HF VH/UP

UNIVERSAL PURPOSE

HF EVOlution is the Osawa family of micrograin carbide endmills for universal application with coatings and cutting edges specifically designed for high performance machining of all ISO materials. The HF EVOlution endmills are available in a broad range of types, lengths and radii. They are the ideal tools for both mass production and small batch manufacturing, thanks to the outstanding performance delivered and the universal applicability.

HF EVOlution è la linea Osawa di frese universali in metallo duro micrograna con spoglie e rivestimenti specifici per la lavorazione ad alto rendimento di tutti i materiali della scala ISO. Le frese HF EVOlution sono disponibili in un'ampia gamma di tipologie, lunghezze e raggi torici. Sono gli utensili ideali sia per le superproduzioni di serie che per la produzione di piccoli lotti, grazie all'eccellenza del rendimento e all'universalità d'impiego.

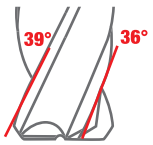
HF EVOlution heißt die Linie der Universalfräser aus mikrokörnigem Hartmetall von Osawa, mit Schneidekanten und spezifischen Beschichtungen zur Hochleistungsbearbeitung von allen Materialien der ISO-Skala. Die Fräser HF EVOlution sind in einer reichen Auswahl an Typologien, Längen und Torusradien erhältlich. Mit ihren ausgezeichneten Leistungen und dem universellen Einsatz sind sie die idealen Werkzeuge, sowohl für die Serienproduktion großer Mengen als auch für die Herstellung kleiner Lose.

HF EVOlution est la ligne Osawa de fraises universelles en carbure micrograin avec dépouilles et revêtements spécifiques pour l'usinage de haute performance de tous les matériaux de l'échelle ISO. Les fraises HF EVOlution sont disponibles dans une large gamme, longueurs et rayons. Ce sont des outils aussi bien pour les grandes séries que pour la production de prototypes, grâce à leur excellence de rendement et leur polyvalence.

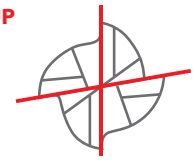
HF EVOlution es la línea de fresas universales de metal duro microgranulado con inclinación y revestimientos específicos para el mecanizado de alto rendimiento de todos los materiales de la escala ISO. Las fresas HF EVOlution están disponibles en una amplia gama de tipologías, longitudes y radios tóricos. Son las herramientas ideales tanto para las superproducciones en serie como para la producción de pequeños lotes, gracias a la excelencia del rendimiento y la universalidad de empleo.

HF EVOlution - это линейка универсальных фрез Osawa из мелкозернистого твердого сплава со специальным покрытием для высокопроизводительной обработки всех материалов по ISO. Доступна широкая гамма фрез этой серии, имеющих различную длину и радиусы на уголках. Благодаря высокой эффективности и универсальности, это идеальные инструменты как для массового, так и для мелкосерийного производства.

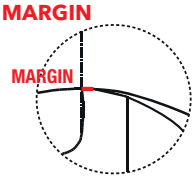
(1) VH



(2) UP



(3) MARGIN



HIGH PERFORMANCE

Thanks to the variable helix geometry VH (1) with unequal pitch UP (2) and to the highly sophisticated cutting edge preparation (3), the HF EVOlution endmills enable the highest level of performances in terms of tool life, volume of chip removed, productivity and surface finishing.

Grâce à la géométrie à hélice variable VH (1) à pas décalé UP (2) et à la préparation technique de la partie coupante (3), les fraises HF EVOlution garantissent des performances de haut niveau en termes de durée, volume de débit copeau, productivité et finition superficielle.

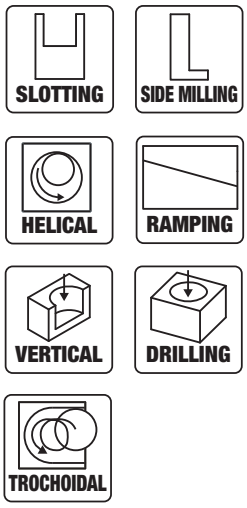
Grazie alla geometria ad elica variabile VH (1) con passo differenziato UP (2) e alla sofisticata preparazione del tagliente (3), le frese HF EVOlution garantiscono performance di alto livello in termini di durata, volume truciolo asportato, produttività e finitura superficiale.

Gracias a la geometría de hélice variable VH (1) con paso diferenciado UP (2) y a la sofisticada preparación del filo (3), las fresas HF EVOlution garantizan rendimientos de alto nivel en términos de duración, volumen de la viruta extraída, productividad y acabado de la superficie.

Dank der Geometrie mit variabler Helix VH (1) mit ungleicher Teilung UP (2) und der sorgfältigen Herstellung der Schneide (3) gewährleisten die Fräser HF EVOlution Höchstleistungen, was die Dauer, das Volumen des abgetragenen Spans, die Produktivität und das Oberflächenfinish betrifft.

Благодаря геометрии с переменным углом наклона спирали VH (1) с неравномерным шагом UP (2) и сложной формой зубьев (3), фрезы HF EVOlution гарантируют высокую производительность, стойкость, объем удаляемого материала и низкую шероховатость обработанной поверхности.

ISO P
ISO M
ISO K
ISO S
ISO H



UNIVERSAL

The HF EVOlution endmills are universal tools, both for the broad range of materials machineable, the type of applications and for the milling strategies applicable: slotting, side milling, helical interpolation, ramping, vertical milling, drilling and trochoidal milling. Just one single HF tool enables roughing, semi-finishing and finishing applications.

Les fraises HF EVOlution sont des outils universels aussi bien pour tous types de matériaux que pour tous types d'usinages et de stratégies de fraisages applicables : fraisage de pièces taillées dans la masse, contournage, interpolation hélicoïdale, entrée sur rampe, fraisage axial, perçage et fraisage trochoïdal. Un seul outil HF permet de réaliser des usinages d'ébauche, semi finition et finition.

Le frese HF EVOlution sono utensili universali sia per la gamma dei materiali lavorabili che per il tipo di lavorazione e strategia di fresatura applicabile: fresatura dal pieno, contornatura, interpolazione elicoidale, entrata in rampa, fresatura assiale, foratura e fresatura trocoidale. Un unico utensile HF permette lavorazioni di sgrossatura, semi-sgrossatura e finitura.

Las fresas HF EVOlution son herramientas universales tanto por su gama de materiales trabajables como por el tipo de elaboración y estrategia de fresado aplicable: fresado de una sola pieza, contorneado, interpolación helicoidal, entrada en rampa, fresado axial, perforación y fresado trocoidal. Un sola herramienta HF permite elaboraciones de desbastado, semidesbastado y acabado.

Die Fräser HF EVOlution sind universelle Werkzeuge, sowohl aufgrund der breiten Palette bearbeitbarer Materialien als auch dank der anwendbaren Bearbeitungsarten und Frässtrategien: Nutfräsen, Konturfräsen, Helixinterpolation, Rampenfräsen, Vertikalfräsen, Bohren und trochoidales Fräsen. Ein einziges HF Werkzeug kann zum Schruppen, Vorschlichten und Schlichten eingesetzt werden.

Фрезы HF EVOlution являются универсальными инструментами как для широкой гаммы обрабатываемых материалов, так и для многих стратегий фрезерования: фрезерование пазов, уступов, по спирали, под углом, вдоль оси, сверление и трохоидальное фрезерование. С помощью одной фрезы серии HF можно выполнять черновую, получистовую и чистовую обработку.

COMPLETE RANGE

2 families of tools with application-specific geometries.
- HF UNI (VH+UP), designed for milling of materials with hardness up to 40 HRC: steel (ISO P), stainless steel (ISO M), cast iron (ISO K) and super alloys (ISO S), such as Inconel or Titanium. The HF UNI range is now extended with the new HF UNI SC "smooth cut" which reduces significantly the cutting forces thanks to the cutting edge geometry, becoming particularly suitable in case of machining with less powerful machines.
- HF HARD (UP) for steel (ISO P), stainless steel (ISO M), cast iron (ISO K), super alloys (ISO S), hardened steel (ISO H) milling, with hardness up to 55 HRC.

2 familles d'outils avec des géométries spécifiques.
- HF UNI (VH+UP), pour fraisage de matériaux dont la dureté peut atteindre 40HRC : acier (ISO P), acier inoxydable (ISO M), fonte (ISO K) et super alliages (ISO S), tels que l' inconel ou titane. La gamme HF UNI s'enrichit de la nouvelle HF UNI SC « smooth cut » qui, grâce à la géométrie de coupe, réduit considérablement les efforts de coupe, ce qui la rend particulièrement adaptée à l'utilisation sur des machines peu puissantes.
- HF HARD (UP), pour fraisage d'acier (ISO P), acier inoxydable (ISO M), fonte (ISO K) et super alliages (ISO S), acier trempé (ISO H), dont la dureté peut atteindre 55HRC.

2 famiglie di utensili con geometrie specifiche.
- HF UNI (VH+UP), per fresatura di materiali con durezza sino a 40 HRC: acciaio (ISO P), acciaio inossidabile (ISO M), ghisa (ISO K) e super leghe (ISO S), quali Inconel o titanio. La gamma HF UNI si arricchisce della nuova HF UNI SC "smooth cut" che, grazie alla geometria del tagliente, riduce notevolmente gli sforzi di taglio, risultando particolarmente adatta all'utilizzo su macchine poco potenti.
- HF HARD (UP) per fresatura di acciaio (ISO P), acciaio inossidabile (ISO M), ghisa (ISO K), super leghe (ISO S), acciaio temprato (ISO H), con durezza sino a 55 HRC.

2 familias de herramientas con geometrías específicas.
- HF UNI (VH+UP), para fresado de materiales con dureza hasta 40HRC: acero (ISO P), acero inoxidable (ISO M), fundición (ISO K) y súper aleaciones (ISO S), como Inconel o titanio. La gama HF UNI se enriquece con la nueva HF UNI SC «smooth cut», que, gracias a la geometría del filo cortante, reduce de forma importante los esfuerzos de corte, resultando especialmente adecuada para su uso en máquinas poco potentes.
- HF HARD (UP), para fresado de acero (ISO P), acero inoxidable (ISO M), fundición (ISO K) y súper aleaciones (ISO S), acero templado (ISO H), con duración de hasta 55 HRC.

2 Werkzeugfamilien mit spezifischen Geometrien.
- HF UNI (VH+UP), zum Fräsen von Materialien mit einer Härte bis zu 40HRC: Stahl (ISO P), korrosionsbeständiger Stahl (ISO M), Gusseisen (ISO K) und Superlegierungen (ISO S) wie Inconel oder Titan. Die Serie HF UNI wird durch den neuen Fräser HF UNI SC „Smooth Cut" erweitert, bei dem dank der Geometrie der Schneide die aufzubringende Schnittkraft wesentlich verringert werden konnte, so dass dieser Fräser besonders für den Einsatz auf weniger leistungsfähigen Maschinen geeignet ist.
- HF HARD (UP) für das Fräsen von Stahl (ISO P), korrosionsbeständigem Stahl (ISO M), Gusseisen (ISO K), Superlegierungen (ISO S), gehärtetem Stahl (ISO H) mit einer Härten bis zu 55HRC.

2 семейства инструментов со специальной геометрией.
- HF UNI (VH+UP), для фрезерования материалов твердостью до 40HRC: сталь (ISO P), нержавеющая сталь (ISO M), чугун (ISO K) и жаропрочные сплавы (ISO S), такие как инконель и титан. К этому семейству добавлена новая фреза HF UNI SC «smooth cut» (плавное резание), которая, благодаря форме зубьев, значительно сокращает усилия резания, что делает ее пригодной для использования на маломощных станках.
- HF HARD (UP) для фрезерования стали (ISO P), нержавеющей стали (ISO M), чугуна (ISO K), жаропрочных сплавов (ISO S), закаленной стали (ISO H) твердостью до 55 HRC.

HF840

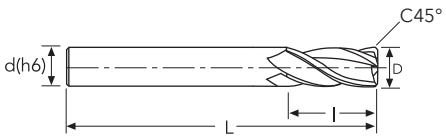
cylindrical shank, 45° chamfer

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | C45° | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
3	0/-0.030	0.10	+/-0.020	6	9		57	4	HF840030	●
4	0/-0.025	0.10	+/-0.020	6	11		57	4	HF840040	●
5	0/-0.025	0.10	+/-0.020	6	13		57	4	HF840050	●
6	0/-0.025	0.10	+/-0.020	6	13		57	4	HF840060	●
8	0/-0.030	0.20	+/-0.020	8	20		64	4	HF840080	●
10	0/-0.030	0.20	+/-0.020	10	22		72	4	HF840100	●
12	0/-0.030	0.20	+/-0.020	12	26		83	4	HF840120	●
14	0/-0.030	0.30	+/-0.020	14	26		83	4	HF840140	●
16	0/-0.030	0.30	+/-0.020	16	32		92	4	HF840160	●
18	0/-0.030	0.30	+/-0.020	18	32		92	4	HF840180	●
20	0/-0.030	0.40	+/-0.020	20	38		104	4	HF840200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

HF840

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	14860	0.014	830	9550	0.013	480	7430	0.011	310	4250	0.010	170
	4	11150	0.019	830	7170	0.017	480	5570	0.014	310	3180	0.013	160
	5	8920	0.023	820	5730	0.021	470	4460	0.017	310	2550	0.016	160
	6	7430	0.027	800	4780	0.024	460	3720	0.020	300	2120	0.019	160
	8	5570	0.035	780	3580	0.032	450	2790	0.026	290	1590	0.025	160
	10	4460	0.042	750	2870	0.038	430	2230	0.032	280	1270	0.029	150
	12	3720	0.048	710	2390	0.043	410	1860	0.036	270	1060	0.034	140
	14	3180	0.054	690	2050	0.049	400	1590	0.041	260	910	0.038	140
	16	2790	0.060	670	1790	0.054	390	1390	0.045	250	800	0.042	130
	18	2480	0.066	650	1590	0.059	380	1240	0.050	250	710	0.046	130
	20	2230	0.073	650	1430	0.066	380	1110	0.055	240	640	0.051	130
ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**160-180**			**100-120**			**70-90**			**40-60**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	18050	0.017	1210	11680	0.015	710	8490	0.013	460	5310	0.018	390
	4	13540	0.022	1200	8760	0.020	700	6370	0.018	450	3980	0.024	390
	5	10830	0.028	1200	7010	0.025	700	5100	0.022	450	3180	0.030	390
	6	9020	0.032	1170	5840	0.029	680	4250	0.026	440	2650	0.036	380
	8	6770	0.042	1140	4380	0.038	660	3180	0.034	430	1990	0.046	370
	10	5410	0.050	1090	3500	0.045	640	2550	0.040	410	1590	0.055	350
	12	4510	0.058	1040	2920	0.052	610	2120	0.046	390	1330	0.063	340
	14	3870	0.065	1000	2500	0.058	580	1820	0.052	380	1140	0.071	330
	16	3380	0.072	970	2190	0.065	570	1590	0.058	370	1000	0.079	320
	18	3010	0.079	950	1950	0.071	560	1420	0.063	360	880	0.087	310
	20	2710	0.088	950	1750	0.079	550	1270	0.070	360	800	0.096	310
ap x ae	**≤ D5**	1.5D x 0.25D			1.5D x 0.25D			1.2D x 0.1D			1.2D x 0.1D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
HELICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	14860	0.010	605	9550	0.010	365	7430	0.008	250	4250	0.008	133
	4	11150	0.013	600	7170	0.013	360	5570	0.011	247	3180	0.010	132
	5	8920	0.017	600	5730	0.016	360	4460	0.014	246	2550	0.013	131
	6	7430	0.020	585	4780	0.018	350	3720	0.016	241	2120	0.015	128
	8	5570	0.025	570	3580	0.024	340	2790	0.021	235	1590	0.020	125
	10	4460	0.031	545	2870	0.029	325	2230	0.025	225	1270	0.024	120
	12	3720	0.035	520	2390	0.033	310	1860	0.029	214	1060	0.027	114
	14	3180	0.039	500	2050	0.037	300	1590	0.032	206	910	0.030	110
	16	2790	0.044	490	1790	0.041	290	1390	0.036	200	800	0.034	108
	18	2480	0.048	475	1590	0.045	285	1240	0.040	197	710	0.037	105
	20	2230	0.053	475	1430	0.050	285	1110	0.044	195	640	0.041	105
α° max	**≤ D5**	2°			2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

HF840

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	7430	0.022	640	4780	0.020	380	3720	0.019	281	2120	0.026	220
8	5570	0.028	620	3580	0.026	370	2790	0.024	273	1590	0.034	214
10	4460	0.034	600	2870	0.031	355	2230	0.029	262	1270	0.040	205
12	3720	0.038	570	2390	0.035	335	1860	0.034	250	1060	0.046	196
14	3180	0.043	550	2050	0.040	325	1590	0.038	240	910	0.052	189
16	2790	0.048	535	1790	0.044	315	1390	0.042	233	800	0.058	185
18	2480	0.053	520	1590	0.048	310	1240	0.046	229	710	0.063	180
20	2230	0.058	520	1430	0.054	305	1110	0.051	227	640	0.070	180

VERTICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	7430	0.027	800	4780	0.024	460	3720	0.020	300	2120	0.019	160
8	5570	0.035	780	3580	0.032	450	2790	0.026	290	1590	0.025	160
10	4460	0.042	750	2870	0.038	430	2230	0.032	280	1270	0.029	150
12	3720	0.048	710	2390	0.043	410	1860	0.036	270	1060	0.034	140
14	3180	0.054	690	2050	0.049	400	1590	0.041	260	910	0.038	140
16	2790	0.060	670	1790	0.054	390	1390	0.045	250	800	0.042	130
18	2480	0.066	650	1590	0.059	380	1240	0.050	250	710	0.046	130
20	2230	0.073	650	1430	0.066	380	1110	0.055	240	640	0.051	130

DRILLING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
Vc (m/min)	**100-120**			**60-80**			**45-65**			**20-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	11680	0.007	330	7430	0.006	190	5840	0.006	130	3180	0.008	100
4	8760	0.009	320	5570	0.008	190	4380	0.007	130	2390	0.010	100
5	7010	0.012	320	4460	0.010	180	3500	0.009	130	1910	0.013	100
6	5840	0.014	320	3720	0.012	180	2920	0.011	130	1590	0.015	90
8	4380	0.018	310	2790	0.016	180	2190	0.014	120	1190	0.019	90
10	3500	0.021	290	2230	0.019	170	1750	0.017	120	960	0.023	90
12	2920	0.024	280	1860	0.022	160	1460	0.019	110	800	0.026	80
14	2500	0.027	270	1590	0.024	150	1250	0.022	110	680	0.030	80
16	2190	0.030	260	1390	0.027	150	1090	0.024	100	600	0.033	80
18	1950	0.033	260	1240	0.030	150	970	0.026	100	530	0.036	80
20	1750	0.037	260	1110	0.033	150	880	0.029	100	480	0.040	80

ap x ae	**≤ D5**	0.5D x D	0.5D x D	0.25D x D	0.25D x D

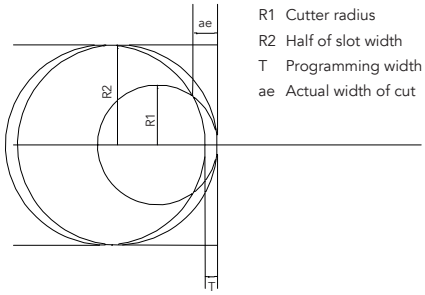
PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF840

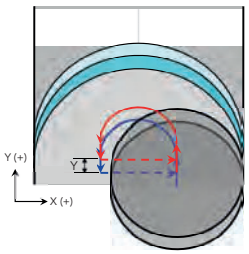
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.2D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**190-230**			**130-150**			**100-120**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	22290	0.035	3120	14860	0.032	1870	11680	0.028	1310	6370	0.039	980
	4	16720	0.046	3090	11150	0.042	1860	8760	0.037	1300	4780	0.051	970
	5	13380	0.058	3080	8920	0.052	1850	7010	0.046	1290	3820	0.063	970
	6	11150	0.068	3010	7430	0.061	1810	5840	0.054	1260	3180	0.074	940
	8	8360	0.088	2930	5570	0.079	1750	4380	0.070	1230	2390	0.096	920
	10	6690	0.105	2810	4460	0.095	1690	3500	0.084	1180	1910	0.116	880
	12	5570	0.120	2670	3720	0.108	1610	2920	0.096	1120	1590	0.132	840
	14	4780	0.135	2580	3180	0.122	1550	2500	0.108	1080	1360	0.149	810
	16	4180	0.150	2510	2790	0.135	1510	2190	0.120	1050	1190	0.165	790
	18	3720	0.165	2460	2480	0.149	1470	1950	0.132	1030	1060	0.182	770
	20	3340	0.183	2440	2230	0.164	1470	1750	0.146	1020	960	0.201	770

ap x ae	**≤ D5**	1.5D x 0.1D	1.5D x 0.1D	

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF440

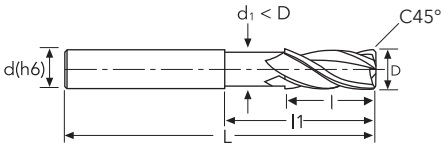
cylindrical shank and reduced neck, 45° chamfer

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | C45° | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING (1.5D) | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
3	0/-0.030	0.10	+/-0.020	6	9	15	2.80	57	4	HF440030	●
4	0/-0.030	0.10	+/-0.020	6	11	18	3.80	57	4	HF440040	●
5	0/-0.030	0.10	+/-0.020	6	13	19	4.80	57	4	HF440050	●
6	0/-0.030	0.10	+/-0.020	6	13	20	5.80	57	4	HF440060	●
8	0/-0.030	0.20	+/-0.020	8	20	26	7.80	64	4	HF440080	●
10	0/-0.030	0.20	+/-0.020	10	22	30	9.80	72	4	HF440100	●
12	0/-0.030	0.20	+/-0.020	12	26	36	11.80	83	4	HF440120	●
14	0/-0.030	0.20	+/-0.020	14	26	36	13.70	83	4	HF440140	●
16	0/-0.030	0.30	+/-0.020	16	32	42	15.70	92	4	HF440160	●
20	0/-0.030	0.40	+/-0.020	20	38	50	19.70	104	4	HF440200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

HF440

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.013	640	8490	0.011	390	6370	0.009	240	4250	0.009	150
	4	9550	0.017	640	6370	0.015	380	4780	0.012	240	3180	0.012	150
	5	7640	0.021	630	5100	0.019	380	3820	0.016	240	2550	0.014	150
	6	6370	0.024	620	4250	0.022	370	3180	0.018	230	2120	0.017	140
	8	4780	0.032	600	3180	0.028	360	2390	0.024	230	1590	0.022	140
	10	3820	0.038	580	2550	0.034	350	1910	0.028	220	1270	0.026	130
	12	3180	0.043	550	2120	0.039	330	1590	0.032	210	1060	0.030	130
	14	2730	0.049	530	1820	0.044	320	1360	0.036	200	910	0.034	120
	16	2390	0.054	520	1590	0.049	310	1190	0.041	190	800	0.038	120
	20	1910	0.066	500	1270	0.059	300	960	0.049	190	640	0.046	120
ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	ap x ae	**1.5D x D**			**1.5D x D**								
	Vc (m/min)	**85-105**			**55-75**								
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	8	3780	0.025	380	2590	0.023	230						
	10	3030	0.030	370	2070	0.027	230						
	12	2520	0.035	350	1730	0.031	220						
	14	2160	0.039	340	1480	0.035	210						
	16	1890	0.043	330	1290	0.039	200						
	20	1510	0.053	320	1040	0.047	200						

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**130-150**			**90-110**			**60-80**			**40-60**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	14860	0.015	900	10620	0.014	580	7430	0.012	360	5310	0.017	350
	4	11150	0.020	890	7960	0.018	570	5570	0.016	360	3980	0.022	350
	5	8920	0.025	890	6370	0.022	570	4460	0.020	350	3180	0.027	350
	6	7430	0.029	870	5310	0.026	560	3720	0.023	350	2650	0.032	340
	8	5570	0.038	840	3980	0.034	540	2790	0.030	340	1990	0.042	330
	10	4460	0.045	810	3180	0.041	520	2230	0.036	320	1590	0.050	320
	12	3720	0.052	770	2650	0.047	490	1860	0.041	310	1330	0.057	300
	14	3180	0.058	740	2270	0.052	480	1590	0.047	300	1140	0.064	290
	16	2790	0.065	720	1990	0.058	460	1390	0.052	290	1000	0.071	290
	20	2230	0.079	700	1590	0.071	450	1110	0.063	280	800	0.087	280
ap x ae	**≤ D5**	1.5D x 0.25D			1.5D x 0.25D			1.2D x 0.1D			1.2D x 0.1D		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

HF440

HELICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	12740	0.009	470	8490	0.009	290	6370	0.008	193	4250	0.007	120
4	9550	0.012	465	6370	0.011	290	4780	0.010	191	3180	0.009	119
5	7640	0.015	460	5100	0.014	285	3820	0.012	190	2550	0.012	118
6	6370	0.018	450	4250	0.016	280	3180	0.015	186	2120	0.014	115
8	4780	0.023	440	3180	0.021	270	2390	0.019	181	1590	0.018	112
10	3820	0.028	420	2550	0.026	260	1910	0.023	173	1270	0.021	108
12	3180	0.031	400	2120	0.029	250	1590	0.026	165	1060	0.024	103
14	2730	0.035	385	1820	0.033	240	1360	0.029	159	910	0.027	99
16	2390	0.039	375	1590	0.037	235	1190	0.032	154	800	0.030	97
20	1910	0.048	365	1270	0.045	225	960	0.039	151	640	0.037	94
α° max	**≤ D5**	2°		2°			1°			1°		

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	5840	0.019	455	3720	0.018	265	2920	0.017	198	1860	0.023	174
8	4380	0.025	440	2790	0.023	260	2190	0.022	193	1390	0.030	168
10	3500	0.030	420	2230	0.028	250	1750	0.026	185	1110	0.036	161
12	2920	0.034	405	1860	0.032	235	1460	0.030	176	930	0.042	154
14	2500	0.039	390	1590	0.036	225	1250	0.034	170	800	0.047	149
16	2190	0.043	375	1390	0.040	220	1090	0.038	165	700	0.052	145
20	1750	0.052	365	1110	0.048	215	880	0.046	162	560	0.063	141

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
α° x ae	**30° x D**			**15° x D**								
Vc (m/min)	**80-100**			**45-65**								
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
10	2870	0.025	280	1750	0.023	160						
12	2390	0.028	270	1460	0.026	150						
14	2050	0.032	260	1250	0.029	145						
16	1790	0.035	250	1090	0.032	140						
20	1430	0.043	245	880	0.039	140						

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF440

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
VERTICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.024	570	3720	0.022	330	2920	0.018	210	1860	0.017	130
	8	4380	0.032	550	2790	0.028	320	2190	0.024	210	1390	0.022	120
	10	3500	0.038	530	2230	0.034	300	1750	0.028	200	1110	0.026	120
	12	2920	0.043	500	1860	0.039	290	1460	0.032	190	930	0.030	110
	14	2500	0.049	490	1590	0.044	280	1250	0.036	180	800	0.034	110
	16	2190	0.054	470	1390	0.049	270	1090	0.041	180	700	0.038	110
	20	1750	0.066	460	1110	0.059	260	880	0.049	170	560	0.046	100

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**85-105**			**55-75**			**40-60**			**20-40**		
DRILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	10080	0.006	250	6900	0.006	160	5310	0.005	110	3180	0.007	90
	4	7560	0.008	250	5180	0.007	160	3980	0.007	110	2390	0.009	90
	5	6050	0.010	250	4140	0.009	150	3180	0.008	110	1910	0.011	90
	6	5040	0.012	240	3450	0.011	150	2650	0.010	100	1590	0.013	90
	8	3780	0.016	240	2590	0.014	150	1990	0.013	100	1190	0.017	80
	10	3030	0.019	230	2070	0.017	140	1590	0.015	100	960	0.021	80
	12	2520	0.022	220	1730	0.019	130	1330	0.017	90	800	0.024	80
	14	2160	0.024	210	1480	0.022	130	1140	0.019	90	680	0.027	70
	16	1890	0.027	200	1290	0.024	130	1000	0.022	90	600	0.030	70
	20	1510	0.033	200	1040	0.030	120	800	0.026	80	480	0.036	70

ap x ae	**≤ D5**	0.5D x D	0.5D x D	0.25D x D	0.25D x D

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

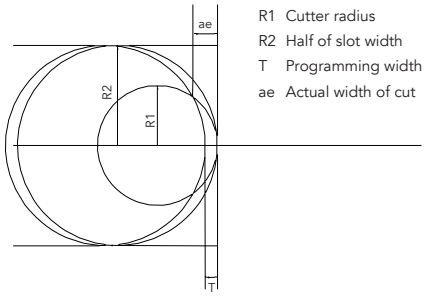
CUTTING PARAMETERS

HF440

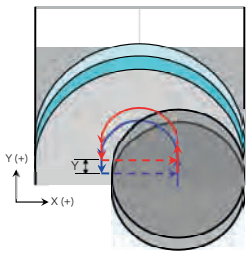
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**160-200**			**110-130**			**80-100**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	19110	0,032	2410	12740	0,028	1440	9550	0,025	960	6370	0,035	880
	4	14330	0,042	2390	9550	0,037	1430	7170	0,033	960	4780	0,046	880
	5	11460	0,052	2370	7640	0,047	1420	5730	0,041	950	3820	0,057	870
	6	9550	0,061	2320	6370	0,055	1390	4780	0,049	930	3180	0,067	850
	8	7170	0,079	2260	4780	0,071	1360	3580	0,063	900	2390	0,087	830
	10	5730	0,095	2170	3820	0,085	1300	2870	0,076	870	1910	0,104	790
	12	4780	0,108	2060	3180	0,097	1240	2390	0,086	830	1590	0,119	760
	14	4090	0,122	1990	2730	0,109	1190	2050	0,097	800	1360	0,134	730
	16	3580	0,135	1930	2390	0,122	1160	1790	0,108	770	1190	0,149	710
	20	2870	0,164	1890	1910	0,148	1130	1430	0,131	750	960	0,181	690

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D								

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF441

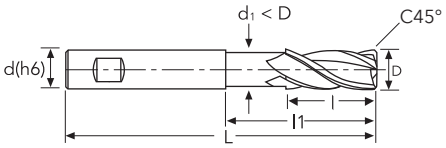
weldon shank and reduced neck, 45° chamfer

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | C45° | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
3	0/-0.030	0.10	+/-0.020	6	9	15	2.80	57	4	HF441030	●
4	0/-0.030	0.10	+/-0.020	6	11	18	3.80	57	4	HF441040	●
5	0/-0.030	0.10	+/-0.020	6	13	19	4.80	57	4	HF441050	●
6	0/-0.030	0.10	+/-0.020	6	13	20	5.80	57	4	HF441060	●
8	0/-0.030	0.20	+/-0.020	8	20	26	7.80	64	4	HF441080	●
10	0/-0.030	0.20	+/-0.020	10	22	30	9.80	72	4	HF441100	●
12	0/-0.030	0.20	+/-0.020	12	26	36	11.80	83	4	HF441120	●
14	0/-0.030	0.20	+/-0.020	14	26	36	13.70	83	4	HF441140	●
16	0/-0.030	0.30	+/-0.020	16	32	42	15.70	92	4	HF441160	●
18	0/-0.030	0.30	+/-0.020	18	32	42	17.70	92	4	HF441180	●
20	0/-0.030	0.40	+/-0.020	20	38	50	19.70	104	4	HF441200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF441

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.013	640	8490	0.011	390	6370	0.009	240	4250	0.009	150
	4	9550	0.017	640	6370	0.015	380	4780	0.012	240	3180	0.012	150
	5	7640	0.021	630	5100	0.019	380	3820	0.016	240	2550	0.014	150
	6	6370	0.024	620	4250	0.022	370	3180	0.018	230	2120	0.017	140
	8	4780	0.032	600	3180	0.028	360	2390	0.024	230	1590	0.022	140
	10	3820	0.038	580	2550	0.034	350	1910	0.028	220	1270	0.026	130
	12	3180	0.043	550	2120	0.039	330	1590	0.032	210	1060	0.030	130
	14	2730	0.049	530	1820	0.044	320	1360	0.036	200	910	0.034	120
	16	2390	0.054	520	1590	0.049	310	1190	0.041	190	800	0.038	120
	18	2120	0.059	500	1420	0.053	300	1060	0.045	190	710	0.042	120
	20	1910	0.066	500	1270	0.059	300	960	0.049	190	640	0.046	120
	ap x ae	**≤ D5**	0.5D x D		0.5D x D			0.25D x D			0.25D x D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	ap x ae	**1.5D x D**			**1.5D x D**								
	Vc (m/min)	**85-105**			**55-75**								
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	8	3780	0.025	380	2590	0.023	230						
	10	3030	0.030	370	2070	0.027	230						
	12	2520	0.035	350	1730	0.031	220						
	14	2160	0.039	340	1480	0.035	210						
	16	1890	0.043	330	1290	0.039	200						
	18	1680	0.048	320	1150	0.043	200						
	20	1510	0.053	320	1040	0.047	200						

	Material Group ISO 513	P1 P2 M1 K1											
	Hardness/Rm	≤ 700 N/mm²											
	ap x ae	**2D x D**											
	Vc (m/min)	**60-80**											
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)									
	10	2230	0.023	200									
	12	1860	0.026	190									
	14	1590	0.029	190									
	16	1390	0.032	180									
	18	1240	0.036	180									
	20	1110	0.039	180									

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF440 PARAMETERS.

HF441

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**130-150**			**90-110**			**60-80**			**40-60**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	14860	0.015	900	10620	0.014	580	7430	0.012	360	5310	0.017	350
	4	11150	0.020	890	7960	0.018	570	5570	0.016	360	3980	0.022	350
	5	8920	0.025	890	6370	0.022	570	4460	0.020	350	3180	0.027	350
	6	7430	0.029	870	5310	0.026	560	3720	0.023	350	2650	0.032	340
	8	5570	0.038	840	3980	0.034	540	2790	0.030	340	1990	0.042	330
	10	4460	0.045	810	3180	0.041	520	2230	0.036	320	1590	0.050	320
	12	3720	0.052	770	2650	0.047	490	1860	0.041	310	1330	0.057	300
	14	3180	0.058	740	2270	0.052	480	1590	0.047	300	1140	0.064	290
	16	2790	0.065	720	1990	0.058	460	1390	0.052	290	1000	0.071	290
	18	2480	0.071	710	1770	0.064	450	1240	0.057	280	880	0.078	280
	20	2230	0.079	700	1590	0.071	450	1110	0.063	280	800	0.087	280
ap x ae	**≤ D5**	1.5D x 0.25D			1.5D x 0.25D			1.2D x 0.1D			1.2D x 0.1D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
HELICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.009	470	8490	0.009	290	6370	0.008	193	4250	0.007	120
	4	9550	0.012	465	6370	0.011	290	4780	0.010	191	3180	0.009	119
	5	7640	0.015	460	5100	0.014	285	3820	0.012	190	2550	0.012	118
	6	6370	0.018	450	4250	0.016	280	3180	0.015	186	2120	0.014	115
	8	4780	0.023	440	3180	0.021	270	2390	0.019	181	1590	0.018	112
	10	3820	0.028	420	2550	0.026	260	1910	0.023	173	1270	0.021	108
	12	3180	0.031	400	2120	0.029	250	1590	0.026	165	1060	0.024	103
	14	2730	0.035	385	1820	0.033	240	1360	0.029	159	910	0.027	99
	16	2390	0.039	375	1590	0.037	235	1190	0.032	154	800	0.030	97
	18	2120	0.043	365	1420	0.040	230	1060	0.036	151	710	0.033	95
	20	1910	0.048	365	1270	0.045	225	960	0.039	151	640	0.037	94
α° max	**≤ D5**	2°			2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF440 PARAMETERS.

CUTTING PARAMETERS

HF441

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.019	455	3720	0.018	265	2920	0.017	198	1860	0.023	174
	8	4380	0.025	440	2790	0.023	260	2190	0.022	193	1390	0.030	168
	10	3500	0.030	420	2230	0.028	250	1750	0.026	185	1110	0.036	161
	12	2920	0.034	405	1860	0.032	235	1460	0.030	176	930	0.042	154
	14	2500	0.039	390	1590	0.036	225	1250	0.034	170	800	0.047	149
	16	2190	0.043	375	1390	0.040	220	1090	0.038	165	700	0.052	145
	18	1950	0.047	370	1240	0.044	215	970	0.042	161	620	0.057	142
	20	1750	0.052	365	1110	0.048	215	880	0.046	162	560	0.063	141

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	α° x ae	**30° x D**			**15° x D**								
	Vc (m/min)	**85-105**			**55-75**								
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	10	3030	0.025	300	2070	0.023	185						
	12	2520	0.028	285	1730	0.026	180						
	14	2160	0.032	275	1480	0.029	170						
	16	1890	0.035	265	1290	0.032	165						
	18	1680	0.039	260	1150	0.036	165						
	20	1510	0.043	260	1040	0.039	165						

RAMPING	Material Group ISO 513	P1 P2 M1 K1											
	Hardness/Rm	≤ 700 N/mm²											
	α° x ae	**45° x D**											
	Vc (m/min)	**60-80**											
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)									
	10	2230	0.024	220									
	12	1860	0.028	210									
	14	1590	0.031	200									
	16	1390	0.035	195									
	18	1240	0.038	190									
	20	1110	0.042	190									

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF440 PARAMETERS.

CUTTING PARAMETERS

HF441

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
VERTICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.024	570	3720	0.022	330	2920	0.018	210	1860	0.017	130
	8	4380	0.032	550	2790	0.028	320	2190	0.024	210	1390	0.022	120
	10	3500	0.038	530	2230	0.034	300	1750	0.028	200	1110	0.026	120
	12	2920	0.043	500	1860	0.039	290	1460	0.032	190	930	0.030	110
	14	2500	0.049	490	1590	0.044	280	1250	0.036	180	800	0.034	110
	16	2190	0.054	470	1390	0.049	270	1090	0.041	180	700	0.038	110
	18	1950	0.059	460	1240	0.053	270	970	0.045	170	620	0.042	100
	20	1750	0.066	460	1110	0.059	260	880	0.049	170	560	0.046	100

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**85-105**			**55-75**			**40-60**			**20-40**		
DRILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	10080	0.006	250	6900	0.006	160	5310	0.005	110	3180	0.007	90
	4	7560	0.008	250	5180	0.007	160	3980	0.007	110	2390	0.009	90
	5	6050	0.010	250	4140	0.009	150	3180	0.008	110	1910	0.011	90
	6	5040	0.012	240	3450	0.011	150	2650	0.010	100	1590	0.013	90
	8	3780	0.016	240	2590	0.014	150	1990	0.013	100	1190	0.017	80
	10	3030	0.019	230	2070	0.017	140	1590	0.015	100	960	0.021	80
	12	2520	0.022	220	1730	0.019	130	1330	0.017	90	800	0.024	80
	14	2160	0.024	210	1480	0.022	130	1140	0.019	90	680	0.027	70
	16	1890	0.027	200	1290	0.024	130	1000	0.022	90	600	0.030	70
	18	1680	0.030	200	1150	0.027	120	880	0.024	80	530	0.033	70
	20	1510	0.033	200	1040	0.030	120	800	0.026	80	480	0.036	70

ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF440 PARAMETERS.

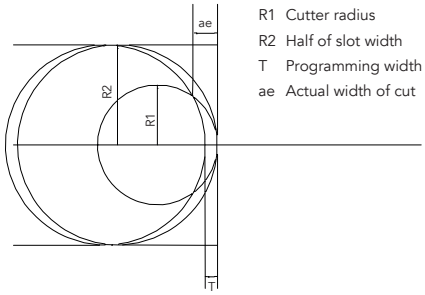
CUTTING PARAMETERS

HF441

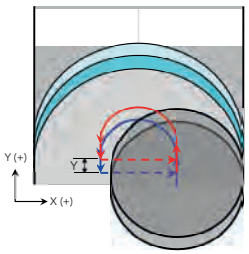
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**160-200**			**110-130**			**80-100**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	19110	0.032	2410	12740	0.028	1440	9550	0.025	960	6370	0.035	880
	4	14330	0.042	2390	9550	0.037	1430	7170	0.033	960	4780	0.046	880
	5	11460	0.052	2370	7640	0.047	1420	5730	0.041	950	3820	0.057	870
	6	9550	0.061	2320	6370	0.055	1390	4780	0.049	930	3180	0.067	850
	8	7170	0.079	2260	4780	0.071	1360	3580	0.063	900	2390	0.087	830
	10	5730	0.095	2170	3820	0.085	1300	2870	0.076	870	1910	0.104	790
	12	4780	0.108	2060	3180	0.097	1240	2390	0.086	830	1590	0.119	760
	14	4090	0.122	1990	2730	0.109	1190	2050	0.097	800	1360	0.134	730
	16	3580	0.135	1930	2390	0.122	1160	1790	0.108	770	1190	0.149	710
	18	3180	0.149	1890	2120	0.134	1130	1590	0.119	760	1060	0.163	690
	20	2870	0.164	1890	1910	0.148	1130	1430	0.131	750	960	0.181	690

ap x ae	**≤ D5**	1.5D x 0.1D	1.5D x 0.1D

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF440 PARAMETERS.

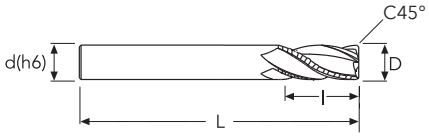
HF844

cylindrical shank, 45° chamfer, roughing HR

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | C45° | HR FINE | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
6	0/-0.030	0.10	+/-0.020	6	16		57	4	HF844060	●
8	0/-0.030	0.20	+/-0.020	8	20		64	4	HF844080	●
10	0/-0.030	0.20	+/-0.020	10	22		72	4	HF844100	●
12	0/-0.030	0.20	+/-0.020	12	26		83	4	HF844120	●
14	0/-0.030	0.20	+/-0.020	14	26		83	4	HF844140	●
16	0/-0.030	0.30	+/-0.020	16	32		92	4	HF844160	●
18	0/-0.030	0.30	+/-0.020	18	32		92	4	HF844180	●
20	0/-0.030	0.40	+/-0.020	20	38		104	4	HF844200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF844

SLOTTING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	6370	0.029	740	4250	0.026	450	3180	0.022	280	2120	0.020	170
	8	4780	0.038	720	3180	0.034	430	2390	0.028	270	1590	0.026	170
	10	3820	0.045	690	2550	0.041	420	1910	0.034	260	1270	0.032	160
	12	3180	0.052	660	2120	0.047	400	1590	0.039	250	1060	0.036	150
	14	2730	0.058	640	1820	0.052	380	1360	0.044	240	910	0.041	150
	16	2390	0.065	620	1590	0.058	370	1190	0.049	230	800	0.045	150
	18	2120	0.071	600	1420	0.064	360	1060	0.053	230	710	0.050	140
	20	1910	0.079	600	1270	0.071	360	960	0.059	230	640	0.055	140

SLOTTING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	ap x ae	**1.5D x D**			**1.5D x D**								
	Vc (m/min)	**85-105**			**55-75**								
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	6	5040	0.023	470	3450	0.021	290						
	8	3780	0.030	460	2590	0.027	280						
	10	3030	0.036	440	2070	0.033	270						
	12	2520	0.041	420	1730	0.037	260						
	14	2160	0.047	400	1480	0.042	250						
	16	1890	0.052	390	1290	0.047	240						
	18	1680	0.057	380	1150	0.051	240						
	20	1510	0.063	380	1040	0.057	240						

SIDE MILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**130-150**			**90-110**			**60-80**			**40-60**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.035	1040	5310	0.031	670	3720	0.028	420	2650	0.038	410
	8	5570	0.045	1010	3980	0.041	650	2790	0.036	400	1990	0.050	400
	10	4460	0.054	970	3180	0.049	620	2230	0.044	390	1590	0.060	380
	12	3720	0.062	930	2650	0.056	590	1860	0.050	370	1330	0.068	360
	14	3180	0.070	890	2270	0.063	570	1590	0.056	360	1140	0.077	350
	16	2790	0.078	870	1990	0.070	560	1390	0.062	350	1000	0.086	340
	18	2480	0.086	850	1770	0.077	550	1240	0.068	340	880	0.094	330
	20	2230	0.095	840	1590	0.085	540	1110	0.076	340	800	0.104	330

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF844

HELICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**8° x 0.4D**			**6° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	6370	0.020	515	4250	0.019	315	3180	0.016	210	2120	0.016	139
	8	4780	0.026	500	3180	0.024	310	2390	0.021	204	1590	0.021	135
	10	3820	0.031	480	2550	0.029	295	1910	0.026	196	1270	0.025	129
	12	3180	0.036	455	2120	0.033	280	1590	0.029	187	1060	0.029	123
	14	2730	0.040	440	1820	0.037	270	1360	0.033	179	910	0.033	119
	16	2390	0.045	430	1590	0.041	265	1190	0.037	174	800	0.036	116
	18	2120	0.049	420	1420	0.046	260	1060	0.040	171	710	0.040	113
	20	1910	0.055	415	1270	0.050	255	960	0.045	171	640	0.044	113

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.023	545	3720	0.021	320	2920	0.020	238	1860	0.028	209
	8	4380	0.030	530	2790	0.028	310	2190	0.026	231	1390	0.036	202
	10	3500	0.036	505	2230	0.033	295	1750	0.032	222	1110	0.044	194
	12	2920	0.041	485	1860	0.038	285	1460	0.036	212	930	0.050	185
	14	2500	0.047	465	1590	0.043	270	1250	0.041	204	800	0.056	179
	16	2190	0.052	455	1390	0.048	265	1090	0.045	197	700	0.062	174
	18	1950	0.057	445	1240	0.052	260	970	0.050	193	620	0.069	170
	20	1750	0.063	440	1110	0.058	255	880	0.055	194	560	0.076	170

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	α° x ae	**30° x D**			**15° x D**								
	Vc (m/min)	**85-105**			**45-65**								
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	10	3030	0.030	360	1750	0.027	190						
	12	2520	0.034	340	1460	0.031	180						
	14	2160	0.038	330	1250	0.035	175						
	16	1890	0.042	320	1090	0.039	170						
	18	1680	0.046	310	970	0.043	165						
	20	1510	0.051	310	880	0.047	165						

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

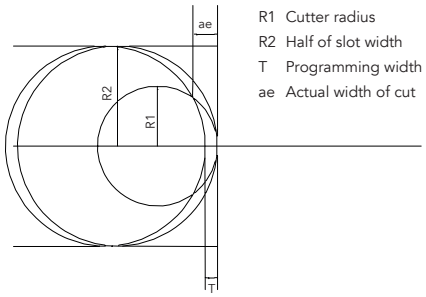
CUTTING PARAMETERS

HF844

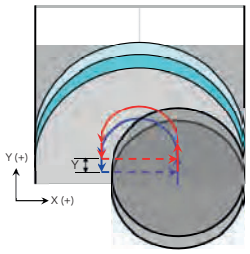
VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.029	680	3720	0.026	390	2920	0.022	260	1860	0.020	150
	8	4380	0.038	660	2790	0.034	380	2190	0.028	250	1390	0.026	150
	10	3500	0.045	640	2230	0.041	360	1750	0.034	240	1110	0.032	140
	12	2920	0.052	610	1860	0.047	350	1460	0.039	230	930	0.036	130
	14	2500	0.058	580	1590	0.052	330	1250	0.044	220	800	0.041	130
	16	2190	0.065	570	1390	0.058	320	1090	0.049	210	700	0.045	130
	18	1950	0.071	560	1240	0.064	320	970	0.053	210	620	0.050	120
	20	1750	0.079	550	1110	0.071	320	880	0.059	210	560	0.055	120

TROCHOIDAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**160-200**			**110-130**			**80-100**			**50-70**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	9550	0.073	2780	6370	0.066	1670	4780	0.058	1120	3180	0.080	1020
	8	7170	0.095	2710	4780	0.085	1630	3580	0.076	1080	2390	0.104	990
	10	5730	0.113	2600	3820	0.102	1560	2870	0.091	1040	1910	0.125	950
	12	4780	0.130	2480	3180	0.117	1480	2390	0.104	990	1590	0.143	910
	14	4090	0.146	2390	2730	0.131	1430	2050	0.117	960	1360	0.160	870
	16	3580	0.162	2320	2390	0.146	1390	1790	0.130	930	1190	0.178	850
	18	3180	0.178	2270	2120	0.160	1360	1590	0.143	910	1060	0.196	830
	20	2870	0.197	2260	1910	0.177	1360	1430	0.158	900	960	0.217	830

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

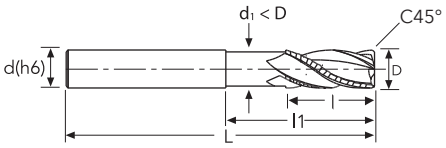
HF444

cylindrical shank and reduced neck, 45° chamfer, roughing HR

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | C45° | HR FINE | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
6	0/-0.030	0.10	+/-0.020	6	13	20	5.80	57	4	HF444060	●
8	0/-0.030	0.20	+/-0.020	8	20	26	7.80	64	4	HF444080	●
10	0/-0.030	0.20	+/-0.020	10	22	30	9.80	72	4	HF444100	●
12	0/-0.030	0.20	+/-0.020	12	26	36	11.80	83	4	HF444120	●
14	0/-0.030	0.20	+/-0.020	14	26	36	13.70	83	4	HF444140	●
16	0/-0.030	0.30	+/-0.020	16	32	42	15.70	92	4	HF444160	●
20	0/-0.030	0.40	+/-0.020	20	38	50	19.70	104	4	HF444200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF444

SLOTTING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	6370	0.026	670	4250	0.024	400	3180	0.020	250	2120	0.018	160
	8	4780	0.034	650	3180	0.031	390	2390	0.026	240	1590	0.024	150
	10	3820	0.041	620	2550	0.037	370	1910	0.031	230	1270	0.029	150
	12	3180	0.047	590	2120	0.042	360	1590	0.035	220	1060	0.033	140
	14	2730	0.052	570	1820	0.047	340	1360	0.039	210	910	0.037	130
	16	2390	0.058	560	1590	0.052	330	1190	0.044	210	800	0.041	130
	20	1910	0.071	540	1270	0.064	320	960	0.053	200	640	0.050	130

SLOTTING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	ap x ae	**1.5D x D**			**1.5D x D**								
	Vc (m/min)	**85-105**			**55-75**								
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	6	5040	0.021	420	3450	0.019	260						
	8	3780	0.027	410	2590	0.024	250						
	10	3030	0.033	400	2070	0.029	240						
	12	2520	0.037	380	1730	0.034	230						
	14	2160	0.042	360	1480	0.038	220						
	16	1890	0.047	350	1290	0.042	220						
	20	1510	0.057	340	1040	0.051	210						

SIDE MILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**130-150**			**90-110**			**60-80**			**40-60**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.031	940	5310	0.028	600	3720	0.025	370	2650	0.035	370
	8	5570	0.041	910	3980	0.037	580	2790	0.033	360	1990	0.045	360
	10	4460	0.049	870	3180	0.044	560	2230	0.039	350	1590	0.054	340
	12	3720	0.056	830	2650	0.050	530	1860	0.045	330	1330	0.062	330
	14	3180	0.063	800	2270	0.057	510	1590	0.050	320	1140	0.069	320
	16	2790	0.070	780	1990	0.063	500	1390	0.056	310	1000	0.077	310
	20	2230	0.085	760	1590	0.077	490	1110	0.068	300	800	0.094	300

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF444

HELICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**7° x 0.4D**			**5° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	6370	0.018	470	4250	0.017	290	3180	0.016	200	2120	0.015	125
8	4780	0.024	455	3180	0.022	285	2390	0.020	195	1590	0.019	121
10	3820	0.029	435	2550	0.027	275	1910	0.025	187	1270	0.023	116
12	3180	0.033	415	2120	0.031	260	1590	0.028	178	1060	0.026	111
14	2730	0.037	400	1820	0.034	250	1360	0.032	171	910	0.029	107
16	2390	0.041	390	1590	0.038	245	1190	0.035	167	800	0.033	105
20	1910	0.050	380	1270	0.046	235	960	0.043	164	640	0.040	102

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	5840	0.021	490	3720	0.019	285	2920	0.018	214	1860	0.025	188
8	4380	0.027	475	2790	0.025	280	2190	0.024	208	1390	0.033	182
10	3500	0.033	455	2230	0.030	265	1750	0.029	200	1110	0.039	174
12	2920	0.037	435	1860	0.034	255	1460	0.033	190	930	0.045	167
14	2500	0.042	420	1590	0.039	245	1250	0.037	183	800	0.050	161
16	2190	0.047	410	1390	0.043	240	1090	0.041	178	700	0.056	157
20	1750	0.057	395	1110	0.052	230	880	0.050	175	560	0.068	153

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
α° x ae	**30° x D**			**15° x D**								
Vc (m/min)	**85-105**			**45-65**								
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
10	3030	0.027	320	1750	0.024	170						
12	2520	0.030	305	1460	0.028	165						
14	2160	0.034	295	1250	0.031	155						
16	1890	0.038	285	1090	0.035	150						
20	1510	0.046	280	880	0.042	150						

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

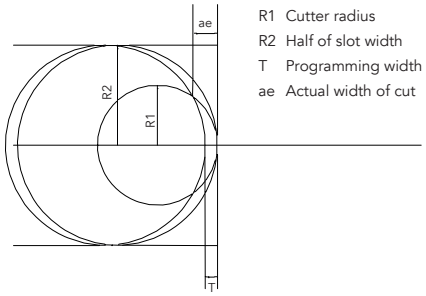
CUTTING PARAMETERS

HF444

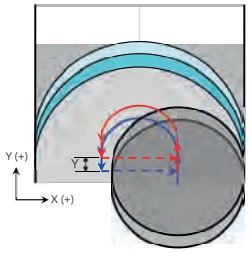
VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	D x 0.4D			D x 0.4D			D x 0.25D			D x 0.25D		
	Vc (m/min)	100-120			60-80			45-65			30-40		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.026	610	3720	0.024	350	2920	0.020	230	1860	0.018	140
	8	4380	0.034	600	2790	0.031	340	2190	0.026	220	1390	0.024	130
	10	3500	0.041	570	2230	0.037	330	1750	0.031	210	1110	0.029	130
	12	2920	0.047	540	1860	0.042	310	1460	0.035	200	930	0.033	120
	14	2500	0.052	520	1590	0.047	300	1250	0.039	200	800	0.037	120
	16	2190	0.058	510	1390	0.052	290	1090	0.044	190	700	0.041	110
	20	1750	0.071	500	1110	0.064	280	880	0.053	190	560	0.050	110

TROCHOIDAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	2D x 0.2D			2D x 0.1D			1.5D x 0.1D			1.5D x 0.1D		
	Vc (m/min)	160-200			110-130			80-100			50-70		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	9550	0.066	2510	6370	0.059	1500	4780	0.052	1000	3180	0.072	920
	8	7170	0.085	2440	4780	0.077	1460	3580	0.068	970	2390	0.094	890
	10	5730	0.102	2340	3820	0.092	1400	2870	0.082	940	1910	0.112	860
	12	4780	0.117	2230	3180	0.105	1340	2390	0.093	890	1590	0.128	820
	14	4090	0.131	2150	2730	0.118	1290	2050	0.105	860	1360	0.144	790
	16	3580	0.146	2090	2390	0.131	1250	1790	0.117	840	1190	0.160	760
	20	2870	0.177	2040	1910	0.160	1220	1430	0.142	810	960	0.195	750

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF445

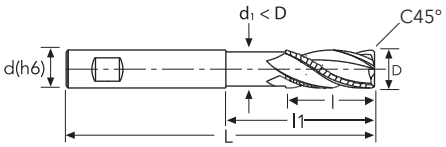
weldon shank and reduced neck, 45° chamfer, roughing HR

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | C45° | HR FINE | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING (1.5D) | SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
6	0/-0.030	0.10	+/-0.020	6	13	20	5.80	57	4	HF445060	●
8	0/-0.030	0.20	+/-0.020	8	20	26	7.80	64	4	HF445080	●
10	0/-0.030	0.20	+/-0.020	10	22	30	9.80	72	4	HF445100	●
12	0/-0.030	0.20	+/-0.020	12	26	36	11.80	83	4	HF445120	●
14	0/-0.030	0.20	+/-0.020	14	26	36	13.70	83	4	HF445140	●
16	0/-0.030	0.30	+/-0.020	16	32	42	15.70	92	4	HF445160	●
20	0/-0.030	0.40	+/-0.020	20	38	50	19.70	104	4	HF445200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF445

SLOTTING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	6370	0.026	670	4250	0.024	400	3180	0.020	250	2120	0.018	160
	8	4780	0.034	650	3180	0.031	390	2390	0.026	240	1590	0.024	150
	10	3820	0.041	620	2550	0.037	370	1910	0.031	230	1270	0.029	150
	12	3180	0.047	590	2120	0.042	360	1590	0.035	220	1060	0.033	140
	14	2730	0.052	570	1820	0.047	340	1360	0.039	210	910	0.037	130
	16	2390	0.058	560	1590	0.052	330	1190	0.044	210	800	0.041	130
	20	1910	0.071	540	1270	0.064	320	960	0.053	200	640	0.050	130

SLOTTING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	ap x ae	**1.5D x D**			**1.5D x D**								
	Vc (m/min)	**85-105**			**55-75**								
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	8	3780	0.027	410	2590	0.024	250						
	10	3030	0.033	400	2070	0.029	240						
	12	2520	0.037	380	1730	0.034	230						
	14	2160	0.042	360	1480	0.038	220						
	16	1890	0.047	350	1290	0.042	220						
	20	1510	0.057	340	1040	0.051	210						

SLOTTING	Material Group ISO 513	P1 P2 M1 K1											
	Hardness/Rm	≤ 700 N/mm²											
	ap x ae	**2D x D**											
	Vc (m/min)	**60-80**											
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)									
	6	3720	0.016	230									
	8	2790	0.020	230									
	10	2230	0.024	220									
	12	1860	0.028	210									
	14	1590	0.031	200									
	16	1390	0.035	190									
	20	1110	0.043	190									

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF444 PARAMETERS.

HF445

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**130-150**			**90-110**			**60-80**			**40-60**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.031	940	5310	0.028	600	3720	0.025	370	2650	0.035	370
	8	5570	0.041	910	3980	0.037	580	2790	0.033	360	1990	0.045	360
	10	4460	0.049	870	3180	0.044	560	2230	0.039	350	1590	0.054	340
	12	3720	0.056	830	2650	0.050	530	1860	0.045	330	1330	0.062	330
	14	3180	0.063	800	2270	0.057	510	1590	0.050	320	1140	0.069	320
	16	2790	0.070	780	1990	0.063	500	1390	0.056	310	1000	0.077	310
	20	2230	0.085	760	1590	0.077	490	1110	0.068	300	800	0.094	300

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**7° x 0.4D**			**5° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
HELICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	6370	0.018	470	4250	0.017	290	3180	0.016	200	2120	0.015	125
	8	4780	0.024	455	3180	0.022	285	2390	0.020	195	1590	0.019	121
	10	3820	0.029	435	2550	0.027	275	1910	0.025	187	1270	0.023	116
	12	3180	0.033	415	2120	0.031	260	1590	0.028	178	1060	0.026	111
	14	2730	0.037	400	1820	0.034	250	1360	0.032	171	910	0.029	107
	16	2390	0.041	390	1590	0.038	245	1190	0.035	167	800	0.033	105
	20	1910	0.050	380	1270	0.046	235	960	0.043	164	640	0.040	102

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
RAMPING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	8	4380	0.027	475	2790	0.025	280	2190	0.024	208	1390	0.033	182
	10	3500	0.033	455	2230	0.030	265	1750	0.029	200	1110	0.039	174
	12	2920	0.037	435	1860	0.034	255	1460	0.033	190	930	0.045	167
	14	2500	0.042	420	1590	0.039	245	1250	0.037	183	800	0.050	161
	16	2190	0.047	410	1390	0.043	240	1090	0.041	178	700	0.056	157
	20	1750	0.057	395	1110	0.052	230	880	0.050	175	560	0.068	153

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF444 PARAMETERS.

HF445

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**30° x D**			**15° x D**								
	Vc (m/min)	**85-105**			**45-65**								
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	10	3030	0.027	320	1750	0.024	170						
	12	2520	0.030	305	1460	0.028	165						
	14	2160	0.034	295	1250	0.031	155						
	16	1890	0.038	285	1090	0.035	150						
	20	1510	0.046	280	880	0.042	150						

RAMPING	Material Group ISO 513	P1 P2 M1 K1											
	Hardness/Rm	≤ 700 N/mm²											
	α° x ae	**45° x D**											
	Vc (m/min)	**55-75**											
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)									
	10	2070	0.026	220									
	12	1730	0.030	210									
	14	1480	0.034	200									
	16	1290	0.038	195									
	20	1040	0.046	190									

VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	9550	0.066	2510	6370	0.059	1500	4780	0.052	1000	3180	0.072	920
	8	7170	0.085	2440	4780	0.077	1460	3580	0.068	970	2390	0.094	890
	10	5730	0.102	2340	3820	0.092	1400	2870	0.082	940	1910	0.112	860
	12	4780	0.117	2230	3180	0.105	1340	2390	0.093	890	1590	0.128	820
	14	4090	0.131	2150	2730	0.118	1290	2050	0.105	860	1360	0.144	790
	16	3580	0.146	2090	2390	0.131	1250	1790	0.117	840	1190	0.160	760
	20	2870	0.177	2040	1910	0.160	1220	1430	0.142	810	960	0.195	750

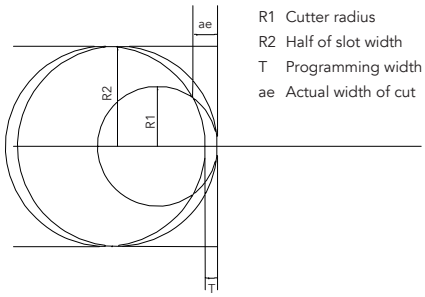
PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF444 PARAMETERS.

CUTTING PARAMETERS

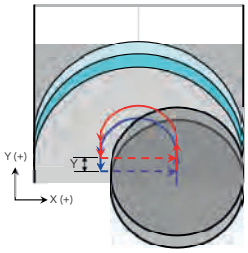
HF445

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**160-200**			**110-130**			**80-100**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	9550	0,066	2510	6370	0,059	1500	4780	0,052	1000	3180	0,072	920
	8	7170	0,085	2440	4780	0,077	1460	3580	0,068	970	2390	0,094	890
	10	5730	0,102	2340	3820	0,092	1400	2870	0,082	940	1910	0,112	860
	12	4780	0,117	2230	3180	0,105	1340	2390	0,093	890	1590	0,128	820
	14	4090	0,131	2150	2730	0,118	1290	2050	0,105	860	1360	0,144	790
	16	3580	0,146	2090	2390	0,131	1250	1790	0,117	840	1190	0,160	760
	20	2870	0,177	2040	1910	0,160	1220	1430	0,142	810	960	0,195	750

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF444 PARAMETERS.

HF342

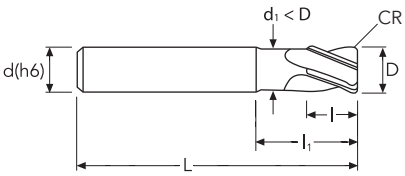
cylindrical shank and reduced neck, extra short, corner radius

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
3	0/-0.030	0.20	+/-0.010	6	5	9	2.80	50	4	HF34202030	●
4	0/-0.030	0.20	+/-0.010	6	6	12	3.80	50	4	HF34202040	●
5	0/-0.030	0.20	+/-0.010	6	8	14	4.80	50	4	HF34202050	●
6	0/-0.030	0.30	+/-0.010	6	9	18	5.80	55	4	HF34203060	●
8	0/-0.030	0.50	+/-0.010	8	12	24	7.80	60	4	HF34205080	●
10	0/-0.030	1.00	+/-0.010	10	15	30	9.80	70	4	HF34210100	●
12	0/-0.030	1.00	+/-0.010	12	18	35	11.80	80	4	HF34210120	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF342

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	14860	0.014	830	9550	0.013	480	7430	0.011	310	4250	0.010	170
	4	11150	0.019	830	7170	0.017	480	5570	0.014	310	3180	0.013	160
	5	8920	0.023	820	5730	0.021	470	4460	0.017	310	2550	0.016	160
	6	7430	0.027	800	4780	0.024	460	3720	0.020	300	2120	0.019	160
	8	5570	0.035	780	3580	0.032	450	2790	0.026	290	1590	0.025	160
	10	4460	0.042	750	2870	0.038	430	2230	0.032	280	1270	0.029	150
	12	3720	0.048	710	2390	0.043	410	1860	0.036	270	1060	0.034	140
ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.2D x 0.5D**			**1.2D x 0.5D**			**D x 0.3D**			**D x 0.3D**		
	Vc (m/min)	**160-180**			**100-120**			**70-90**			**40-60**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	18050	0.017	1210	11680	0.015	710	8490	0.013	460	5310	0.018	390
	4	13540	0.022	1200	8760	0.020	700	6370	0.018	450	3980	0.024	390
	5	10830	0.028	1200	7010	0.025	700	5100	0.022	450	3180	0.030	390
	6	9020	0.032	1170	5840	0.029	680	4250	0.026	440	2650	0.036	380
	8	6770	0.042	1140	4380	0.038	660	3180	0.034	430	1990	0.046	370
	10	5410	0.050	1090	3500	0.045	640	2550	0.040	410	1590	0.055	350
	12	4510	0.058	1040	2920	0.052	610	2120	0.046	390	1330	0.063	340
ap x ae	**≤ D5**	1.2D x 0.3D			1.2D x 0.3D			D x 0.2D			D x 0.2D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
HELICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	14860	0.010	605	9550	0.010	365	7430	0.008	250	4250	0.008	133
	4	11150	0.013	600	7170	0.013	360	5570	0.011	247	3180	0.010	132
	5	8920	0.017	600	5730	0.016	360	4460	0.014	246	2550	0.013	131
	6	7430	0.020	585	4780	0.018	350	3720	0.016	241	2120	0.015	128
	8	5570	0.025	570	3580	0.024	340	2790	0.021	235	1590	0.020	125
	10	4460	0.031	545	2870	0.029	325	2230	0.025	225	1270	0.024	120
	12	3720	0.035	520	2390	0.033	310	1860	0.029	214	1060	0.027	114
α°	**≤ D5**	2°			2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

HF342

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**15° x 0.4D**			**10° x 0.4D**			**5° x 0.4D**			**5° x 0.4D**		
Vc (m/min)	**120-140**			**70-90**			**55-75**			**25-45**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	6900	0.022	595	4250	0.020	335	3450	0.019	260	1860	0.026	193
8	5180	0.028	580	3180	0.026	325	2590	0.024	253	1390	0.034	187
10	4140	0.034	555	2550	0.031	315	2070	0.029	243	1110	0.040	179
12	3450	0.038	530	2120	0.035	300	1730	0.034	232	930	0.046	172

VERTICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
Vc (m/min)	**120-140**			**70-90**			**55-75**			**25-45**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	6900	0.027	750	4250	0.024	410	3450	0.020	280	1860	0.019	140
8	5180	0.035	730	3180	0.032	400	2590	0.026	270	1390	0.025	140
10	4140	0.042	700	2550	0.038	390	2070	0.032	260	1110	0.029	130
12	3450	0.048	660	2120	0.043	370	1730	0.036	250	930	0.034	120

DRILLING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
Vc (m/min)	**100-120**			**60-80**			**45-65**			**20-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	11680	0.007	330	7430	0.006	190	5840	0.006	130	3180	0.008	100
4	8760	0.009	320	5570	0.008	190	4380	0.007	130	2390	0.010	100
5	7010	0.012	320	4460	0.010	180	3500	0.009	130	1910	0.013	100
6	5840	0.014	320	3720	0.012	180	2920	0.011	130	1590	0.015	90
8	4380	0.018	310	2790	0.016	180	2190	0.014	120	1190	0.019	90
10	3500	0.021	290	2230	0.019	170	1750	0.017	120	960	0.023	90
12	2920	0.024	280	1860	0.022	160	1460	0.019	110	800	0.026	80

ap x ae	**≤ D5**	0.5D x D	0.5D x D	0.25D x D	0.25D x D

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF842

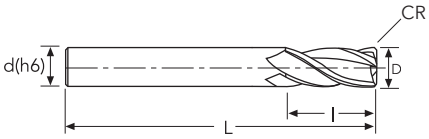
cylindrical shank, corner radius

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
4	0/-0.025	0.30	+/-0.010	6	11		57	4	HF84203040	●
4	0/-0.025	0.50	+/-0.010	6	11		57	4	HF84205040	●
5	0/-0.025	0.30	+/-0.010	6	13		57	4	HF84203050	●
5	0/-0.025	0.50	+/-0.010	6	13		57	4	HF84205050	●
6	0/-0.025	0.30	+/-0.010	6	13		57	4	HF84203060	●
6	0/-0.025	0.50	+/-0.010	6	13		57	4	HF84205060	●
6	0/-0.025	1.00	+/-0.010	6	13		57	4	HF84210060	●
8	0/-0.030	0.50	+/-0.010	8	20		64	4	HF84205080	●
8	0/-0.030	1.00	+/-0.010	8	20		64	4	HF84210080	●
10	0/-0.030	0.50	+/-0.010	10	22		72	4	HF84205100	●
10	0/-0.030	1.00	+/-0.010	10	22		72	4	HF84210100	●
12	0/-0.030	0.50	+/-0.010	12	26		83	4	HF84205120	●
12	0/-0.030	1.00	+/-0.010	12	26		83	4	HF84210120	●
12	0/-0.030	2.00	+/-0.010	12	26		83	4	HF84220120	●
12	0/-0.030	3.00	+/-0.010	12	26		83	4	HF84230120	●
14	0/-0.030	1.00	+/-0.010	14	26		83	4	HF84210140	●
16	0/-0.030	1.00	+/-0.010	16	32		92	4	HF84210160	●
16	0/-0.030	2.00	+/-0.010	16	32		92	4	HF84220160	●
16	0/-0.030	3.00	+/-0.010	16	32		92	4	HF84230160	●
18	0/-0.030	1.00	+/-0.010	18	32		92	4	HF84210180	●
20	0/-0.030	1.00	+/-0.010	20	38		104	4	HF84210200	●
20	0/-0.030	2.00	+/-0.010	20	38		104	4	HF84220200	●
20	0/-0.030	3.00	+/-0.010	20	38		104	4	HF84230200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF842

SLOTTING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
4	11150	0.019	830	7170	0.017	480	5570	0.014	310	3180	0.013	160
5	8920	0.023	820	5730	0.021	470	4460	0.017	310	2550	0.016	160
6	7430	0.027	800	4780	0.024	460	3720	0.020	300	2120	0.019	160
8	5570	0.035	780	3580	0.032	450	2790	0.026	290	1590	0.025	160
10	4460	0.042	750	2870	0.038	430	2230	0.032	280	1270	0.029	150
12	3720	0.048	710	2390	0.043	410	1860	0.036	270	1060	0.034	140
14	3180	0.054	690	2050	0.049	400	1590	0.041	260	910	0.038	140
16	2790	0.060	670	1790	0.054	390	1390	0.045	250	800	0.042	130
18	2480	0.066	650	1590	0.059	380	1240	0.050	250	710	0.046	130
20	2230	0.073	650	1430	0.066	380	1110	0.055	240	640	0.051	130
ap x ae	**≤ D5**	0.5D x D		0.5D x D			0.25D x D			0.25D x D		

SIDE MILLING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
Vc (m/min)	**160-180**			**100-120**			**70-90**			**40-60**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
4	13540	0.022	1200	8760	0.020	700	6370	0.018	450	3980	0.024	390
5	10830	0.028	1200	7010	0.025	700	5100	0.022	450	3180	0.030	390
6	9020	0.032	1170	5840	0.029	680	4250	0.026	440	2650	0.036	380
8	6770	0.042	1140	4380	0.038	660	3180	0.034	430	1990	0.046	370
10	5410	0.050	1090	3500	0.045	640	2550	0.040	410	1590	0.055	350
12	4510	0.058	1040	2920	0.052	610	2120	0.046	390	1330	0.063	340
14	3870	0.065	1000	2500	0.058	580	1820	0.052	380	1140	0.071	330
16	3380	0.072	970	2190	0.065	570	1590	0.058	370	1000	0.079	320
18	3010	0.079	950	1950	0.071	560	1420	0.063	360	880	0.087	310
20	2710	0.088	950	1750	0.079	550	1270	0.070	360	800	0.096	310
ap x ae	**≤ D5**	1.5D x 0.25D		1.5D x 0.25D			1.2D x 0.1D			1.2D x 0.1D		

HELICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
4	11150	0.013	600	7170	0.013	360	5570	0.011	247	3180	0.010	132
5	8920	0.017	600	5730	0.016	360	4460	0.014	246	2550	0.013	131
6	7430	0.020	585	4780	0.018	350	3720	0.016	241	2120	0.015	128
8	5570	0.025	570	3580	0.024	340	2790	0.021	235	1590	0.020	125
10	4460	0.031	545	2870	0.029	325	2230	0.025	225	1270	0.024	120
12	3720	0.035	520	2390	0.033	310	1860	0.029	214	1060	0.027	114
14	3180	0.039	500	2050	0.037	300	1590	0.032	206	910	0.030	110
16	2790	0.044	490	1790	0.041	290	1390	0.036	200	800	0.034	108
18	2480	0.048	475	1590	0.045	285	1240	0.040	197	710	0.037	105
20	2230	0.053	475	1430	0.050	285	1110	0.044	195	640	0.041	105
α° max	**≤ D5**	2°		2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF842

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**15° x 0.4D**			**10° x 0.4D**			**5° x 0.4D**			**5° x 0.4D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.022	640	4780	0.020	380	3720	0.019	281	2120	0.026	220
	8	5570	0.028	620	3580	0.026	370	2790	0.024	273	1590	0.034	214
	10	4460	0.034	600	2870	0.031	355	2230	0.029	262	1270	0.040	205
	12	3720	0.038	570	2390	0.035	335	1860	0.034	250	1060	0.046	196
	14	3180	0.043	550	2050	0.040	325	1590	0.038	240	910	0.052	189
	16	2790	0.048	535	1790	0.044	315	1390	0.042	233	800	0.058	185
	18	2480	0.053	520	1590	0.048	310	1240	0.046	229	710	0.063	180
	20	2230	0.058	520	1430	0.054	305	1110	0.051	227	640	0.070	180

VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.027	800	4780	0.024	460	3720	0.020	300	2120	0.019	160
	8	5570	0.035	780	3580	0.032	450	2790	0.026	290	1590	0.025	160
	10	4460	0.042	750	2870	0.038	430	2230	0.032	280	1270	0.029	150
	12	3720	0.048	710	2390	0.043	410	1860	0.036	270	1060	0.034	140
	14	3180	0.054	690	2050	0.049	400	1590	0.041	260	910	0.038	140
	16	2790	0.060	670	1790	0.054	390	1390	0.045	250	800	0.042	130
	18	2480	0.066	650	1590	0.059	380	1240	0.050	250	710	0.046	130
	20	2230	0.073	650	1430	0.066	380	1110	0.055	240	640	0.051	130

DRILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**20-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	8760	0.009	320	5570	0.008	190	4380	0.007	130	2390	0.010	100
	5	7010	0.012	320	4460	0.010	180	3500	0.009	130	1910	0.013	100
	6	5840	0.014	320	3720	0.012	180	2920	0.011	130	1590	0.015	90
	8	4380	0.018	310	2790	0.016	180	2190	0.014	120	1190	0.019	90
	10	3500	0.021	290	2230	0.019	170	1750	0.017	120	960	0.023	90
	12	2920	0.024	280	1860	0.022	160	1460	0.019	110	800	0.026	80
	14	2500	0.027	270	1590	0.024	150	1250	0.022	110	680	0.030	80
	16	2190	0.030	260	1390	0.027	150	1090	0.024	100	600	0.033	80
	18	1950	0.033	260	1240	0.030	150	970	0.026	100	530	0.036	80
	20	1750	0.037	260	1110	0.033	150	880	0.029	100	480	0.040	80
ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

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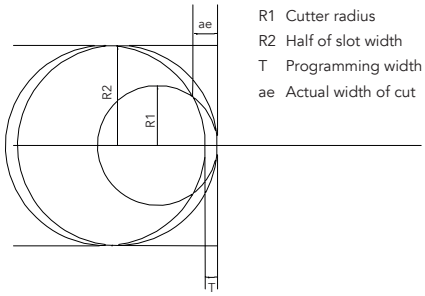
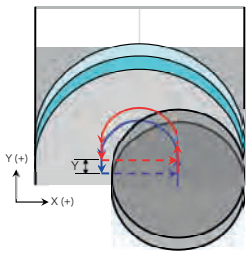
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**190-230**			**130-150**			**100-120**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	16720	0.046	3090	11150	0.042	1860	8760	0.037	1300	4780	0.051	970
	5	13380	0.058	3080	8920	0.052	1850	7010	0.046	1290	3820	0.063	970
	6	11150	0.068	3010	7430	0.061	1810	5840	0.054	1260	3180	0.074	940
	8	8360	0.088	2930	5570	0.079	1750	4380	0.070	1230	2390	0.096	920
	10	6690	0.105	2810	4460	0.095	1690	3500	0.084	1180	1910	0.116	880
	12	5570	0.120	2670	3720	0.108	1610	2920	0.096	1120	1590	0.132	840
	14	4780	0.135	2580	3180	0.122	1550	2500	0.108	1080	1360	0.149	810
	16	4180	0.150	2510	2790	0.135	1510	2190	0.120	1050	1190	0.165	790
	18	3720	0.165	2460	2480	0.149	1470	1950	0.132	1030	1060	0.182	770
	20	3340	0.183	2440	2230	0.164	1470	1750	0.146	1020	960	0.201	770

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D								

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF442

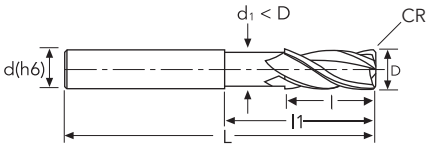
cylindrical shank and reduced neck, corner radius

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

1.5D SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
3	0/-0.030	0.30	+/-0.020	6	9	15	2.80	57	4	HF44203030	●
3	0/-0.030	0.50	+/-0.020	6	9	15	2.80	57	4	HF44205030	●
4	0/-0.030	0.30	+/-0.020	6	11	18	3.80	57	4	HF44203040	●
4	0/-0.030	0.50	+/-0.020	6	11	18	3.80	57	4	HF44205040	●
5	0/-0.030	0.30	+/-0.020	6	13	19	4.80	57	4	HF44203050	●
5	0/-0.030	0.50	+/-0.020	6	13	19	4.80	57	4	HF44205050	●
6	0/-0.030	0.30	+/-0.020	6	13	20	5.80	57	4	HF44203060	●
6	0/-0.030	0.50	+/-0.020	6	13	20	5.80	57	4	HF44205060	●
6	0/-0.030	1.00	+/-0.020	6	13	20	5.80	57	4	HF44210060	●
8	0/-0.030	0.50	+/-0.020	8	20	26	7.80	64	4	HF44205080	●
8	0/-0.030	1.00	+/-0.020	8	20	26	7.80	64	4	HF44210080	●
10	0/-0.030	0.50	+/-0.020	10	22	30	9.80	72	4	HF44205100	●
10	0/-0.030	1.00	+/-0.020	10	22	30	9.80	72	4	HF44210100	●
12	0/-0.030	0.50	+/-0.020	12	26	36	11.80	83	4	HF44205120	●
12	0/-0.030	1.00	+/-0.020	12	26	36	11.80	83	4	HF44210120	●
14	0/-0.030	1.00	+/-0.020	14	26	36	13.70	83	4	HF44210140	●
16	0/-0.030	1.00	+/-0.020	16	32	42	15.70	92	4	HF44210160	●
16	0/-0.030	2.00	+/-0.020	16	32	42	15.70	92	4	HF44220160	●
20	0/-0.030	1.00	+/-0.020	20	38	50	19.70	104	4	HF44210200	●
20	0/-0.030	2.00	+/-0.020	20	38	50	19.70	104	4	HF44220200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF442

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.013	640	8490	0.011	390	6370	0.009	240	4250	0.009	150
	4	9550	0.017	640	6370	0.015	380	4780	0.012	240	3180	0.012	150
	5	7640	0.021	630	5100	0.019	380	3820	0.016	240	2550	0.014	150
	6	6370	0.024	620	4250	0.022	370	3180	0.018	230	2120	0.017	140
	8	4780	0.032	600	3180	0.028	360	2390	0.024	230	1590	0.022	140
	10	3820	0.038	580	2550	0.034	350	1910	0.028	220	1270	0.026	130
	12	3180	0.043	550	2120	0.039	330	1590	0.032	210	1060	0.030	130
	14	2730	0.049	530	1820	0.044	320	1360	0.036	200	910	0.034	120
	16	2390	0.054	520	1590	0.049	310	1190	0.041	190	800	0.038	120
	20	1910	0.066	500	1270	0.059	300	960	0.049	190	640	0.046	120
ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	ap x ae	**1.5D x D**			**1.5D x D**								
	Vc (m/min)	**85-105**			**55-75**								
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	8	3780	0.025	380	2590	0.023	230						
	10	3030	0.030	370	2070	0.027	230						
	12	2520	0.035	350	1730	0.031	220						
	14	2160	0.039	340	1480	0.035	210						
	16	1890	0.043	330	1290	0.039	200						
	20	1510	0.053	320	1040	0.047	200						

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**130-150**			**90-110**			**60-80**			**40-60**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	14860	0.015	900	10620	0.014	580	7430	0.012	360	5310	0.017	350
	4	11150	0.020	890	7960	0.018	570	5570	0.016	360	3980	0.022	350
	5	8920	0.025	890	6370	0.022	570	4460	0.020	350	3180	0.027	350
	6	7430	0.029	870	5310	0.026	560	3720	0.023	350	2650	0.032	340
	8	5570	0.038	840	3980	0.034	540	2790	0.030	340	1990	0.042	330
	10	4460	0.045	810	3180	0.041	520	2230	0.036	320	1590	0.050	320
	12	3720	0.052	770	2650	0.047	490	1860	0.041	310	1330	0.057	300
	14	3180	0.058	740	2270	0.052	480	1590	0.047	300	1140	0.064	290
	16	2790	0.065	720	1990	0.058	460	1390	0.052	290	1000	0.071	290
	20	2230	0.079	700	1590	0.071	450	1110	0.063	280	800	0.087	280
ap x ae	**≤ D5**	1.5D x 0.25D			1.5D x 0.25D			1.2D x 0.1D			1.2D x 0.1D		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF442

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	5° x 0.4D			4° x 0.4D			3° x 0.4D			3° x 0.4D		
	Vc (m/min)	110-130			70-90			50-70			30-50		
HELICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.009	470	8490	0.009	290	6370	0.008	193	4250	0.007	120
	4	9550	0.012	465	6370	0.011	290	4780	0.010	191	3180	0.009	119
	5	7640	0.015	460	5100	0.014	285	3820	0.012	190	2550	0.012	118
	6	6370	0.018	450	4250	0.016	280	3180	0.015	186	2120	0.014	115
	8	4780	0.023	440	3180	0.021	270	2390	0.019	181	1590	0.018	112
	10	3820	0.028	420	2550	0.026	260	1910	0.023	173	1270	0.021	108
	12	3180	0.031	400	2120	0.029	250	1590	0.026	165	1060	0.024	103
	14	2730	0.035	385	1820	0.033	240	1360	0.029	159	910	0.027	99
	16	2390	0.039	375	1590	0.037	235	1190	0.032	154	800	0.030	97
	20	1910	0.048	365	1270	0.045	225	960	0.039	151	640	0.037	94
	α° max	≤ D5	2°		2°			1°			1°		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	15° x D			10° x D			5° x D			5° x D		
	Vc (m/min)	100-120			60-80			45-65			30-40		
RAMPING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.019	455	3720	0.018	265	2920	0.017	198	1860	0.023	174
	8	4380	0.025	440	2790	0.023	260	2190	0.022	193	1390	0.030	168
	10	3500	0.030	420	2230	0.028	250	1750	0.026	185	1110	0.036	161
	12	2920	0.034	405	1860	0.032	235	1460	0.030	176	930	0.042	154
	14	2500	0.039	390	1590	0.036	225	1250	0.034	170	800	0.047	149
	16	2190	0.043	375	1390	0.040	220	1090	0.038	165	700	0.052	145
	20	1750	0.052	365	1110	0.048	215	880	0.046	162	560	0.063	141

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	α° x ae	30° x D			15° x D								
	Vc (m/min)	80-100			45-65								
RAMPING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	10	2870	0.025	280	1750	0.023	160						
	12	2390	0.028	270	1460	0.026	150						
	14	2050	0.032	260	1250	0.029	145						
	16	1790	0.035	250	1090	0.032	140						
	20	1430	0.043	245	880	0.039	140						

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

HF442

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
VERTICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.024	570	3720	0.022	330	2920	0.018	210	1860	0.017	130
	8	4380	0.032	550	2790	0.028	320	2190	0.024	210	1390	0.022	120
	10	3500	0.038	530	2230	0.034	300	1750	0.028	200	1110	0.026	120
	12	2920	0.043	500	1860	0.039	290	1460	0.032	190	930	0.030	110
	14	2500	0.049	490	1590	0.044	280	1250	0.036	180	800	0.034	110
	16	2190	0.054	470	1390	0.049	270	1090	0.041	180	700	0.038	110
	20	1750	0.066	460	1110	0.059	260	880	0.049	170	560	0.046	100

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**85-105**			**55-75**			**40-60**			**20-40**		
DRILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	10080	0.006	250	6900	0.006	160	5310	0.005	110	3180	0.007	90
	4	7560	0.008	250	5180	0.007	160	3980	0.007	110	2390	0.009	90
	5	6050	0.010	250	4140	0.009	150	3180	0.008	110	1910	0.011	90
	6	5040	0.012	240	3450	0.011	150	2650	0.010	100	1590	0.013	90
	8	3780	0.016	240	2590	0.014	150	1990	0.013	100	1190	0.017	80
	10	3030	0.019	230	2070	0.017	140	1590	0.015	100	960	0.021	80
	12	2520	0.022	220	1730	0.019	130	1330	0.017	90	800	0.024	80
	14	2160	0.024	210	1480	0.022	130	1140	0.019	90	680	0.027	70
	16	1890	0.027	200	1290	0.024	130	1000	0.022	90	600	0.030	70
	20	1510	0.033	200	1040	0.030	120	800	0.026	80	480	0.036	70

ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

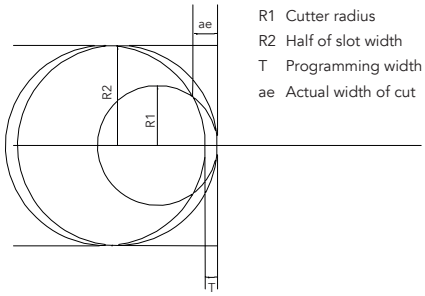
CUTTING PARAMETERS

HF442

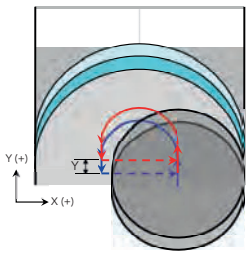
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**160-200**			**110-130**			**80-100**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	19110	0.032	2410	12740	0.028	1440	9550	0.025	960	6370	0.035	880
	4	14330	0.042	2390	9550	0.037	1430	7170	0.033	960	4780	0.046	880
	5	11460	0.052	2370	7640	0.047	1420	5730	0.041	950	3820	0.057	870
	6	9550	0.061	2320	6370	0.055	1390	4780	0.049	930	3180	0.067	850
	8	7170	0.079	2260	4780	0.071	1360	3580	0.063	900	2390	0.087	830
	10	5730	0.095	2170	3820	0.085	1300	2870	0.076	870	1910	0.104	790
	12	4780	0.108	2060	3180	0.097	1240	2390	0.086	830	1590	0.119	760
	14	4090	0.122	1990	2730	0.109	1190	2050	0.097	800	1360	0.134	730
	16	3580	0.135	1930	2390	0.122	1160	1790	0.108	770	1190	0.149	710
	20	2870	0.164	1890	1910	0.148	1130	1430	0.131	750	960	0.181	690

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D								

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF443

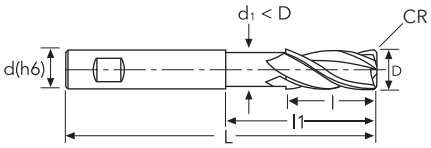
weldon shank and reduced neck, corner radius

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
3	0/-0.030	0.30	+/-0.020	6	9	15	2.80	57	4	HF44303030	●
3	0/-0.030	0.50	+/-0.020	6	9	15	2.80	57	4	HF44305030	●
4	0/-0.030	0.30	+/-0.020	6	11	18	3.80	57	4	HF44303040	●
4	0/-0.030	0.50	+/-0.020	6	11	18	3.80	57	4	HF44305040	●
5	0/-0.030	0.50	+/-0.020	6	13	19	4.80	57	4	HF44305050	●
6	0/-0.030	0.50	+/-0.020	6	13	20	5.80	57	4	HF44305060	●
6	0/-0.030	1.00	+/-0.020	6	13	20	5.80	57	4	HF44310060	●
8	0/-0.030	0.50	+/-0.020	8	20	26	7.80	64	4	HF44305080	●
8	0/-0.030	1.00	+/-0.020	8	20	26	7.80	64	4	HF44310080	●
10	0/-0.030	0.50	+/-0.020	10	22	30	9.80	72	4	HF44305100	●
10	0/-0.030	1.00	+/-0.020	10	22	30	9.80	72	4	HF44310100	●
12	0/-0.030	0.50	+/-0.020	12	26	36	11.80	83	4	HF44305120	●
12	0/-0.030	1.00	+/-0.020	12	26	36	11.80	83	4	HF44310120	●
14	0/-0.030	1.00	+/-0.020	14	26	36	13.70	83	4	HF44310140	●
16	0/-0.030	1.00	+/-0.020	16	32	42	15.70	92	4	HF44310160	●
20	0/-0.030	1.00	+/-0.020	20	38	50	19.70	104	4	HF44310200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

HF443

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.013	640	8490	0.011	390	6370	0.009	240	4250	0.009	150
	4	9550	0.017	640	6370	0.015	380	4780	0.012	240	3180	0.012	150
	5	7640	0.021	630	5100	0.019	380	3820	0.016	240	2550	0.014	150
	6	6370	0.024	620	4250	0.022	370	3180	0.018	230	2120	0.017	140
	8	4780	0.032	600	3180	0.028	360	2390	0.024	230	1590	0.022	140
	10	3820	0.038	580	2550	0.034	350	1910	0.028	220	1270	0.026	130
	12	3180	0.043	550	2120	0.039	330	1590	0.032	210	1060	0.030	130
	14	2730	0.049	530	1820	0.044	320	1360	0.036	200	910	0.034	120
	16	2390	0.054	520	1590	0.049	310	1190	0.041	190	800	0.038	120
	20	1910	0.066	500	1270	0.059	300	960	0.049	190	640	0.046	120
ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	ap x ae	**1.5D x D**			**1.5D x D**								
	Vc (m/min)	**85-105**			**55-75**								
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	8	3780	0.025	380	2590	0.023	230						
	10	3030	0.030	370	2070	0.027	230						
	12	2520	0.035	350	1730	0.031	220						
	14	2160	0.039	340	1480	0.035	210						
	16	1890	0.043	330	1290	0.039	200						
	20	1510	0.053	320	1040	0.047	200						

	Material Group ISO 513	P1 P2 M1 K1											
	Hardness/Rm	≤ 700 N/mm²											
	ap x ae	**2D x D**											
	Vc (m/min)	**60-80**											
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)									
	10	2230	0.023	200									
	12	1860	0.026	190									
	14	1590	0.029	190									
	16	1390	0.032	180									
	20	1110	0.039	180									

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF442 PARAMETERS.

CUTTING PARAMETERS

HF443

SIDE MILLING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
Vc (m/min)	**130-150**			**90-110**			**60-80**			**40-60**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	14860	0.015	900	10620	0.014	580	7430	0.012	360	5310	0.017	350
4	11150	0.020	890	7960	0.018	570	5570	0.016	360	3980	0.022	350
5	8920	0.025	890	6370	0.022	570	4460	0.020	350	3180	0.027	350
6	7430	0.029	870	5310	0.026	560	3720	0.023	350	2650	0.032	340
8	5570	0.038	840	3980	0.034	540	2790	0.030	340	1990	0.042	330
10	4460	0.045	810	3180	0.041	520	2230	0.036	320	1590	0.050	320
12	3720	0.052	770	2650	0.047	490	1860	0.041	310	1330	0.057	300
14	3180	0.058	740	2270	0.052	480	1590	0.047	300	1140	0.064	290
16	2790	0.065	720	1990	0.058	460	1390	0.052	290	1000	0.071	290
20	2230	0.079	700	1590	0.071	450	1110	0.063	280	800	0.087	280

ap x ae	**≤ D5**	1.5D x 0.25D	1.5D x 0.25D	1.2D x 0.1D	1.2D x 0.1D

HELICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	12740	0.009	470	8490	0.009	290	6370	0.008	193	4250	0.007	120
4	9550	0.012	465	6370	0.011	290	4780	0.010	191	3180	0.009	119
5	7640	0.015	460	5100	0.014	285	3820	0.012	190	2550	0.012	118
6	6370	0.018	450	4250	0.016	280	3180	0.015	186	2120	0.014	115
8	4780	0.023	440	3180	0.021	270	2390	0.019	181	1590	0.018	112
10	3820	0.028	420	2550	0.026	260	1910	0.023	173	1270	0.021	108
12	3180	0.031	400	2120	0.029	250	1590	0.026	165	1060	0.024	103
14	2730	0.035	385	1820	0.033	240	1360	0.029	159	910	0.027	99
16	2390	0.039	375	1590	0.037	235	1190	0.032	154	800	0.030	97
20	1910	0.048	365	1270	0.045	225	960	0.039	151	640	0.037	94

α° max	**≤ D5**	2°	2°	1°	1°

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
Vc (m/min)	**100-120**			**60-80**			**45-65**			**30-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	5840	0.019	455	3720	0.018	265	2920	0.017	198	1860	0.023	174
8	4380	0.025	440	2790	0.023	260	2190	0.022	193	1390	0.030	168
10	3500	0.030	420	2230	0.028	250	1750	0.026	185	1110	0.036	161
12	2920	0.034	405	1860	0.032	235	1460	0.030	176	930	0.042	154
14	2500	0.039	390	1590	0.036	225	1250	0.034	170	800	0.047	149
16	2190	0.043	375	1390	0.040	220	1090	0.038	165	700	0.052	145
20	1750	0.052	365	1110	0.048	215	880	0.046	162	560	0.063	141

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF442 PARAMETERS.

HF443

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	30° x D			15° x D								
	Vc (m/min)	85-105			55-75								
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	10	3030	0.025	300	2070	0.023	185						
	12	2520	0.028	285	1730	0.026	180						
	14	2160	0.032	275	1480	0.029	170						
	16	1890	0.035	265	1290	0.032	165						
	20	1510	0.043	260	1040	0.039	165						

RAMPING	Material Group ISO 513	P1 P2 M1 K1											
	Hardness/Rm	≤ 700 N/mm²											
	α° x ae	45° x D											
	Vc (m/min)	60-80											
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)									
	10	2230	0.024	220									
	12	1860	0.028	210									
	14	1590	0.031	200									
	16	1390	0.035	195									
	20	1110	0.042	190									

VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	D x 0.4D			D x 0.4D			D x 0.25D			D x 0.25D		
	Vc (m/min)	100-120			60-80			45-65			30-40		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5840	0.024	570	3720	0.022	330	2920	0.018	210	1860	0.017	130
	8	4380	0.032	550	2790	0.028	320	2190	0.024	210	1390	0.022	120
	10	3500	0.038	530	2230	0.034	300	1750	0.028	200	1110	0.026	120
	12	2920	0.043	500	1860	0.039	290	1460	0.032	190	930	0.030	110
	14	2500	0.049	490	1590	0.044	280	1250	0.036	180	800	0.034	110
	16	2190	0.054	470	1390	0.049	270	1090	0.041	180	700	0.038	110
	20	1750	0.066	460	1110	0.059	260	880	0.049	170	560	0.046	100

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF442 PARAMETERS.

CUTTING PARAMETERS

HF443

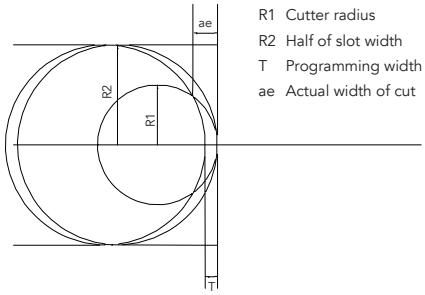
DRILLING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
Vc (m/min)	**85-105**			**55-75**			**40-60**			**20-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	10080	0.006	250	6900	0.006	160	5310	0.005	110	3180	0.007	90
4	7560	0.008	250	5180	0.007	160	3980	0.007	110	2390	0.009	90
5	6050	0.010	250	4140	0.009	150	3180	0.008	110	1910	0.011	90
6	5040	0.012	240	3450	0.011	150	2650	0.010	100	1590	0.013	90
8	3780	0.016	240	2590	0.014	150	1990	0.013	100	1190	0.017	80
10	3030	0.019	230	2070	0.017	140	1590	0.015	100	960	0.021	80
12	2520	0.022	220	1730	0.019	130	1330	0.017	90	800	0.024	80
14	2160	0.024	210	1480	0.022	130	1140	0.019	90	680	0.027	70
16	1890	0.027	200	1290	0.024	130	1000	0.022	90	600	0.030	70
20	1510	0.033	200	1040	0.030	120	800	0.026	80	480	0.036	70
ap x ae	**≤ D5**	0.5D x D		0.5D x D			0.25D x D			0.25D x D		

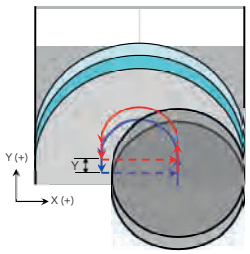
TROCHOIDAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
Vc (m/min)	**160-200**			**110-130**			**80-100**			**50-70**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	19110	0.032	2410	12740	0.028	1440	9550	0.025	960	6370	0.035	880
4	14330	0.042	2390	9550	0.037	1430	7170	0.033	960	4780	0.046	880
5	11460	0.052	2370	7640	0.047	1420	5730	0.041	950	3820	0.057	870
6	9550	0.061	2320	6370	0.055	1390	4780	0.049	930	3180	0.067	850
8	7170	0.079	2260	4780	0.071	1360	3580	0.063	900	2390	0.087	830
10	5730	0.095	2170	3820	0.085	1300	2870	0.076	870	1910	0.104	790
12	4780	0.108	2060	3180	0.097	1240	2390	0.086	830	1590	0.119	760
14	4090	0.122	1990	2730	0.109	1190	2050	0.097	800	1360	0.134	730
16	3580	0.135	1930	2390	0.122	1160	1790	0.108	770	1190	0.149	710
20	2870	0.164	1890	1910	0.148	1130	1430	0.131	750	960	0.181	690
ap x ae	**≤ D5**	1.5D x 0.1D		1.5D x 0.1D								

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF442 PARAMETERS.

HF542

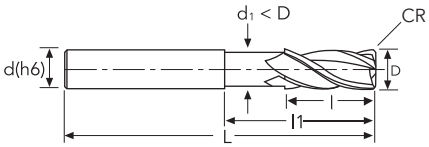
cylindrical shank and reduced neck, long reach, corner radius

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
6	0/-0.030	0.30	+/-0.010	6	12	30	5.80	75	4	HF5420306075	●
6	0/-0.030	0.50	+/-0.010	6	12	30	5.80	75	4	HF5420506075	●
6	0/-0.030	1.00	+/-0.010	6	12	30	5.80	75	4	HF5421006075	●
6	0/-0.030	0.30	+/-0.010	6	12	30	5.80	100	4	HF54203060100	●
6	0/-0.030	0.50	+/-0.010	6	12	30	5.80	100	4	HF54205060100	●
6	0/-0.030	1.00	+/-0.010	6	12	30	5.80	100	4	HF54210060100	●
8	0/-0.030	0.50	+/-0.010	8	16	40	7.80	100	4	HF54205080100	●
8	0/-0.030	1.00	+/-0.010	8	16	40	7.80	100	4	HF54210080100	●
8	0/-0.030	2.00	+/-0.010	8	16	40	7.80	100	4	HF54220080100	●
10	0/-0.030	0.50	+/-0.010	10	20	50	9.80	125	4	HF54205100125	●
10	0/-0.030	1.00	+/-0.010	10	20	50	9.80	125	4	HF54210100125	●
10	0/-0.030	2.00	+/-0.010	10	20	50	9.80	125	4	HF54220100125	●
12	0/-0.030	0.50	+/-0.010	12	24	60	11.80	125	4	HF54205120125	●
12	0/-0.030	1.00	+/-0.010	12	24	60	11.80	125	4	HF54210120125	●
12	0/-0.030	2.00	+/-0.010	12	24	60	11.80	125	4	HF54220120125	●
12	0/-0.030	3.00	+/-0.010	12	24	60	11.80	125	4	HF54230120125	●
12	0/-0.030	0.50	+/-0.010	12	24	60	11.80	150	4	HF54205120150	●
12	0/-0.030	1.00	+/-0.010	12	24	60	11.80	150	4	HF54210120150	●
12	0/-0.030	2.00	+/-0.010	12	24	60	11.80	150	4	HF54220120150	●
12	0/-0.030	3.00	+/-0.010	12	24	60	11.80	150	4	HF54230120150	●
16	0/-0.030	0.50	+/-0.010	16	32	80	15.70	150	4	HF54205160150	●
16	0/-0.030	1.00	+/-0.010	16	32	80	15.70	150	4	HF54210160150	●
16	0/-0.030	2.00	+/-0.010	16	32	80	15.70	150	4	HF54220160150	●
16	0/-0.030	3.00	+/-0.010	16	32	80	15.70	150	4	HF54230160150	●
16	0/-0.030	4.00	+/-0.010	16	32	80	15.70	150	4	HF54240160150	●
20	0/-0.030	0.50	+/-0.010	20	40	100	19.70	150	4	HF54205200150	●
20	0/-0.030	1.00	+/-0.010	20	40	100	19.70	150	4	HF54210200150	●
20	0/-0.030	2.00	+/-0.010	20	40	100	19.70	150	4	HF54220200150	●
20	0/-0.030	3.00	+/-0.010	20	40	100	19.70	150	4	HF54230200150	●
20	0/-0.030	4.00	+/-0.010	20	40	100	19.70	150	4	HF54240200150	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF542

SLOTTING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**0.5D x D**			**0.3D x D**			**0.2D x D**			**0.2D x D**		
Vc (m/min)	**90-110**			**60-80**			**40-60**			**20-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	5310	0.019	410	3720	0.017	260	2650	0.015	150	1590	0.014	90
8	3980	0.025	400	2790	0.023	250	1990	0.019	150	1190	0.018	80
10	3180	0.030	380	2230	0.027	240	1590	0.023	140	960	0.021	80
12	2650	0.035	370	1860	0.031	230	1330	0.026	140	800	0.024	80
16	1990	0.043	340	1390	0.039	220	1000	0.032	130	600	0.030	70
20	1590	0.053	330	1110	0.047	210	800	0.039	130	480	0.037	70

SIDE MILLING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**1.5D x 0.3D**			**1.5D x 0.3D**			**1.2D x 0.2D**			**1.2D x 0.2D**		
Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	6370	0.023	590	4250	0.021	360	3180	0.019	240	2120	0.026	220
8	4780	0.030	580	3180	0.027	350	2390	0.024	230	1590	0.033	210
10	3820	0.036	550	2550	0.033	330	1910	0.029	220	1270	0.040	200
12	3180	0.041	530	2120	0.037	320	1590	0.033	210	1060	0.046	190
16	2390	0.052	500	1590	0.047	300	1190	0.041	200	800	0.057	180
20	1910	0.063	480	1270	0.057	290	960	0.050	190	640	0.069	180

HELICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
Vc (m/min)	**90-110**			**60-80**			**40-60**			**20-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	5310	0.015	310	3720	0.014	210	2650	0.012	124	1590	0.012	78
8	3980	0.019	305	2790	0.018	205	1990	0.015	120	1190	0.016	76
10	3180	0.023	290	2230	0.022	195	1590	0.018	115	960	0.019	73
12	2650	0.026	275	1860	0.025	185	1330	0.021	110	800	0.022	70
16	1990	0.033	260	1390	0.031	175	1000	0.026	104	600	0.027	66
20	1590	0.040	250	1110	0.038	170	800	0.032	101	480	0.033	64

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**7° x 0.4D**			**5° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
Vc (m/min)	**80-100**			**50-70**			**35-55**			**20-30**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	4780	0.016	310	3180	0.015	195	2390	0.015	143	1330	0.021	109
8	3580	0.021	305	2390	0.020	190	1790	0.019	139	1000	0.027	107
10	2870	0.025	290	1910	0.024	180	1430	0.023	133	800	0.032	102
12	2390	0.029	275	1590	0.027	175	1190	0.027	126	660	0.037	96
16	1790	0.036	260	1190	0.034	160	900	0.033	120	500	0.046	91
20	1430	0.044	250	960	0.041	160	720	0.040	116	400	0.056	89

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

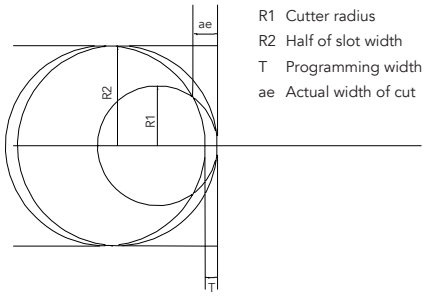
HF542

VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	D x 0.4D			D x 0.4D			D x 0.25D			D x 0.25D		
	Vc (m/min)	80-100			50-70			35-55			20-30		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	4780	0.019	370	3180	0.017	220	2390	0.015	140	1330	0.014	70
	8	3580	0.025	360	2390	0.023	220	1790	0.019	140	1000	0.018	70
	10	2870	0.030	350	1910	0.027	210	1430	0.023	130	800	0.021	70
	12	2390	0.035	330	1590	0.031	200	1190	0.026	120	660	0.024	60
	16	1790	0.043	310	1190	0.039	190	900	0.032	120	500	0.030	60
	20	1430	0.053	300	960	0.047	180	720	0.039	110	400	0.037	60

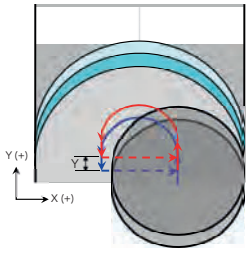
DRILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	D x D			D x D			0.5D x D			0.5D x D		
	Vc (m/min)	70-90			50-60			35-45			20-30		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	4250	0.010	170	2920	0.009	100	2120	0.008	70	1330	0.011	60
	8	3180	0.013	160	2190	0.011	100	1590	0.010	60	1000	0.014	60
	10	2550	0.015	150	1750	0.014	100	1270	0.012	60	800	0.017	50
	12	2120	0.017	150	1460	0.016	90	1060	0.014	60	660	0.019	50
	16	1590	0.022	140	1090	0.019	80	800	0.017	60	500	0.024	50
	20	1270	0.026	130	880	0.024	80	640	0.021	50	400	0.029	50

TROCHOIDAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	2D x 0.1D			2D x 0.1D			1.5D x 0.1D			1.5D x 0.1D		
	Vc (m/min)	150-170			90-100			80-90			45-55		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	8490	0.049	1650	5040	0.044	880	3980	0.039	620	2650	0.053	570
	8	6370	0.063	1610	3780	0.057	860	2990	0.050	600	1990	0.069	550
	10	5100	0.076	1540	3030	0.068	820	2390	0.060	580	1590	0.083	530
	12	4250	0.086	1470	2520	0.078	780	1990	0.069	550	1330	0.095	510
	16	3180	0.108	1370	1890	0.097	730	1490	0.086	510	1000	0.119	480
	20	2550	0.131	1340	1510	0.118	710	1190	0.105	500	800	0.145	460

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



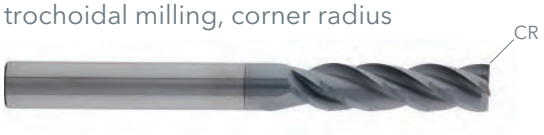
R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF942

cylindrical shank, long cutting edge ideal for trochoidal milling, corner radius

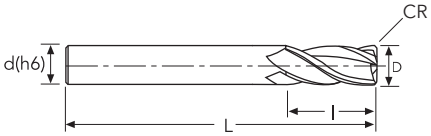


OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
4	0/-0.025	0.10	+/-0.010	6	19		75	4	HF9420104075	●
5	0/-0.025	0.10	+/-0.010	6	19		75	4	HF9420105075	●
6	0/-0.025	0.10	+/-0.010	6	25		75	4	HF9420106075	●
8	0/-0.030	0.20	+/-0.010	8	30		75	4	HF9420208075	●
10	0/-0.030	0.20	+/-0.010	10	40		100	4	HF94202100100	●
12	0/-0.030	0.30	+/-0.010	12	45		100	4	HF94203120100	●
16	0/-0.030	0.30	+/-0.010	16	65		125	4	HF94203160125	●
20	0/-0.030	0.30	+/-0.010	20	65		125	4	HF94203200125	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF942

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.3D**			**1.5D x 0.3D**			**1.2D x 0.2D**			**1.2D x 0.2D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	9550	0.016	620	6370	0.015	370	4780	0.013	250	3180	0.018	230
	5	7640	0.021	650	5100	0.019	390	3820	0.017	260	2550	0.023	240
	6	6370	0.026	660	4250	0.023	400	3180	0.021	260	2120	0.029	240
	8	4780	0.031	590	3180	0.028	350	2390	0.025	230	1590	0.034	210
	10	3820	0.036	560	2550	0.033	330	1910	0.029	220	1270	0.040	200
	12	3180	0.041	530	2120	0.037	320	1590	0.033	210	1060	0.045	190
	16	2390	0.047	450	1590	0.042	270	1190	0.038	180	800	0.052	170
	20	1910	0.063	480	1270	0.057	290	960	0.051	190	640	0.070	180
ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			1.2D x 0.1D			1.2D x 0.1D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
	Vc (m/min)	**90-110**			**60-80**			**40-60**			**20-40**		
HELICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	7960	0.010	325	5570	0.010	220	3980	0.008	130	2390	0.009	82
	5	6370	0.013	340	4460	0.013	225	3180	0.011	134	1910	0.011	85
	6	5310	0.016	345	3720	0.016	230	2650	0.013	137	1590	0.014	87
	8	3980	0.019	305	2790	0.018	205	1990	0.015	122	1190	0.016	77
	10	3180	0.023	290	2230	0.022	195	1590	0.018	116	960	0.019	74
	12	2650	0.026	275	1860	0.025	185	1330	0.021	110	800	0.022	70
	16	1990	0.030	235	1390	0.028	155	1000	0.024	94	600	0.025	59
	20	1590	0.040	255	1110	0.038	170	800	0.032	101	480	0.033	64
α° max	**≤ D5**	2°			2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

HF942

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**5° x 0.4D**			**5° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**80-100**			**50-70**			**35-55**			**20-30**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	7170	0.012	340	4780	0.011	205	3580	0.010	150	1990	0.014	114
	5	5730	0.015	350	3820	0.014	210	2870	0.014	155	1590	0.019	118
	6	4780	0.019	360	3180	0.017	215	2390	0.017	159	1330	0.023	121
	8	3580	0.022	320	2390	0.020	190	1790	0.020	141	1000	0.027	108
	10	2870	0.027	305	1910	0.024	185	1430	0.023	134	800	0.032	103
	12	2390	0.030	285	1590	0.027	170	1190	0.026	126	660	0.036	96
	16	1790	0.034	245	1190	0.031	145	900	0.030	108	500	0.041	83
	20	1430	0.046	265	960	0.042	160	720	0.041	117	400	0.056	89

VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**80-100**			**50-70**			**35-55**			**20-30**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	7170	0.014	390	4780	0.012	230	3580	0.010	150	1990	0.010	80
	5	5730	0.018	400	3820	0.016	240	2870	0.013	150	1590	0.012	80
	6	4780	0.022	410	3180	0.019	250	2390	0.016	150	1330	0.015	80
	8	3580	0.026	370	2390	0.023	220	1790	0.019	140	1000	0.018	70
	10	2870	0.030	350	1910	0.027	210	1430	0.023	130	800	0.021	70
	12	2390	0.034	330	1590	0.031	200	1190	0.026	120	660	0.024	60
	16	1790	0.039	280	1190	0.035	170	900	0.029	110	500	0.027	50
	20	1430	0.053	300	960	0.048	180	720	0.040	110	400	0.037	60

DRILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**70-90**			**50-60**			**35-45**			**20-30**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	6370	0.007	170	4380	0.006	110	3180	0.005	70	1990	0.007	60
	5	5100	0.009	180	3500	0.008	110	2550	0.007	70	1590	0.010	60
	6	4250	0.011	180	2920	0.010	110	2120	0.009	70	1330	0.012	60
	8	3180	0.013	160	2190	0.012	100	1590	0.010	70	1000	0.014	60
	10	2550	0.015	160	1750	0.014	100	1270	0.012	60	800	0.017	50
	12	2120	0.017	150	1460	0.015	90	1060	0.014	60	660	0.019	50
	16	1590	0.020	120	1090	0.018	80	800	0.016	50	500	0.022	40
	20	1270	0.026	130	880	0.024	80	640	0.021	50	400	0.029	50
ap x ae	**≤ D5**	0.5D x D			0.5D x D			0.25D x D			0.25D x D		

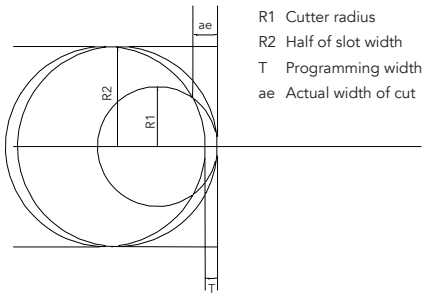
PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF942

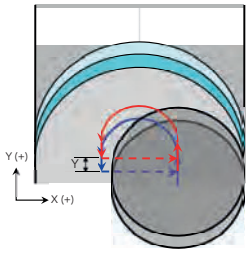
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.1D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**140-160**			**100-120**			**70-90**			**40-60**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	11940	0.034	1620	8760	0.031	1070	6370	0.027	690	3980	0.037	600
	5	9550	0.044	1680	7010	0.040	1110	5100	0.035	720	3180	0.048	620
	6	7960	0.054	1720	5840	0.049	1140	4250	0.043	730	2650	0.059	630
	8	5970	0.064	1530	4380	0.058	1010	3180	0.051	650	1990	0.070	560
	10	4780	0.076	1450	3500	0.068	960	2550	0.061	620	1590	0.084	530
	12	3980	0.086	1370	2920	0.077	900	2120	0.069	580	1330	0.095	500
	16	2990	0.098	1170	2190	0.088	770	1590	0.078	500	1000	0.108	430
	20	2390	0.132	1260	1750	0.119	830	1270	0.106	540	800	0.145	460

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			1.2D x 0.05D			1.2D x 0.05D		

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF943

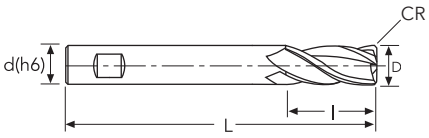
weldon shank, long cutting edge ideal for trochoidal milling, corner radius

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
4	0/-0.025	0.10	+/-0.010	6	19		75	4	HF9430104075	●
5	0/-0.025	0.10	+/-0.010	6	19		75	4	HF9430105075	●
6	0/-0.025	0.10	+/-0.010	6	25		75	4	HF9430106075	●
8	0/-0.030	0.20	+/-0.010	8	30		75	4	HF9430208075	●
10	0/-0.030	0.20	+/-0.010	10	40		100	4	HF94302100100	●
12	0/-0.030	0.30	+/-0.010	12	45		100	4	HF94303120100	●
16	0/-0.030	0.30	+/-0.010	16	65		125	4	HF94303160125	●
20	0/-0.030	0.30	+/-0.010	20	65		125	4	HF94303200125	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF943

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.3D**			**1.5D x 0.3D**			**1.2D x 0.2D**			**1.2D x 0.2D**		
	Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	9550	0.016	620	6370	0.015	370	4780	0.013	250	3180	0.018	230
	5	7640	0.021	650	5100	0.019	390	3820	0.017	260	2550	0.023	240
	6	6370	0.026	660	4250	0.023	400	3180	0.021	260	2120	0.029	240
	8	4780	0.031	590	3180	0.028	350	2390	0.025	230	1590	0.034	210
	10	3820	0.036	560	2550	0.033	330	1910	0.029	220	1270	0.040	200
	12	3180	0.041	530	2120	0.037	320	1590	0.033	210	1060	0.045	190
	16	2390	0.047	450	1590	0.042	270	1190	0.038	180	800	0.052	170
	20	1910	0.063	480	1270	0.057	290	960	0.051	190	640	0.070	180
ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			1.2D x 0.1D			1.2D x 0.1D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
	Vc (m/min)	**90-110**			**60-80**			**40-60**			**20-40**		
HELICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	7960	0.010	325	5570	0.010	220	3980	0.008	130	2390	0.009	82
	5	6370	0.013	340	4460	0.013	225	3180	0.011	134	1910	0.011	85
	6	5310	0.016	345	3720	0.016	230	2650	0.013	137	1590	0.014	87
	8	3980	0.019	305	2790	0.018	205	1990	0.015	122	1190	0.016	77
	10	3180	0.023	290	2230	0.022	195	1590	0.018	116	960	0.019	74
	12	2650	0.026	275	1860	0.025	185	1330	0.021	110	800	0.022	70
	16	1990	0.030	235	1390	0.028	155	1000	0.024	94	600	0.025	59
	20	1590	0.040	255	1110	0.038	170	800	0.032	101	480	0.033	64
α° max	**≤ D5**	2°			2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF942 PARAMETERS.

CUTTING PARAMETERS

HF943

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**5° x 0.4D**			**5° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**80-100**			**50-70**			**35-55**			**20-30**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	7170	0.012	340	4780	0.011	205	3580	0.010	150	1990	0.014	114
	5	5730	0.015	350	3820	0.014	210	2870	0.014	155	1590	0.019	118
	6	4780	0.019	360	3180	0.017	215	2390	0.017	159	1330	0.023	121
	8	3580	0.022	320	2390	0.020	190	1790	0.020	141	1000	0.027	108
	10	2870	0.027	305	1910	0.024	185	1430	0.023	134	800	0.032	103
	12	2390	0.030	285	1590	0.027	170	1190	0.026	126	660	0.036	96
	16	1790	0.034	245	1190	0.031	145	900	0.030	108	500	0.041	83
	20	1430	0.046	265	960	0.042	160	720	0.041	117	400	0.056	89

VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**80-100**			**50-70**			**35-55**			**20-30**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	7170	0.014	390	4780	0.012	230	3580	0.010	150	1990	0.010	80
	5	5730	0.018	400	3820	0.016	240	2870	0.013	150	1590	0.012	80
	6	4780	0.022	410	3180	0.019	250	2390	0.016	150	1330	0.015	80
	8	3580	0.026	370	2390	0.023	220	1790	0.019	140	1000	0.018	70
	10	2870	0.030	350	1910	0.027	210	1430	0.023	130	800	0.021	70
	12	2390	0.034	330	1590	0.031	200	1190	0.026	120	660	0.024	60
	16	1790	0.039	280	1190	0.035	170	900	0.029	110	500	0.027	50
	20	1430	0.053	300	960	0.048	180	720	0.040	110	400	0.037	60

DRILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**70-90**			**50-60**			**35-45**			**20-30**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	6370	0.007	170	4380	0.006	110	3180	0.005	70	1990	0.007	60
	5	5100	0.009	180	3500	0.008	110	2550	0.007	70	1590	0.010	60
	6	4250	0.011	180	2920	0.010	110	2120	0.009	70	1330	0.012	60
	8	3180	0.013	160	2190	0.012	100	1590	0.010	70	1000	0.014	60
	10	2550	0.015	160	1750	0.014	100	1270	0.012	60	800	0.017	50
	12	2120	0.017	150	1460	0.015	90	1060	0.014	60	660	0.019	50
	16	1590	0.020	120	1090	0.018	80	800	0.016	50	500	0.022	40
	20	1270	0.026	130	880	0.024	80	640	0.021	50	400	0.029	50

ap x ae	**≤ D5**	0.5D x D	0.5D x D	0.25D x D	0.25D x D

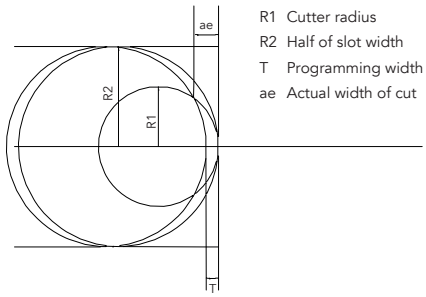
PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF942 PARAMETERS.

HF943

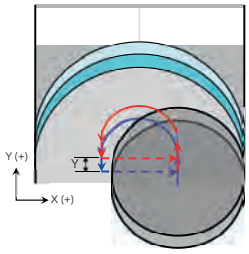
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.1D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**140-160**			**100-120**			**70-90**			**40-60**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	11940	0.034	1620	8760	0.031	1070	6370	0.027	690	3980	0.037	600
	5	9550	0.044	1680	7010	0.040	1110	5100	0.035	720	3180	0.048	620
	6	7960	0.054	1720	5840	0.049	1140	4250	0.043	730	2650	0.059	630
	8	5970	0.064	1530	4380	0.058	1010	3180	0.051	650	1990	0.070	560
	10	4780	0.076	1450	3500	0.068	960	2550	0.061	620	1590	0.084	530
	12	3980	0.086	1370	2920	0.077	900	2120	0.069	580	1330	0.095	500
	16	2990	0.098	1170	2190	0.088	770	1590	0.078	500	1000	0.108	430
	20	2390	0.132	1260	1750	0.119	830	1270	0.106	540	800	0.145	460

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			1.2D x 0.05D			1.2D x 0.05D		

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF942 PARAMETERS.

HF642

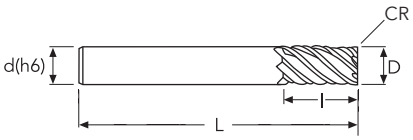
cylindrical shank, 5F ideal for trochoidal milling, corner radius

OSAWA NORM | MG PV300 | <40 HRC | 36°/37°/38° | RADIUS | Z5

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
4	0/-0.025	0.10	+/-0.010	6	12		57	5	HF64201040	●
5	0/-0.025	0.10	+/-0.010	6	13		57	5	HF64201050	●
6	0/-0.025	0.10	+/-0.010	6	13		57	5	HF64201060	●
8	0/-0.030	0.20	+/-0.010	8	20		64	5	HF64202080	●
10	0/-0.030	0.20	+/-0.010	10	22		72	5	HF64202100	●
12	0/-0.030	0.30	+/-0.010	12	26		83	5	HF64203120	●
16	0/-0.030	0.30	+/-0.010	16	32		92	5	HF64203160	●
20	0/-0.030	0.30	+/-0.010	20	38		104	5	HF64203200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF642

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**160-180**			**100-120**			**70-90**			**40-60**		
SIDE MILLING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	13540	0.019	1280	8760	0.017	740	6370	0.015	480	3980	0.021	410
	5	10830	0.023	1270	7010	0.021	740	5100	0.019	480	3180	0.026	410
	6	9020	0.028	1240	5840	0.025	720	4250	0.022	470	2650	0.030	400
	8	6770	0.036	1210	4380	0.032	700	3180	0.029	450	1990	0.039	390
	10	5410	0.043	1160	3500	0.039	670	2550	0.034	440	1590	0.047	370
	12	4510	0.049	1100	2920	0.044	640	2120	0.039	420	1330	0.054	360
	16	3380	0.061	1030	2190	0.055	600	1590	0.049	390	1000	0.067	340
	20	2710	0.074	1010	1750	0.067	590	1270	0.060	380	800	0.082	330
ap x ae	**≤ D5**	1.5D x 0.3D			1.5D x 0.3D			1.2D x 0.2D			1.2D x 0.2D		

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
HELICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	11150	0.011	640	7170	0.011	385	5570	0.009	263	3180	0.009	140
	5	8920	0.014	635	5730	0.013	380	4460	0.012	262	2550	0.011	140
	6	7430	0.017	620	4780	0.016	370	3720	0.014	256	2120	0.013	136
	8	5570	0.022	605	3580	0.020	360	2790	0.018	249	1590	0.017	133
	10	4460	0.026	580	2870	0.024	350	2230	0.021	239	1270	0.020	127
	12	3720	0.030	555	2390	0.028	330	1860	0.024	228	1060	0.023	121
	16	2790	0.037	520	1790	0.035	310	1390	0.031	213	800	0.029	114
	20	2230	0.045	505	1430	0.042	300	1110	0.037	207	640	0.035	111
α° max	**≤ D5**	2°			2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

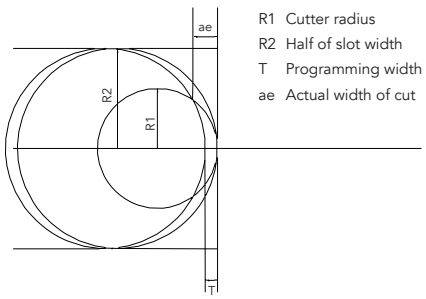
HF642

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.018	680	4780	0.017	405	3720	0.016	298	2120	0.022	234
	8	5570	0.024	660	3580	0.022	390	2790	0.021	290	1590	0.029	227
	10	4460	0.028	635	2870	0.026	375	2230	0.025	278	1270	0.034	218
	12	3720	0.033	605	2390	0.030	360	1860	0.029	265	1060	0.039	208
	16	2790	0.041	570	1790	0.037	335	1390	0.036	248	800	0.049	196
	20	2230	0.050	550	1430	0.046	325	1110	0.043	241	640	0.060	191

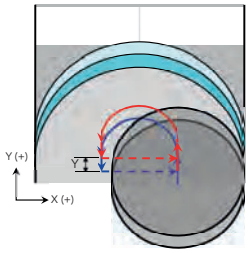
VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.023	850	4780	0.021	490	3720	0.017	320	2120	0.016	170
	8	5570	0.030	830	3580	0.027	480	2790	0.022	310	1590	0.021	170
	10	4460	0.036	800	2870	0.032	460	2230	0.027	300	1270	0.025	160
	12	3720	0.041	760	2390	0.037	440	1860	0.031	280	1060	0.029	150
	16	2790	0.051	710	1790	0.046	410	1390	0.038	270	800	0.036	140
	20	2230	0.062	690	1430	0.056	400	1110	0.047	260	640	0.043	140

TROCHOIDAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**190-230**			**130-150**			**100-120**			**50-70**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	11150	0.057	3200	7430	0.052	1920	5840	0.046	1340	3180	0.063	1000
	8	8360	0.074	3110	5570	0.067	1860	4380	0.060	1300	2390	0.082	980
	10	6690	0.089	2990	4460	0.080	1790	3500	0.071	1250	1910	0.098	940
	12	5570	0.102	2840	3720	0.092	1710	2920	0.082	1190	1590	0.112	890
	16	4180	0.128	2660	2790	0.115	1600	2190	0.102	1120	1190	0.140	830
	20	3340	0.155	2590	2230	0.140	1560	1750	0.124	1090	960	0.171	820
ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			D x 0.1D			D x 0.1D		

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF643

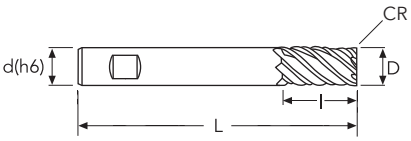
weldon shank, 5 flutes ideal for trochoidal milling, corner radius

OSAWA NORM | MG PV300 | <40 HRC | 36°/37°/38° | RADIUS | Z5

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
4	0/-0.025	0.10	+/-0.010	6	12		57	5	HF64301040	●
5	0/-0.025	0.10	+/-0.010	6	13		57	5	HF64301050	●
6	0/-0.025	0.10	+/-0.010	6	13		57	5	HF64301060	●
8	0/-0.030	0.20	+/-0.010	8	20		64	5	HF64302080	●
10	0/-0.030	0.20	+/-0.010	10	22		72	5	HF64302100	●
12	0/-0.030	0.30	+/-0.010	12	26		83	5	HF64303120	●
16	0/-0.030	0.30	+/-0.010	16	32		92	5	HF64303160	●
20	0/-0.030	0.30	+/-0.010	20	38		104	5	HF64303200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF643

SIDE MILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
	Vc (m/min)	**160-180**			**100-120**			**70-90**			**40-60**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	13540	0.019	1280	8760	0.017	740	6370	0.015	480	3980	0.021	410
	5	10830	0.023	1270	7010	0.021	740	5100	0.019	480	3180	0.026	410
	6	9020	0.028	1240	5840	0.025	720	4250	0.022	470	2650	0.030	400
	8	6770	0.036	1210	4380	0.032	700	3180	0.029	450	1990	0.039	390
	10	5410	0.043	1160	3500	0.039	670	2550	0.034	440	1590	0.047	370
	12	4510	0.049	1100	2920	0.044	640	2120	0.039	420	1330	0.054	360
	16	3380	0.061	1030	2190	0.055	600	1590	0.049	390	1000	0.067	340
	20	2710	0.074	1010	1750	0.067	590	1270	0.060	380	800	0.082	330
ap x ae	**≤ D5**	1.5D x 0.3D			1.5D x 0.3D			1.2D x 0.2D			1.2D x 0.2D		

HELICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**5° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	11150	0.011	640	7170	0.011	385	5570	0.009	263	3180	0.009	140
	5	8920	0.014	635	5730	0.013	380	4460	0.012	262	2550	0.011	140
	6	7430	0.017	620	4780	0.016	370	3720	0.014	256	2120	0.013	136
	8	5570	0.022	605	3580	0.020	360	2790	0.018	249	1590	0.017	133
	10	4460	0.026	580	2870	0.024	350	2230	0.021	239	1270	0.020	127
	12	3720	0.030	555	2390	0.028	330	1860	0.024	228	1060	0.023	121
	16	2790	0.037	520	1790	0.035	310	1390	0.031	213	800	0.029	114
	20	2230	0.045	505	1430	0.042	300	1110	0.037	207	640	0.035	111
α° max	**≤ D5**	2°			2°			1°			1°		

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	11150	0.013	700	7170	0.012	415	5570	0.011	306	3180	0.015	240
	5	8920	0.016	695	5730	0.014	410	4460	0.014	305	2550	0.019	240
	6	7430	0.018	680	4780	0.017	405	3720	0.016	298	2120	0.022	234
	8	5570	0.024	660	3580	0.022	390	2790	0.021	290	1590	0.029	227
	10	4460	0.028	635	2870	0.026	375	2230	0.025	278	1270	0.034	218
	12	3720	0.033	605	2390	0.030	360	1860	0.029	265	1060	0.039	208
	16	2790	0.041	570	1790	0.037	335	1390	0.036	248	800	0.049	196
	20	2230	0.050	550	1430	0.046	325	1110	0.043	241	640	0.060	191

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF642 PARAMETERS.

CUTTING PARAMETERS

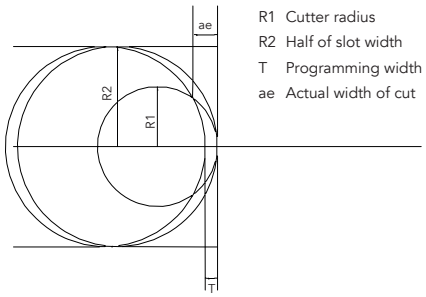
HF643

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
VERTICAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	11150	0.016	880	7170	0.014	510	5570	0.012	330	3180	0.011	180
	5	8920	0.020	870	5730	0.018	500	4460	0.015	330	2550	0.014	170
	6	7430	0.023	850	4780	0.021	490	3720	0.017	320	2120	0.016	170
	8	5570	0.030	830	3580	0.027	480	2790	0.022	310	1590	0.021	170
	10	4460	0.036	800	2870	0.032	460	2230	0.027	300	1270	0.025	160
	12	3720	0.041	760	2390	0.037	440	1860	0.031	280	1060	0.029	150
	16	2790	0.051	710	1790	0.046	410	1390	0.038	270	800	0.036	140
	20	2230	0.062	690	1430	0.056	400	1110	0.047	260	640	0.043	140

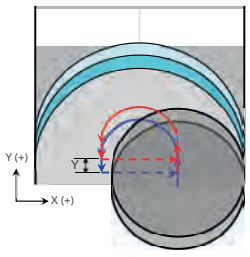
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**190-230**			**130-150**			**100-120**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	16720	0.039	3290	11150	0.035	1970	8760	0.031	1380	4780	0.043	1030
	5	13380	0.049	3270	8920	0.044	1960	7010	0.039	1370	3820	0.054	1030
	6	11150	0.057	3200	7430	0.052	1920	5840	0.046	1340	3180	0.063	1000
	8	8360	0.074	3110	5570	0.067	1860	4380	0.060	1300	2390	0.082	980
	10	6690	0.089	2990	4460	0.080	1790	3500	0.071	1250	1910	0.098	940
	12	5570	0.102	2840	3720	0.092	1710	2920	0.082	1190	1590	0.112	890
	16	4180	0.128	2660	2790	0.115	1600	2190	0.102	1120	1190	0.140	830
	20	3340	0.155	2590	2230	0.140	1560	1750	0.124	1090	960	0.171	820

ap x ae	**≤ D5**	1.5D x 0.1D	1.5D x 0.1D	D x 0.1D	D x 0.1D

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF642 PARAMETERS.

HF742

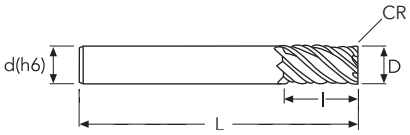
cylindrical shank, long 5 flutes ideal for trochoidal milling, corner radius

OSAWA NORM | MG PV300 | <40 HRC | 36°/37°/38° | RADIUS | Z5

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
6	0/-0.025	0.10	+/-0.010	6	25		75	5	HF7420106075	●
8	0/-0.030	0.20	+/-0.010	8	25		75	5	HF7420208075	●
10	0/-0.030	0.20	+/-0.010	10	38		100	5	HF74202100100	●
12	0/-0.030	0.30	+/-0.010	12	45		100	5	HF74203120100	●
16	0/-0.030	0.30	+/-0.010	16	55		125	5	HF74203160125	●
20	0/-0.030	0.30	+/-0.010	20	65		125	5	HF74203200125	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF742

SIDE MILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	1.5D x 03D			1.5D x 0.3D			1.2D x 0.2D			1.2D x 0.2D		
	Vc (m/min)	110-130			70-90			50-70			30-50		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	6370	0.023	740	4250	0.021	450	3180	0.019	300	2120	0.026	270
	8	4780	0.028	660	3180	0.025	400	2390	0.022	260	1590	0.030	240
	10	3820	0.033	630	2550	0.030	380	1910	0.026	250	1270	0.036	230
	12	3180	0.037	590	2120	0.033	350	1590	0.030	240	1060	0.041	220
	16	2390	0.042	510	1590	0.038	300	1190	0.034	200	800	0.047	190
	20	1910	0.057	540	1270	0.051	330	960	0.046	220	640	0.063	200

HELICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	4° x 0.4D			3° x 0.4D			3° x 0.4D			2° x 0.4D		
	Vc (m/min)	90-110			60-80			40-60			20-40		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	5310	0.016	435	3720	0.016	290	2650	0.013	172	1590	0.014	109
	8	3980	0.019	385	2790	0.018	255	1990	0.015	153	1190	0.016	96
	10	3180	0.023	365	2230	0.022	245	1590	0.018	145	960	0.019	92
	12	2650	0.026	345	1860	0.025	230	1330	0.021	137	800	0.022	87
	16	1990	0.030	295	1390	0.028	195	1000	0.024	118	600	0.025	74
	20	1590	0.040	315	1110	0.038	210	800	0.032	127	480	0.033	80

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	5° x D			4° x D			3° x D			3° x D		
	Vc (m/min)	80-100			50-70			35-55			20-30		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	4780	0.017	405	3180	0.016	250	2390	0.015	179	1330	0.021	137
	8	3580	0.020	360	2390	0.019	225	1790	0.018	158	1000	0.024	122
	10	2870	0.024	345	1910	0.022	215	1430	0.021	150	800	0.029	116
	12	2390	0.027	325	1590	0.025	200	1190	0.024	142	660	0.033	108
	16	1790	0.031	275	1190	0.029	170	900	0.027	122	500	0.037	93
	20	1430	0.042	295	960	0.039	185	720	0.037	131	400	0.050	100

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

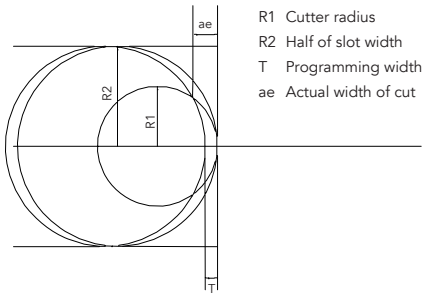
CUTTING PARAMETERS

HF742

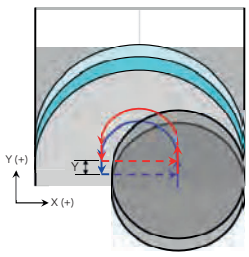
VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	D x 0.4D			D x 0.4D			D x 0.25D			D x 0.25D		
	Vc (m/min)	80-100			50-70			35-55			20-30		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	4780	0.022	520	3180	0.019	310	2390	0.016	190	1330	0.015	100
	8	3580	0.026	460	2390	0.023	280	1790	0.019	170	1000	0.018	90
	10	2870	0.030	440	1910	0.027	260	1430	0.023	160	800	0.021	90
	12	2390	0.034	410	1590	0.031	250	1190	0.026	150	660	0.024	80
	16	1790	0.039	350	1190	0.035	210	900	0.029	130	500	0.027	70
	20	1430	0.053	380	960	0.048	230	720	0.040	140	400	0.037	70

TROCHOIDAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	3D x 0.1D			3D x 0.1D			2D x 0.1D			2D x 0.1D		
	Vc (m/min)	130-170			100-120			70-90			40-60		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7960	0.054	2150	5840	0.049	1420	4250	0.043	920	2650	0.059	790
	8	5970	0.064	1910	4380	0.058	1260	3180	0.051	810	1990	0.070	700
	10	4780	0.076	1820	3500	0.068	1200	2550	0.061	780	1590	0.084	660
	12	3980	0.086	1710	2920	0.077	1130	2120	0.069	730	1330	0.095	630
	16	2990	0.098	1470	2190	0.088	970	1590	0.078	620	1000	0.108	540
	20	2390	0.132	1580	1750	0.119	1040	1270	0.106	670	800	0.145	580

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF743

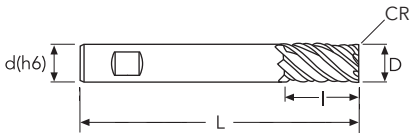
weldon shank, long 5 flutes ideal for trochoidal milling, corner radius

OSAWA NORM | MG PV300 | <40 HRC | 36°/37°/38° | RADIUS | Z5

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
6	0/-0.025	0.10	+/-0.010	6	25		75	5	HF7430106075	●
8	0/-0.030	0.20	+/-0.010	8	25		75	5	HF7430208075	●
10	0/-0.030	0.20	+/-0.010	10	38		100	5	HF74302100100	●
12	0/-0.030	0.30	+/-0.010	12	45		100	5	HF74303120100	●
16	0/-0.030	0.30	+/-0.010	16	55		125	5	HF74303160125	●
20	0/-0.030	0.30	+/-0.010	20	65		125	5	HF74303200125	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF743

SIDE MILLING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**1.5D x 03D**			**1.5D x 0.3D**			**1.2D x 0.2D**			**1.2D x 0.2D**		
Vc (m/min)	**110-130**			**70-90**			**50-70**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	6370	0.023	740	4250	0.021	450	3180	0.019	300	2120	0.026	270
8	4780	0.028	660	3180	0.025	400	2390	0.022	260	1590	0.030	240
10	3820	0.033	630	2550	0.030	380	1910	0.026	250	1270	0.036	230
12	3180	0.037	590	2120	0.033	350	1590	0.030	240	1060	0.041	220
16	2390	0.042	510	1590	0.038	300	1190	0.034	200	800	0.047	190
20	1910	0.057	540	1270	0.051	330	960	0.046	220	640	0.063	200

HELICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
Vc (m/min)	**90-110**			**60-80**			**40-60**			**20-40**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	5310	0.016	435	3720	0.016	290	2650	0.013	172	1590	0.014	109
8	3980	0.019	385	2790	0.018	255	1990	0.015	153	1190	0.016	96
10	3180	0.023	365	2230	0.022	245	1590	0.018	145	960	0.019	92
12	2650	0.026	345	1860	0.025	230	1330	0.021	137	800	0.022	87
16	1990	0.030	295	1390	0.028	195	1000	0.024	118	600	0.025	74
20	1590	0.040	315	1110	0.038	210	800	0.032	127	480	0.033	80

RAMPING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**5° x D**			**4° x D**			**3° x D**			**3° x D**		
Vc (m/min)	**80-100**			**50-70**			**35-55**			**20-30**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	4780	0.017	405	3180	0.016	250	2390	0.015	179	1330	0.021	137
8	3580	0.020	360	2390	0.019	225	1790	0.018	158	1000	0.024	122
10	2870	0.024	345	1910	0.022	215	1430	0.021	150	800	0.029	116
12	2390	0.027	325	1590	0.025	200	1190	0.024	142	660	0.033	108
16	1790	0.031	275	1190	0.029	170	900	0.027	122	500	0.037	93
20	1430	0.042	295	960	0.039	185	720	0.037	131	400	0.050	100

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF742 PARAMETERS.

CUTTING PARAMETERS

HF743

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
VERTICAL	Vc (m/min)	**80-100**			**50-70**			**35-55**			**20-30**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	4780	0.022	520	3180	0.019	310	2390	0.016	190	1330	0.015	100
	8	3580	0.026	460	2390	0.023	280	1790	0.019	170	1000	0.018	90
	10	2870	0.030	440	1910	0.027	260	1430	0.023	160	800	0.021	90
	12	2390	0.034	410	1590	0.031	250	1190	0.026	150	660	0.024	80
	16	1790	0.039	350	1190	0.035	210	900	0.029	130	500	0.027	70
	20	1430	0.053	380	960	0.048	230	720	0.040	140	400	0.037	70

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**3D x 0.1D**			**3D x 0.1D**			**2D x 0.1D**			**2D x 0.1D**		
TROCHOIDAL	Vc (m/min)	**130-170**			**100-120**			**70-90**			**40-60**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7960	0.054	2150	5840	0.049	1420	4250	0.043	920	2650	0.059	790
	8	5970	0.064	1910	4380	0.058	1260	3180	0.051	810	1990	0.070	700
	10	4780	0.076	1820	3500	0.068	1200	2550	0.061	780	1590	0.084	660
	12	3980	0.086	1710	2920	0.077	1130	2120	0.069	730	1330	0.095	630
	16	2990	0.098	1470	2190	0.088	970	1590	0.078	620	1000	0.108	540
	20	2390	0.132	1580	1750	0.119	1040	1270	0.106	670	800	0.145	580

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
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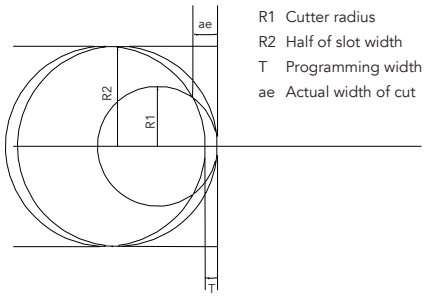
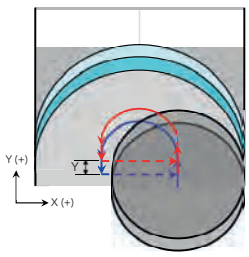
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF742 PARAMETERS.

HF861

weldon shank, SC smooth cut for low cutting force, chamfer + radius

OSAWA NORM | MG PV300 | <40 HRC | VH 36°/39° | C+R | Z4 UP

from D1 to D2.5: cylindrical shank

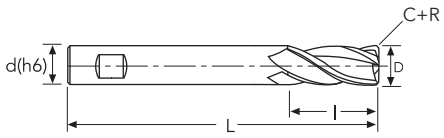
C+R

from D3: weldon shank

P	M	K	N	S	H
★	★	★		★	

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | DRILLING | TROCHOIDAL



D	D Tol.	C+R	C+R Tol	d(h6)	l	l1	L	z	EDP No.	Stock
1	0/-0.020		+/-0.020	4	3		50	4	HF861010	●
1.5	0/-0.020		+/-0.020	4	4.5		50	4	HF861015	●
2	0/-0.020		+/-0.020	4	6.5		50	4	HF861020	●
2.5	0/-0.020		+/-0.020	4	6.5		50	4	HF861025	●
3	0/-0.025	0.1	+/-0.020	6	9		50	4	HF861030	●
3.5	0/-0.025	0.1	+/-0.020	6	12		50	4	HF861035	●
4	0/-0.025	0.1	+/-0.020	6	12		50	4	HF861040	●
4.5	0/-0.025	0.1	+/-0.020	6	15		50	4	HF861045	●
5	0/-0.025	0.1	+/-0.020	6	15		50	4	HF861050	●
6	0/-0.025	0.1	+/-0.020	6	20		60	4	HF861060	●
7	0/-0.030	0.2	+/-0.020	8	22		64	4	HF861070	●
8	0/-0.030	0.2	+/-0.020	8	22		64	4	HF861080	●
9	0/-0.030	0.2	+/-0.020	10	27		70	4	HF861090	●
10	0/-0.030	0.2	+/-0.020	10	27		70	4	HF861100	●
11	0/-0.030	0.2	+/-0.020	12	32		75	4	HF861110	●
12	0/-0.030	0.2	+/-0.020	12	32		75	4	HF861120	●
13	0/-0.030	0.2	+/-0.020	14	32		90	4	HF861130	●
14	0/-0.030	0.2	+/-0.020	14	32		90	4	HF861140	●
15	0/-0.030	0.2	+/-0.020	16	32		90	4	HF861150	●
16	0/-0.030	0.2	+/-0.020	16	32		90	4	HF861160	●
18	0/-0.030	0.2	+/-0.020	18	38		100	4	HF861180	●
20	0/-0.030	0.2	+/-0.020	20	38		100	4	HF861200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

HF861

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D X D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	1	30000	0.005	600	28660	0.005	520	22290	0.004	330	12740	0.004	180
	1.5	29720	0.008	890	19110	0.007	520	14860	0.006	330	8490	0.005	180
	2	22290	0.010	890	14330	0.009	520	11150	0.008	330	6370	0.007	180
	3	14860	0.014	830	9550	0.013	480	7430	0.011	310	4250	0.010	170
	4	11150	0.019	830	7170	0.017	480	5570	0.014	310	3180	0.013	160
	5	8920	0.023	820	5730	0.021	470	4460	0.017	310	2550	0.016	160
	6	7430	0.027	800	4780	0.024	460	3720	0.020	300	2120	0.019	160
	8	5570	0.035	780	3580	0.032	450	2790	0.026	290	1590	0.025	160
	10	4460	0.042	750	2870	0.038	430	2230	0.032	280	1270	0.029	150
	12	3720	0.048	710	2390	0.043	410	1860	0.036	270	1060	0.034	140
	14	3180	0.054	690	2050	0.049	400	1590	0.041	260	910	0.038	140
	16	2790	0.060	670	1790	0.054	390	1390	0.045	250	800	0.042	130
	18	2480	0.066	650	1590	0.059	380	1240	0.050	250	710	0.046	130
	20	2230	0.073	650	1430	0.066	380	1110	0.055	240	640	0.051	130

ap x ae	**D1**	0.25D x D
ap x ae	**≤ D3**	0.5D x D

	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3								
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²								
	ap x ae	**1.5D x D**			**1.5D x D**								
	Vc (m/min)	**100-120**			**60-80**								
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)						
	8	4380	0.028	490	2790	0.025	280						
	10	3500	0.034	470	2230	0.030	270						
	12	2920	0.038	450	1860	0.035	260						
	14	2500	0.043	430	1590	0.039	250						
	16	2190	0.048	420	1390	0.043	240						
	18	1950	0.053	410	1240	0.048	240						
	20	1750	0.058	410	1110	0.053	230						

	Material Group ISO 513	P1 P2 M1 K1											
	Hardness/Rm	≤ 700 N/mm²											
	ap x ae	**2D x D**											
	Vc (m/min)	**75-95**											
SLOTTING	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)									
	10	2710	0.025	270									
	12	2260	0.029	260									
	14	1930	0.032	250									
	16	1690	0.036	240									
	18	1500	0.040	240									
	20	1350	0.044	240									

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF840 PARAMETERS.

CUTTING PARAMETERS

HF861

SIDE MILLING

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
ap x ae	**1.5D x 0.5D**			**1.5D x 0.5D**			**1.2D x 0.3D**			**1.2D x 0.3D**		
Vc (m/min)	**160-180**			**100-120**			**70-90**			**40-60**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
1	30000	0.006	720	30000	0.005	650	25480	0.005	490	15920	0.007	420
1.5	36090	0.009	1300	23350	0.008	760	16990	0.007	490	10620	0.010	420
2	27070	0.012	1300	17520	0.011	760	12740	0.010	490	7960	0.013	420
3	18050	0.017	1210	11680	0.015	710	8490	0.013	460	5310	0.018	390
4	13540	0.022	1200	8760	0.020	700	6370	0.018	450	3980	0.024	390
5	10830	0.028	1200	7010	0.025	700	5100	0.022	450	3180	0.030	390
6	9020	0.032	1170	5840	0.029	680	4250	0.026	440	2650	0.036	380
8	6770	0.042	1140	4380	0.038	660	3180	0.034	430	1990	0.046	370
10	5410	0.050	1090	3500	0.045	640	2550	0.040	410	1590	0.055	350
12	4510	0.058	1040	2920	0.052	610	2120	0.046	390	1330	0.063	340
14	3870	0.065	1000	2500	0.058	580	1820	0.052	380	1140	0.071	330
16	3380	0.072	970	2190	0.065	570	1590	0.058	370	1000	0.079	320
18	3010	0.079	950	1950	0.071	560	1420	0.063	360	880	0.087	310
20	2710	0.088	950	1750	0.079	550	1270	0.070	360	800	0.096	310

ap x ae	**≤ D3**	1.5D x 0.1D

HELICAL

Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**3° x 0.4D**		
Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
1	30000	0.004	435	28660	0.003	390	22290	0.003	268	12740	0.003	143
1.5	29720	0.005	650	19110	0.005	390	14860	0.005	268	8490	0.004	143
2	22290	0.007	650	14330	0.007	390	11150	0.006	268	6370	0.006	143
3	14860	0.010	605	9550	0.010	365	7430	0.008	250	4250	0.008	133
4	11150	0.013	600	7170	0.013	360	5570	0.011	247	3180	0.010	132
5	8920	0.017	600	5730	0.016	360	4460	0.014	246	2550	0.013	131
6	7430	0.020	585	4780	0.018	350	3720	0.016	241	2120	0.015	128
8	5570	0.025	570	3580	0.024	340	2790	0.021	235	1590	0.020	125
10	4460	0.031	545	2870	0.029	325	2230	0.025	225	1270	0.024	120
12	3720	0.035	520	2390	0.033	310	1860	0.029	214	1060	0.027	114
14	3180	0.039	500	2050	0.037	300	1590	0.032	206	910	0.030	110
16	2790	0.044	490	1790	0.041	290	1390	0.036	200	800	0.034	108
18	2480	0.048	475	1590	0.045	285	1240	0.040	197	710	0.037	105
20	2230	0.053	475	1430	0.050	285	1110	0.044	195	640	0.041	105

α° max	**≤ D3**	1°

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF840 PARAMETERS.

HF861

RAMPING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	α° x ae	**15° x D**			**10° x D**			**5° x D**			**5° x D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.022	640	4780	0.020	380	3720	0.019	281	2120	0.026	220
	8	5570	0.028	620	3580	0.026	370	2790	0.024	273	1590	0.034	214
	10	4460	0.034	600	2870	0.031	355	2230	0.029	262	1270	0.040	205
	12	3720	0.038	570	2390	0.035	335	1860	0.034	250	1060	0.046	196
	14	3180	0.043	550	2050	0.040	325	1590	0.038	240	910	0.052	189
	16	2790	0.048	535	1790	0.044	315	1390	0.042	233	800	0.058	185
	18	2480	0.053	520	1590	0.048	310	1240	0.046	229	710	0.063	180
	20	2230	0.058	520	1430	0.054	305	1110	0.051	227	640	0.070	180

VERTICAL	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
	Vc (m/min)	**130-150**			**80-100**			**60-80**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	6	7430	0.027	800	4780	0.024	460	3720	0.020	300	2120	0.019	160
	8	5570	0.035	780	3580	0.032	450	2790	0.026	290	1590	0.025	160
	10	4460	0.042	750	2870	0.038	430	2230	0.032	280	1270	0.029	150
	12	3720	0.048	710	2390	0.043	410	1860	0.036	270	1060	0.034	140
	14	3180	0.054	690	2050	0.049	400	1590	0.041	260	910	0.038	140
	16	2790	0.060	670	1790	0.054	390	1390	0.045	250	800	0.042	130
	18	2480	0.066	650	1590	0.059	380	1240	0.050	250	710	0.046	130
	20	2230	0.073	650	1430	0.066	380	1110	0.055	240	640	0.051	130

DRILLING	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**D x D**			**D x D**			**0.5D x D**			**0.5D x D**		
	Vc (m/min)	**100-120**			**60-80**			**45-65**			**20-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	1	30000	0.003	300	22290	0.002	200	17520	0.002	140	9550	0.003	110
	1.5	23350	0.004	350	14860	0.003	200	11680	0.003	140	6370	0.004	110
	2	17520	0.005	350	11150	0.005	200	8760	0.004	140	4780	0.006	110
	3	11680	0.007	330	7430	0.006	190	5840	0.006	130	3180	0.008	100
	4	8760	0.009	320	5570	0.008	190	4380	0.007	130	2390	0.010	100
	5	7010	0.012	320	4460	0.010	180	3500	0.009	130	1910	0.013	100
	6	5840	0.014	320	3720	0.012	180	2920	0.011	130	1590	0.015	90
	8	4380	0.018	310	2790	0.016	180	2190	0.014	120	1190	0.019	90
	10	3500	0.021	290	2230	0.019	170	1750	0.017	120	960	0.023	90
	12	2920	0.024	280	1860	0.022	160	1460	0.019	110	800	0.026	80
	14	2500	0.027	270	1590	0.024	150	1250	0.022	110	680	0.030	80
	16	2190	0.030	260	1390	0.027	150	1090	0.024	100	600	0.033	80
	18	1950	0.033	260	1240	0.030	150	970	0.026	100	530	0.036	80
	20	1750	0.037	260	1110	0.033	150	880	0.029	100	480	0.040	80

ap x ae	**≤ D3**	0.5D x D											

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF840 PARAMETERS.

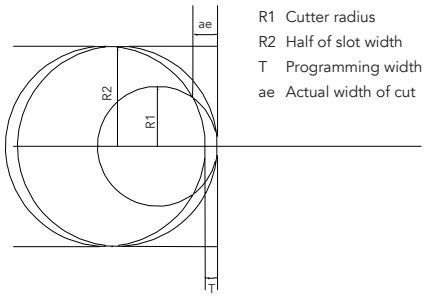
CUTTING PARAMETERS

HF861

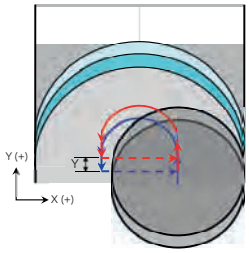
	Material Group ISO 513	P1 P2 M1 K1			P3 P4 M2 K2 K3			P5 M3 M4 K4 S1 S4			S2 S3 S5		
	Hardness/Rm	≤ 700 N/mm²			700-1000 N/mm²			≤ 35 HRC			≤ 40 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**190-230**			**130-150**			**100-120**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	1	30000	0.013	1500	30000	0.011	1350	30000	0.010	1200	19110	0.014	1050
	1.5	23350	0.019	1750	29720	0.017	2010	23350	0.015	1400	12740	0.021	1050
	2	30000	0.025	3000	22290	0.023	2010	17520	0.020	1400	9550	0.028	1050
	3	22290	0.035	3120	14860	0.032	1870	11680	0.028	1310	6370	0.039	980
	4	16720	0.046	3090	11150	0.042	1860	8760	0.037	1300	4780	0.051	970
	5	13380	0.058	3080	8920	0.052	1850	7010	0.046	1290	3820	0.063	970
	6	11150	0.068	3010	7430	0.061	1810	5840	0.054	1260	3180	0.074	940
	8	8360	0.088	2930	5570	0.079	1750	4380	0.070	1230	2390	0.096	920
	10	6690	0.105	2810	4460	0.095	1690	3500	0.084	1180	1910	0.116	880
	12	5570	0.120	2670	3720	0.108	1610	2920	0.096	1120	1590	0.132	840
	14	4780	0.135	2580	3180	0.122	1550	2500	0.108	1080	1360	0.149	810
	16	4180	0.150	2510	2790	0.135	1510	2190	0.120	1050	1190	0.165	790
	18	3720	0.165	2460	2480	0.149	1470	1950	0.132	1030	1060	0.182	770
	20	3340	0.183	2440	2230	0.164	1470	1750	0.146	1020	960	0.201	770

ap x ae	**D1**	D x 0.1D	D x 0.1D	D x 0.1D	D x 0.1D
ap x ae	**≤ D3**	1.5D x 0.1D	1.5D x 0.1D	D x 0.1D	D x 0.1D

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF840 PARAMETERS.

HF850

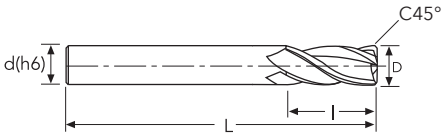
cylindrical shank, 45° chamfer

OSAWA NORM | MG PV300 | 30÷55 HRC | 40° | C45° | Z4 UP

P	M	K	N	S	H
★	★	★		★	★

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
3	0/-0.030	0.10	+/-0.020	6	9		57	4	HF850030	●
4	0/-0.030	0.10	+/-0.020	6	11		57	4	HF850040	●
5	0/-0.030	0.10	+/-0.020	6	13		57	4	HF850050	●
6	0/-0.030	0.10	+/-0.020	6	13		57	4	HF850060	●
8	0/-0.030	0.20	+/-0.020	8	20		64	4	HF850080	●
10	0/-0.030	0.20	+/-0.020	10	22		72	4	HF850100	●
12	0/-0.030	0.20	+/-0.020	12	26		83	4	HF850120	●
14	0/-0.030	0.30	+/-0.020	14	26		90	4	HF850140	●
16	0/-0.030	0.30	+/-0.020	16	32		92	4	HF850160	●
20	0/-0.030	0.40	+/-0.020	20	38		104	4	HF850200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF850

SLOTTING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**0.5D x D**			**0.5D x D**			**0.3D x D**			**0.3D x D**		
Vc (m/min)	**80-100**			**60-80**			**40-60**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	9550	0.012	450	7430	0.011	320	5310	0.009	190	4250	0.008	140
4	7170	0.016	450	5570	0.014	320	3980	0.012	190	3180	0.011	140
5	5730	0.020	450	4460	0.018	310	3180	0.015	190	2550	0.014	140
6	4780	0.023	440	3720	0.021	310	2650	0.017	180	2120	0.016	140
8	3580	0.030	430	2790	0.027	300	1990	0.022	180	1590	0.021	130
10	2870	0.036	410	2230	0.032	290	1590	0.027	170	1270	0.025	130
12	2390	0.041	390	1860	0.037	270	1330	0.031	160	1060	0.029	120
14	2050	0.046	380	1590	0.041	260	1140	0.034	160	910	0.032	120
16	1790	0.051	370	1390	0.046	260	1000	0.038	150	800	0.036	110
20	1430	0.062	350	1110	0.056	250	800	0.047	150	640	0.043	110

ap x ae	**≤ D5**	0.3D x D	0.3D x D	0.2D x D	0.1D x D

SIDE MILLING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**1.5D x 0.3D**			**1.5D x 0.2D**			**1.2D x 0.2D**			**1.2D x 0.1D**		
Vc (m/min)	**100-120**			**70-90**			**50-70**			**40-60**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	11680	0.014	670	8490	0.013	440	6370	0.011	290	5310	0.016	330
4	8760	0.019	660	6370	0.017	430	4780	0.015	290	3980	0.021	330
5	7010	0.023	660	5100	0.021	430	3820	0.019	290	3180	0.026	330
6	5840	0.028	640	4250	0.025	420	3180	0.022	280	2650	0.030	320
8	4380	0.036	630	3180	0.032	410	2390	0.029	270	1990	0.039	310
10	3500	0.043	600	2550	0.039	390	1910	0.034	260	1590	0.047	300
12	2920	0.049	570	2120	0.044	370	1590	0.039	250	1330	0.054	290
14	2500	0.055	550	1820	0.050	360	1360	0.044	240	1140	0.061	280
16	2190	0.061	540	1590	0.055	350	1190	0.049	230	1000	0.067	270
20	1750	0.074	520	1270	0.067	340	960	0.060	230	800	0.082	260

ap x ae	**≤ D5**	1.2D x 0.2D	1.2D x 0.1D	D x 0.2D	D x 0.1D

HELICAL

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
Vc (m/min)	**80-100**			**60-80**			**40-60**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
3	9550	0.009	330	7430	0.008	240	5310	0.007	152	4250	0.008	128
4	7170	0.011	330	5570	0.011	240	3980	0.009	150	3180	0.010	126
5	5730	0.014	325	4460	0.013	235	3180	0.012	149	2550	0.012	126
6	4780	0.017	320	3720	0.016	230	2650	0.014	146	2120	0.015	123
8	3580	0.022	310	2790	0.020	225	1990	0.018	142	1590	0.019	120
10	2870	0.026	300	2230	0.024	215	1590	0.021	136	1270	0.023	115
12	2390	0.030	285	1860	0.028	205	1330	0.024	130	1060	0.026	109
14	2050	0.033	275	1590	0.031	200	1140	0.028	126	910	0.029	106
16	1790	0.037	265	1390	0.035	190	1000	0.031	122	800	0.032	103
20	1430	0.045	260	1110	0.042	185	800	0.037	119	640	0.039	100

α°	**≤ D5**	2°	2°	1°	1°

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF850

RAMPING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
α° x ae	**5° x D**			**4° x D**			**3° x D**			**2° x D**		
Vc (m/min)	**80-100**			**60-80**			**40-60**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	4780	0.020	385	3720	0.019	280	2650	0.018	187	2120	0.027	232
8	3580	0.026	370	2790	0.024	270	1990	0.023	182	1590	0.035	226
10	2870	0.031	360	2230	0.029	260	1590	0.027	175	1270	0.043	216
12	2390	0.036	340	1860	0.033	245	1330	0.031	167	1060	0.049	206
14	2050	0.040	330	1590	0.037	240	1140	0.035	161	910	0.055	199
16	1790	0.045	320	1390	0.042	230	1000	0.039	157	800	0.061	195
20	1430	0.054	310	1110	0.051	225	800	0.048	153	640	0.074	189

VERTICAL

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
Vc (m/min)	**80-100**			**60-80**			**40-60**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	4780	0.023	440	3720	0.021	310	2650	0.017	180	2120	0.016	140
8	3580	0.030	430	2790	0.027	300	1990	0.022	180	1590	0.021	130
10	2870	0.036	410	2230	0.032	290	1590	0.027	170	1270	0.025	130
12	2390	0.041	390	1860	0.037	270	1330	0.031	160	1060	0.029	120
14	2050	0.046	380	1590	0.041	260	1140	0.034	160	910	0.032	120
16	1790	0.051	370	1390	0.046	260	1000	0.038	150	800	0.036	110
20	1430	0.062	350	1110	0.056	250	800	0.047	150	640	0.043	110

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

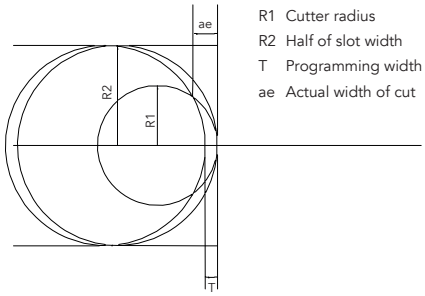
CUTTING PARAMETERS

HF850

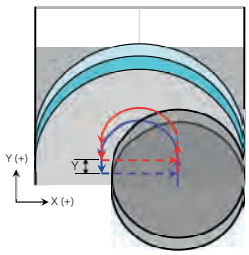
	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**130-150**			**100-120**			**70-90**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	14860	0.030	1770	11680	0.027	1250	8490	0.024	810	6370	0.033	830
	4	11150	0.039	1750	8760	0.035	1240	6370	0.031	800	4780	0.043	830
	5	8920	0.049	1740	7010	0.044	1230	5100	0.039	800	3820	0.054	820
	6	7430	0.057	1710	5840	0.052	1210	4250	0.046	780	3180	0.063	800
	8	5570	0.074	1660	4380	0.067	1170	3180	0.060	760	2390	0.082	780
	10	4460	0.089	1590	3500	0.080	1120	2550	0.071	730	1910	0.098	750
	12	3720	0.102	1520	2920	0.092	1070	2120	0.082	690	1590	0.112	710
	14	3180	0.115	1460	2500	0.103	1030	1820	0.092	670	1360	0.126	690
	16	2790	0.128	1420	2190	0.115	1010	1590	0.102	650	1190	0.140	670
	20	2230	0.155	1380	1750	0.140	980	1270	0.124	630	960	0.171	660

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			D x 0.1D			D x 0.05D		

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF450

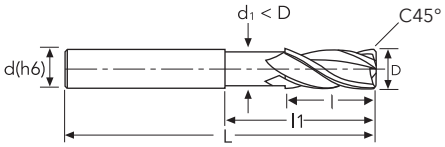
cylindrical shank and reduced neck, 45° chamfer

OSAWA NORM | MG PV300 | 30÷55 HRC | 40° | C45° | Z4 UP

P	M	K	N	S	H
★	★	★		★	★

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
3	0/-0.030	0.10	+/-0.020	6	9	15	2.80	57	4	HF450030	●
4	0/-0.030	0.10	+/-0.020	6	11	18	3.80	57	4	HF450040	●
5	0/-0.030	0.10	+/-0.020	6	13	19	4.80	57	4	HF450050	●
6	0/-0.030	0.10	+/-0.020	6	13	20	5.80	57	4	HF450060	●
8	0/-0.030	0.20	+/-0.020	8	20	26	7.80	64	4	HF450080	●
10	0/-0.030	0.20	+/-0.020	10	22	30	9.80	72	4	HF450100	●
12	0/-0.030	0.20	+/-0.020	12	26	36	11.80	83	4	HF450120	●
14	0/-0.030	0.20	+/-0.020	14	26	36	13.70	83	4	HF450140	●
16	0/-0.030	0.30	+/-0.020	16	32	42	15.70	92	4	HF450160	●
20	0/-0.030	0.40	+/-0.020	20	38	50	19.70	104	4	HF450200	●

● stock standard ○ non-standard stock ∇ stock exhaustion

CUTTING PARAMETERS

HF450

SLOTTING	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**0.5D x D**			**0.5D x D**			**0.3D x D**			**0.2D x D**		
	Vc (m/min)	**70-90**			**50-70**			**30-50**			**20-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	8490	0.011	360	6370	0.010	250	4250	0.008	140	3180	0.007	100
	4	6370	0.014	360	4780	0.013	240	3180	0.011	140	2390	0.010	90
	5	5100	0.018	360	3820	0.016	240	2550	0.013	130	1910	0.012	90
	6	4250	0.021	350	3180	0.019	240	2120	0.015	130	1590	0.014	90
	8	3180	0.027	340	2390	0.024	230	1590	0.020	130	1190	0.019	90
	10	2550	0.032	330	1910	0.029	220	1270	0.024	120	960	0.022	90
	12	2120	0.037	310	1590	0.033	210	1060	0.028	120	800	0.026	80
	14	1820	0.041	300	1360	0.037	200	910	0.031	110	680	0.029	80
	16	1590	0.046	290	1190	0.041	200	800	0.034	110	600	0.032	80
	20	1270	0.056	280	960	0.050	190	640	0.042	110	480	0.039	80
ap x ae	**≤ D5**	0.3D x D			0.3D x D			0.2D x D			0.1D x D		

SIDE MILLING	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**1.5D x 0.3D**			**1.5D x 0.2D**			**1.2D x 0.2D**			**D x 0.1D**		
	Vc (m/min)	**90-110**			**60-80**			**40-60**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	10620	0.013	550	7430	0.012	340	5310	0.010	220	4250	0.014	240
	4	7960	0.017	540	5570	0.015	340	3980	0.014	220	3180	0.019	240
	5	6370	0.021	540	4460	0.019	340	3180	0.017	210	2550	0.023	240
	6	5310	0.025	530	3720	0.022	330	2650	0.020	210	2120	0.027	230
	8	3980	0.032	510	2790	0.029	320	1990	0.026	200	1590	0.035	220
	10	3180	0.039	490	2230	0.035	310	1590	0.031	200	1270	0.042	220
	12	2650	0.044	470	1860	0.040	300	1330	0.035	190	1060	0.048	210
	14	2270	0.050	450	1590	0.045	280	1140	0.040	180	910	0.055	200
	16	1990	0.055	440	1390	0.050	280	1000	0.044	180	800	0.061	190
	20	1590	0.067	430	1110	0.060	270	800	0.054	170	640	0.074	190
ap x ae	**≤ D5**	1.2D x 0.2D			1.2D x 0.1D			D x 0.1D			D x 0.05D		

HELICAL	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
	Vc (m/min)	**70-90**			**50-70**			**30-50**			**20-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	8490	0.008	265	6370	0.007	185	4250	0.006	109	3180	0.007	86
	4	6370	0.010	265	4780	0.010	185	3180	0.008	108	2390	0.009	86
	5	5100	0.013	260	3820	0.012	185	2550	0.011	108	1910	0.011	85
	6	4250	0.015	255	3180	0.014	180	2120	0.012	105	1590	0.013	83
	8	3180	0.019	250	2390	0.018	175	1590	0.016	102	1190	0.017	81
	10	2550	0.023	240	1910	0.022	165	1270	0.019	98	960	0.020	78
	12	2120	0.027	225	1590	0.025	160	1060	0.022	93	800	0.023	74
	14	1820	0.030	220	1360	0.028	155	910	0.025	90	680	0.026	71
	16	1590	0.033	215	1190	0.031	150	800	0.028	88	600	0.029	70
	20	1270	0.041	205	960	0.038	145	640	0.034	86	480	0.035	68
α°	**≤ D5**	2°			2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF450

RAMPING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
α° x ae	**5° x D**			**4° x D**			**3° x D**			**2° x D**		
Vc (m/min)	**60-80**			**50-60**			**30-40**			**20-30**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	3720	0.018	270	2920	0.017	195	1860	0.016	118	1330	0.025	131
8	2790	0.023	260	2190	0.022	190	1390	0.021	114	1000	0.032	128
10	2230	0.028	250	1750	0.026	185	1110	0.025	110	800	0.038	123
12	1860	0.032	240	1460	0.030	175	930	0.028	105	660	0.044	116
14	1590	0.036	230	1250	0.034	170	800	0.032	102	570	0.049	112
16	1390	0.040	225	1090	0.037	165	700	0.035	99	500	0.055	109
20	1110	0.049	215	880	0.045	160	560	0.043	96	400	0.067	107

VERTICAL

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
Vc (m/min)	**60-80**			**50-60**			**30-40**			**20-30**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	3720	0.021	310	2920	0.019	220	1860	0.015	120	1330	0.014	80
8	2790	0.027	300	2190	0.024	210	1390	0.020	110	1000	0.019	70
10	2230	0.032	290	1750	0.029	200	1110	0.024	110	800	0.022	70
12	1860	0.037	270	1460	0.033	190	930	0.028	100	660	0.026	70
14	1590	0.041	260	1250	0.037	190	800	0.031	100	570	0.029	70
16	1390	0.046	260	1090	0.041	180	700	0.034	100	500	0.032	60
20	1110	0.056	250	880	0.050	180	560	0.042	90	400	0.039	60

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

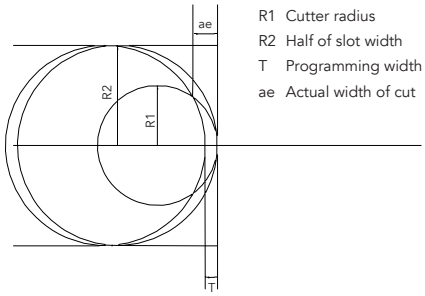
CUTTING PARAMETERS

HF450

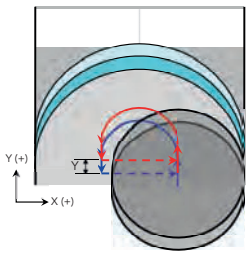
	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**1.5D x 0.1D**			**1.5D x 0.1D**			**D x 0.1D**			**D x 0.1D**		
	Vc (m/min)	**110-130**			**80-100**			**50-70**			**40-60**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.027	1360	9550	0.024	920	6370	0.021	550	5310	0.029	630
	4	9550	0.035	1350	7170	0.032	910	4780	0.028	540	3980	0.039	620
	5	7640	0.044	1340	5730	0.040	910	3820	0.035	540	3180	0.048	620
	6	6370	0.052	1320	4780	0.046	890	3180	0.041	530	2650	0.057	600
	8	4780	0.067	1280	3580	0.060	860	2390	0.054	510	1990	0.074	590
	10	3820	0.080	1230	2870	0.072	830	1910	0.064	490	1590	0.088	560
	12	3180	0.092	1170	2390	0.083	790	1590	0.073	470	1330	0.101	540
	14	2730	0.103	1130	2050	0.093	760	1360	0.083	450	1140	0.114	520
	16	2390	0.115	1100	1790	0.103	740	1190	0.092	440	1000	0.126	500
	20	1040	0.140	580	1430	0.126	720	960	0.112	430	800	0.154	490

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			D x 0.1D			D x 0.05D		

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF451

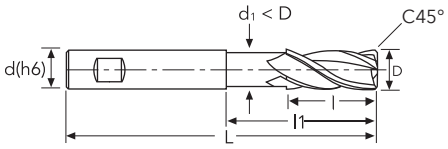
weldon shank and reduced neck, 45° chamfer

OSAWA NORM | MG PV300 | 30÷55 HRC | 40° | C45° | Z4 UP

P	M	K	N	S	H
★	★	★		★	★

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	C45°	C45° Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
3	0/-0.030	0.10	+/-0.020	6	9	15	2.80	57	4	HF451030	●
4	0/-0.030	0.10	+/-0.020	6	11	18	3.80	57	4	HF451040	●
5	0/-0.030	0.10	+/-0.020	6	13	19	4.80	57	4	HF451050	●
6	0/-0.030	0.10	+/-0.020	6	13	20	5.80	57	4	HF451060	●
8	0/-0.030	0.20	+/-0.020	8	20	26	7.80	64	4	HF451080	●
10	0/-0.030	0.20	+/-0.020	10	22	30	9.80	72	4	HF451100	●
12	0/-0.030	0.20	+/-0.020	12	26	36	11.80	83	4	HF451120	●
14	0/-0.030	0.20	+/-0.020	14	26	36	13.70	83	4	HF451140	●
16	0/-0.030	0.30	+/-0.020	16	32	42	15.70	92	4	HF451160	●
20	0/-0.030	0.40	+/-0.020	20	38	50	19.70	104	4	HF451200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF451

SLOTTING	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**0.5D x D**			**0.5D x D**			**0.3D x D**			**0.2D x D**		
	Vc (m/min)	**70-90**			**50-70**			**30-50**			**20-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	8490	0.011	360	6370	0.010	250	4250	0.008	140	3180	0.007	100
	4	6370	0.014	360	4780	0.013	240	3180	0.011	140	2390	0.010	90
	5	5100	0.018	360	3820	0.016	240	2550	0.013	130	1910	0.012	90
	6	4250	0.021	350	3180	0.019	240	2120	0.015	130	1590	0.014	90
	8	3180	0.027	340	2390	0.024	230	1590	0.020	130	1190	0.019	90
	10	2550	0.032	330	1910	0.029	220	1270	0.024	120	960	0.022	90
	12	2120	0.037	310	1590	0.033	210	1060	0.028	120	800	0.026	80
	14	1820	0.041	300	1360	0.037	200	910	0.031	110	680	0.029	80
	16	1590	0.046	290	1190	0.041	200	800	0.034	110	600	0.032	80
	20	1270	0.056	280	960	0.050	190	640	0.042	110	480	0.039	80
ap x ae	**≤ D5**	0.3D x D			0.3D x D			0.2D x D			0.1D x D		

SIDE MILLING	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**1.5D x 0.3D**			**1.5D x 0.2D**			**1.2D x 0.2D**			**D x 0.1D**		
	Vc (m/min)	**90-110**			**60-80**			**40-60**			**30-50**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	10620	0.013	550	7430	0.012	340	5310	0.010	220	4250	0.014	240
	4	7960	0.017	540	5570	0.015	340	3980	0.014	220	3180	0.019	240
	5	6370	0.021	540	4460	0.019	340	3180	0.017	210	2550	0.023	240
	6	5310	0.025	530	3720	0.022	330	2650	0.020	210	2120	0.027	230
	8	3980	0.032	510	2790	0.029	320	1990	0.026	200	1590	0.035	220
	10	3180	0.039	490	2230	0.035	310	1590	0.031	200	1270	0.042	220
	12	2650	0.044	470	1860	0.040	300	1330	0.035	190	1060	0.048	210
	14	2270	0.050	450	1590	0.045	280	1140	0.040	180	910	0.055	200
	16	1990	0.055	440	1390	0.050	280	1000	0.044	180	800	0.061	190
	20	1590	0.067	430	1110	0.060	270	800	0.054	170	640	0.074	190
ap x ae	**≤ D5**	1.2D x 0.2D			1.2D x 0.1D			D x 0.1D			D x 0.05D		

HELICAL	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
	Vc (m/min)	**70-90**			**50-70**			**30-50**			**20-40**		
	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	8490	0.008	265	6370	0.007	185	4250	0.006	109	3180	0.007	86
	4	6370	0.010	265	4780	0.010	185	3180	0.008	108	2390	0.009	86
	5	5100	0.013	260	3820	0.012	185	2550	0.011	108	1910	0.011	85
	6	4250	0.015	255	3180	0.014	180	2120	0.012	105	1590	0.013	83
	8	3180	0.019	250	2390	0.018	175	1590	0.016	102	1190	0.017	81
	10	2550	0.023	240	1910	0.022	165	1270	0.019	98	960	0.020	78
	12	2120	0.027	225	1590	0.025	160	1060	0.022	93	800	0.023	74
	14	1820	0.030	220	1360	0.028	155	910	0.025	90	680	0.026	71
	16	1590	0.033	215	1190	0.031	150	800	0.028	88	600	0.029	70
	20	1270	0.041	205	960	0.038	145	640	0.034	86	480	0.035	68
α°	**≤ D5**	2°			2°			1°			1°		

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF450 PARAMETERS.

CUTTING PARAMETERS

HF451

RAMPING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
α° x ae	5° x D			4° x D			3° x D			2° x D		
Vc (m/min)	60-80			50-60			30-40			20-30		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	3720	0.018	270	2920	0.017	195	1860	0.016	118	1330	0.025	131
8	2790	0.023	260	2190	0.022	190	1390	0.021	114	1000	0.032	128
10	2230	0.028	250	1750	0.026	185	1110	0.025	110	800	0.038	123
12	1860	0.032	240	1460	0.030	175	930	0.028	105	660	0.044	116
14	1590	0.036	230	1250	0.034	170	800	0.032	102	570	0.049	112
16	1390	0.040	225	1090	0.037	165	700	0.035	99	500	0.055	109
20	1110	0.049	215	880	0.045	160	560	0.043	96	400	0.067	107

VERTICAL

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	D x 0.4D			D x 0.4D			D x 0.25D			D x 0.25D		
Vc (m/min)	60-80			50-60			30-40			20-30		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	3720	0.021	310	2920	0.019	220	1860	0.015	120	1330	0.014	80
8	2790	0.027	300	2190	0.024	210	1390	0.020	110	1000	0.019	70
10	2230	0.032	290	1750	0.029	200	1110	0.024	110	800	0.022	70
12	1860	0.037	270	1460	0.033	190	930	0.028	100	660	0.026	70
14	1590	0.041	260	1250	0.037	190	800	0.031	100	570	0.029	70
16	1390	0.046	260	1090	0.041	180	700	0.034	100	500	0.032	60
20	1110	0.056	250	880	0.050	180	560	0.042	90	400	0.039	60

PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF450 PARAMETERS.

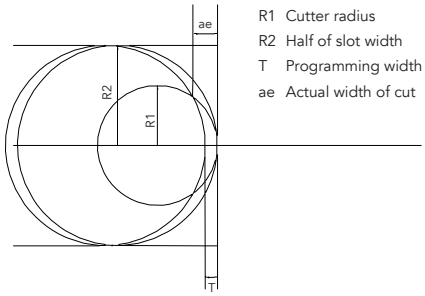
CUTTING PARAMETERS

HF451

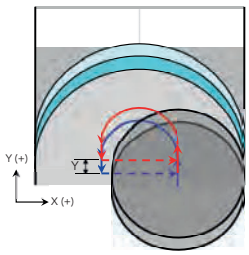
	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**1.5D x 0.1D**			**1.5D x 0.1D**			**D x 0.1D**			**D x 0.1D**		
	Vc (m/min)	**110-130**			**80-100**			**50-70**			**40-60**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.027	1360	9550	0.024	920	6370	0.021	550	5310	0.029	630
	4	9550	0.035	1350	7170	0.032	910	4780	0.028	540	3980	0.039	620
	5	7640	0.044	1340	5730	0.040	910	3820	0.035	540	3180	0.048	620
	6	6370	0.052	1320	4780	0.046	890	3180	0.041	530	2650	0.057	600
	8	4780	0.067	1280	3580	0.060	860	2390	0.054	510	1990	0.074	590
	10	3820	0.080	1230	2870	0.072	830	1910	0.064	490	1590	0.088	560
	12	3180	0.092	1170	2390	0.083	790	1590	0.073	470	1330	0.101	540
	14	2730	0.103	1130	2050	0.093	760	1360	0.083	450	1140	0.114	520
	16	2390	0.115	1100	1790	0.103	740	1190	0.092	440	1000	0.126	500
	20	1910	0.140	1070	1430	0.126	720	960	0.112	430	800	0.154	490

ap x ae	**≤ D5**	1.5D x 0.1D	1.5D x 0.1D	D x 0.1D	D x 0.05D

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH PRECISION WELDON CHUCK AND STABLE MACHINING CONDITION.
FOR APPLICATION ON HIGH POWER MILLING CHUCK, PLEASE REFER TO HF450 PARAMETERS.

HF852

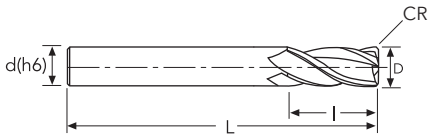
cylindrical shank, corner radius

OSAWA NORM | MG PV300 | 30÷55 HRC | 40° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	★

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	L	z	EDP No.	Stock
4	0/-0.025	0.30	+/-0.010	6	12		57	4	HF85203040	●
4	0/-0.025	0.50	+/-0.010	6	12		57	4	HF85205040	●
5	0/-0.025	0.30	+/-0.010	6	15		57	4	HF85203050	●
5	0/-0.025	0.50	+/-0.010	6	15		57	4	HF85205050	●
6	0/-0.025	0.30	+/-0.010	6	16		57	4	HF85203060	●
6	0/-0.025	0.50	+/-0.010	6	16		57	4	HF85205060	●
6	0/-0.025	1.00	+/-0.010	6	16		57	4	HF85210060	●
8	0/-0.030	0.50	+/-0.010	8	20		64	4	HF85205080	●
8	0/-0.030	1.00	+/-0.010	8	20		64	4	HF85210080	●
10	0/-0.030	0.50	+/-0.010	10	22		72	4	HF85205100	●
10	0/-0.030	1.00	+/-0.010	10	22		72	4	HF85210100	●
12	0/-0.030	0.50	+/-0.010	12	26		83	4	HF85205120	●
12	0/-0.030	1.00	+/-0.010	12	26		83	4	HF85210120	●
12	0/-0.030	2.00	+/-0.010	12	26		83	4	HF85220120	●
12	0/-0.030	3.00	+/-0.010	12	26		83	4	HF85230120	●
14	0/-0.030	1.00	+/-0.010	14	32		83	4	HF85210140	●
16	0/-0.030	1.00	+/-0.010	16	32		92	4	HF85210160	●
16	0/-0.030	2.00	+/-0.010	16	32		92	4	HF85220160	●
20	0/-0.030	1.00	+/-0.010	20	38		104	4	HF85210200	●
20	0/-0.030	2.00	+/-0.010	20	38		104	4	HF85220200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

CUTTING PARAMETERS

HF852

SLOTTING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**0.5D x D**			**0.5D x D**			**0.3D x D**			**0.2D x D**		
Vc (m/min)	**80-100**			**60-80**			**40-60**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
4	7170	0.016	450	5570	0.014	320	3980	0.012	190	3180	0.011	140
5	5730	0.020	450	4460	0.018	310	3180	0.015	190	2550	0.014	140
6	4780	0.023	440	3720	0.021	310	2650	0.017	180	2120	0.016	140
8	3580	0.030	430	2790	0.027	300	1990	0.022	180	1590	0.021	130
10	2870	0.036	410	2230	0.032	290	1590	0.027	170	1270	0.025	130
12	2390	0.041	390	1860	0.037	270	1330	0.031	160	1060	0.029	120
14	2050	0.046	380	1590	0.041	260	1140	0.034	160	910	0.032	120
16	1790	0.051	370	1390	0.046	260	1000	0.038	150	800	0.036	110
20	1430	0.062	350	1110	0.056	250	800	0.047	150	640	0.043	110

ap x ae	**≤ D5**	0.3D x D	0.3D x D	0.2D x D	0.1D x D

SIDE MILLING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**1.5D x 0.3D**			**1.5D x 0.2D**			**1.2D x 0.2D**			**1.2D x 0.1D**		
Vc (m/min)	**100-120**			**70-90**			**50-70**			**40-60**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
4	8760	0.019	660	6370	0.017	430	4780	0.015	290	3980	0.021	330
5	7010	0.023	660	5100	0.021	430	3820	0.019	290	3180	0.026	330
6	5840	0.028	640	4250	0.025	420	3180	0.022	280	2650	0.030	320
8	4380	0.036	630	3180	0.032	410	2390	0.029	270	1990	0.039	310
10	3500	0.043	600	2550	0.039	390	1910	0.034	260	1590	0.047	300
12	2920	0.049	570	2120	0.044	370	1590	0.039	250	1330	0.054	290
14	2500	0.055	550	1820	0.050	360	1360	0.044	240	1140	0.061	280
16	2190	0.061	540	1590	0.055	350	1190	0.049	230	1000	0.067	270
20	1750	0.074	520	1270	0.067	340	960	0.060	230	800	0.082	260

ap x ae	**≤ D5**	1.2D x 0.2D	1.2D x 0.1D	D x 0.2D	D x 0.1D

HELICAL

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
Vc (m/min)	**80-100**			**60-80**			**40-60**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
4	7170	0.011	330	5570	0.011	240	3980	0.009	150	3180	0.010	126
5	5730	0.014	325	4460	0.013	235	3180	0.012	149	2550	0.012	126
6	4780	0.017	320	3720	0.016	230	2650	0.014	146	2120	0.015	123
8	3580	0.022	310	2790	0.020	225	1990	0.018	142	1590	0.019	120
10	2870	0.026	300	2230	0.024	215	1590	0.021	136	1270	0.023	115
12	2390	0.030	285	1860	0.028	205	1330	0.024	130	1060	0.026	109
14	2050	0.033	275	1590	0.031	200	1140	0.028	126	910	0.029	106
16	1790	0.037	265	1390	0.035	190	1000	0.031	122	800	0.032	103
20	1430	0.045	260	1110	0.042	185	800	0.037	119	640	0.039	100

α°	**≤ D5**	2°	2°	1°	1°

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

HF852

RAMPING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
α° x ae	**5° x D**			**4° x D**			**3° x D**			**2° x D**		
Vc (m/min)	**80-100**			**60-80**			**40-60**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	4780	0.020	385	3720	0.019	280	2650	0.018	187	2120	0.027	232
8	3580	0.026	370	2790	0.024	270	1990	0.023	182	1590	0.035	226
10	2870	0.031	360	2230	0.029	260	1590	0.027	175	1270	0.043	216
12	2390	0.036	340	1860	0.033	245	1330	0.031	167	1060	0.049	206
14	2050	0.040	330	1590	0.037	240	1140	0.035	161	910	0.055	199
16	1790	0.045	320	1390	0.042	230	1000	0.039	157	800	0.061	195
20	1430	0.054	310	1110	0.051	225	800	0.048	153	640	0.074	189

VERTICAL

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
Vc (m/min)	**80-100**			**60-80**			**40-60**			**30-50**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	4780	0.023	440	3720	0.021	310	2650	0.017	180	2120	0.016	140
8	3580	0.030	430	2790	0.027	300	1990	0.022	180	1590	0.021	130
10	2870	0.036	410	2230	0.032	290	1590	0.027	170	1270	0.025	130
12	2390	0.041	390	1860	0.037	270	1330	0.031	160	1060	0.029	120
14	2050	0.046	380	1590	0.041	260	1140	0.034	160	910	0.032	120
16	1790	0.051	370	1390	0.046	260	1000	0.038	150	800	0.036	110
20	1430	0.062	350	1110	0.056	250	800	0.047	150	640	0.043	110

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

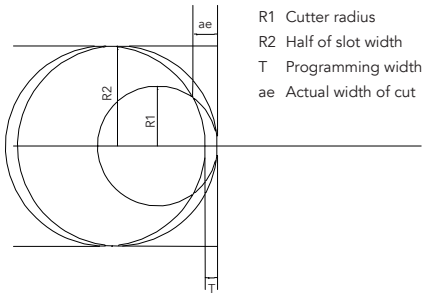
CUTTING PARAMETERS

HF852

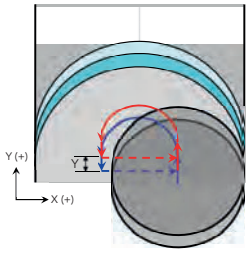
	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**2D x 0.2D**			**2D x 0.1D**			**1.5D x 0.1D**			**1.5D x 0.1D**		
	Vc (m/min)	**130-150**			**100-120**			**70-90**			**50-70**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	4	11150	0.039	1750	8760	0.035	1240	6370	0.031	800	4780	0.043	830
	5	8920	0.049	1740	7010	0.044	1230	5100	0.039	800	3820	0.054	820
	6	7430	0.057	1710	5840	0.052	1210	4250	0.046	780	3180	0.063	800
	8	5570	0.074	1660	4380	0.067	1170	3180	0.060	760	2390	0.082	780
	10	4460	0.089	1590	3500	0.080	1120	2550	0.071	730	1910	0.098	750
	12	3720	0.102	1520	2920	0.092	1070	2120	0.082	690	1590	0.112	710
	14	3180	0.115	1460	2500	0.103	1030	1820	0.092	670	1360	0.126	690
	16	2790	0.128	1420	2190	0.115	1010	1590	0.102	650	1190	0.140	670
	20	2230	0.155	1380	1750	0.140	980	1270	0.124	630	960	0.171	660

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			D x 0.1D			D x 0.05D		

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

HF452

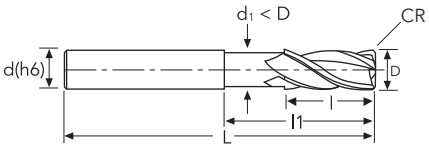
cylindrical shank and reduced neck, corner radius

OSAWA NORM | MG PV300 | 30÷55 HRC | 40° | RADIUS | Z4 UP

P	M	K	N	S	H
★	★	★		★	★

★ 1st choice ☆ suitable

SLOTTING | SIDE MILLING | HELICAL | RAMPING | VERTICAL | TROCHOIDAL



D	D Tol.	CR	CR Tol.	d(h6)	l	l1	d1	L	z	EDP No.	Stock
3	0/-0.030	0.30	+/-0.020	6	9	15	2.80	57	4	HF45203030	●
3	0/-0.030	0.50	+/-0.020	6	9	15	2.80	57	4	HF45205030	●
4	0/-0.030	0.30	+/-0.020	6	11	18	3.80	57	4	HF45203040	●
4	0/-0.030	0.50	+/-0.020	6	11	18	3.80	57	4	HF45205040	●
5	0/-0.030	0.50	+/-0.020	6	13	19	4.80	57	4	HF45205050	●
6	0/-0.030	0.50	+/-0.020	6	13	20	5.80	57	4	HF45205060	●
6	0/-0.030	1.00	+/-0.020	6	13	20	5.80	57	4	HF45210060	●
8	0/-0.030	0.50	+/-0.020	8	20	26	7.80	64	4	HF45205080	●
8	0/-0.030	1.00	+/-0.020	8	20	26	7.80	64	4	HF45210080	●
10	0/-0.030	0.50	+/-0.020	10	22	30	9.80	72	4	HF45205100	●
10	0/-0.030	1.00	+/-0.020	10	22	30	9.80	72	4	HF45210100	●
12	0/-0.030	0.50	+/-0.020	12	26	36	11.80	83	4	HF45205120	●
12	0/-0.030	1.00	+/-0.020	12	26	36	11.80	83	4	HF45210120	●
16	0/-0.030	1.00	+/-0.020	16	32	42	15.70	92	4	HF45210160	●
16	0/-0.030	2.00	+/-0.020	16	32	42	15.70	92	4	HF45220160	●
20	0/-0.030	1.00	+/-0.020	20	38	50	19.70	104	4	HF45210200	●
20	0/-0.030	2.00	+/-0.020	20	38	50	19.70	104	4	HF45220200	●

● stock standard ○ non-standard stock ▽ stock exhaustion

HF452

SLOTTING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**0.5D x D**			**0.5D x D**			**0.3D x D**			**0.2D x D**		
Vc (m/min)	**70-90**			**50-70**			**30-50**			**20-40**		
D (mm)	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**
3	8490	0.011	360	6370	0.010	250	4250	0.008	140	3180	0.007	100
4	6370	0.014	360	4780	0.013	240	3180	0.011	140	2390	0.010	90
5	5100	0.018	360	3820	0.016	240	2550	0.013	130	1910	0.012	90
6	4250	0.021	350	3180	0.019	240	2120	0.015	130	1590	0.014	90
8	3180	0.027	340	2390	0.024	230	1590	0.020	130	1190	0.019	90
10	2550	0.032	330	1910	0.029	220	1270	0.024	120	960	0.022	90
12	2120	0.037	310	1590	0.033	210	1060	0.028	120	800	0.026	80
14	1820	0.041	300	1360	0.037	200	910	0.031	110	680	0.029	80
16	1590	0.046	290	1190	0.041	200	800	0.034	110	600	0.032	80
20	1270	0.056	280	960	0.050	190	640	0.042	110	480	0.039	80

ap x ae	**≤ D5**	0.3D x D	0.3D x D	0.2D x D	0.1D x D

SIDE MILLING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**1.5D x 0.3D**			**1.5D x 0.2D**			**1.2D x 0.2D**			**D x 0.1D**		
Vc (m/min)	**90-110**			**60-80**			**40-60**			**30-50**		
D (mm)	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**
3	10620	0.013	550	7430	0.012	340	5310	0.010	220	4250	0.014	240
4	7960	0.017	540	5570	0.015	340	3980	0.014	220	3180	0.019	240
5	6370	0.021	540	4460	0.019	340	3180	0.017	210	2550	0.023	240
6	5310	0.025	530	3720	0.022	330	2650	0.020	210	2120	0.027	230
8	3980	0.032	510	2790	0.029	320	1990	0.026	200	1590	0.035	220
10	3180	0.039	490	2230	0.035	310	1590	0.031	200	1270	0.042	220
12	2650	0.044	470	1860	0.040	300	1330	0.035	190	1060	0.048	210
14	2270	0.050	450	1590	0.045	280	1140	0.040	180	910	0.055	200
16	1990	0.055	440	1390	0.050	280	1000	0.044	180	800	0.061	190
20	1590	0.067	430	1110	0.060	270	800	0.054	170	640	0.074	190

ap x ae	**≤ D5**	1.2D x 0.2D	1.2D x 0.1D	D x 0.1D	D x 0.05D

HELICAL

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
α° x ae	**5° x 0.4D**			**4° x 0.4D**			**3° x 0.4D**			**2° x 0.4D**		
Vc (m/min)	**70-90**			**50-70**			**30-50**			**20-40**		
D (mm)	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**	**n (rpm)**	**fz (mm/z)**	**Vf (mm/min)**
3	8490	0.008	265	6370	0.007	185	4250	0.006	109	3180	0.007	86
4	6370	0.010	265	4780	0.010	185	3180	0.008	108	2390	0.009	86
5	5100	0.013	260	3820	0.012	185	2550	0.011	108	1910	0.011	85
6	4250	0.015	255	3180	0.014	180	2120	0.012	105	1590	0.013	83
8	3180	0.019	250	2390	0.018	175	1590	0.016	102	1190	0.017	81
10	2550	0.023	240	1910	0.022	165	1270	0.019	98	960	0.020	78
12	2120	0.027	225	1590	0.025	160	1060	0.022	93	800	0.023	74
14	1820	0.030	220	1360	0.028	155	910	0.025	90	680	0.026	71
16	1590	0.033	215	1190	0.031	150	800	0.028	88	600	0.029	70
20	1270	0.041	205	960	0.038	145	640	0.034	86	480	0.035	68

α°	**≤ D5**	2°	2°	1°	1°

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

CUTTING PARAMETERS

HF452

RAMPING

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
α° x ae	**5° x D**			**4° x D**			**3° x D**			**2° x D**		
Vc (m/min)	**60-80**			**50-60**			**30-40**			**20-30**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	3720	0.018	270	2920	0.017	195	1860	0.016	118	1330	0.025	131
8	2790	0.023	260	2190	0.022	190	1390	0.021	114	1000	0.032	128
10	2230	0.028	250	1750	0.026	185	1110	0.025	110	800	0.038	123
12	1860	0.032	240	1460	0.030	175	930	0.028	105	660	0.044	116
14	1590	0.036	230	1250	0.034	170	800	0.032	102	570	0.049	112
16	1390	0.040	225	1090	0.037	165	700	0.035	99	500	0.055	109
20	1110	0.049	215	880	0.045	160	560	0.043	96	400	0.067	107

VERTICAL

Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
ap x ae	**D x 0.4D**			**D x 0.4D**			**D x 0.25D**			**D x 0.25D**		
Vc (m/min)	**60-80**			**50-60**			**30-40**			**20-30**		
D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
6	3720	0.021	310	2920	0.019	220	1860	0.015	120	1330	0.014	80
8	2790	0.027	300	2190	0.024	210	1390	0.020	110	1000	0.019	70
10	2230	0.032	290	1750	0.029	200	1110	0.024	110	800	0.022	70
12	1860	0.037	270	1460	0.033	190	930	0.028	100	660	0.026	70
14	1590	0.041	260	1250	0.037	190	800	0.031	100	570	0.029	70
16	1390	0.046	260	1090	0.041	180	700	0.034	100	500	0.032	60
20	1110	0.056	250	880	0.050	180	560	0.042	90	400	0.039	60

PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION

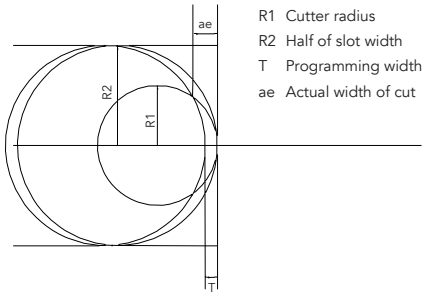
CUTTING PARAMETERS

HF452

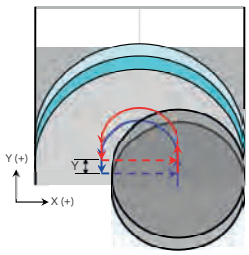
	Material Group ISO 513	P4 M4 K4			P4 P5 M4 M5 K4 S1			P5 P6 M5 K4 S2 S3			H1 H4 H5		
	Hardness/Rm	800-1000 N/mm²			900-1200 N/mm²			35-45 HRC			≤ 55 HRC		
	ap x ae	**1.5D x 0.1D**			**1.5D x 0.1D**			**D x 0.1D**			**D x 0.1D**		
	Vc (m/min)	**110-130**			**80-100**			**50-70**			**40-60**		
TROCHOIDAL	D (mm)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)	n (rpm)	fz (mm/z)	Vf (mm/min)
	3	12740	0.027	1360	9550	0.024	920	6370	0.021	550	5310	0.029	630
	4	9550	0.035	1350	7170	0.032	910	4780	0.028	540	3980	0.039	620
	5	7640	0.044	1340	5730	0.040	910	3820	0.035	540	3180	0.048	620
	6	6370	0.052	1320	4780	0.046	890	3180	0.041	530	2650	0.057	600
	8	4780	0.067	1280	3580	0.060	860	2390	0.054	510	1990	0.074	590
	10	3820	0.080	1230	2870	0.072	830	1910	0.064	490	1590	0.088	560
	12	3180	0.092	1170	2390	0.083	790	1590	0.073	470	1330	0.101	540
	14	2730	0.103	1130	2050	0.093	760	1360	0.083	450	1140	0.114	520
	16	2390	0.115	1100	1790	0.103	740	1190	0.092	440	1000	0.126	500
	20	1910	0.140	1070	1430	0.126	720	960	0.112	430	800	0.154	490

ap x ae	**≤ D5**	1.5D x 0.1D			1.5D x 0.1D			D x 0.1D			D x 0.05D		

NOTES:
Down milling CNC programming is required.
"ae" value max 0.2xD - "T" value max 0.1xD.
The use of end mill with diameter 30-40% smaller than the width of the slot is recommended.
The cutting conditions are based on CNC programming with medium dynamic speed.
With lower CNC dynamic speed, use the same cutting conditions or reduce the cutting speed Vc.
With higher CNC dynamic speed, reduce the "T" value by approximately -30 -50% and apply the maximum available cutting speed Vc.



R1 Cutter radius
R2 Half of slot width
T Programming width of cut
ae Actual width of cut



PARAMETERS SUGGESTED WITH HIGH POWER MILLING CHUCK AND STABLE MACHINING CONDITION