SGS®
Solid Carbide Tools

CARB-HPR
HIGH PERFORMANCE ROUGHER

High Performance End Mills | *VALUE AT THE SPINDLE*

ISO 9001 Certified Company

New Expanded Offering

www.sgstool.com

Z-CARB-HPR

HIGH PERFORMANCE ROUGHER

INTRODUCING THE NEXT GENERATION Z-CARB

The New Z-Carb HPR Five Flute Roughing End Mills are ideal for achieving high material removal rates (MRR) and a finish of 80 RMS or better on most materials. The specialized five flute design is engineered for increased productivity over three and four flute end mills. The variable indexing geometry allows for improved chatter suppression over symmetrical designs. The new series is offered in a variety of length, square, and corner radius options and is coated with Ti-NAMITE-M and Ti-NAMITE-A for superior performance in difficult to machine materials like Titanium and Stainless Steel.

THE Z-CARB HPR MATERIAL REMOVAL RATES (MRR) MAKE THIS TOOL IDEAL FOR THE FOLLOWING TARGET MARKETS:

- Aerospace Structural Components
- Medical Implants
- Automotive & Heavy Transportation
- Energy & Power Generation
- Castings & Forgings
- General Engineering

EXPANSIVE OFFERING

- Over 300 items in portfolio
- Available in stub and regular lengths
- Full complement of corner radii available
- Central coolant hole option available on select diameters
- Plain and Weldon Flat options available for diameters ½" and 12mm and above (other retention methods available upon request)
- Special tooling design attributes available upon request
- Now available in Ti-NAMITE-A coating ideal for Stainless Steel applications

Ti-NAMITE-M

Features of Ti-Namite-M include high wear resistance, reduced friction, and excellent prevention of cutting edge build up. This coating provides superior material removal rates and tool life when used in high performance operations with difficult to machine materials like Titanium.

Hardness (HV): 3600
Oxidation Temperature: 1150°C / 2100°F
Coefficient of Friction: 0.45
Thickness: 1 – 4 Microns (based on tool diameter)

Ti-NAMITE-A

The Z-Carb HPR is available with an abrasive resistant and hard coating, Aluminum Titanium Nitride (AlTiN) or Ti-NAMITE-A. With excellent thermal and chemical resistance, Ti-NAMITE-A allows for dry cutting and improvements in performance of carbide. The coating has a high hardness giving ultimate protection against abrasive wear and erosion. Ideal for cast iron, high temperature alloys, steels, and stainless steel applications.

Hardness (HV): 3700
Oxidation Temperature: 1100°C / 2010°F
Coefficient of Friction: 0.45
Thickness: 1 – 4 Microns (based on tool diameter)

FEATURES

RADIAL RAKE
- Specially designed radial rake balances positive cutting action and edge strength
- End grind features include: (1) Positive axial rake for high performance shearing and lifting of material; and (2) Increased clearances to eliminate edge build-up during ramping

THROUGH COOLANT
- Central hole delivers coolant effectively to the cutting zone
- Enhances chip removal when pocketing or slotting
- Select fractional and metric diameters in stock

FLUTING & HELIX ANGLE
- Specialized five flute design is engineered for strength, chip evacuation, and increased productivity over three and four flute end mills by 20–40%
- The variable flute pattern provides excellent chatter suppression over a range of spindle speeds
- Open center design delivers efficiency during entry movements into the work-piece
- Helix angle engineered for balance between positive cutting action and reduced contact area to control tool pressure and spindle load

PATENT PENDING VARIABLE DESIGN
- Reduces force and torque by more than 10%
- Improves shearing capability and enhances tool life

CAPABILITIES

RAMPING

- Typical ramp angles of 5 degrees are common; greater than 5 degree ramp angles are obtainable with reduced feed rates
- Entry feed rates can achieve 100% of the slotting value
- The open center provides an ideal exit for central coolant and chip flushing while maintaining the 5 degree ramp angle

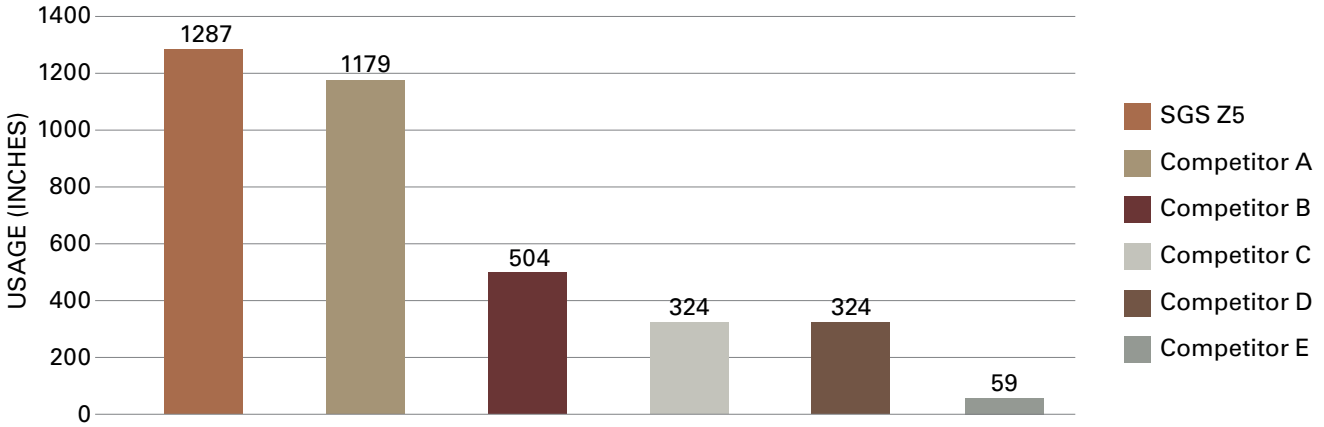
ROUGHING

- One times diameter slotting capability is typical
- 50% radial by 150% axial heavy profiling capability is common

HIGH-SPEED MACHINING

- Variable geometry design and open fluting eliminate vibration to enable increased rates for High Speed Machining
- Exclusive Ti-NAMITE-M coating for higher heat resistance to enhance tool life in difficult to machine materials like Titanium
- Now 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

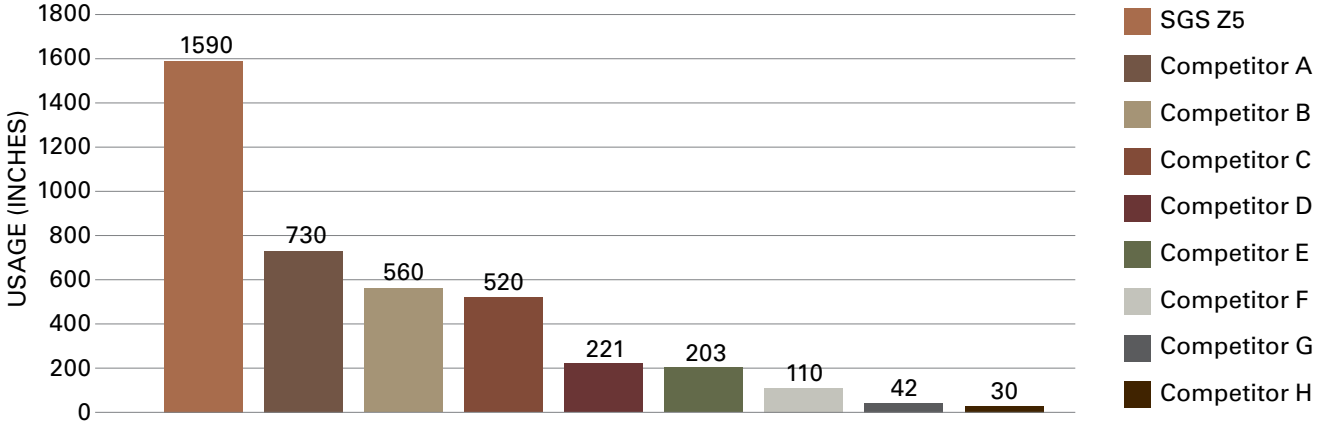
LAB TESTING RESULTS – HEAVY PROFILING IN TITANIUM



RESULTS IN TITANIUM 6AL4V @ 32HRC Z5CR 1/2" TESTED AT 1643 RPM X 16.4 IPM
.250" RADIAL WIDTH OF CUT X .750" AXIAL DEPTH OF CUT

Ti-NAMITE-M

LAB TESTING RESULTS – HEAVY PROFILING IN STAINLESS STEEL



RESULTS IN STAINLESS STEEL 316 @ 160HB Z5CR 1/2" TESTED AT 2540 RPM X 31.7 IPM
.250" RADIAL WIDTH OF CUT X .750" AXIAL DEPTH OF CUT

Ti-NAMITE-A

DESIGN AND ENGINEERING
ENSURE UNPARALLELED PERFORMANCE
IN A VARIETY OF DIFFICULT TO MACHINE MATERIALS.

SGS Tool Company actively maintains a serious commitment to research and development. Our reputation for quality and ever increasing Value at the Spindle pushes us to continually innovate and discover the next best thing in cutting tool technology. The Z-Carb HPR is the latest product of this passionate pursuit.

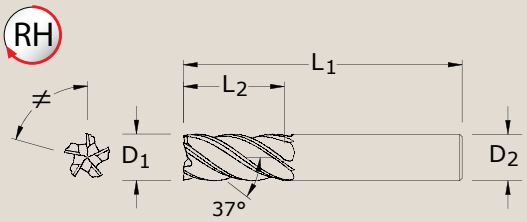
Field testing demonstrates the SGS design achieved higher material removal rates while meeting or exceeding expected tool life. The specialized geometry increases productivity by generating high chip load at aggressive feed rates, while achieving a finish of 80 RMS or better on most materials.

TOLERANCES (inch)

DIAMETER	D_1	D_2
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)

R = +0.0000 / –0.0020

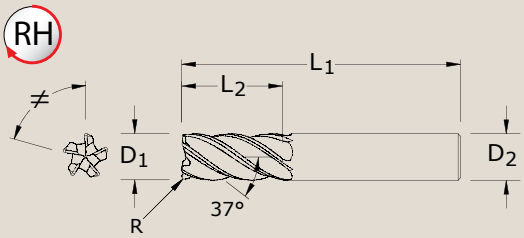


Z-CARB-HPR HIGH PERFORMANCE ROUGHER

New Expanded Tools

SERIES Z5 (FRACTIONAL)

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Ti-Namite-A (TA) EDP No. w/o Flat	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-M (TM) EDP No. w/o Flat	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
1/8	1/4	1-1/2	1/8	–	–	37000	–	–
1/8	3/8	1-1/2	1/8	37180	–	37002	–	–
3/16	5/16	2	3/16	–	–	37004	–	–
3/16	1/2	2	3/16	37182	–	37006	–	–
1/4	3/8	2-1/2	1/4	–	–	37008	–	–
1/4	1/2	2-1/2	1/4	37184	–	37011	–	–
5/16	7/16	2-1/2	5/16	–	–	37014	–	–
5/16	5/8	2-1/2	5/16	–	–	37016	–	–
3/8	1/2	2-1/2	3/8	–	–	37018	–	–
3/8	3/4	2-1/2	3/8	37187	–	37021	–	–
1/2	5/8	3	1/2	–	–	37024	37030	–
1/2	1	3	1/2	–	–	37036	37042	–
1/2	1-1/4	3-1/4	1/2	37190	37194	37048	37054	–
5/8	3/4	3-1/2	5/8	–	–	37060	37067	37260
5/8	1-1/4	3-1/2	5/8	37198	37202	37074	37081	37267
3/4	7/8	4	3/4	–	–	37088	37095	37274
3/4	1-1/2	4	3/4	37206	37210	37102	37109	37281
1	1-1/8	4	1	–	–	37116	37123	37288
1	1-1/2	4	1	37214	37218	37130	37137	37295
1	2	4-1/2	1	–	–	37144	37151	37302



TOLERANCES (inch)

DIAMETER	D_1	D_2
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)

R = +0.0000 / –0.0020

New Expanded Tools

SERIES Z5CR (FRACTIONAL)

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No. w/o Flat	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-M (TM) EDP No. w/o Flat	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
1/8	1/4	1-1/2	1/8	.015	–	–	37001	–	–
1/8	3/8	1-1/2	1/8	.015	37181	–	37003	–	–
3/16	5/16	2	3/16	.015	–	–	37005	–	–
3/16	1/2	2	3/16	.015	37183	–	37007	–	–
1/4	3/8	2-1/2	1/4	.015	–	–	37009	–	–
1/4	3/8	2-1/2	1/4	.030	–	–	37010	–	–
1/4	1/2	2-1/2	1/4	.015	37185	–	37012	–	–
1/4	1/2	2-1/2	1/4	.030	37186	–	37013	–	–
5/16	7/16	2-1/2	5/16	.015	–	–	37015	–	–
5/16	5/8	2-1/2	5/16	.015	–	–	37017	–	–
3/8	1/2	2-1/2	3/8	.015	–	–	37019	–	–
3/8	1/2	2-1/2	3/8	.030	–	–	37020	–	–
3/8	3/4	2-1/2	3/8	.015	37188	–	37022	–	–
3/8	3/4	2-1/2	3/8	.030	37189	–	37023	–	–
1/2	5/8	3	1/2	.015	–	–	37025	37031	–
1/2	5/8	3	1/2	.030	–	–	37026	37032	–
1/2	5/8	3	1/2	.060	–	–	37027	37033	–
1/2	5/8	3	1/2	.090	–	–	37028	37034	–
1/2	5/8	3	1/2	.120	–	–	37029	37035	–
1/2	1	3	1/2	.015	–	–	37037	37043	–
1/2	1	3	1/2	.030	–	–	37038	37044	–
1/2	1	3	1/2	.060	–	–	37039	37045	–
1/2	1	3	1/2	.090	–	–	37040	37046	–
1/2	1	3	1/2	.120	–	–	37041	37047	–
1/2	1-1/4	3-1/4	1/2	.015	37191	37195	37049	37055	–
1/2	1-1/4	3-1/4	1/2	.030	37192	37196	37050	37056	–
1/2	1-1/4	3-1/4	1/2	.060	37193	37197	37051	37057	–
1/2	1-1/4	3-1/4	1/2	.090	–	–	37052	37058	–
1/2	1-1/4	3-1/4	1/2	.120	–	–	37053	37059	–
5/8	3/4	3-1/2	5/8	.015	–	–	37061	37068	37261
5/8	3/4	3-1/2	5/8	.030	–	–	37062	37069	37262
5/8	3/4	3-1/2	5/8	.060	–	–	37063	37070	37263
5/8	3/4	3-1/2	5/8	.090	–	–	37064	37071	37264
5/8	3/4	3-1/2	5/8	.120	–	–	37065	37072	37265
5/8	3/4	3-1/2	5/8	.190	–	–	37066	37073	37266
5/8	1-1/4	3-1/2	5/8	.015	37199	37203	37075	37082	37268

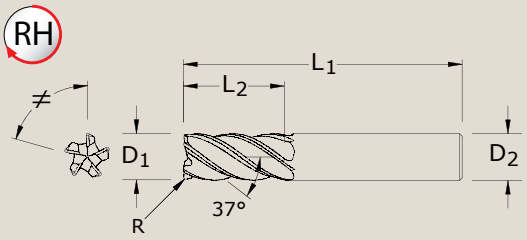
(continued on next page)

TOLERANCES (inch)

DIAMETER	D_1	D_2
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)

R = +0.0000 / –0.0020



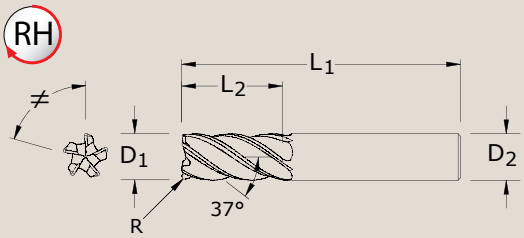
CARB-HPR
HIGH PERFORMANCE ROUGHER

New Expanded Tools

SERIES Z5CR (FRACTIONAL)

(CONTINUED)

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No. w/o Flat	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-M (TM) EDP No. w/o Flat	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
5/8	1-1/4	3-1/2	5/8	.030	37200	37204	37076	37083	37269
5/8	1-1/4	3-1/2	5/8	.060	37201	37205	37077	37084	37270
5/8	1-1/4	3-1/2	5/8	.090	–	–	37078	37085	37271
5/8	1-1/4	3-1/2	5/8	.120	–	–	37079	37086	37272
5/8	1-1/4	3-1/2	5/8	.190	–	–	37080	37087	37273
3/4	7/8	4	3/4	.030	–	–	37089	37096	37275
3/4	7/8	4	3/4	.060	–	–	37090	37097	37276
3/4	7/8	4	3/4	.090	–	–	37091	37098	37277
3/4	7/8	4	3/4	.120	–	–	37092	37099	37278
3/4	7/8	4	3/4	.190	–	–	37093	37100	37279
3/4	7/8	4	3/4	.250	–	–	37094	37101	37280
3/4	1-1/2	4	3/4	.030	37207	37211	37103	37110	37282
3/4	1-1/2	4	3/4	.060	37208	37212	37104	37111	37283
3/4	1-1/2	4	3/4	.090	–	–	37105	37112	37284
3/4	1-1/2	4	3/4	.120	37209	37213	37106	37113	37285
3/4	1-1/2	4	3/4	.190	–	–	37107	37114	37286
3/4	1-1/2	4	3/4	.250	–	–	37108	37115	37287
1	1-1/8	4	1	.030	–	–	37117	37124	37289
1	1-1/8	4	1	.060	–	–	37118	37125	37290
1	1-1/8	4	1	.090	–	–	37119	37126	37291
1	1-1/8	4	1	.120	–	–	37120	37127	37292
1	1-1/8	4	1	.190	–	–	37121	37128	37293
1	1-1/8	4	1	.250	–	–	37122	37129	37294
1	1-1/2	4	1	.030	37215	37219	37131	37138	37296
1	1-1/2	4	1	.060	37216	37220	37132	37139	37297
1	1-1/2	4	1	.090	–	–	37133	37140	37298
1	1-1/2	4	1	.120	37217	37221	37134	37141	37299
1	1-1/2	4	1	.190	–	–	37135	37142	37300
1	1-1/2	4	1	.250	–	–	37136	37143	37301
1	2	4-1/2	1	.030	–	–	37145	37152	37303
1	2	4-1/2	1	.060	–	–	37146	37153	37304
1	2	4-1/2	1	.090	–	–	37147	37154	37305
1	2	4-1/2	1	.120	–	–	37148	37155	37306
1	2	4-1/2	1	.190	–	–	37149	37156	37307
1	2	4-1/2	1	.250	–	–	37150	37157	37308



TOLERANCES (mm)

DIAMETER	D_1	D_2
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

R = +0,000 / –0,050

New Expanded Tools

SERIES Z5MCR (METRIC)

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No. w/o Flat	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) EDP No. w/Internal Coolant	Ti-Namite-M (TM) EDP No. w/o Flat	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
6,0	9,0	54,0	6,0	0,5	–	–	–	47000	–	–
6,0	13,0	57,0	6,0	0,3	–	–	–	47001	–	–
6,0	13,0	57,0	6,0	0,5	47120	–	–	47002	–	–
6,0	13,0	57,0	6,0	1,0	–	–	–	47003	–	–
6,0	13,0	57,0	6,0	1,5	–	–	–	47004	–	–
8,0	11,0	58,0	8,0	0,5	–	–	–	47005	–	–
8,0	18,0	63,0	8,0	0,5	47121	–	–	47006	–	–
8,0	18,0	63,0	8,0	1,0	47122	–	–	47007	–	–
8,0	18,0	63,0	8,0	1,5	–	–	–	47008	–	–
8,0	18,0	63,0	8,0	2,0	–	–	–	47009	–	–
10,0	13,0	66,0	10,0	1,0	–	–	–	47010	–	–
10,0	22,0	72,0	10,0	0,5	47123	–	–	47011	–	–
10,0	22,0	72,0	10,0	1,0	47124	–	–	47012	–	–
10,0	22,0	72,0	10,0	1,5	–	–	–	47013	–	–
10,0	22,0	72,0	10,0	2,0	–	–	–	47014	–	–
10,0	22,0	72,0	10,0	2,5	–	–	–	47015	–	–
12,0	15,0	73,0	12,0	1,0	–	–	–	47016	47024	–
12,0	26,0	83,0	12,0	0,5	47125	47128	–	47017	47025	–
12,0	26,0	83,0	12,0	0,76	47126	47129	–	47018	47026	–
12,0	26,0	83,0	12,0	1,0	47127	47130	–	47019	47027	–
12,0	26,0	83,0	12,0	1,5	–	–	–	47020	47028	–
12,0	26,0	83,0	12,0	2,0	–	–	–	47021	47029	–
12,0	26,0	83,0	12,0	2,5	–	–	–	47022	47030	–
12,0	26,0	83,0	12,0	3,0	–	–	–	47023	47031	–

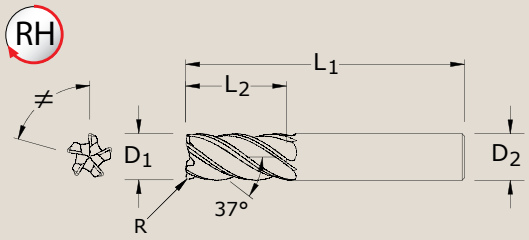
(continued on next page)

TOLERANCES (mm)

DIAMETER	D_1	D_2
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

R = +0,000 / –0,050



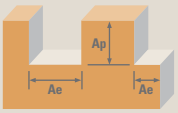
CARB-HPR
HIGH PERFORMANCE ROUGHER

New Expanded Tools

SERIES Z5MCR (METRIC)

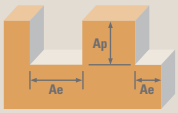
(CONTINUED)

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No. w/o Flat	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) EDP No. w/Internal Coolant	Ti-Namite-M (TM) EDP No. w/o Flat	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
16,0	19,0	82,0	16,0	1,0	–	–	–	47032	47039	47046
16,0	35,0	92,0	16,0	1,0	47131	–	47134	47033	47040	47047
16,0	35,0	92,0	16,0	1,5	–	–	–	47034	47041	47048
16,0	35,0	92,0	16,0	2,0	47132	–	47135	47035	47042	47049
16,0	35,0	92,0	16,0	2,5	–	–	–	47036	47043	47050
16,0	35,0	92,0	16,0	3,0	47133	–	47136	47037	47044	47051
16,0	35,0	92,0	16,0	4,0	–	–	–	47038	47045	47052
20,0	23,0	92,0	20,0	1,0	–	–	–	47053	47061	47069
20,0	43,0	104,0	20,0	1,0	47137	–	47140	47054	47062	47070
20,0	43,0	104,0	20,0	1,5	–	–	–	47055	47063	47071
20,0	43,0	104,0	20,0	2,0	47138	–	47141	47056	47064	47072
20,0	43,0	104,0	20,0	2,5	–	–	–	47057	47065	47073
20,0	43,0	104,0	20,0	3,0	47139	–	47142	47058	47066	47074
20,0	43,0	104,0	20,0	4,0	–	–	–	47059	47067	47075
20,0	43,0	104,0	20,0	5,0	–	–	–	47060	47068	47076
25,0	28,0	100,0	25,0	1,0	–	–	–	47077	47084	47091
25,0	53,0	121,0	25,0	1,0	47143	–	47146	47078	47085	47092
25,0	53,0	121,0	25,0	2,0	47144	–	47147	47079	47086	47093
25,0	53,0	121,0	25,0	2,5	–	–	–	47080	47087	47094
25,0	53,0	121,0	25,0	3,0	47145	–	47148	47081	47088	47095
25,0	53,0	121,0	25,0	4,0	–	–	–	47082	47089	47096
25,0	53,0	121,0	25,0	5,0	–	–	–	47083	47090	47097



	Series Z5, Z5CR Fractional	Hardness (Brinell)		Ae x D_1	Ap x D_1	Vc (SFM)		Diameter (D_1) (inch) 1/8	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	Profile	≤ 0.5	≤ 1.5	555	RPM	16961	8480	5654	4240	3392	2827	2120
						(444-666)	Fz	0.0005	0.0012	0.0023	0.0031	0.0034	0.0037	0.0043
							Feed (IPM)	39.9	50.9	65.0	65.7	57.7	52.3	45.6
			Slot	1	≤ 1	440	RPM	13446	6723	4482	3362	2689	2241	1681
						(352-528)	Fz	0.0005	0.0012	0.0023	0.0031	0.0034	0.0037	0.0043
							Feed (IPM)	31.6	40.3	51.5	52.1	45.7	41.5	36.1
P	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375	Profile	≤ 0.5	≤ 1.5	315	RPM	9626	4813	3209	2407	1925	1604	1203
						(252-378)	Fz	0.0004	0.0009	0.0017	0.0023	0.0026	0.0028	0.0032
							Feed (IPM)	16.8	21.7	27.3	27.7	25.0	22.5	19.3
			Slot	1	≤ 1	250	RPM	7640	3820	2547	1910	1528	1273	955
						(200-300)	Fz	0.0004	0.0009	0.0017	0.0023	0.0026	0.0028	0.0032
							Feed (IPM)	13.4	17.2	21.6	22.0	19.9	17.8	15.3
P	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 375	Profile	≤ 0.5	≤ 1.5	185	RPM	5654	2827	1885	1413	1131	942	707
						(148-222)	Fz	0.0003	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (IPM)	7.6	9.9	13.2	12.7	11.3	10.4	8.8
			Slot	1	≤ 1	145	RPM	4431	2216	1477	1108	886	739	554
						(116-174)	Fz	0.0003	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (IPM)	6.0	7.8	10.3	10.0	8.9	8.1	6.9
K	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	≤ 220	Profile	≤ 0.5	≤ 1.5	445	RPM	13599	6800	4533	3400	2720	2267	1700
						(356-534)	Fz	0.0004	0.0011	0.0021	0.0028	0.0031	0.0034	0.0039
							Feed (IPM)	28.6	37.4	47.6	47.6	42.2	38.5	33.1
			Slot	1	≤ 1	355	RPM	10849	5424	3616	2712	2170	1808	1356
						(284-426)	Fz	0.0004	0.0011	0.0021	0.0028	0.0031	0.0034	0.0039
							Feed (IPM)	22.8	29.8	38.0	38.0	33.6	30.7	26.4
K	CAST IRONS (HIGH ALLOY) Gray, Malleable, Ductile	> 220 ≤ 260	Profile	≤ 0.5	≤ 1.5	340	RPM	10390	5195	3463	2598	2078	1732	1299
						(272-408)	Fz	0.0003	0.0008	0.0016	0.0021	0.0023	0.0025	0.0029
							Feed (IPM)	15.6	21.8	27.7	27.3	23.9	21.6	18.8
			Slot	1	≤ 1	270	RPM	8251	4126	2750	2063	1650	1375	1031
						(216-324)	Fz	0.0003	0.0008	0.0016	0.0021	0.0023	0.0025	0.0029
							Feed (IPM)	12.4	17.3	22.0	21.7	19.0	17.2	15.0
M	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F	≤ 275	Profile	≤ 0.5	≤ 1.5	490	RPM	14974	7487	4991	3744	2995	2496	1872
						(392-588)	Fz	0.0004	0.0009	0.0017	0.0023	0.0026	0.0028	0.0032
							Feed (IPM)	26.2	33.7	42.4	43.1	38.9	34.9	29.9
			Slot	1	≤ 1	390	RPM	11918	5959	3973	2980	2384	1986	1490
						(312-468)	Fz	0.0004	0.0009	0.0017	0.0023	0.0026	0.0028	0.0032
							Feed (IPM)	20.9	26.8	33.8	34.3	31.0	27.8	23.8
M	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L	≤ 275	Profile	≤ 0.5	≤ 1.5	340	RPM	10390	5195	3463	2598	2078	1732	1299
						(272-408)	Fz	0.0003	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (IPM)	14.0	18.2	24.2	23.4	20.8	19.0	16.2
			Slot	1	≤ 1	270	RPM	8251	4126	2750	2063	1650	1375	1031
						(216-324)	Fz	0.0003	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (IPM)	11.1	14.4	19.3	18.6	16.5	15.1	12.9
M	STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450	≤ 325	Profile	≤ 0.5	≤ 1.5	310	RPM	9474	4737	3158	2368	1895	1579	1184
						(248-372)	Fz	0.0003	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (IPM)	12.8	16.6	22.1	21.3	18.9	17.4	14.8
			Slot	1	≤ 1	250	RPM	7640	3820	2547	1910	1528	1273	955
						(200-300)	Fz	0.0003	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (IPM)	10.3	13.4	17.8	17.2	15.3	14.0	11.9

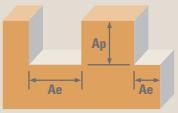
continued on next page



	Series Z5, Z5CR Fractional	Hardness (Brinell)		Ae x D_1	Ap x D_1	Vc (SFM)		Diameter (D_1) (inch) 1/8	1/4	3/8	1/2	5/8	3/4	1
S	**SUPER ALLOYS (NICKEL , COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400**	≤ 300	Profile	≤ 0.5	≤ 1.5	80	RPM	2445	1222	815	611	489	407	306
						(64-96)	Fz	0.0002	0.0006	0.0011	0.0015	0.0017	0.0018	0.0021
							Feed (IPM)	2.8	3.7	4.5	4.6	4.2	3.7	3.2
			Slot	1	≤ 1	65	RPM	1986	993	662	497	397	331	248
						(52-78)	Fz	0.0002	0.0006	0.0011	0.0015	0.0017	0.0018	0.0021
							Feed (IPM)	2.3	3.0	3.6	3.7	3.4	3.0	2.6
S	**SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene**	> 300	Profile	≤ 0.5	≤ 1.5	62	RPM	1895	947	632	474	379	316	237
						(50-74)	Fz	0.0002	0.0005	0.0009	0.0012	0.0013	0.0014	0.0017
							Feed (IPM)	1.7	2.3	2.8	2.8	2.5	2.2	2.0
			Slot	1	≤ 1	50	RPM	1528	764	509	382	306	255	191
						(40-60)	Fz	0.0002	0.0005	0.0009	0.0012	0.0013	0.0014	0.0017
							Feed (IPM)	1.4	1.8	2.3	2.3	2.0	1.8	1.6
S	**TITANIUM ALLOYS Pure Ttanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si**	≤ 350	Profile	≤ 0.5	≤ 1.5	215	RPM	6570	3285	2190	1643	1314	1095	821
						(172-258)	Fz	0.0003	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (IPM)	9.9	13.1	16.4	16.4	14.5	13.1	11.5
			Slot	1	≤ 1	170	RPM	5195	2598	1732	1299	1039	866	649
						(136-204)	Fz	0.0003	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (IPM)	7.8	10.4	13.0	13.0	11.4	10.4	9.1
S	**TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al**	> 350 ≤ 440	Profile	≤ 0.5	≤ 1.5	75	RPM	2292	1146	764	573	458	382	287
						(60-90)	Fz	0.0003	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (IPM)	3.4	4.6	5.7	5.7	5.0	4.6	4.0
			Slot	1	≤ 1	60	RPM	1834	917	611	458	367	306	229
						(48-72)	Fz	0.0003	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (IPM)	2.8	3.7	4.6	4.6	4.0	3.7	3.2

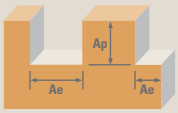
Note:

- rpm = sfm x 3.82 / D_1
- ipm = (inch / flute) x 5 x rpm
- ramp at 5 degrees or less, using slotting speed and feed rates (do not plunge)
- reduce speed and feed for materials harder than listed
- reduce feed and Ae when finish milling (.02 x D_1 maximum)
- refer to the SGS Tool Wizard for complete technical information (www.sgstool.com)



	Series Z5MCR Metric	Hardness (Brinell)		Ae x D_1	Ap x D_1	Vc (m/min)		Diameter (D_1) (mm) 6	8	10	12	16	20	25
P	CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	≤ 275	Profile	≤ 0.5	≤ 1.5	169	RPM	8967	6725	5380	4484	3363	2690	2152
						(135-203)	Fz	0.029	0.049	0.061	0.074	0.087	0.099	0.108
							Feed (mm/min)	1300	1648	1641	1659	1463	1332	1162
			Slot	1	≤ 1	134	RPM	7109	5332	4265	3555	2666	2133	1706
						(107-161)	Fz	0.029	0.049	0.061	0.074	0.087	0.099	0.108
							Feed (mm/min)	1031	1306	1301	1315	1160	1056	921
P	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375	Profile	≤ 0.5	≤ 1.5	96	RPM	5089	3817	3054	2545	1909	1527	1221
						(77-115)	Fz	0.022	0.036	0.045	0.055	0.067	0.075	0.080
							Feed (mm/min)	560	687	687	700	639	573	489
			Slot	1	≤ 1	76	RPM	4039	3029	2424	2020	1515	1212	969
						(61-91)	Fz	0.022	0.036	0.045	0.055	0.067	0.075	0.080
							Feed (mm/min)	444	545	545	555	507	454	388
P	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 375	Profile	≤ 0.5	≤ 1.5	56	RPM	2989	2242	1793	1495	1121	897	717
						(45-68)	Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	254	336	332	321	286	265	226
			Slot	1	≤ 1	44	RPM	2343	1757	1406	1171	879	703	562
						(35-53)	Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	199	264	260	252	224	207	177
K	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	≤ 220	Profile	≤ 0.5	≤ 1.5	136	RPM	7190	5392	4314	3595	2696	2157	1726
						(109-163)	Fz	0.026	0.045	0.056	0.067	0.079	0.091	0.098
							Feed (mm/min)	935	1213	1208	1204	1065	981	846
			Slot	1	≤ 1	108	RPM	5736	4302	3441	2868	2151	1721	1377
						(87-130)	Fz	0.026	0.045	0.056	0.067	0.079	0.091	0.098
							Feed (mm/min)	746	968	964	961	850	783	675
K	CAST IRONS (HIGH ALLOY) Gray, Malleable, Ductile	> 220 ≤ 260	Profile	≤ 0.5	≤ 1.5	104	RPM	5493	4120	3296	2747	2060	1648	1318
						(83-124)	Fz	0.020	0.034	0.043	0.050	0.059	0.067	0.073
							Feed (mm/min)	549	700	709	687	608	552	481
			Slot	1	≤ 1	82	RPM	4362	3272	2617	2181	1636	1309	1047
						(66-99)	Fz	0.020	0.034	0.043	0.050	0.059	0.067	0.073
							Feed (mm/min)	436	556	563	545	483	438	382
M	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F	≤ 275	Profile	≤ 0.5	≤ 1.5	149	RPM	7917	5938	4750	3958	2969	2375	1900
						(119-179)	Fz	0.022	0.036	0.045	0.055	0.067	0.075	0.080
							Feed (mm/min)	871	1069	1069	1089	995	891	760
			Slot	1	≤ 1	119	RPM	6301	4726	3781	3151	2363	1890	1512
						(95-143)	Fz	0.022	0.036	0.045	0.055	0.067	0.075	0.080
							Feed (mm/min)	693	851	851	866	792	709	605
M	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L	≤ 275	Profile	≤ 0.5	≤ 1.5	104	RPM	5493	4120	3296	2747	2060	1648	1318
						(83-124)	Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	467	618	610	591	525	486	415
			Slot	1	≤ 1	82	RPM	4362	3272	2617	2181	1636	1309	1047
						(66-99)	Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	371	491	484	469	417	386	330
M	STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450	≤ 325	Profile	≤ 0.5	≤ 1.5	94	RPM	5009	3756	3005	2504	1878	1503	1202
						(76-113)	Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	426	563	556	538	479	443	379
			Slot	1	≤ 1	76	RPM	4039	3029	2424	2020	1515	1212	969
						(61-91)	Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	343	454	448	434	386	357	305

continued on next page



	Series Z5MCR Metric	Hardness (Brinell)		Ae x D_1	Ap x D_1	Vc (m/min)		Diameter (D_1) (mm) 6	8	10	12	16	20	25
S	**SUPER ALLOYS (NICKEL , COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400**	≤ 300	Profile	≤ 0.5	≤ 1.5	24	RPM	1293	969	776	646	485	388	310
						(20-29)	Fz	0.014	0.023	0.029	0.036	0.044	0.048	0.053
							Feed (mm/min)	90	111	112	116	107	93	82
			Slot	1	≤ 1	20	RPM	1050	788	630	525	394	315	252
						(16-24)	Fz	0.014	0.023	0.029	0.036	0.044	0.048	0.053
							Feed (mm/min)	74	91	91	95	87	76	67
S	**SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene**	> 300	Profile	≤ 0.5	≤ 1.5	19	RPM	1002	751	601	501	376	301	240
						(15-23)	Fz	0.012	0.019	0.024	0.029	0.033	0.037	0.043
							Feed (mm/min)	60	71	72	73	62	56	52
			Slot	1	≤ 1	15	RPM	808	606	485	404	303	242	194
						(12-18)	Fz	0.012	0.019	0.024	0.029	0.033	0.037	0.043
							Feed (mm/min)	48	58	58	59	50	45	42
S	**TITANIUM ALLOYS Pure Ttanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si**	≤ 350	Profile	≤ 0.5	≤ 1.5	66	RPM	3474	2605	2084	1737	1303	1042	834
						(52-79)	Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	330	417	417	417	365	333	292
			Slot	1	≤ 1	52	RPM	2747	2060	1648	1373	1030	824	659
						(41-62)	Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	261	330	330	330	288	264	231
S	**TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al**	> 350 ≤ 440	Profile	≤ 0.5	≤ 1.5	23	RPM	1212	909	727	606	454	364	291
						(18-27)	Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	115	145	145	145	127	116	102
			Slot	1	≤ 1	18	RPM	969	727	582	485	364	291	233
						(15-22)	Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	92	116	116	116	102	93	81

Note:

- rpm = (1000 x m/min) / (3.14 x D_1)
- mm / min = (mm / flute) x 5 x rpm
- ramp at 5 degrees or less, using slotting speed and feed rates (do not plunge)
- reduce speed and feed for materials harder than listed
- reduce feed and Ae when finish milling (.02 x D_1 maximum)
- refer to the SGS Tool Wizard for complete technical information (www.sgstool.com)

SGS
Solid Carbide Tools

Solutions Around The Globe
SGS Tool Company is a privately-held, ISO-certified leader of round solid carbide cutting tool technology for the aerospace, metalworking, and automotive industries with manufacturing sites in the United States and United Kingdom. Our global network of Sales Representatives, Industrial Distributors, and Agents blanket the world selling into more than 60 countries.

Leaders in Solid Carbide Tool Technology
Brand names such as Z-Carb, S-Carb, V-Carb, Hi-PerCarb, Multi-Carb have become synonymous with high performance tooling in the machining and metalworking industry.

We're proud to have pioneered some of the world's most advanced cutting technology right here on our Northeast Ohio manufacturing campus. SGS high performance end mills, drills and routers are increasing productivity and reducing cost around the world.

Exceeding Customer Expectations
In addition to our substantial R&D facilities, we offer a portfolio of products and services that have an unparalleled track record in manufacture, supply and value at the spindle.

- Incredible batch-to-batch consistency
- Metallurgical lab dedicated to testing and rigorous quality control
- ISO-certified quality procedures
- Patented geometries that extend tool life, reduce chatter, cut cycle times, and improve part quality—even at extreme parameters
- Specialists in extreme and demanding product applications
- Specialty Group tooling services
- Experienced Field Sales Engineers who work to optimize a tool for your particular application
- Dedicated multi-lingual customer service representatives

SGS Products are distributed by:

VALUE AT THE SPINDLE

UNITED STATES OF AMERICA
SGS TOOL COMPANY
World Headquarters
P.O. Box 187
55 South Main Street
Munroe Falls, Ohio 44262 U.S.A.
customer service -
US and Canada: (330) 686-5700
fax - US & Canada: (800) 447-4017
international fax: (330) 686-2146
e-mail: webmaster@sgstool.com

UNITED KINGDOM
SGS TOOL EUROPE LTD.
10 Ashville Way
Wokingham, Berkshire
RG41 2PL England
phone: (44) 1189-795-200
fax: (44) 1189-795-295
e-mail: sales@sgstool.eu

FRANCE
DOGA-SGS FRANCE
8, Avenue Gutenburg
78310 Maurepas
France
phone: +33 (0) 1 82 88 49 14
fax: +33 (0) 1 82 88 49 39
e-mail: sgsfrance@sgstool.eu

GERMANY
SGS TOOL GmbH
Am Sägebach 6
D- 88356 Ostrach-Einhart
Germany
phone: +49 (0) 7585 427 980
fax: +49 (0) 7585 4279819
e-mail: info@sgstool.eu

POLAND
SGS TOOL POLAND
phone: +48 530 432 002
e-mail: infopolska@sgstool.pl

SPAIN
SGS TOOL IBERICA
e-mail: sgsiberica@sgstool.es

EASTERN EUROPE
SINTCOM
Sintcom Tools
95 Arsenalski Blvd.
1421 Sofia, Bulgaria
phone: (359) 283-64421
fax: (359) 286-52493
e-mail: sintcom@sintcomtools.com

RUSSIA
HALTEC
phone: (7) 495-252-05-00
e-mail: info@haltec.ru
web: www.haltec.ru

CHINA
SGS TOOL DIVISION
Unit 301, Building A, No.200,
Jin Su Road
Jinqiao Export Processing Zone,
Pudong New Area
Shanghai 201206
China
phone: (86) 21-50589822
fax: (86) 21-50817160
e-mail: china@sgstool.com
web: www.sgstool.com/china

sgstool.com

EDP 00066 Rev 1015