



HIGH FEED MILLING SOLUTIONS

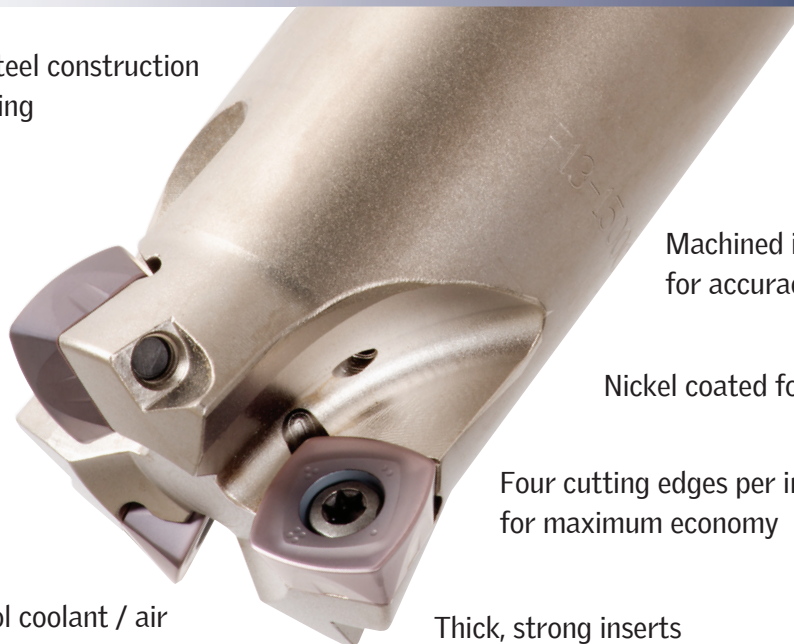
For maximum
metal removal rates
in a range of milling
applications



High quality alloy tool steel construction for strong and long-lasting cutter bodies

High precision cutter bodies provide consistent performance and tool life

Through-the-tool coolant / air capability for excellent chip evacuation



Machined in pre-hardened state for accuracy and low runout

Nickel coated for durability

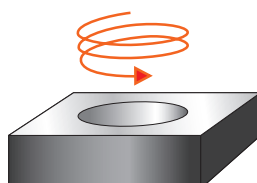
Four cutting edges per insert for maximum economy

Thick, strong inserts for demanding applications

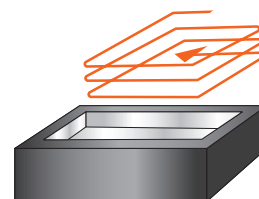
VERSATILITY | HIGH PERFORMANCE IN A VARIETY OF APPLICATIONS



Face Milling



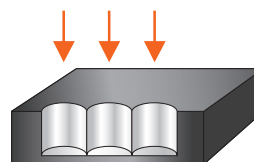
Helical Milling



Pocketing



Ramping

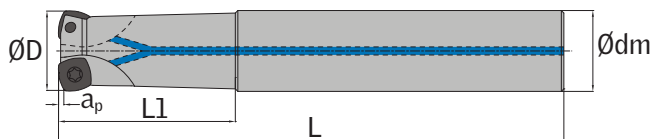


Plunging

SUITABLE FOR
A BROAD RANGE
OF MATERIALS

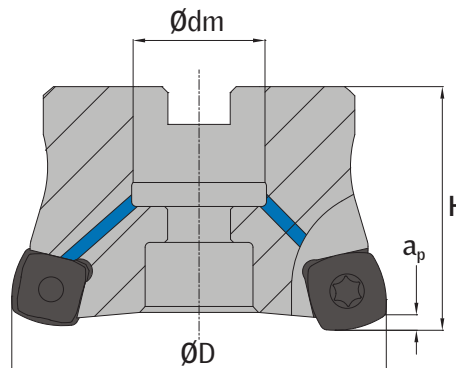
P	Steel
M	Stainless Steel
K	Cast Iron
S	High Temp Alloys
H	Hardened Steel

ENDMILLS - CYLINDRICAL SHANK



DIAMETER D	CATALOG NUMBER	NUMBER OF INSERTS z	SHANK DIAMETER dm	OVERALL LENGTH L	NECK LENGTH L1	MAX DEPTH OF CUT a _p	COOLANT THROUGH
1.250	HF13-1250C1250-12Z02	2	1.250	10.00	2.50	.078	YES
1.500	HF13-1500C1250-12Z03	3	1.250	10.00	-	.078	YES

FACEMILLS - ARBOR MOUNT



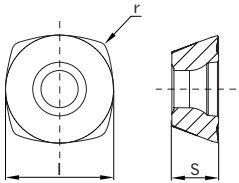


DIAMETER D	CATALOG NUMBER	NUMBER OF INSERTS z	MOUNTING BORE DIAMETER dm	HEIGHT H	MAX DEPTH OF CUT a _p	COOLANT THROUGH
2.000	HF13-2000A0750-12Z04	4	0.750	1.58	.078	YES
2.500	HF13-2500A0750-12Z05	5	0.750	1.58	.078	YES
3.000	HF13-3000A1000-12Z06	6	1.000	1.97	.078	YES
4.000	HF13-4000A1250-12Z08	8	1.250	1.97	.078	YES
5.000	HF13-5000A1500-12Z10	10	1.500	2.48	.078	YES

Ordering Example: 2 pcs HF13-5000A1500-12Z10

NOTE: All cutters are delivered with insert mounting screws and a wrench. Inserts are ordered separately - see page 4.

See page 9 for Spare Parts information.

HIGH FEED MILLING

SDMT			Versatile inserts for high feed facemilling, plunging, ramping and pocketing applications. Thick, strong inserts with four cutting edges for maximum economy. <i>GM: Medium machining with lower cutting forces</i> <i>GH: Roughing with highest edge security</i>									
APPLICATION	ITEM	CATALOG NUMBER	DIMENSIONS (INCH)			MULTI-MATERIAL						
			l	s	r	GA4225	GA4230			P	M	S
MEDIUM		SDMT 120512-GM	.500	.219	.047	★	★			★	★	★
HEAVY		SDMT 120512-GH	.500	.219	.047	★	★			★	★	

Ordering Example: 20 pcs SDMT 120512-GH GA4230

GRADE INFORMATION

GA4230 P M K S H

Universal, first-choice grade with broad application range. PVD TiAlN+ coating with excellent heat and oxidation resistance characteristics.

GA4225 P M K

Complementary grade for steel, stainless steel and cast iron materials. PVD AlCrN coating with high hardness substrate offers increased wear resistance.

GP2115 P

Best for steel machining with stable set-ups. MT-CVD dual layer TiCN and Al₂O₃ coating with extremely hard substrate offers high wear resistance.

GM2140 M

Outstanding performance in austenitic and ferritic, martensitic and PH stainless steels. MT-CVD coated grade with secondary application in titanium and HRSA materials.

GS4130 S

Primary application in titanium and iron-based, cobalt-based and nickel-based heat resistant alloys. Latest PVD TiAlN coating technology with complementary use in stainless steels.

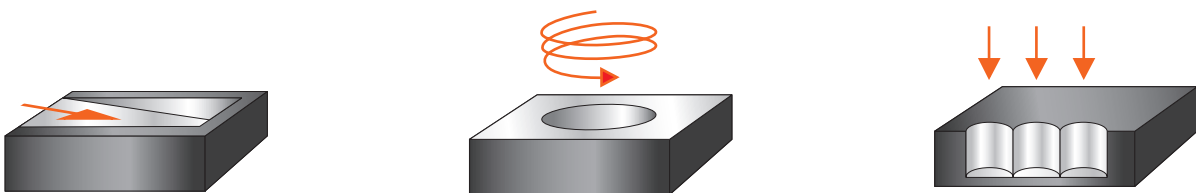
REFERENCE PAGES

MILLING CUTTERS	3	FEED RECOMMENDATIONS	5	CUTTING SPEED RECOMMENDATIONS	6
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ISO	Workpiece Material	Rockwell Hardness HRC	Recommended feed per insert f_z (inches) starting (range)	
			GM (medium)	GH (heavy)
P Steel	Low-Carbon Steel	<25	.045 (.030 - .060)	.060 (.040 - .080)
	Alloy Steel and Tool Steel	<35	.045 (.030 - .060)	.060 (.040 - .080)
	Alloy Steel and Tool Steel	35 - 45	.035 (.025 - .050)	.045 (.030 - .060)
M Stainless Steel	Stainless Steel	<35	.030 (.025 - .040)	.040 (.030 - .050)
K Cast Iron	Cast Iron	<35	.045 (.030 - .060)	.060 (.040 - .080)
S High-Temp Alloys	Heat-Resistant and Titanium Alloys	<35	.015 (.006 - .024)	.020 (.008 - .036)
H Hardened Steel	Alloy Steel and Tool Steel	45 - 55	.010 (.004 - .020)	.015 (.006 - .030)

RECOMMENDED STARTING FEED VALUES RELATIVE TO DEPTH OF CUT	depth of cut a_p (inches)			
	.020	.040	.060	.078
Recommended feed per insert f_z (inches) starting (range)	.070 (.060 - .080)	.060 (.040 - .070)	.040 (.025 - .060)	.030 (.015 - .040)

OTHER APPLICATIONS



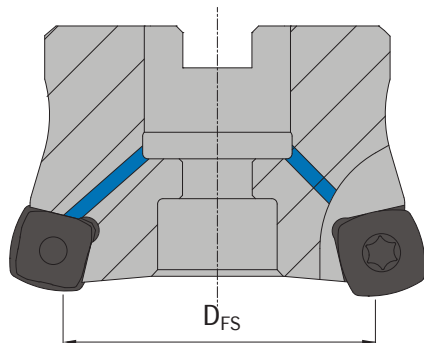
See pages 8 and 9 for feed recommendations for ramping, helical milling and plunging applications.

ISO	Material Group	Workpiece Material	Brinell Hardness HB	Rockwell Hardness HRC	Tensile Strength MPa	Recommended Starting Speeds v_c (ft/min)											
						GP2115			GA4225			GA4230			GM2140		
						f_z (inch)			f_z (inch)			f_z (inch)			f_z (inch)		
						.035	.050	.065	.035	.050	.065	.035	.050	.065	.035	.045	.055
P Steel	P0	Low-Carbon Steels, Long Chipping (C < .25%) Ex. A36, 1008, 1010, 1018, 1108, 1117	<125		<530	920	810	640	860	760	600	830	730	580			
	P1	Low-Carbon Steels, Short Chipping, Free Machining (C < .25%) Ex. 10L18, 1200 Series, 1213, 12L14	<125		<530	860	760	600	780	680	530	740	650	510			
	P2	Medium- and High-Carbon Steels (C > .25%) Ex. 1035, 1045, 10L45, 1080, 1137, 1144, 1525, 1572	<220	<25	>530	780	680	530	660	560	450	630	540	430			
	P3	Alloy Steels and Tool Steels (C > .25%) Ex. P20, 1300, 2000, 3000, 4000, 5000, 8000, SAE A, D, H, O, S, M, T	<330	<35	600-850	660	560	450	600	500	400	570	480	390			
	P4	High-Strength Alloy Steels and Tool Steels (C > .25%) Ex. P20, 1300, 2000, 3000, 4000, 5000, 8000, SAE A, D, H, O, S, M, T	340-450	35-48	850-1400	600	500	400	540	440	360	515	425	340			
	P5	Ferritic, Martensitic and PH Stainless Steels Ex. 13-8 PH, 15-5 PH, 17-4 PH, 400 and 500 Series	<330	<35	600-900				490	400	330	450	380	310	540	440	360
	P6	High-Strength Ferritic, Martensitic and PH Stainless Steels Ex. 13-8 PH, 15-5 PH, 17-4 PH, 400 and 500 Series	340-450	35-48	900-1350				400	340	275	380	320	260	450	380	310

ISO	Material Group	Workpiece Material	Brinell Hardness HB	Rockwell Hardness HRC	Tensile Strength MPa	Recommended Starting Speeds v_c (ft/min)											
						GA4225			GA4230			GS4130			GM2140		
						f_z (inch)			f_z (inch)			f_z (inch)			f_z (inch)		
						.025	.035	.045	.025	.035	.045	.025	.035	.045	.025	.035	.045
M Stainless Steel	M1	Austenitic Stainless Steels Ex. 200 Series, 301, 302, 304, 304L, 309	130-200		<600	530	430	340	490	405	325	490	405	325	570	480	390
	M2	High-Strength Austenitic Stainless and Cast Stainless Steels Ex. 310, 316, 316L, 321, 347, 384	150-230	<25	600-800	480	410	325	450	380	305	450	380	305	530	440	350
	M3	Duplex Stainless Steels Ex. 323, 329, F55, 2205	135-275	<30	<800	420	340	275	380	310	260	380	310	260	450	380	310

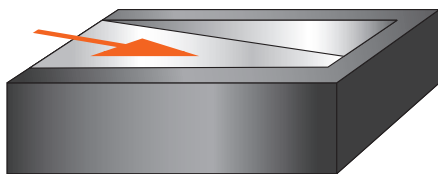
ISO	Material Group	Workpiece Material	Brinell Hardness HB	Rockwell Hardness HRC	Tensile Strength MPa	Recommended Starting Speeds v_c (ft/min)								
						GA4225			GA4230					
						f_z (inch)			f_z (inch)					
						.035	.050	.065	.035	.050	.065			
K Cast Iron	K1	Gray Cast Iron Ex. Class 20, 25, 30, 35, 40, 45, 50, 55, 60, G1800, G3000, G3500, G4000	120-290	<32	125-500	715	635	555	680	605	530			
	K2	Ductile Cast Irons (Nodular Irons) and Compacted Graphite Irons (CGI) Ex. 60-40-18, 65-45-12, 80-55-06, SAE J434: D4018, D4512, D5506	130-260	<28	<600	555	490	435	530	470	415			
	K3	High-Strength Ductile Irons and Austempered Ductile Irons (ADI) Ex. ASTM A536: 100-70-03, 120-90-02, SAE J434: D7003	180-350	<43	>600	490	420	370	470	400	355			
ISO	Material Group	Workpiece Material	Brinell Hardness HB	Rockwell Hardness HRC	Tensile Strength MPa	Recommended Starting Speeds v_c (ft/min)								
						GA4230			GS4130			GM2140		
						f_z (inch)			f_z (inch)			f_z (inch)		
						.008	.016	.024	.008	.016	.024	.008	.016	.024
S High Temp Alloys	S1	Iron-Based Heat-Resistant Alloys Ex. A286, A608, INCOLOY 800 Series, N-155, Haynes 556, Discaloy	200-280	<30	600-1000	210	140	100	210	140	100	230	160	110
	S2	Cobalt-Based Heat-Resistant Alloys Ex. Haynes 25 (L605), Haynes 188, Stellite, MAR-M302, MAR-M509	250-350	<35	800-1200	180	120	80	180	120	80	200	130	90
	S3	Nickel-Based Heat-Resistant Alloys Ex. Astroloy, Hastelloy X, INCONEL 600 and 700 Series, Waspalloy	250-350	<35	800-1200	180	120	80	180	120	80	200	130	90
	S4	Titanium and Titanium Alloys Ex. Commercially Pure Ti, Ti-5Al-2.5Sn, Ti-6Al-4V, Ti-3Al-8V-6Cr-4Zr-4Mo	300-400	33-48	900-1600	200	130	90	200	130	90	215	145	100
ISO	Material Group	Workpiece Material	Brinell Hardness HB	Rockwell Hardness HRC	Tensile Strength MPa	Recommended Starting Speeds v_c (ft/min)								
						GA4230								
						f_z (inch)								
						.006	.012	.020						
H Hardened Steels	H1	Hardened Alloy Steels and Tool Steels Ex. H13D2, D3, 4340, P20		44-48		320	260	210						
	H2	Hardened Alloy Steels and Tool Steels Ex. H13D2, D3, 4340, P20		48-55		260	210	165						
	H3	Hardened Alloy Steels and Tool Steels Ex. H13D2, D3, 4340, P20		56-60										
	H4	Hardened Alloy Steels and Tool Steels Ex. H13D2, D3, 4340, P20		>60										

WIDTH OF CUT FOR FLAT SURFACES



CUTTER DIAMETER	D_{FS}
1.250	0.53
1.500	0.78
2.000	1.28
2.500	1.78
3.000	2.28
4.000	3.28
5.000	4.28

RAMPING



FEED RECOMMENDATION

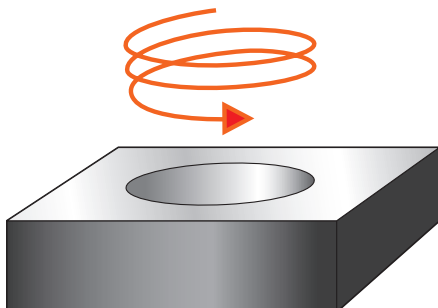
Reduce feed for ramping applications to 75% of normal value.

EXAMPLE: If the calculated face milling feed rate is 200 inches/min, reduce the feed rate for ramping to:

$$200 \text{ inches/min} \times 75\% = 150 \text{ inches/min}$$

CUTTER DIAMETER	MAX RAMPING ANGLE
1.250	1.8°
1.500	1.5°
2.000	1.2°
2.500	0.9°
3.000	0.8°
4.000	0.6°
5.000	0.4°

HELICAL MILLING



FEED RECOMMENDATION

Reduce feed for helical milling applications to 30% - 50% of normal value.

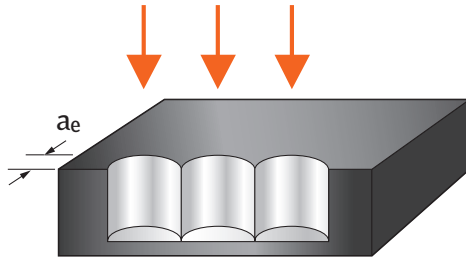
EXAMPLE: If the calculated face milling feed rate is 200 inches/min, reduce the feed rate for helical milling to a range of:

$$200 \text{ inches/min} \times 30\% = 60 \text{ inches/min}$$

$$200 \text{ inches/min} \times 50\% = 100 \text{ inches/min}$$

CUTTER DIAMETER	MINIMUM HOLE SIZE	MAXIMUM HOLE SIZE
1.250	1.71	2.42
1.500	2.21	2.92
2.000	3.21	3.92
2.500	4.21	4.92
3.000	5.21	5.92
4.000	7.21	7.92
5.000	9.21	9.92

PLUNGE MILLING



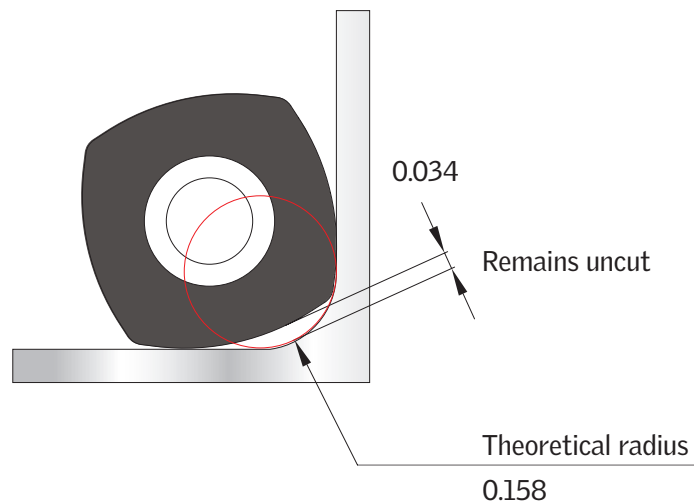
Maximum width of cut $a_e = 0.330$

FEED RECOMMENDATION


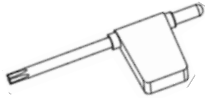
Recommended starting feed per insert
 $f_z = .006$ (.002-.010)

PROGRAMMING INFORMATION

CAD/CAM systems require a defined theoretical radius value when programming pocketing applications (cavity machining). The theoretical radius value is noted on the drawing to the right, as well as the approximate amount of material that will remain uncut.



SPARE PARTS

INSERT SCREW 	WRENCH 
NS521	FWT15

Spindle speed, n (rpm)

$$n = \frac{3.82 \times v_c}{D}$$

Cutting speed, v_c (ft / min)

$$v_c = .262 \times D \times n$$

Feed rate, v_f (in / min)

$$v_f = n \times f_z \times z$$

Feed per insert, f_z (in)

$$f_z = \frac{v_f}{n \times z}$$

Metal removal rate, Q (in³ / min)

$$Q = a_e \times a_p \times v_f$$

a_e	width of cut	inches
a_p	depth of cut	inches
D	cutter diameter	inches
f_z	feed per insert	inches
n	spindle speed	rev/min
Q	metal removal rate	inches ³ /min
v_c	cutting speed	feet/min
v_f	feed rate	inches/min
z	number of inserts	

Metalcutting Safety

Read before using the tools in this catalog!

Projectile and Fragmentation Hazards:

Modern metalcutting operations involve high spindle and cutter speeds and high temperatures and cutting forces. Hot metal chips may fly off the workpiece during metalcutting. Although cutting tools are designed and manufactured to withstand high cutting forces and temperatures, they can sometimes fragment, particularly if they are subjected to over-stress, severe impact, or other abuse. Many variables affect machining operations. It is impossible to cover every specific situation. The technical information included in this catalog and recommendations on machining practices may not apply to your particular operation. As sold and under normal conditions of use, hardmetal products and tools do not present inhalation, ingestion or other chemical hazards. The health hazards relate only to hardmetal powder. Under normal conditions of use, operations involving hardmetal products and tools do not result in the release of hardmetal powder (either in the form of dusts or fumes) and do not present inhalation, ingestion or other chemical hazards.

To avoid injury:

- Always wear appropriate personal protective equipment, including safety goggles, when operating metalcutting machines or working nearby.
- Always make sure all machine guards are in place.

Breathing and Skin Contact Hazards:

Grinding carbide or other advanced cutting tool materials produces dust or mist containing metallic particles.

To avoid injury:

- If grinding, read the applicable Material Safety Data Sheet and consult General Industry Safety and Health Regulations, Part 1910, Title 29 of the Code of Federal Regulations. These safety instructions are general guidelines.

Although we have attempted to provide current and accurate information herein, we make no representations regarding the accuracy or the completeness of the information and assume no liability for any loss, damage, or injury of any kind which may result from or arise out of the use of or reliance on the information by any person.

PRODUCT HANDBOOK

HIGH FEED MILLING SOLUTIONS ENDMILLS AND FACEMILLS

TechMet

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