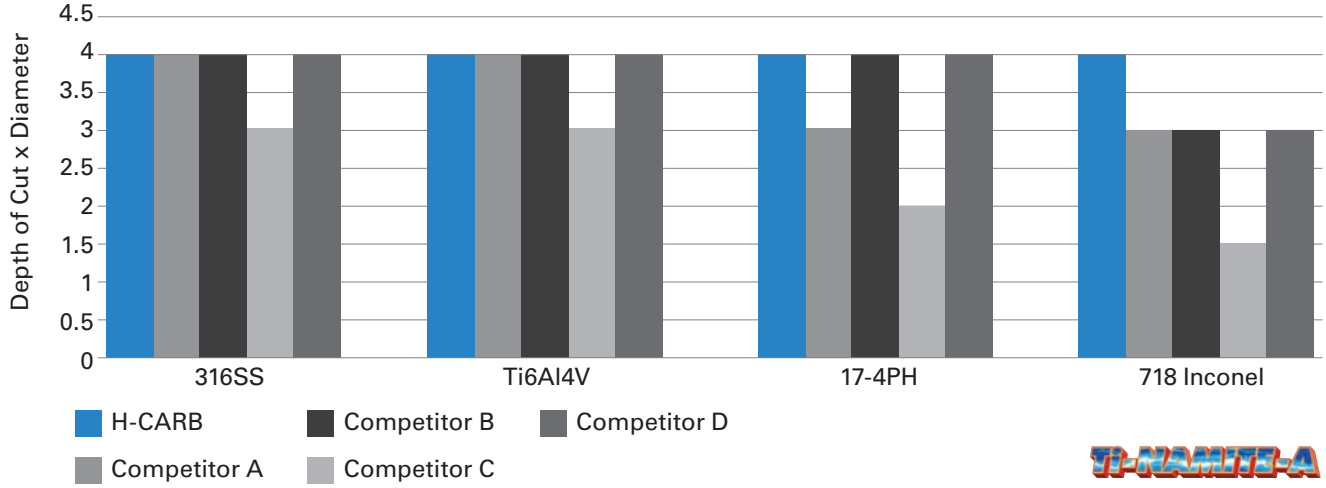
MATERIAL REMOVAL RATE COMPARISON
(Suggested Parameters for 5% Ae)



*TOOL FAILURE AT COMPETITOR'S SUGGESTED RATES
**COMPETITOR A IN 17-4PH HAD HEAVY CHATTER

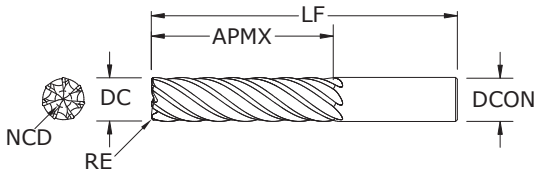
TI-NAMITE-M

MAX SUGGESTED AXIAL DEPTH OF CUT
10% Ae (4xD Tools)



TI-NAMITE-A

H-CARB



TOLERANCES (inch)

DC	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter (NCD)	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. Chip Breaker	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. Chip Breaker
1/4	5/8	2-1/2	1/4	–	0.0845	77100	77102	77101	77103
1/4	5/8	2-1/2	1/4	0.015	0.0845	77104	77106	77105	77107
1/4	5/8	2-1/2	1/4	0.030	0.0845	77108	77110	77109	77111
1/4	3/4	2-1/2	1/4	–	0.0845	77112	77114	77113	77115
1/4	3/4	2-1/2	1/4	0.015	0.0845	77116	77118	77117	77119
1/4	3/4	2-1/2	1/4	0.030	0.0845	77120	77122	77121	77123
1/4	1	3	1/4	–	0.0845	77124	77126	77125	77127
1/4	1	3	1/4	0.015	0.0845	77128	77130	77129	77131
1/4	1	3	1/4	0.030	0.0845	77132	77134	77133	77135
3/8	15/16	3	3/8	–	0.1268	77136	77138	77137	77139
3/8	15/16	3	3/8	0.015	0.1268	77140	77142	77141	77143
3/8	15/16	3	3/8	0.030	0.1268	77144	77146	77145	77147
3/8	1-1/8	3-1/4	3/8	–	0.1268	77148	77150	77149	77151
3/8	1-1/8	3-1/4	3/8	0.015	0.1268	77152	77154	77153	77155
3/8	1-1/8	3-1/4	3/8	0.030	0.1268	77156	77158	77157	77159
3/8	1-1/2	3-1/2	3/8	–	0.1268	77160	77162	77161	77163
3/8	1-1/2	3-1/2	3/8	0.015	0.1268	77164	77166	77165	77167
3/8	1-1/2	3-1/2	3/8	0.030	0.1268	77168	77170	77169	77171
1/2	1-1/4	3-1/4	1/2	–	0.1690	77172	77174	77173	77175
1/2	1-1/4	3-1/4	1/2	0.030	0.1690	77176	77178	77177	77179
1/2	1-1/4	3-1/4	1/2	0.060	0.1690	77180	77182	77181	77183
1/2	1-1/2	3-1/2	1/2	–	0.1690	77184	77186	77185	77187
1/2	1-1/2	3-1/2	1/2	0.030	0.1690	77188	77190	77189	77191
1/2	1-1/2	3-1/2	1/2	0.060	0.1690	77192	77194	77193	77195
1/2	2	4	1/2	–	0.1690	77196	77198	77197	77199
1/2	2	4	1/2	0.030	0.1690	77200	77202	77201	77203
1/2	2	4	1/2	0.060	0.1690	77204	77206	77205	77207
5/8	1-9/16	3-3/4	5/8	–	0.2113	77208	77210	77209	77211
5/8	1-9/16	3-3/4	5/8	0.030	0.2113	77212	77214	77213	77215
5/8	1-9/16	3-3/4	5/8	0.060	0.2113	77216	77218	77217	77219
5/8	1-7/8	4	5/8	–	0.2113	77220	77222	77221	77223
5/8	1-7/8	4	5/8	0.030	0.2113	77224	77226	77225	77227
5/8	1-7/8	4	5/8	0.060	0.2113	77228	77230	77229	77231

(continued on next page)

Square

Corner

Straight

Right Spiral

2.5xD Length of Cut

3xD Length of Cut

4xD Length of Cut

Flute Spacing Unequal

Positive Rake Angle

External Coolant

Chip Breaker

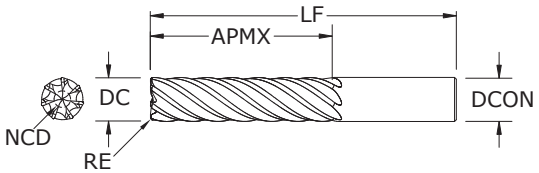
7 Flutes

TOLERANCES (inch)

DC	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



77 H-CARB

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Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter (NCD)	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. Chip Breaker	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. Chip Breaker
5/8	2-1/2	4-1/2	5/8	–	0.2113	77232	77234	77233	77235
5/8	2-1/2	4-1/2	5/8	0.030	0.2113	77236	77238	77237	77239
5/8	2-1/2	4-1/2	5/8	0.060	0.2113	77240	77242	77241	77243
3/4	1-7/8	4	3/4	–	0.2535	77244	77246	77245	77247
3/4	1-7/8	4	3/4	.030	0.2113	77248	77250	77249	77251
3/4	1-7/8	4	3/4	.060	0.2113	77252	77254	77253	77255
3/4	1-7/8	4	3/4	.120	0.2113	77256	77258	77257	77259
3/4	2-1/4	4-1/2	3/4	–	0.2535	77260	77262	77261	77263
3/4	2-1/4	4-1/2	3/4	.030	0.2535	77264	77266	77265	77267
3/4	2-1/4	4-1/2	3/4	.060	0.2535	77268	77270	77269	77271
3/4	2-1/4	4-1/2	3/4	.120	0.2535	77272	77274	77273	77275
3/4	3	5-1/4	3/4	–	0.2535	77276	77278	77277	77279
3/4	3	5-1/4	3/4	.030	0.2535	77280	77282	77281	77283
3/4	3	5-1/4	3/4	.060	0.2535	77284	77286	77285	77287
3/4	3	5-1/4	3/4	.120	0.2535	77288	77290	77289	77291
1	2-1/2	5-1/2	1	–	0.3380	77292	77294	77293	77295
1	2-1/2	5-1/2	1	.030	0.3380	77296	77298	77297	77299
1	2-1/2	5-1/2	1	.060	0.3380	77300	77302	77301	77303
1	2-1/2	5-1/2	1	.120	0.3380	77304	77306	77305	77307
1	3	6	1	–	0.3380	77308	77310	77309	77311
1	3	6	1	.030	0.3380	77312	77314	77313	77315
1	3	6	1	.060	0.3380	77316	77318	77317	77319
1	3	6	1	.120	0.3380	77320	77322	77321	77323
1	4	7	1	–	0.3380	77324	77326	77325	77327
1	4	7	1	.030	0.3380	77328	77330	77329	77331
1	4	7	1	.060	0.3380	77332	77334	77333	77335
1	4	7	1	.120	0.3380	77336	77338	77337	77339

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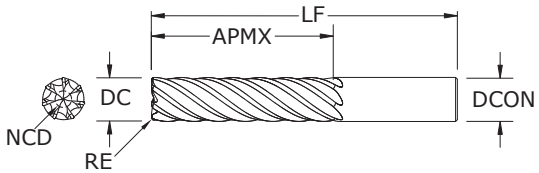


TOLERANCES (mm)

DC	DC	DCON
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

RE = +0,000 / –0,050

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter (NCD)	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. Chip Breaker	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. Chip Breaker
6,0	15,0	63,0	6,0	–	2,03	74300	74302	74301	74303
6,0	15,0	63,0	6,0	0,3	2,03	74304	74306	74305	74307
6,0	15,0	63,0	6,0	0,5	2,03	74308	74310	74309	74311
6,0	18,0	63,0	6,0	–	2,03	74316	74318	74317	74319
6,0	18,0	63,0	6,0	0,3	2,03	74320	74322	74321	74323
6,0	18,0	63,0	6,0	0,5	2,03	74324	74326	74325	74327
6,0	24,0	75,0	6,0	–	2,03	74332	74334	74333	74335
6,0	24,0	75,0	6,0	0,3	2,03	74336	74338	74337	74339
6,0	24,0	75,0	6,0	0,5	2,03	74340	74342	74341	74343
8,0	20,0	75,0	8,0	–	2,71	74348	74350	74349	74351
8,0	20,0	75,0	8,0	0,5	2,71	74352	74354	74353	74355
8,0	20,0	75,0	8,0	1,0	2,71	74356	74358	74357	74359
8,0	20,0	75,0	8,0	2,0	2,71	74360	74362	74361	74363
8,0	24,0	75,0	8,0	–	2,71	74364	74366	74365	74367
8,0	24,0	75,0	8,0	0,5	2,71	74368	74370	74369	74371
8,0	24,0	75,0	8,0	1,0	2,71	74372	74374	74373	74375
8,0	24,0	75,0	8,0	2,0	2,71	74376	74378	74377	74379
8,0	32,0	85,0	8,0	–	2,71	74380	74382	74381	74383
8,0	32,0	85,0	8,0	0,5	2,71	74384	74386	74385	74387
8,0	32,0	85,0	8,0	1,0	2,71	74388	74390	74389	74391
8,0	32,0	85,0	8,0	2,0	2,71	74392	74394	74393	74395
10,0	25,0	75,0	10,0	–	3,38	74396	74398	74397	74399
10,0	25,0	75,0	10,0	0,5	3,38	74400	74402	74401	74403
10,0	25,0	75,0	10,0	1,0	3,38	74404	74406	74405	74407
10,0	30,0	80,0	10,0	–	3,38	74408	74410	74409	74411
10,0	30,0	80,0	10,0	0,5	3,38	74412	74414	74413	74415
10,0	30,0	80,0	10,0	1,0	3,38	74416	74418	74417	74419
10,0	40,0	100,0	10,0	–	3,38	74420	74422	74421	74423
10,0	40,0	100,0	10,0	0,5	3,38	74424	74426	74425	74427
10,0	40,0	100,0	10,0	1,0	3,38	74428	74430	74429	74431
12,0	30,0	83,0	12,0	–	4,06	74432	74434	74433	74435
12,0	30,0	83,0	12,0	0,5	4,06	74436	74438	74437	74439
12,0	30,0	83,0	12,0	1,0	4,06	74440	74442	74441	74443
12,0	36,0	83,0	12,0	–	4,06	74444	74446	74445	74447
12,0	36,0	83,0	12,0	0,5	4,06	74448	74450	74449	74451
12,0	36,0	83,0	12,0	1,0	4,06	74452	74454	74453	74455

(continued on next page)

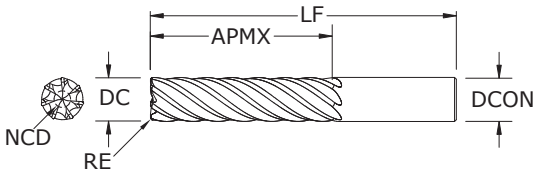
Square
Corner
Straight
Right Spiral
2.5xD Length of Cut
3xD Length of Cut
4xD Length of Cut
Flute Spacing Unequal
Positive Rake Angle
External Coolant
Chip Breaker
7 Flutes

TOLERANCES (mm)

DC	DC	DCON
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

RE = +0,000 / –0,050



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Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter (NCD)	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. Chip Breaker	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. Chip Breaker
12,0	48,0	100,0	12,0	–	4,06	74456	74458	74457	74459
12,0	48,0	100,0	12,0	0,5	4,06	74460	74462	74461	74463
12,0	48,0	100,0	12,0	1,0	4,06	74464	74466	74465	74467
16,0	40,0	92,0	16,0	–	5,41	74468	74470	74469	74471
16,0	40,0	92,0	16,0	0,5	5,41	74472	74474	74473	74475
16,0	40,0	92,0	16,0	1,0	5,41	74476	74478	74477	74479
16,0	48,0	100,0	16,0	–	5,41	74480	74482	74481	74483
16,0	48,0	100,0	16,0	0,5	5,41	74484	74486	74485	74487
16,0	48,0	100,0	16,0	1,0	5,41	74488	74490	74489	74491
16,0	64,0	115,0	16,0	–	5,41	74492	74494	74493	74495
16,0	64,0	115,0	16,0	0,5	5,41	74496	74498	74497	74499
16,0	64,0	115,0	16,0	1,0	5,41	74500	74502	74501	74503
20,0	50,0	100,0	20,0	–	6,76	74504	74506	74505	74507
20,0	50,0	100,0	20,0	0,5	6,76	74508	74510	74509	74511
20,0	50,0	100,0	20,0	1,0	6,76	74512	74514	74513	74515
20,0	50,0	100,0	20,0	2,0	6,76	74516	74518	74517	74519
20,0	60,0	115,0	20,0	–	6,76	74520	74522	74521	74523
20,0	60,0	115,0	20,0	0,5	6,76	74524	74526	74525	74527
20,0	60,0	115,0	20,0	1,0	6,76	74528	74530	74529	74531
20,0	60,0	115,0	20,0	2,0	6,76	74532	74534	74533	74535
20,0	80,0	140,0	20,0	–	6,76	74536	74538	74537	74539
20,0	80,0	140,0	20,0	0,5	6,76	74540	74542	74541	74543
20,0	80,0	140,0	20,0	1,0	6,76	74544	74546	74545	74547
20,0	80,0	140,0	20,0	2,0	6,76	74548	74550	74549	74551
25,0	63,0	135,0	25,0	–	8,45	74552	74554	74553	74555
25,0	63,0	135,0	25,0	1,0	8,45	74556	74558	74557	74559
25,0	63,0	135,0	25,0	2,0	8,45	74560	74562	74561	74563
25,0	63,0	135,0	25,0	3,0	8,45	74564	74566	74565	74567
25,0	75,0	150,0	25,0	–	8,45	74568	74570	74569	74571
25,0	75,0	150,0	25,0	1,0	8,45	74572	74574	74573	74575
25,0	75,0	150,0	25,0	2,0	8,45	74576	74578	74577	74579
25,0	75,0	150,0	25,0	3,0	8,45	74580	74582	74581	74583
25,0	100,0	170,0	25,0	–	8,45	74584	74586	74585	74587
25,0	100,0	170,0	25,0	1,0	8,45	74588	74590	74589	74591
25,0	100,0	170,0	25,0	2,0	8,45	74592	74594	74593	74595
25,0	100,0	170,0	25,0	3,0	8,45	74596	74598	74597	74599

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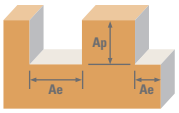

	Series 77, 77CR Fractional	Hardness		Ae x DC	Ap x DC	Vc (sfm)		DC • inch 1/4	3/8	1/2	5/8	3/4	1
P	**CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536**	≤ 275 Bhn or ≤ 28 HRc					RPM	11552	7701	5776	4621	3851	2888
			HSM	2.5xD		816 (653-979)	Fz	0.0015	0.0024	0.0031	0.0035	0.0038	0.0042
				≤ 0.2	≤ APMX		Feed (ipm)	121	129	125	113	102	85
			HSM	3xD		845 (676-1014)	Fz	0.0017	0.0027	0.0035	0.0040	0.0043	0.0047
				≤ 0.15	≤ APMX		Feed (ipm)	136	146	140	129	116	95
			HSM	4xD		756 (605-907)	Fz	0.0018	0.0028	0.0036	0.0041	0.0044	0.0049
				≤ 0.1	≤ APMX		Feed (ipm)	146	151	146	133	119	99
	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375 Bhn or ≤ 40 HRc					RPM	8419	5613	4210	3368	2806	2105
			HSM	2.5xD		595 (476-714)	Fz	0.0009	0.0019	0.0026	0.0028	0.0031	0.0035
				≤ 0.2	≤ APMX		Feed (ipm)	53	75	77	66	61	52
			HSM	3xD		616 (493-739)	Fz	0.0010	0.0021	0.0030	0.0033	0.0035	0.0039
				≤ 0.15	≤ APMX		Feed (ipm)	59	83	88	78	69	57
			HSM	4xD		551 (441-661)	Fz	0.0011	0.0022	0.0031	0.0034	0.0036	0.0041
				≤ 0.1	≤ APMX		Feed (ipm)	65	86	91	80	71	60
M	**STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F**	≤ 275 Bhn or ≤ 28 HRc					RPM	9137	6092	4569	3655	3046	2284
			HSM	2.5xD		646 (517-775)	Fz	0.0009	0.0017	0.0023	0.0025	0.0028	0.0032
				≤ 0.2	≤ APMX		Feed (ipm)	58	72	74	64	60	51
			HSM	3xD		669 (535-803)	Fz	0.0010	0.0019	0.0026	0.0029	0.0031	0.0036
				≤ 0.15	≤ APMX		Feed (ipm)	64	81	83	74	66	58
			HSM	4xD		598 (478-718)	Fz	0.0011	0.0020	0.0027	0.0030	0.0033	0.0037
				≤ 0.1	≤ APMX		Feed (ipm)	70	85	86	77	70	59
	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L	≤ 275 Bhn or ≤ 28 HRc					RPM	6020	4014	3010	2408	2007	1505
			HSM	2.5xD		425 (340-510)	Fz	0.0007	0.0014	0.0019	0.0023	0.0026	0.0030
				≤ 0.2	≤ APMX		Feed (ipm)	29	39	40	39	37	32
			HSM	3xD		440 (352-528)	Fz	0.0008	0.0016	0.0021	0.0025	0.0029	0.0034
				≤ 0.15	≤ APMX		Feed (ipm)	34	45	44	42	41	36
			HSM	4xD		394 (315-473)	Fz	0.0008	0.0016	0.0022	0.0026	0.0030	0.0035
				≤ 0.1	≤ APMX		Feed (ipm)	34	45	46	44	42	37
	STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450	≤ 325 Bhn or ≤ 35 HRc					RPM	5776	3851	2888	2310	1925	1444
			HSM	2.5xD		408 (326-490)	Fz	0.0007	0.0014	0.0019	0.0023	0.0026	0.0030
				≤ 0.2	≤ APMX		Feed (ipm)	28	38	38	37	35	30
			HSM	3xD		422 (338-506)	Fz	0.0008	0.0016	0.0021	0.0025	0.0029	0.0034
				≤ 0.15	≤ APMX		Feed (ipm)	32	43	42	40	39	34
			HSM	4xD		378 (302-454)	Fz	0.0008	0.0016	0.0022	0.0026	0.0030	0.0035
				≤ 0.1	≤ APMX		Feed (ipm)	32	43	44	42	40	35

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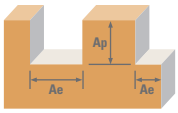

	Series 77, 77CR Fractional	Hardness		Ae x DC	Ap x DC	Vc (sfm)		DC • inch 1/4	3/8	1/2	5/8	3/4	1
P	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	≤ 220 Bhn or ≤ 19 HRc					RPM	10100	6733	5050	4040	3367	2525
			HSM	2.5xD		714 (571-857)	Fz	0.0010	0.0018	0.0024	0.0028	0.0033	0.0037
				≤ 0.2	≤ APMX		Feed (ipm)	71	85	85	79	78	65
			HSM	3xD		739 (591-887)	Fz	0.0011	0.0020	0.0027	0.0033	0.0037	0.0042
				≤ 0.15	≤ APMX		Feed (ipm)	78	94	95	93	87	73
			HSM	4xD		661 (529-793)	Fz	0.0012	0.0021	0.0028	0.0034	0.0039	0.0043
				≤ 0.1	≤ APMX		Feed (ipm)	85	99	99	96	92	76
	CAST IRONS (HIGH ALLOY) Gray, Malleable, Ductile	≤ 260 Bhn or ≤ 26 HRc					RPM	6020	4014	3010	2408	2007	1505
			HSM	2.5xD		425 (340-510)	Fz	0.0007	0.0014	0.0019	0.0023	0.0026	0.0030
				≤ 0.2	≤ APMX		Feed (ipm)	29	39	40	39	37	32
			HSM	3xD		440 (352-528)	Fz	0.0008	0.0016	0.0021	0.0025	0.0029	0.0037
				≤ 0.15	≤ APMX		Feed (ipm)	34	45	44	42	41	39
			HSM	4xD		394 (315-473)	Fz	0.0008	0.0016	0.0022	0.0026	0.0030	0.0035
				≤ 0.1	≤ APMX		Feed (ipm)	34	45	46	44	42	37
N	NON-FERROUS MATERIALS	Not Recommended for this Material Group											
S	SUPER ALLOYS (NICKEL , COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	≤ 300 Bhn or ≤ 32 HRc					RPM	1925	1284	963	770	642	481
			HSM	2.5xD		136 (109-163)	Fz	0.0006	0.0011	0.0016	0.0018	0.0021	0.0025
				≤ 0.2	≤ APMX		Feed (ipm)	8	10	11	10	9	8
			HSM	3xD		141 (113-169)	Fz	0.0007	0.0012	0.0018	0.0021	0.0024	0.0028
				≤ 0.15	≤ APMX		Feed (ipm)	9	11	12	11	11	9
			HSM	4xD		126 (101-151)	Fz	0.0007	0.0013	0.0018	0.0022	0.0025	0.0029
				≤ 0.1	≤ APMX		Feed (ipm)	9	12	12	12	11	10
	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	≤ 400 Bhn or ≤ 43 HRc					RPM	1207	805	604	483	402	302
			HSM	2.5xD		85 (68-102)	Fz	0.0005	0.0009	0.0013	0.0015	0.0018	0.0022
				≤ 0.2	≤ APMX		Feed (ipm)	4	5	5	5	5	5
			HSM	3xD		88 (70-106)	Fz	0.0005	0.0010	0.0015	0.0018	0.0020	0.0025
				≤ 0.15	≤ APMX		Feed (ipm)	4	6	6	6	6	5
			HSM	4xD		79 (63-95)	Fz	0.0006	0.0011	0.0015	0.0018	0.0021	0.0026
				≤ 0.1	≤ APMX		Feed (ipm)	5	6	6	6	6	5
	TITANIUM ALLOYS Pure Ttanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	≤ 350 Bhn or ≤ 38 HRc					RPM	4095	2730	2048	1638	1365	1024
			HSM	2.5xD		289 (231-347)	Fz	0.0008	0.0015	0.0021	0.0024	0.0028	0.0032
				≤ 0.2	≤ APMX		Feed (ipm)	23	29	30	28	27	23
			HSM	3xD		299 (239-359)	Fz	0.0009	0.0017	0.0023	0.0025	0.0028	0.0036
				≤ 0.15	≤ APMX		Feed (ipm)	26	32	33	29	27	26
			HSM	4xD		268 (214-322)	Fz	0.0009	0.0018	0.0024	0.0029	0.0033	0.0037
				≤ 0.1	≤ APMX		Feed (ipm)	26	34	34	33	32	27
	TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	≤ 440 Bhn or ≤ 47 HRc					RPM	2399	1599	1199	960	800	600
			HSM	2.5xD		170 (136-204)	Fz	0.0008	0.0015	0.0021	0.0024	0.0028	0.0032
				≤ 0.2	≤ APMX		Feed (ipm)	13	17	18	16	16	13
			HSM	3xD		176 (141-211)	Fz	0.0009	0.0017	0.0023	0.0025	0.0028	0.0036
				≤ 0.15	≤ APMX		Feed (ipm)	15	19	19	17	16	15
			HSM	4xD		157 (126-188)	Fz	0.0009	0.0018	0.0024	0.0029	0.0033	0.0037
				≤ 0.1	≤ APMX		Feed (ipm)	15	20	20	19	18	16

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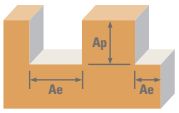
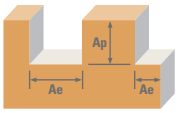


	Series 77, 77CR Fractional	Hardness		Ae x DC	Ap x DC	Vc (sfm)		DC • inch 1/4	3/8	1/2	5/8	3/4	1
							RPM	3851	2567	1925	1540	1284	963
H	**TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2**	≤ 375 Bhn or ≤ 40 HRc	HSM	2.5xD		272 (218-326)	Fz	0.0006	0.0011	0.0014	0.0017	0.0020	0.0024
				≤ 0.2	≤ APMX		Feed (ipm)	16	20	19	18	18	16
			HSM	3xD		282 (226-338)	Fz	0.0007	0.0012	0.0016	0.0019	0.0022	0.0027
				≤ 0.15	≤ APMX		Feed (ipm)	19	22	22	20	20	18
			HSM	4xD		252 (202-302)	Fz	0.0007	0.0013	0.0017	0.0020	0.0023	0.0028
				≤ 0.1	≤ APMX		Feed (ipm)	19	23	23	22	21	19

Note:
- Bhn (Brinell) HRc (Rockwell C) HSM (High Speed Machining)
- rpm = sfm x 3.82 / DC
- ipm = Fz x 7 x rpm
- reduce speed and feed for materials harder than listed
- reduce feed and Ae when finish milling (.02 x DC maximum)
- refer to the KYOCERA SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

SGS® TOOL WIZARD



	Series 77M, 77MCR Metric	Hardness		Ae x DC	Ap x DC	Vc (m/min)		DC • mm 6	8	10	12	16	20	25
P	CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	≤ 275 Bhn or ≤ 28 HRc					RPM	12208	9156	7325	6104	4578	3662	2930
			HSM	2.5xD		284 (227-341)	Fz	0.0413	0.0411	0.0640	0.0711	0.0889	0.1013	0.1050
				≤ 0.2	≤ APMX		Feed (mm/min)	3529	2634	3282	3038	2849	2597	2154
			HSM	3xD		257 (206-308)	Fz	0.0347	0.0461	0.0717	0.0797	0.0996	0.1135	0.1176
				≤ 0.15	≤ APMX		Feed (mm/min)	2965	2955	3676	3405	3192	2910	2412
			HSM	4xD		230 (184-276)	Fz	0.0362	0.0480	0.0747	0.0830	0.1037	0.1182	0.0919
				≤ 0.1	≤ APMX		Feed (mm/min)	3094	3076	3830	3546	3323	3030	1885
	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375 Bhn or ≤ 40 HRc					RPM	8068	6051	4841	4034	3025	2420	1936
			HSM	2.5xD		132 (106-159)	Fz	0.0213	0.0285	0.0512	0.0610	0.0711	0.0827	0.0875
				≤ 0.2	≤ APMX		Feed (mm/min)	1203	1207	1735	1723	1506	1401	1186
			HSM	3xD		138 (111-166)	Fz	0.0239	0.0319	0.0574	0.0683	0.0797	0.0926	0.0980
				≤ 0.15	≤ APMX		Feed (mm/min)	1350	1351	1945	1929	1688	1569	1328
			HSM	4xD		152 (122-182)	Fz	0.0249	0.0332	0.0597	0.0711	0.0830	0.0964	0.1021
				≤ 0.1	≤ APMX		Feed (mm/min)	1406	1406	2023	2008	1758	1633	1384
M	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F	≤ 275 Bhn or ≤ 28 HRc					RPM	9660	7245	5796	4830	3623	2898	2318
			HSM	2.5xD		197 (158-236)	Fz	0.0216	0.0285	0.0448	0.0533	0.0635	0.0747	0.0800
				≤ 0.2	≤ APMX		Feed (mm/min)	1461	1445	1818	1803	1610	1515	1298
			HSM	3xD		204 (163-245)	Fz	0.0242	0.0319	0.0502	0.0598	0.0711	0.0837	0.0896
				≤ 0.15	≤ APMX		Feed (mm/min)	1636	1618	2037	2022	1803	1698	1454
			HSM	4xD		182 (146-218)	Fz	0.0252	0.0332	0.0523	0.0622	0.0741	0.0871	0.0933
				≤ 0.1	≤ APMX		Feed (mm/min)	1704	1684	2122	2104	1879	1767	1514
	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L	≤ 275 Bhn or ≤ 28 HRc					RPM	6369	4777	3822	3185	2389	1911	1529
			HSM	2.5xD		130 (104-156)	Fz	0.0168	0.0221	0.0371	0.0432	0.0584	0.0693	0.0750
				≤ 0.2	≤ APMX		Feed (mm/min)	749	739	993	963	976	927	803
			HSM	3xD		134 (107-161)	Fz	0.0188	0.0248	0.0416	0.0484	0.0655	0.0777	0.0840
				≤ 0.15	≤ APMX		Feed (mm/min)	838	829	1113	1079	1095	1039	899
			HSM	4xD		120 (96-144)	Fz	0.0196	0.0258	0.0433	0.0504	0.0682	0.0809	0.0875
				≤ 0.1	≤ APMX		Feed (mm/min)	874	863	1158	1124	1140	1082	936
	STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450	≤ 325 Bhn or ≤ 35 HRc					RPM	6104	4578	3662	3052	2289	1831	1465
			HSM	2.5xD		124 (99-149)	Fz	0.0168	0.0221	0.0371	0.0432	0.0584	0.0693	0.0750
				≤ 0.2	≤ APMX		Feed (mm/min)	718	708	952	923	936	888	769
			HSM	3xD		129 (103-155)	Fz	0.0188	0.0248	0.0416	0.0484	0.0655	0.0777	0.0840
				≤ 0.15	≤ APMX		Feed (mm/min)	803	795	1066	1034	1050	996	861
			HSM	4xD		115 (92-138)	Fz	0.0196	0.0258	0.0433	0.0504	0.0682	0.0809	0.0875
				≤ 0.1	≤ APMX		Feed (mm/min)	837	827	1110	1077	1093	1037	897

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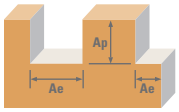
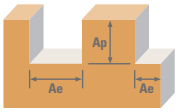


	Series 77M, 77MCR Metric	Hardness		Ae x DC	Ap x DC	Vc (m/min)		DC • mm 6	8	10	12	16	20	25
P	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	≤ 220 Bhn or ≤ 19 HRc					RPM	10722	8041	6433	5361	4021	3217	2573
			HSM	2.5xD		218 (174-262)	Fz	0.0239	0.0315	0.0474	0.0559	0.0762	0.0880	0.0925
				≤ 0.2	≤ APMX		Feed (mm/min)	1794	1773	2135	2098	2145	1981	1666
			HSM	3xD		225 (180-270)	Fz	0.0268	0.0353	0.0531	0.0626	0.0854	0.0986	0.1036
				≤ 0.15	≤ APMX		Feed (mm/min)	2011	1987	2391	2349	2404	2220	1866
			HSM	4xD		202 (162-242)	Fz	0.0279	0.0368	0.0553	0.0652	0.0889	0.1027	0.1079
				≤ 0.1	≤ APMX		Feed (mm/min)	2094	2071	2490	2447	2502	2312	1944
	CAST IRONS (HIGH ALLOY) Gray, Malleable, Ductile	≤ 260 Bhn or ≤ 26 HRc					RPM	6369	4777	3822	3185	2389	1911	1529
			HSM	2.5xD		130 (104-156)	Fz	0.0168	0.0221	0.0371	0.0432	0.0584	0.0693	0.0750
				≤ 0.2	≤ APMX		Feed (mm/min)	749	739	993	963	976	927	803
			HSM	3xD		134 (107-161)	Fz	0.0188	0.0248	0.0416	0.0484	0.0655	0.0777	0.0840
				≤ 0.15	≤ APMX		Feed (mm/min)	838	829	1113	1079	1095	1039	899
			HSM	4xD		120 (96-144)	Fz	0.0196	0.0258	0.0433	0.0504	0.0682	0.0809	0.0875
				≤ 0.1	≤ APMX		Feed (mm/min)	874	863	1158	1124	1140	1082	936
N	NON-FERROUS MATERIALS	Not Recommended for this Material Group												
S	SUPER ALLOYS (NICKEL , COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	≤ 300 Bhn or ≤ 32 HRc					RPM	2017	1513	1210	1008	756	605	484
			HSM	2.5xD		41 (33-49)	Fz	0.0140	0.0183	0.0294	0.0356	0.0457	0.0560	0.0625
				≤ 0.2	≤ APMX		Feed (mm/min)	198	194	249	251	242	237	212
			HSM	3xD		43 (34-52)	Fz	0.0157	0.0205	0.0330	0.0398	0.0512	0.0627	0.0700
				≤ 0.15	≤ APMX		Feed (mm/min)	222	217	280	281	271	266	237
			HSM	4xD		38 (30-46)	Fz	0.0163	0.0213	0.0344	0.0415	0.0533	0.0653	0.0729
				≤ 0.1	≤ APMX		Feed (mm/min)	230	226	291	293	282	277	247
	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	≤ 400 Bhn or ≤ 43 HRc					RPM	1274	955	764	637	478	382	306
			HSM	2.5xD		26 (21-31)	Fz	0.0114	0.0152	0.0243	0.0305	0.0381	0.0480	0.0550
				≤ 0.2	≤ APMX		Feed (mm/min)	102	102	130	136	127	128	118
			HSM	3xD		27 (22-32)	Fz	0.0128	0.0171	0.0273	0.0342	0.0427	0.0538	0.0616
				≤ 0.15	≤ APMX		Feed (mm/min)	114	114	146	152	143	144	132
			HSM	4xD		24 (19-29)	Fz	0.0133	0.0178	0.0284	0.0356	0.0445	0.0560	0.0642
				≤ 0.1	≤ APMX		Feed (mm/min)	119	119	152	159	149	150	137
	TITANIUM ALLOYS Pure Ttanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	≤ 350 Bhn or ≤ 38 HRc					RPM	4352	3264	2611	2176	1632	1306	1045
			HSM	2.5xD		88 (70-106)	Fz	0.0191	0.0254	0.0397	0.0483	0.0635	0.0747	0.0800
				≤ 0.2	≤ APMX		Feed (mm/min)	582	580	726	736	725	683	585
			HSM	3xD		91 (73-109)	Fz	0.0213	0.0285	0.0445	0.0541	0.0711	0.0837	0.0896
				≤ 0.15	≤ APMX		Feed (mm/min)	649	651	813	824	812	765	655
			HSM	4xD		82 (66-98)	Fz	0.0222	0.0296	0.0463	0.0563	0.0741	0.0871	0.0933
				≤ 0.1	≤ APMX		Feed (mm/min)	676	676	846	858	847	796	682
	TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	≤ 440 Bhn or ≤ 47 HRc					RPM	2548	1911	1529	1274	955	764	611
			HSM	2.5xD		52 (42-62)	Fz	0.0163	0.0254	0.0397	0.0483	0.0635	0.0747	0.0800
				≤ 0.2	≤ APMX		Feed (mm/min)	291	340	425	431	425	400	342
			HSM	3xD		54 (43-65)	Fz	0.0182	0.0285	0.0445	0.0541	0.0711	0.0837	0.0896
				≤ 0.15	≤ APMX		Feed (mm/min)	325	381	476	482	476	448	384
			HSM	4xD		48 (38-58)	Fz	0.0190	0.0296	0.0463	0.0563	0.0741	0.0871	0.0933
				≤ 0.1	≤ APMX		Feed (mm/min)	339	396	495	502	496	466	399

continued on next page



	Series 77M, 77MCR Metric	Hardness		Ae x DC	Ap x DC	Vc (m/min)		DC • mm 6	8	10	12	16	20	25
							RPM	4087	3065	2452	2044	1533	1226	981
H	**TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2**	≤ 375 Bhn or ≤ 40 HRc	HSM	2.5xD		83 (66-100)	Fz	0.0140	0.0183	0.0294	0.0356	0.0457	0.0560	0.0625
				≤ 0.2	≤ APMX		Feed (mm/min)	401	393	505	509	490	481	429
			HSM	3xD		86 (69-103)	Fz	0.0157	0.0205	0.0330	0.0398	0.0512	0.0627	0.0700
				≤ 0.15	≤ APMX		Feed (mm/min)	449	440	566	569	549	538	481
			HSM	4xD		77 (62-92)	Fz	0.0163	0.0213	0.0344	0.0415	0.0533	0.0653	0.0729
				≤ 0.1	≤ APMX		Feed (mm/min)	466	457	590	594	572	560	501

Note:

- Bhn (Brinell) HRc (Rockwell C) HSM (High Speed Machining)
- rpm = (Vc x 1000) / (DC x 3.14)
- mm/min = Fz x 7 x rpm
- reduce speed and feed for materials harder than listed
- reduce feed and Ae when finish milling (.02 x DC maximum)
- refer to the KYOCERA SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

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