INTEG

Milling power

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TOOLING SOLUTIONS EXPERTS

SINCE1916

NEW

SOLID CARBIDE END MILLS

Catalogue

PDF

VIDEO

SINCE 1916

CODIFICATION SYSTEM FOR SOLID CARBIDE END MILLS

Sistema de codificação para fresas de metal duro | Sistema de codificación para fresas de carburo

H	F	30	G	S	4	120	32	R050	-	W
1	2	3	4	5	6	7	8	9		10

1 - Tool type

H - Solid carbide end mill (Hard metal)

2 - Design

F - Square form (Flat top)
R - Square form with corner radius
C - Square form with corner chamfer
B - Ball nose
CH - Conical Top
XC - Conical Segment
XT - Tangential Segment
RO - Rougher

3 - Helix Angle (Suppressed when it is 90°)

... - Degree of helix rounded to nearest 5 degree

4 - Application

A - Aluminium
G - General application
F - Finishing
M - Steel
S - Stainless steel
H - Hard materials
TSP - Trochoidal milling
MIN - Micro milling

5 - Length of Shank

S - Short length
L - Long length
XL - Extra long length

6 - Flutes number (Z)

Example: Z = 1 ; Z = 2 ; Z = 3 ;

7 - Cutting diameter (ØDc)

Example: 120 = 12,0 mm ; 008 = 0,8 mm

8 - Max cutting depth (ap)

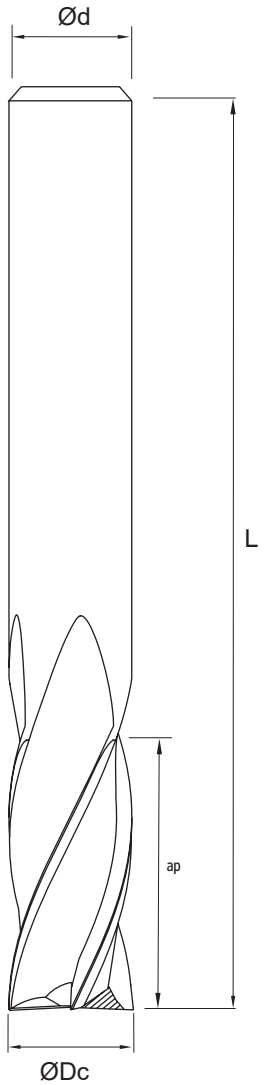
Example: 04 = 4 mm ; 06 = 6 mm

9 - Shank diameter (only on straight flute solid carbide)

Example for corner radius: R150 = 1,5 mm ; R015 = 0,15 mm
Example for conical segment: 18RM120 - α/2 = 18° , RM = 1200 mm
Example for tangential segment: RM090 - RM = 90 mm

10 - Weldon (Suppressed when it doesn't exist)

Integral Solid Carbide technical drawing example



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SELECTION GUIDE FOR SOLID CARBIDE ENDMILLS

	INTEG					
	General Purpose Endmills					
						
	HF30GS 2	HF30GS 4	HF30GXL 4	HR30GS 4	HB30GS 2	HB30GL 2
ØDc	2 - 20	2 - 20	2 - 12	3 - 20	2 - 12	4 - 12
	2	4	4	4	2	2
Helix angle	30	30	30	30	30	30
Geometry	Square	Square	Square	Corner radius	Ball nose	Ball nose
Grade	PHP920	PHP920	PHP920	PHP920	PHP920	PHP920
Finishing	▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲▲	▲▲▲	▲▲▲
Roughing	▲▲▲	▲▲	▲▲	▲▲	▲▲▲	▲▲▲
P	◎	◎	◎	◎	◎	◎
M	◎	◎	◎	◎	◎	◎
K	◎	◎	◎	◎	◎	◎
N						
S						
H						
Page	8	9	10	11	12	13

INTEG			FIN-INTEG	MIN-INTEG	CHAMF INTEG
General Purpose Endmills			Finishing Endmills	Endmills for Micro Machining	Endmills for Chamferings
					
HB30GS 4	HB30GL 4	HRO45GS	HC45FL	HB30MINS	HCHGS
2 - 12	2 - 20	3 - 12	3 - 20	0,4 - 3,0	3 - 20
4	4	3 - 6	6	2	4
30	30	45	43 - 45	30	-
 Ball nose	 Ball nose	 Rougher	 Corner chamfer	 Ball nose	 Conical Top
PHP920	PHP920	PHU920	PHP603 | PHP920	PHH603	PHU920
					
					
14	15	17	18	20 - 21	23

SELECTION GUIDE FOR SOLID CARBIDE ENDMILLS

	RAD-INTEG		DYN-INTEG	STEEL-INTEG	
	Radial Segment Endmills		Trochoidal Milling	Steel Specialized Endmills	
					
	HXC30GL	HXT30GL	HC40TSPL	HC35ML	HR35GL
ØDc	8 - 16	6 - 16	6 - 20	1 - 20	12 - 20
	4	4	5	4	4
Helix angle	30	30	40 - 41 - 42	35 - 38	35 - 38
Geometry	 Radial Segment	 Radial Segment	 Corner chamfer	 Corner chamfer	 Corner radius
Grade	PHP920 | PHH920	PHP920 | PHH920	PHP920	PHP920	PHP920
Finishing					
Roughing					
P					
M					
K					
N					
S					
H					
Page	24	24	26	27	28

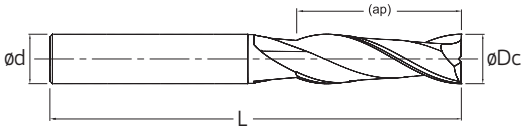
INOX-INTEG		AL-INTEG		HARD-INTEG	
Stainless Steel Specialized Endmills		Aluminium Specialized Endmills		We Make It Hard	
					
HC40SS	HRO40SS	HC38AS	HF30AS	HF30HL	HB30HL
2 - 20	4 - 20	2 - 20	2 - 12	4 - 12	2 - 12
4	4	3	1	4	2
40 - 41	39 - 41	38	30	30	30
 Corner chamfer	 Rougher	 Corner chamfer	 Square	 Square	 Ball nose
PHU920	PHU920	PH0920	PH0920	PHH603	PHH603
					
					
					
					
					
29	30	31	32	33	34

NEW

HF30GS 2 Flat top endmill

PHP
NEW
GRADE

P M K



(1) Order code		(2) Grade code		T1	Dimensions | Dimensões | Dimensiones (mm)			
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PHP920	ØDc	Ød (h6)	ap max	L
1180587	-	HF30GS 2 020 06	2	●	2	4	6	38
1180588	-	HF30GS 2 030 12	2	●	3	4	12	38
1180589	-	HF30GS 2 040 14	2	●	4	4	14	50
1180590	-	HF30GS 2 050 16	2	●	5	6	16	50
1180591	-	HF30GS 2 060 19	2	●	6	6	19	50
1180592	1180532	HF30GS 2 080 20	2	●	8	8	20	63
1180593	1180533	HF30GS 2 100 22	2	●	10	10	22	75
1180594	1180534	HF30GS 2 120 25	2	●	12	12	25	75
1180595	1180535	HF30GS 2 140 26	2	●	14	14	26	83
1180596	1180536	HF30GS 2 160 32	2	●	16	16	32	89
1180597	1180537	HF30GS 2 180 32	2	●	18	18	32	92
1180598	1180538	HF30GS 2 200 38	2	●	20	20	38	104

● Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

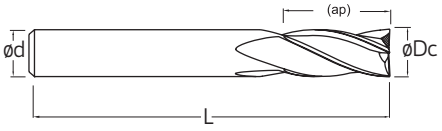
NEW

HF30GS 4 Flat top endmill

P M K

PHP NEW GRADE

Short | 4 | 30° | Square | < 45 HRC



(1) Order code		(2) Grade code		T1	Dimensions | Dimensões | Dimensiones (mm)			
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PHP920	ØDc	Ød (h6)	ap max	L
1180262	-	HF30GS 4 020 06	4	●	2	4	6	38
1180219	-	HF30GS 4 030 12	4	●	3	4	12	38
1180215	-	HF30GS 4 040 14	4	●	4	4	14	50
1180195	-	HF30GS 4 050 16	4	●	5	6	16	50
1180263	-	HF30GS 4 060 19	4	●	6	6	19	50
1180223	1180605	HF30GS 4 070 19	4	○	7	8	19	63
1180202	1180544	HF30GS 4 080 20	4	●	8	8	20	63
1180224	1180606	HF30GS 4 090 22	4	○	9	10	22	75
1180216	1180545	HF30GS 4 100 22	4	●	10	10	22	75
1180264	1180546	HF30GS 4 120 25	4	●	12	12	25	75
1180220	1180547	HF30GS 4 140 26	4	●	14	14	26	83
1180129	1180548	HF30GS 4 160 32	4	●	16	16	32	89
1180221	1180549	HF30GS 4 180 32	4	●	18	18	32	92
1180222	1180550	HF30GS 4 200 38	4	●	20	20	38	104

● Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

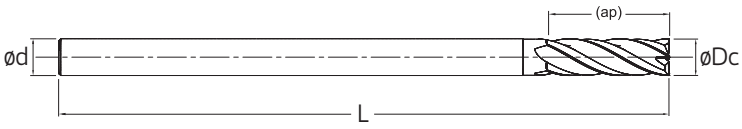
Endmill order code = (1) Geometry Code + (2) Grade Code

NEW

HF30GXL 4 Flat top endmill

PHP
NEW
GRADE

P M K



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1 PHP920	G4 PH7920	\Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	ap max	L
1180708	HF30GXL 4 020 09	4	◯	⚠	2	4	9	100
1180265	HF30GXL 4 030 12	4	◯	⚠	3	6	12	100
1180266	HF30GXL 4 040 16	4	◯	⚠	4	6	16	100
1180267	HF30GXL 4 050 20	4	♻		5	6	20	100
1180268	HF30GXL 4 060 20	4	♻		6	6	20	100
1180269	HF30GXL 4 080 20	4	♻		8	8	20	120
1180270	HF30GXL 4 100 25	4	♻		10	10	25	120
1180057	HF30GXL 4 120 30	4	♻		12	12	30	120

♻ Stock item | Produto de stock | Itens de stock

⚠ Stock available until sold out | Stock disponível até acabar o stock | Stock disponible hasta acabar el stock

◯ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

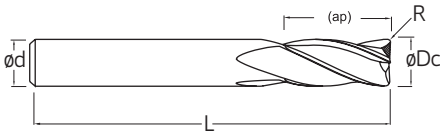
NEW

HR30GS 4 Round corner endmill

P M K

PHP NEW GRADE

Short | 4 | 30° | Corner radius | < 45 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1: PHP920	Dimensions | Dimensões | Dimensiones (mm): ØDc	Ød (h6)	ap max	R	L
1180231	HR30GS 4 030 12 R025	4	○	3	4	12	0,25	50
1180232	HR30GS 4 030 12 R050	4	○	3	4	12	0,5	50
1180233	HR30GS 4 040 14 R025	4	○	4	4	14	0,25	50
1180234	HR30GS 4 040 14 R050	4	○	4	4	14	0,5	50
1180235	HR30GS 4 050 16 R025	4	○	5	6	16	0,25	50
1180236	HR30GS 4 050 16 R050	4	○	5	6	16	0,5	50
1180237	HR30GS 4 060 19 R050	4	◈	6	6	19	0,5	50
1180238	HR30GS 4 060 19 R100	4	◈	6	6	19	1	50
1180239	HR30GS 4 070 19 R050	4	○	7	8	19	0,5	63
1180240	HR30GS 4 070 19 R100	4	○	7	8	19	1	63
1180241	HR30GS 4 080 20 R050	4	◈	8	8	20	0,5	63
1180242	HR30GS 4 080 20 R100	4	◈	8	8	20	1	63
1180243	HR30GS 4 090 22 R050	4	○	9	10	22	0,5	75
1180244	HR30GS 4 090 22 R100	4	○	9	10	22	1	75
1180245	HR30GS 4 100 22 R100	4	◈	10	10	22	1	75
1180246	HR30GS 4 100 22 R200	4	◈	10	10	22	2	75
1180247	HR30GS 4 120 25 R100	4	◈	12	12	25	1	75
1180248	HR30GS 4 120 25 R200	4	◈	12	12	25	2	75
1180249	HR30GS 4 140 26 R100	4	○	14	14	26	1	83
1180250	HR30GS 4 140 26 R200	4	○	14	14	26	2	83
1180251	HR30GS 4 160 32 R100	4	◈	16	16	32	1	89
1180252	HR30GS 4 160 32 R200	4	◈	16	16	32	2	89
1180253	HR30GS 4 180 32 R100	4	○	18	18	32	1	92
1180254	HR30GS 4 180 32 R200	4	○	18	18	32	2	92
1180255	HR30GS 4 200 38 R100	4	◈	20	20	38	1	104
1180256	HR30GS 4 200 38 R200	4	◈	20	20	38	2	104

◈ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

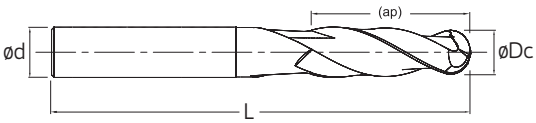
NEW

HB30GS 2 Ball nose endmill

P M K

PHP NEW GRADE

Short | 2 | 30º | Ball nose | < 45 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1 PHP920	G4 PH7920	Dimensions | Dimensões | Dimensiones (mm): ØDc	Ød (h6)	ap max	L
1180278	HB30GS 2 020 06	2	○	◬	2	3	6	38
1180279	HB30GS 2 030 12	2	◭		3	3	12	38
1180280	HB30GS 2 040 14	2	○	◬	4	4	14	50
1180281	HB30GS 2 050 16	2	◭		5	6	16	50
1180282	HB30GS 2 060 19	2	○	◬	6	6	19	50
1180283	HB30GS 2 080 20	2	◭		8	8	20	63
1180284	HB30GS 2 100 22	2	◭		10	10	22	75
1180285	HB30GS 2 120 25	2	◭		12	12	25	75

◭ Stock item | Produto de stock | Itens de stock

◬ Stock available until sold out | Stock disponível até acabar o stock | Stock disponible hasta acabar el stock

○ Available under request | Disponível sobre consulta | Disponible bajo consulta

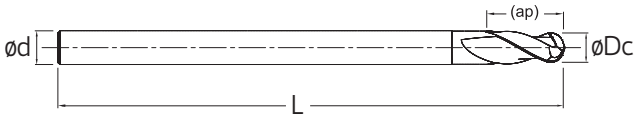
Endmill order code = (1) Geometry Code + (2) Grade Code

HB30GL 2 Ball nose endmill

P M K

PHP NEW GRADE

Long | 2 | 30º | Ball nose | < 45 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1 PHP920	Dimensions | Dimensões | Dimensiones (mm): ØDc	Ød (h6)	ap max	L
1180286	HB30GL 2 040 08	2	◭	4	6	8	70
1180128	HB30GL 2 060 12	2	◭	6	6	12	75
1180029	HB30GL 2 080 14	2	◭	8	8	14	100
1180030	HB30GL 2 100 18	2	◭	10	10	18	100
1180031	HB30GL 2 120 22	2	◭	12	12	22	100

◭ Stock item | Produto de stock | Itens de stock

◬ Stock available until sold out | Stock disponível até acabar o stock | Stock disponible hasta acabar el stock

○ Available under request | Disponível sobre consulta | Disponible bajo consulta

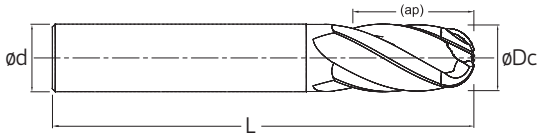
Endmill order code = (1) Geometry Code + (2) Grade Code

NEW

HB30GS 4 Ball nose endmill

P M K

PHP NEW GRADE



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1 PHP920	Dimensions | Dimensões | Dimensiones (mm): ØDc	Ød (h6)	ap max	L
1180156	HB30GS 4 020 03	4	◉	2	4	3	50
1180157	HB30GS 4 030 05	4	◉	3	4	5	50
1180068	HB30GS 4 040 06	4	◉	4	6	6	60
1181837	HB30GS 4 050 08	4	◉	5	6	8	60
1180272	HB30GS 4 060 09	4	◉	6	6	9	60
1180066	HB30GS 4 080 16	4	◉	8	8	16	63
1180432	HB30GS 4 100 20	4	◉	10	10	20	75
1180287	HB30GS 4 120 25	4	◉	12	12	25	75

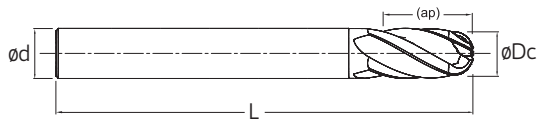
◉ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

HB30GL 4 Ball nose endmill

P M K

PHP NEW GRADE



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1 PHP920	Dimensions | Dimensões | Dimensiones (mm): ØDc	Ød (h6)	ap max	L
1180273	HB30GL 4 020 04	4	◉	2	4	4	75
1180274	HB30GL 4 030 08	4	◉	3	4	8	75
1180275	HB30GL 4 040 11	4	○	4	4	11	75
1180150	HB30GL 4 050 13	4	◉	5	6	13	75
1180032	HB30GL 4 060 13	4	◉	6	6	13	75
1180064	HB30GL 4 080 16	4	◉	8	8	16	100
1180065	HB30GL 4 100 16	4	◉	10	10	16	100
1180071	HB30GL 4 120 25	4	◉	12	12	25	100
1180276	HB30GL 4 160 32	4	◉	16	16	32	120
1180277	HB30GL 4 200 38	4	◉	20	20	38	120

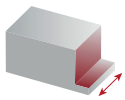
◉ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

NEW

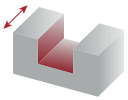
CUTTING PARAMETERS | Parâmetros de corte | Parámetros de corte

Side Milling



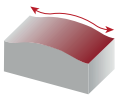
Finishing: $a_e < 0,15 \times Dc$
Semi-finishing: $0,15 \times Dc < a_e < 0,3 \times Dc$
Roughing: $a_e > 0,3 \times Dc$

Slotting



$a_e = 100\% \times Dc$

Copying



Finishing: $a_e < 0,20 \times Dc$
$a_p < 0,03 \times Dc$
Semi-finishing: $0,20 \times Dc < a_e < 0,40 \times Dc$
$0,03 \times Dc < a_p < 0,10 \times Dc$
Roughing: $a_e > 0,40 \times Dc$
$a_p > 0,10 \times Dc$

α: Surface inclination angle.

ISO	Material	fz (mm/t)					
		Side Milling			Slotting	Copying	
		$a_e = 12,5\%$	$a_e = 25\%$	$a_e = 50\%$	$a_e = 100\%$	α < 15º	α > 15º
P	Unalloyed Steel	0,009 x Dc	0,008 x Dc	0,005 x Dc	0,004 x Dc	0,012 x Dc	0,004 x Dc
	Low-Alloyed Steel	0,008 x Dc	0,007 x Dc	0,004 x Dc	0,003 x Dc	0,010 x Dc	0,003 x Dc
	High-Alloyed Steel	0,007 x Dc	0,006 x Dc	0,004 x Dc	0,003 x Dc	0,009 x Dc	0,003 x Dc
M	Stainless Steel (Ferritic / Martensitic)	0,007 x Dc	0,006 x Dc	0,004 x Dc	0,003 x Dc	0,009 x Dc	0,003 x Dc
	Stainless Steel (Austenitic)	0,005 x Dc	0,005 x Dc	0,003 x Dc	0,002 x Dc	0,007 x Dc	0,002 x Dc
	Stainless Steel (Austenitic/Ferritic/Duplex)	0,004 x Dc	0,004 x Dc	0,002 x Dc	0,002 x Dc	0,006 x Dc	0,002 x Dc
K	Malleable Cast Iron	0,009 x Dc	0,008 x Dc	0,005 x Dc	0,004 x Dc	0,012 x Dc	0,004 x Dc
	Grey Cast Iron	0,009 x Dc	0,008 x Dc	0,005 x Dc	0,004 x Dc	0,012 x Dc	0,004 x Dc
	Nodular Cast Iron	0,008 x Dc	0,008 x Dc	0,004 x Dc	0,004 x Dc	0,011 x Dc	0,004 x Dc

(Note 1) Side milling and slotting feed valid for when the endmill works with its whole a_p, for when the endmill is working with lower depths of cut consider increasing the feed up to 25%.
(Note 2) Copying feed valid for low a_p (a_p / D < 0,1), for higher a_p consider decreasing the feed by 50%.

ISO	Material	Vc (m/min)							
		Side Milling			Slotting	Copying			
		$a_e = 12,5\%$	$a_e = 25\%$	$a_e = 50\%$	$a_e = 100\%$	$a_p = 0,05ØDc$ α < 15º	$a_p = 0,25ØD$ α < 15º	$a_p = 0,05ØDc$ α > 15º	$a_p = 0,25ØDc$ α > 15º
P	Unalloyed Steel	200	190	180	150	480	240	320	160
	Low-Alloyed Steel	190	180	160	130	440	220	290	150
	High-Alloyed Steel	170	160	150	120	400	200	260	130
M	Stainless Steel (Ferritic / Martensitic)	150	140	130	110	360	180	240	120
	Stainless Steel (Austenitic)	120	110	100	80	290	140	190	100
	Stainless Steel (Austenitic/Ferritic/Duplex)	100	100	80	70	250	120	160	80
K	Malleable Cast Iron	240	230	220	170	580	290	380	190
	Grey Cast Iron	230	230	210	170	560	280	380	190
	Nodular Cast Iron	220	210	190	160	520	260	350	170

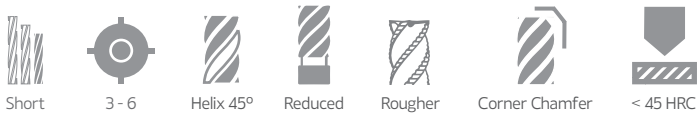
(Note 3) Table valid for PHP920 grade, for PH7920 consider reducing the cutting velocity by 10 m/min.
(Note 4) Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.
(Note 5) For copying, spindle speed is calculated as follows: $n = \frac{Vc \times 1000}{\pi \times 2 \sqrt{a_p(Dc - a_p)}}$

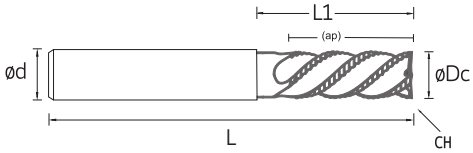
NEW

HRO45GS Rougher endmill

PHU
NEW
GRADE

P M K





(1) Order code		(2) Grade code		Z9	Dimensions | Dimensões | Dimensiones (mm)					
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PHU920	ØDc	Ød	ap_{max}	CH	L1	L
1180557	1180558	HRO45GS 3 030 08	3	○	3	6	8	0,15 x 45º	15	57
1180559	1180560	HRO45GS 4 040 11	4	○	4	6	11	0,15 x 45º	17	57
1180561	1180562	HRO45GS 4 050 13	4	○	5	6	13	0,15 x 45º	19	57
1180439	1180563	HRO45GS 4 060 13	4	◈	6	6	13	0,15 x 45º	21	57
1180440	1180564	HRO45GS 4 080 19	4	◈	8	8	19	0,15 x 45º	27	63
1180441	1180565	HRO45GS 4 100 22	4	◈	10	10	22	0,20 x 45º	32	72
1180374	1180465	HRO45GS 4 120 26	4	◈	12	12	26	0,20 x 45º	38	83
1180566	1180567	HRO45GS 5 160 32	5	◈	16	16	32	0,35 x 45º	44	92
1180568	1180569	HRO45GS 6 200 38	6	◈	20	20	38	0,60 x 45º	54	104

◈ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

RECOMMENDED CUTTING CONDITIONS | Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	fz (mm/t)			Vc (m/min)		
		ae = 25%	ae = 50%	ae = 100%	ae = 25%	ae = 50%	ae = 100%
P	Unalloyed Steel	0,008 x ØDc	0,007 x ØDc	0,005 x ØDc	170	160	140
	Low-Alloyed Steel	0,007 x ØDc	0,006 x ØDc	0,004 x ØDc	150	140	120
	High-Alloyed Steel	0,006 x ØDc	0,005 x ØDc	0,004 x ØDc	130	120	100
M	Stainless Steel (Ferritic / Martensitic)	0,006 x ØDc	0,005 x ØDc	0,004 x ØDc	110	110	90
	Stainless Steel (Austenitic)	0,005 x ØDc	0,004 x ØDc	0,003 x ØDc	100	90	80
	Stainless Steel (Austenitic/Ferritic/Duplex)	0,004 x ØDc	0,003 x ØDc	0,002 x ØDc	80	80	70
K	Malleable Cast Iron	0,008 x ØDc	0,007 x ØDc	0,005 x ØDc	200	190	170
	Grey Cast Iron	0,008 x ØDc	0,007 x ØDc	0,005 x ØDc	200	190	160
	Nodular Cast Iron	0,008 x ØDc	0,007 x ØDc	0,004 x ØDc	180	170	150

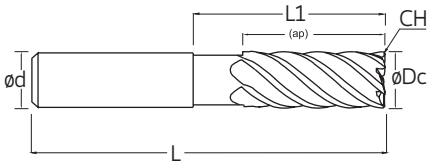
NEW

HC45FL Corner chamfer finishing endmills

P M K H

PHP NEW GRADE

Long | 6 | Variable Helix 43º - 45º | Reduced Neck Ø | Corner Chamfer | < 60 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1 PHP920	X7 PHP603	Dimensions | Dimensões | Dimensiones (mm): ØDc	Ød (h6)	ap max	CH	L1	L
1180845	HC45FL 6 030 08	6	○	◈	3	6	8	0,15 x 45º	15	57
1180846	HC45FL 6 040 11	6	○	◈	4	6	11	0,15 x 45º	17	57
1180847	HC45FL 6 050 13	6	○	◈	5	6	13	0,15 x 45º	19	57
1180342	HC45FL 6 060 13	6	◈	◈	6	6	13	0,15 x 45º	21	57
1180062	HC45FL 6 080 19	6	◈	◈	8	8	19	0,15 x 45º	28	63
1180344	HC45FL 6 100 22	6	◈	◈	10	10	22	0,20 x 45º	30	72
1180343	HC45FL 6 120 26	6	◈	◈	12	12	26	0,20 x 45º	34	83
1180848	HC45FL 6 160 32	6	○	○	16	16	32	0,35 x 45º	44	92
1180849	HC45FL 6 200 38	6	○	○	20	20	38	0,60 x 45º	54	104

◈ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

PDF VIDEO

NEW

GRADES SELECTION GUIDE | Guia para selecção de graus | Tabla para selección de calidades

ISO	Material	Grades	
		PHP603	PHP920
P	Unalloyed Steel	◬	◉
	Low-Alloyed Steel	◉	◬
	High-Alloyed Steel	◉	◬
M	Stainless Steel (Ferritic / Martensitic)	◬	◉
	Stainless Steel (Austenitic)	◬	◉
	Stainless Steel (Austenitic/Ferritic/Duplex)	◬	◉
K	Malleable Cast Iron	◬	◉
	Grey Cast Iron	◉	◬
	Nodular Cast Iron	◉	◬
H	Hardened Steels	◉	

◉ First choice | 1ª Escolha | 1ª Opción ◬ Suitable | Adequado | Adecuado

RECOMMENDED CUTTING CONDITIONS | Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	Vc (m/min)		fz (mm/t)
		PHP603	PHP920	
P	Unalloyed Steel	200	190	0,009 x ØDc
	Low-Alloyed Steel	170	160	0,007 x ØDc
	High-Alloyed Steel	140	130	0,005 x ØDc
M	Stainless Steel (Ferritic / Martensitic)	130	120	0,006 x ØDc
	Stainless Steel (Austenitic)	120	110	0,005 x ØDc
	Stainless Steel (Austenitic/Ferritic/Duplex)	90	90	0,004 x ØDc
K	Malleable Cast Iron	240	230	0,009 x ØDc
	Grey Cast Iron	240	230	0,009 x ØDc
	Nodular Cast Iron	200	190	0,008 x ØDc
H	Hardened Steels	80		0,004 x ØDc

Note[1]: Feed valid for when the endmill works with its whole ap, for when the endmill is working with lower depths of cut consider increasing the feed up to 25%.
Note[2]: Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.

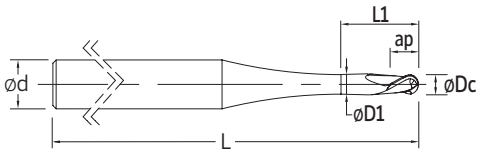
NEW

HB30MINS Short neck endmills for micro machining

P M K S H

PHH
NEW
GRADE

Short | 2 | 30° | Reduced Neck Ø | Ball nose | < 70 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		X4 PHH603	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	D1	a_p	L1	L
1180769	HB30MINS 2 004 01 010	2	◎	0,4	4	0,37	0,4	1,0	50
1180297	HB30MINS 2 005 01 015	2	◎	0,5	4	0,45	0,6	1,5	50
1180288	HB30MINS 2 006 01 020	2	◎	0,6	4	0,58	0,6	2	50
1180289	HB30MINS 2 008 01 020	2	◎	0,8	4	0,78	0,8	2	50
1180298	HB30MINS 2 010 02 025	2	◎	1	4	0,95	1,3	2,5	50
1180290	HB30MINS 2 010 01 030	2	◎	1	4	0,95	1	3	50
1180291	HB30MINS 2 012 02 030	2	◎	1,2	4	1,15	1,2	3	50
1180292	HB30MINS 2 016 02 040	2	◎	1,6	4	1,55	1,6	4	50
1180293	HB30MINS 2 020 02 040	2	◎	2	4	1,94	2	4	50
1180307	HB30MINS 2 020 03 050	2	◎	2	4	1,95	2,5	5	50
1180299	HB30MINS 2 025 03 060	2	◎	2,5	6	2,45	3	6	60
1180309	HB30MINS 2 030 04 075	2	◎	3	6	2,95	4	7,5	60

◎ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

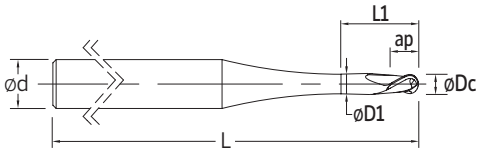
NEW

HB30MINS Medium neck endmills for micro machining

P M K S H

PHH NEW GRADE

Short | 2 | 30° | Reduced Neck Ø | Ball nose | < 70 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		X4 PHH603	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	D1	a_p	L1	L
1180305	HB30MINS 2 005 01 025	2	◈	0,5	4	0,45	0,4	2,5	50
1180308	HB30MINS 2 010 02 050	2	◈	1	4	0,95	1,3	5	50
1180336	HB30MINS 2 016 02 080	2	◈	1,6	4	1,55	1,6	8	50
1180310	HB30MINS 2 020 03 100	2	◈	2	4	1,95	2,5	10	50
1180311	HB30MINS 2 025 03 125	2	◈	2,5	6	2,45	3	12,5	60
1180301	HB30MINS 2 030 04 150	2	◈	3	6	2,95	4	15	60

◈ Stock item | Produto de stock | Itens de stock ◯ Available under request | Disponível sobre consulta | Disponible bajo consulta

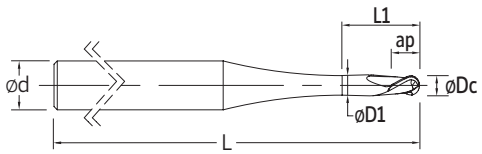
Endmill order code = (1) Geometry Code + (2) Grade Code

HB30MINS Long neck endmills for micro machining

P M K S H

PHH NEW GRADE

Short | 2 | 30° | Reduced Neck Ø | Ball nose | < 70 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		X4 PHH603	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	D1	a_p	L1	L
1180306	HB30MINS 2 005 01 040	2	◈	0,5	4	0,45	0,6	4	50
1180300	HB30MINS 2 010 02 080	2	◈	1	4	0,95	1,3	8	50
1180337	HB30MINS 2 016 02 128	2	◈	1,6	4	1,55	1,6	12,8	50
1180302	HB30MINS 2 020 03 160	2	◈	2	4	1,95	2,5	16	50
1180312	HB30MINS 2 025 03 200	2	◈	2,5	6	2,45	3	20	60
1180313	HB30MINS 2 030 04 240	2	◈	3	6	2,95	4	24	60

◈ Stock item | Produto de stock | Itens de stock ◯ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

NEW

RECOMMENDED CUTTING CONDITIONS | Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	Copying					
		fz (mm/t)		Vc (m/min)			
		α < 15°	α > 15°	a_p = 0,05 ØDc α < 15°	a_p = 0,25 ØD α < 15°	a_p = 0,05 ØDc α > 15°	a_p = 0,25 ØD α > 15°
P	Unalloyed Steel	0,01 x ØDc	0,003 x ØDc	700	340	460	220
	Low-Alloyed Steel	0,009 x ØDc	0,003 x ØDc	650	320	430	210
	High-Alloyed Steel	0,008 x ØDc	0,003 x ØDc	590	290	390	190
M	Stainless Steel (Ferritic / Martensitic)	0,009 x ØDc	0,003 x ØDc	600	300	400	200
	Stainless Steel (Austenitic)	0,008 x ØDc	0,003 x ØDc	560	280	370	190
	Stainless Steel (Austenitic/Ferritic/Duplex)	0,007 x ØDc	0,002 x ØDc	540	270	360	180
K	Malleable Cast Iron	0,008 x ØDc	0,003 x ØDc	650	320	430	210
	Grey Cast Iron	0,008 x ØDc	0,003 x ØDc	640	310	420	200
	Nodular Cast Iron	0,007 x ØDc	0,002 x ØDc	600	300	400	190
S	Heat Resistant Super Alloys	0,007 x ØDc	0,002 x ØDc	230	110	150	80
H	Hardened Steels	0,008 x ØDc	0,003 x ØDc	460	230	310	150

Note: Since some of the endmills have low ØDc the above Vc cannot be achieved by any conventional machining center. The endmills still work at much lower Vc.

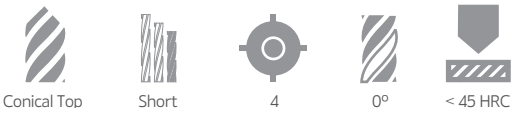
CHAMF-INTEG = Chamfering Endmill

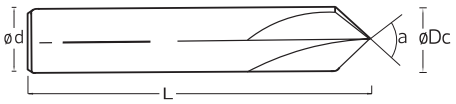
NEW

HCHGS Chamfering endmill

PHU
NEW
GRADE

P M K





(1) Order code		(2) Grade code		Z9	Dimensions | Dimensões | Dimensiones (mm)			
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PHU920	ØDc	Ød (h6)	a	L
1180366	-	HCHGS 4 030 02 90	4	◎	3	3	90	38
1180367	-	HCHGS 4 040 02 90	4	◎	4	4	90	50
1180368	1180496	HCHGS 4 060 03 90	4	◎	6	6	90	57
1180369	1180497	HCHGS 4 080 04 90	4	◎	8	8	90	63
1180370	1180498	HCHGS 4 100 05 90	4	◎	10	10	90	72
1180371	1180499	HCHGS 4 120 06 90	4	◎	12	12	90	83
1180372	1180500	HCHGS 4 160 08 90	4	◎	16	16	90	92
1180373	1180553	HCHGS 4 200 10 90	4	◎	20	20	90	104

◎ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

Note: For HB (weldon) endmills, the reference ends with "-W "

RECOMMENDED CUTTING CONDITIONS | Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	Chamfering	
		fz (mm/t)	Vc (m/min)
P	Unalloyed Steel	0,008 x ØDc	180
	Low-Alloyed Steel	0,007 x ØDc	160
	High-Alloyed Steel	0,006 x ØDc	140
M	Stainless Steel (Ferritic / Martensitic)	0,007 x ØDc	150
	Stainless Steel (Austenitic)	0,006 x ØDc	130
	Stainless Steel (Austenitic/Ferritic/Duplex)	0,004 x ØDc	110
K	Malleable Cast Iron	0,008 x ØDc	210
	Grey Cast Iron	0,008 x ØDc	210
	Nodular Cast Iron	0,008 x ØDc	190

PDF

RAD-INTEG = Conical and Tangential Segment Endmills

NEW

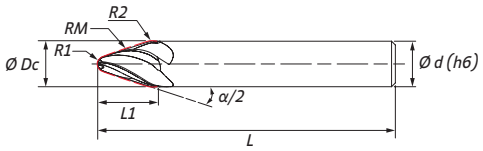
HXC30GL Conical

P M K S

PHP NEW GRADE

PHH NEW GRADE

Long | 4 | 30º | Radial Segment | < 50 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1 PHP920	Y3 PHH920	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	α/2	RM	R1	R2	L1	L
1180046	HXC30GL 4 080 10 18RM030	4	◎	◎	8	8	18	300	1	1	10	75
1180047	HXC30GL 4 120 14 18RM045	4	◎	◎	12	12	18	450	2	2	14	83
1180048	HXC30GL 4 160 18 18RM120	4	◎	◎	16	16	18	1200	3	3	18	95
1180049	HXC30GL 4 160 12 28RM080	4	◎	◎	16	16	28	800	3	3	12	95
1180050	HXC30GL 4 160 16 18RM120	4	◎	◎	16	16	18	1200	4	4	16	110
1180051	HXC30GL 4 160 11 28RM080	4	◎	◎	16	16	28	800	4	4	11	110

◎ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

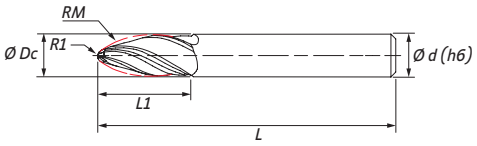
HXT30GL Tangential

P M K S

PHP NEW GRADE

PHH NEW GRADE

Long | 4 | 30º | Radial Segment | < 50 HRC



All order codes are cylindrical shank.
Weldon shank available under request.

(1) Geometry code	(2) Grade code: Reference Referência Referencia		T1 PHP920	Y3 PHH920	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	RM	R1	L1	L
1180045	HXT30GL 3 060 22 RM095	4	◎	◎	6	6	95	1	22	63
1180037	HXT30GL 4 080 24 RM095	4	◎	◎	8	8	95	1	24	70
1180038	HXT30GL 4 100 28 RM085	4	◎	◎	10	10	85	2	28	72
1180039	HXT30GL 4 120 28 RM090	4	◎	◎	12	12	90	2	28	83
1180691	HXT30GL 4 160 30 RM080	4	◎	◎	16	16	80	3	30	110

PDF VIDEO

◎ Stock item | Produto de stock | Itens de stock

○ Available under request | Disponível sobre consulta
Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

RAD-INTEG = Conical and Tangential Segment Endmills

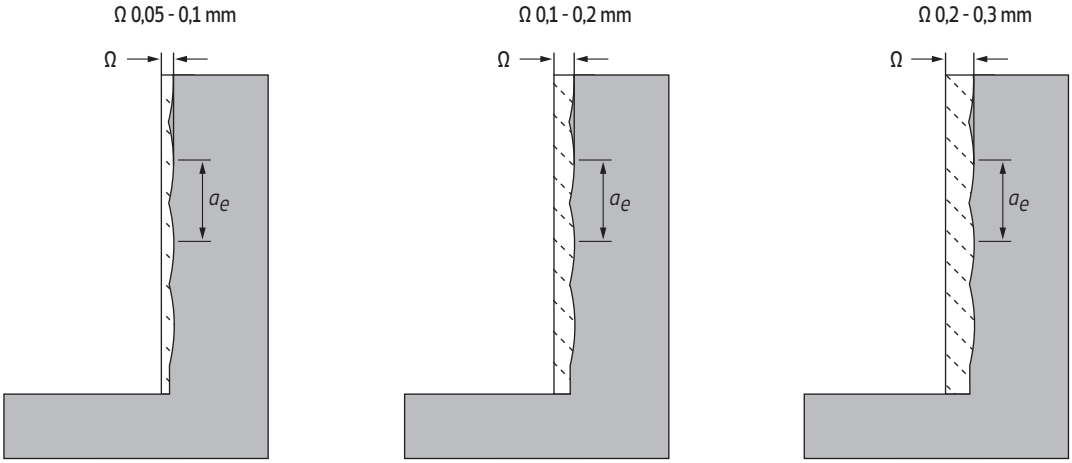
NEW

GRADES SELECTION GUIDE ‖ Guia para selecção de graus | Tabla para selección de calidades

ISO	Material	Grades	
		PHP920	PHH920
P	Unalloyed Steel	●	
	Low-Alloyed Steel	●	
	High-Alloyed Steel	●	
M	Stainless Steel (Ferritic / Martensitic)		●
	Stainless Steel (Austenitic)		●
	Stainless Steel (Austenitic/Ferritic/Duplex)		●
K	Malleable Cast Iron	●	
	Grey Cast Iron	●	
	Nodular Cast Iron	●	
S	Heat Resistant Super Alloys		●

RECOMMENDED CUTTING CONDITIONS ‖ Condições de corte recomendadas | Condiciones de corte recomendables

Ω - Allowance
a_e - Stepover



Fine Finishing | Finishing | Semi-Finishing

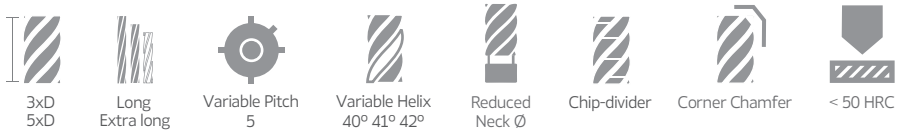
ISO	Workpiece Material	Vc (m/min)	fz (mm/t)				
			HXC30GL - Conical		HXT30GL - Tangential		
			Ω 0,05 - 0,1 mm	Ω 0,1 - 0,2 mm	Ω 0,05 - 0,1 mm	Ω 0,1 - 0,2 mm	Ω 0,2 - 0,3 mm
P	Unalloyed Steel	180	0,007 x ØDc	0,006 x ØDc	0,007 x ØDc	0,006 x ØDc	0,005 x ØDc
	Low-Alloyed Steel	160	0,006 x ØDc	0,005 x ØDc	0,006 x ØDc	0,005 x ØDc	0,004 x ØDc
	High-Alloyed Steel	150	0,005 x ØDc	0,004 x ØDc	0,005 x ØDc	0,004 x ØDc	0,004 x ØDc
M	Stainless Steel (Ferritic / Martensitic)	120	0,005 x ØDc	0,004 x ØDc	0,005 x ØDc	0,004 x ØDc	0,004 x ØDc
	Stainless Steel (Austenitic)	120	0,004 x ØDc	0,003 x ØDc	0,004 x ØDc	0,003 x ØDc	0,003 x ØDc
	Stainless Steel (Austenitic/Ferritic/Duplex)	110	0,003 x ØDc	0,003 x ØDc	0,003 x ØDc	0,003 x ØDc	0,002 x ØDc
K	Malleable Cast Iron	220	0,007 x ØDc	0,006 x ØDc	0,007 x ØDc	0,006 x ØDc	0,005 x ØDc
	Grey Cast Iron	210	0,007 x ØDc	0,006 x ØDc	0,007 x ØDc	0,006 x ØDc	0,005 x ØDc
	Nodular Cast Iron	190	0,006 x ØDc	0,005 x ØDc	0,006 x ØDc	0,005 x ØDc	0,005 x ØDc
S	Heat Resistant Super Alloys	60	0,003 x ØDc	0,003 x ØDc	0,003 x ØDc	0,003 x ØDc	0,002 x ØDc

DYN-INTEG = Trochoidal Milling

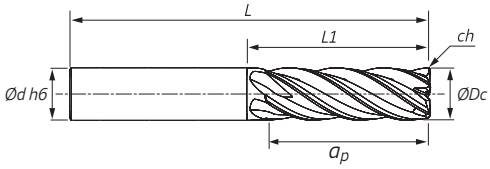
NEW

HC40TSP Corner chamfer, variable helix 40º-42º ‖ Trochoidal Speed Cutting

P K



PHP NEW GRADE



(1) Order code		(2) Grade code		T1	Dimensions | Dimensões | Dimensiones (mm)					
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PHP920	ØDc	Ød (h6)	a_p max	CH	L1	L
HC40TSPL										
1180118	1180456	HC40TSPL 5 060 20	5	◈	6	6	20	0,15 x 45º	26	63
1180119	1180457	HC40TSPL 5 080 25	5	◈	8	8	25	0,15 x 45º	32	70
1180225	1180458	HC40TSPL 5 100 32	5	◈	10	10	32	0,20 x 45º	38	79
1180690	1180689	HC40TSPL 5 120 41	5	◈	12	12	41	0,20 x 45º	48	100
1180226	1180460	HC40TSPL 5 160 50	5	◈	16	16	50	0,25 x 45º	56	110
1180123	1180461	HC40TSPL 5 180 60	5	◈	18	18	60	0,30 x 45º	66	130
1180462	1180463	HC40TSPL 5 200 64	5	◈	20	20	64	0,35 x 45º	70	130
HC40TSPXL										
1180507	1180514	HC40TSPXL 5 060 30	5	◇	6	6	30	0,15 x 45º	36	75
1180508	1180515	HC40TSPXL 5 080 40	5	◇	8	8	40	0,15 x 45º	46	81
1180509	1180516	HC40TSPXL 5 100 50	5	◇	10	10	50	0,20 x 45º	59	100
1180510	1180517	HC40TSPXL 5 120 60	5	◇	12	12	60	0,20 x 45º	67	120
1180511	1180518	HC40TSPXL 5 160 80	5	◇	16	16	80	0,20 x 45º	85	136
1180512	-	HC40TSPXL 5 180 90	5	◇	18	18	90	0,30 x 45º	100	150
1180513	1180520	HC40TSPXL 5 200 100	5	◇	20	20	100	0,35 x 45º	104	162

◈ Stock item | Produto de stock | Itens de stock ◯ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

◇ Stock available until sold out | Stock disponível até acabar o stock | Stock disponible hasta acabar el stock

Note: For HB (weldon) endmills, the reference ends with "-W"

RECOMMENDED CUTTING CONDITIONS ‖ Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Workpiece Material	fz (mm/t)			Vc (m/min)		
		ae (mm)			ae (mm)		
		5,0%	15%	30%	5,0%	15%	30%
P	Unalloyed Steel	0,009 x ØDc	0,009 x ØDc	0,008 x ØDc	180	170	170
	Low-Alloyed Steel	0,008 x ØDc	0,007 x ØDc	0,007 x ØDc	160	160	150
	High-Alloyed Steel	0,007 x ØDc	0,007 x ØDc	0,006 x ØDc	140	140	140
K	Malleable Cast Iron	0,009 x ØDc	0,009 x ØDc	0,008 x ØDc	210	210	200
	Grey Cast Iron	0,009 x ØDc	0,009 x ØDc	0,008 x ØDc	210	200	200
	Nodular Cast Iron	0,009 x ØDc	0,008 x ØDc	0,007 x ØDc	190	190	180

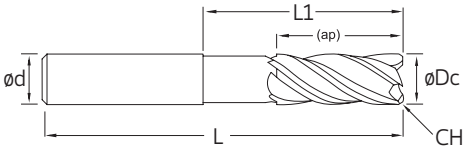
PDF

NEW

HC35ML Corner chamfer steel specialized endmills

P K

PHP
NEW
GRADE



(1) Order code		(2) Grade code		T1	Dimensions | Dimensões | Dimensiones (mm)					
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PHP920	ØDc	Ød (h6)	ap max	CH	L1	L
1180480	-	HF35ML 4 010 03	4	○	1	6	2,5	-	5	57
1180482	1180483	HC35ML 4 020 05	4	◎	2	6	5	0,07 x 45°	10	57
1180466	1180467	HC35ML 4 030 08	4	◎	3	6	8	0,15 x 45°	15	57
1180137	1180468	HC35ML 4 040 11	4	◎	4	6	11	0,15 x 45°	17	57
1180469	1180521	HC35ML 4 050 13	4	◎	5	6	13	0,15 x 45°	19	57
1180138	1180470	HC35ML 4 060 13	4	◎	6	6	13	0,15 x 45°	21	57
1180052	1180471	HC35ML 4 080 19	4	◎	8	8	19	0,15 x 45°	27	63
1180053	1180472	HC35ML 4 100 22	4	◎	10	10	22	0,20 x 45°	32	72
1180139	1180473	HC35ML 4 120 26	4	◎	12	12	26	0,20 x 45°	38	83
1180474	1180475	HC35ML 4 140 26	4	◎	14	14	26	0,25 x 45°	38	83
1180153	1180476	HC35ML 4 160 32	4	◎	16	16	32	0,35 x 45°	44	92
1180477	1180478	HC35ML 4 180 32	4	◎	18	18	32	0,45 x 45°	44	92
1180140	1180479	HC35ML 4 200 38	4	◎	20	20	38	0,60 x 45°	54	104

◎ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

Note: For HB (Weldon) endmills, the reference ends with "-W "
Example: "HC35ML 4 030 08-W"

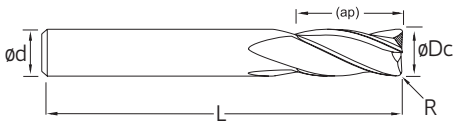
PDF

NEW

HR35GL Corner radius steel specialized endmills

P K

PHP NEW GRADE



(1) Geometry code	(2) Grade code: Reference / Referência / Referencia		T1 PHP920	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	ap max	R	L
1180042	HR35GL 4 120 26 R100	4	●	12	12	26	1	81
1180043	HR35GL 4 120 26 R200	4	●	12	12	26	2	81
1180044	HR35GL 4 120 26 R300	4	●	12	12	26	3	81
1180187	HR35GL 4 160 24 R100	4	●	16	16	24	1	100
1180188	HR35GL 4 160 24 R200	4	●	16	16	24	2	100
1180189	HR35GL 4 200 40 R100	4	●	20	20	40	1	100
1180190	HR35GL 4 200 40 R200	4	●	20	20	40	2	100

● Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

RECOMMENDED CUTTING CONDITIONS | Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	fz (mm/t) ae = 25%	ae = 50%	ae = 100%	Vc (m/min) ae = 25%	ae = 50%	ae = 100%
P	Unalloyed Steel	0,008 x ØDc	0,005 x ØDc	0,004 x ØDc	190	180	150
P	Low-Alloyed Steel	0,007 x ØDc	0,004 x ØDc	0,003 x ØDc	180	160	130
P	High-Alloyed Steel	0,006 x ØDc	0,004 x ØDc	0,003 x ØDc	160	150	120
K	Malleable Cast Iron	0,008 x ØDc	0,005 x ØDc	0,004 x ØDc	230	210	180
K	Grey Cast Iron	0,008 x ØDc	0,005 x ØDc	0,004 x ØDc	230	210	170
K	Nodular Cast Iron	0,008 x ØDc	0,004 x ØDc	0,004 x ØDc	210	190	160

Note[1]: Recommended feed values for maximum ap. For reduced ap, consider increasing Fz up to 25%.
Note[2]: Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.

PDF

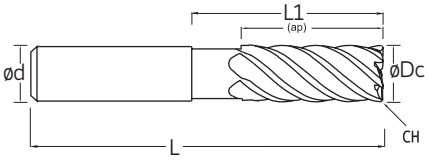
NEW

HC40SS Corner chamfer stainless steel specialized endmills

M

PHU
NEW
GRADE

Short | Variable Pitch 4 | Variable Helix 40°/41° | Reduced Neck Ø | 45° Corner chamfer | < 42 HRC



(1) Order code		(2) Grade code		Z9	Dimensions | Dimensões | Dimensiones (mm)					
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PHU920	ØDc	Ød (h6)	ap max	CH	L1	L
1180484	1180485	HF40SS 4 010 03	4	◎	1	6	2,5	-	5	57
1180380	1180487	HF40SS 4 020 05	4	◎	2	6	5	-	10	57
1180381	1180488	HC40SS 4 030 08	4	◎	3	6	8	0,15 x 45º	15	57
1180382	1180489	HC40SS 4 040 11	4	◎	4	6	11	0,15 x 45º	17	57
1180383	1180490	HC40SS 4 050 13	4	◎	5	6	13	0,15 x 45º	19	57
1180384	1180389	HC40SS 4 060 13	4	◎	6	6	13	0,15 x 45º	21	57
1180329	1180491	HC40SS 4 080 19	4	◎	8	8	19	0,15 x 45º	27	63
1180385	1180492	HC40SS 4 100 22	4	◎	10	10	22	0,20 x 45º	32	72
1180386	1180493	HC40SS 4 120 26	4	◎	12	12	26	0,20 x 45º	38	83
1180436	1180494	HC40SS 4 140 26	4	◎	14	14	26	0,25 x 45º	38	83
1180387	1180390	HC40SS 4 160 32	4	◎	16	16	32	0,35 x 45º	44	92
1180555	1180556	HC40SS 4 180 32	4	◎	18	18	32	0,45 x 45º	44	92
1180388	1180455	HC40SS 4 200 38	4	◎	20	20	38	0,60 x 45º	54	104

◎ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

RECOMMENDED CUTTING CONDITIONS | Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	fz (mm/t)			Vc (m/min)		
		ae			ae		
		25%	50%	100%	25%	50%	100%
M	SS - Ferritic / Martensitic	0,007 x ØDc	0,004 x ØDc	0,003 x ØDc	160	150	120
	SS – Austenitic	0,006 x ØDc	0,004 x ØDc	0,003 x ØDc	140	130	100
	SS - Austenitic-ferritic (Duplex)	0,006 x ØDc	0,003 x ØDc	0,003 x ØDc	130	120	100

Note[1]: Feed valid for when the endmill works with its whole ap, for when the endmill is working with lower depths of cut consider increasing the feed up to 25%.
Note[2]: Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.

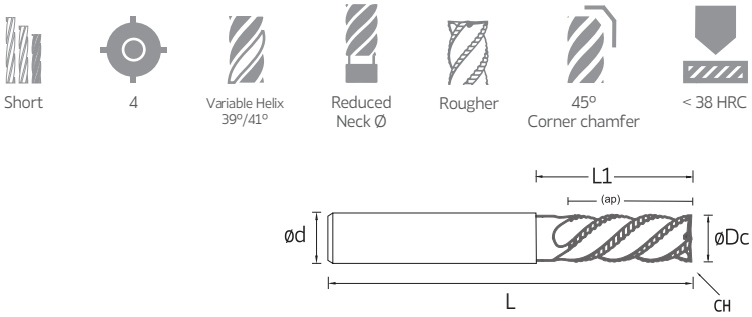
PDF

NEW

HRO40SS Rougher stainless steel specialized endmills

M

PHU
NEW
GRADE



(1) Order code		(2) Grade code		Z9	Dimensions | Dimensões | Dimensiones (mm)					
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PHU920	ØDc	Ød (h6)	ap max	CH	L1	L
1180701	1180702	HRO40SS 4 030 08	4	◎	3	6	8	0,15 x 45°	24	57
1180445	1180392	HRO40SS 4 040 11	4	◎	4	6	11	0,15 x 45°	17	57
1180446	1180393	HRO40SS 4 050 13	4	◎	5	6	13	0,15 x 45°	19	57
1180447	1180394	HRO40SS 4 060 13	4	◎	6	6	13	0,15 x 45°	21	57
1180448	1180395	HRO40SS 4 080 19	4	◎	8	8	19	0,15 x 45°	27	63
1180391	1180396	HRO40SS 4 100 22	4	◎	10	10	22	0,20 x 45°	32	72
1180449	1180397	HRO40SS 4 120 26	4	◎	12	12	26	0,20 x 45°	38	83
1180450	1180398	HRO40SS 4 140 26	4	◎	14	14	26	0,25 x 45°	38	83
1180451	1180399	HRO40SS 4 160 32	4	◎	16	16	32	0,35 x 45°	44	92
1180452	1180400	HRO40SS 4 180 32	4	◎	18	18	32	0,45 x 45°	44	92
1180453	1180454	HRO40SS 4 200 38	4	◎	20	20	38	0,60 x 45°	54	104

◎ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

RECOMMENDED CUTTING CONDITIONS | Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	f_z (mm/t)			Vc (m/min)		
		ae			ae		
		25%	50%	100%	25%	50%	100%
M	SS - Ferritic / Martensitic	0,006 x ØDc	0,005 x ØDc	0,004 x ØDc	140	130	110
	SS – Austenitic	0,006 x ØDc	0,005 x ØDc	0,003 x ØDc	130	120	110
	SS - Austenitic-ferritic (Duplex)	0,005 x ØDc	0,004 x ØDc	0,003 x ØDc	120	110	100

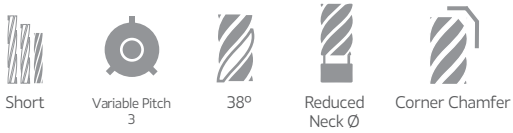
Note¹: Feed valid for when the endmill works with its whole ap, for when the endmill is working with lower depths of cut consider increasing the feed up to 25%.
Note²: Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.

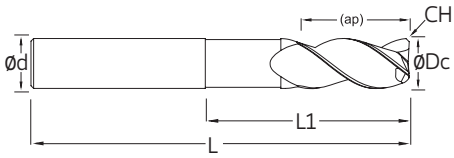
PDF

NEW

HC38AS 3 Corner chamfer aluminium specialized endmills

N





(1) Order code		(2) Grade code		12	Dimensions | Dimensões | Dimensiones (mm)					
HA (Cylindrical)	HB (Weldon)	Reference Referência Referencia		PH0920	ØDc	Ød (h6)	ap_{max}	CH	L1	L
1180401	1180410	HC38AS 3 030 07	3	◎	3	6	7	0,15 x 45°	15	57
1180402	1180411	HC38AS 3 040 08	3	◎	4	6	8	0,15 x 45°	17	57
1180403	1180412	HC38AS 3 050 10	3	◎	5	6	10	0,15 x 45°	19	57
1180404	1180413	HC38AS 3 060 10	3	◎	6	6	10	0,15 x 45°	21	57
1180405	1180414	HC38AS 3 080 16	3	◎	8	8	16	0,15 x 45°	27	63
1180406	1180415	HC38AS 3 100 19	3	◎	10	10	19	0,20 x 45°	32	72
1180407	1180416	HC38AS 3 120 22	3	◎	12	12	22	0,20 x 45°	38	83
1180408	1180417	HC38AS 3 160 26	3	◎	16	16	26	0,35 x 45°	44	92
1180409	1180418	HC38AS 3 200 32	3	◎	20	20	32	0,35 x 45°	54	104

◎ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

Note: For HB (Weldon) endmills, the reference ends with "-W "
Example: "HC38AS 3 030 07-W PH0920"

RECOMMENDED CUTTING CONDITIONS | Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	f_z (mm/t)			Vc (m/min)		
		a_e = 25%	a_e = 50%	a_e = 100%	a_e = 25%	a_e = 50%	a_e = 100%
N	Aluminium <6%Si	0,011 x ØDc	0,009 x ØDc	0,006 x ØDc	230	220	190
	Aluminium <12%Si	0,009 x ØDc	0,008 x ØDc	0,005 x ØDc	210	200	180
	Aluminium >12%Si	0,008 x ØDc	0,007 x ØDc	0,005 x ØDc	200	190	170

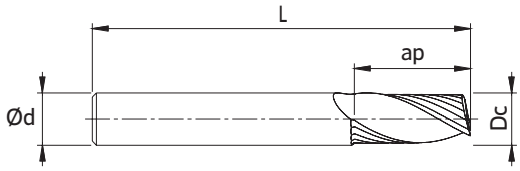
Note¹: Recommended feed values for maximum a_p. For reduced a_p, consider increasing f_z up to 25%.
Note²: Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.

PDF

NEW

HF30AS Single edge aluminium endmills

N



(1) Geometry code	(2) Grade code: Reference / Referência / Referencia		12 PH0920	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	ap max	L
1180751	HF30AS 1 020 05	1	◈	2	6	5	57
1180752	HF30AS 1 030 08	1	◈	3	6	8	57
1180753	HF30AS 1 040 11	1	◈	4	6	11	57
1180754	HF30AS 1 050 13	1	◈	5	6	13	57
1180755	HF30AS 1 060 13	1	◈	6	6	13	57
1180756	HF30AS 1 080 19	1	◈	8	8	19	63
1180757	HF30AS 1 100 25	1	◈	10	10	22	72
1180758	HF30AS 1 120 26	1	◈	12	12	26	83

◈ Stock item | Produto de stock | Itens de stock ◯ Available under request | Disponível sobre consulta | Disponible bajo consulta

Endmill order code = (1) Geometry Code + (2) Grade Code

RECOMMENDED CUTTING CONDITIONS ‖ Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Material	f_z (mm/t) a_e = 25%	a_e = 50%	a_e = 100%	Vc (m/min) a_e = 25%	a_e = 50%	a_e = 100%
N	Aluminium <6%Si	0,011 x ØDc	0,009 x ØDc	0,006 x ØDc	230	220	190
	Aluminium <12%Si	0,009 x ØDc	0,008 x ØDc	0,005 x ØDc	210	200	180
	Aluminium >12%Si	0,008 x ØDc	0,007 x ØDc	0,005 x ØDc	200	190	170

Note[1]: Recommended feed values for maximum ap. For reduced ap, consider increasing f_z up to 25%.
Note[2]: Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.

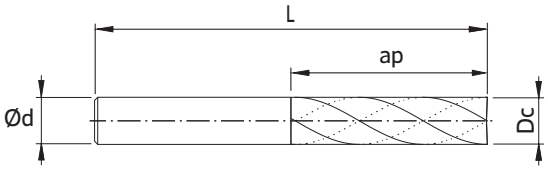
PDF

NEW

HF30HL Flat top endmill for hard materials

PHH
NEW
GRADE

H



(1) Geometry code	(2) Grade code: Reference Referência Referencia		X4 PHH603	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	ap max	L
1180112	HF30HL 4 040 20	4	⚙	4	6	20	75
1180358	HF30HL 4 050 20	4	⚙	5	6	20	75
1180196	HF30HL 4 060 30	4	⚙	6	6	30	75
1180113	HF30HL 4 080 35	4	⚙	8	8	35	100
1180359	HF30HL 4 100 40	4	⚙	10	10	40	100
1180111	HF30HL 4 120 50	4	⚙	12	12	50	100

⚙ Stock item | Produto de stock | Itens de stock ◯ Available under request | Disponível sobre consulta | Disponible bajo consulta

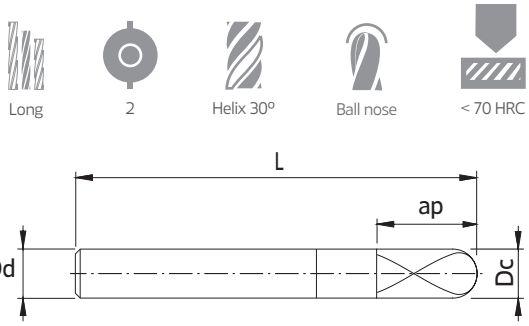
Endmill order code = (1) Geometry Code + (2) Grade Code

NEW

HB30HL Ball nose endmill for hard materials

PHH
NEW
GRADE

H



(1) Geometry code	(2) Grade code: Reference Referência Referencia		X4 PHH603	Dimensions | Dimensões | Dimensiones (mm) ØDc	Ød (h6)	ap max	L
1180356	HB30HL 2 020 04	2	●	2	6	4	75
1180357	HB30HL 2 030 06	2	●	3	6	6	75
1180093	HB30HL 2 040 08	2	●	4	6	8	75
1180109	HB30HL 2 050 10	2	●	5	6	10	75
1180130	HB30HL 2 060 12	2	●	6	6	12	75
1180131	HB30HL 2 080 16	2	●	8	8	16	75
1180132	HB30HL 2 100 20	2	●	10	10	20	100
1180141	HB30HL 2 120 24	2	●	12	12	24	100

● Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta

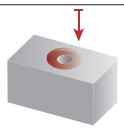
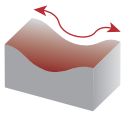
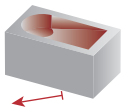
Endmill order code = (1) Geometry Code + (2) Grade Code

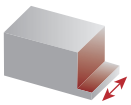
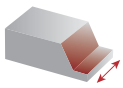
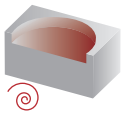
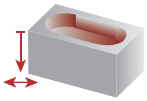
RECOMMENDED CUTTING CONDITIONS ‖ Condições de corte recomendadas | Condiciones de corte recomendables

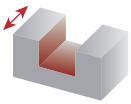
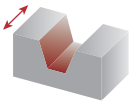
ISO	Material	Vc (m/min) 10%	Vc (m/min) 30%	f_z (mm/t) 10%	f_z (mm/t) 30%
H	Hardened Steels	120	110	0,006 x ØDc	0,005 x ØDc

NEW

CUTTING PROCESS

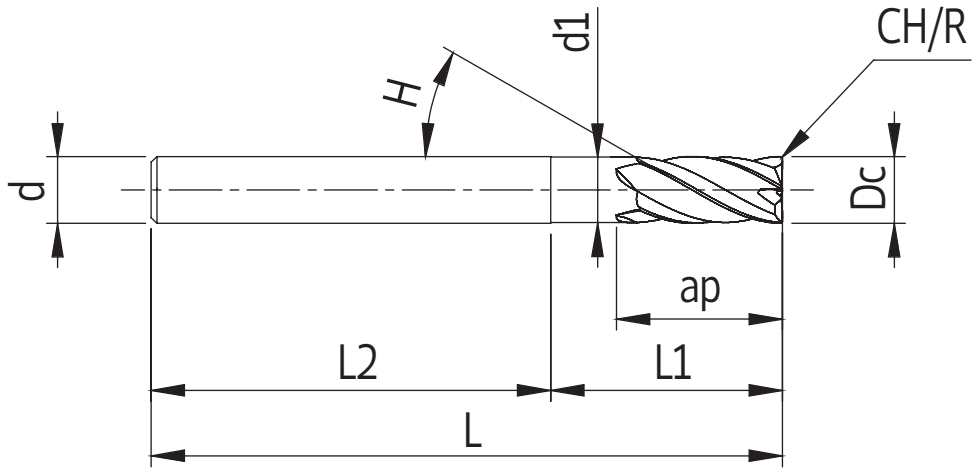
FACE SIDE	 Spot Facing	Uses the face of the Mill to normally cut a small blind hole. • Smaller Helix angles
	 Profiling	Used for slanted surfaces or irregular profiles. • Radial Segment or Ball Nose
	 Ramp down	Uses the face of the Mill and cuts the surface with an angle producing a “ramp” like path. • Cylindrical End Mills

ONE SURFACE	 Side milling	Grind a surface at a time, normally perpendicular to the tool path. • Cylindrical End Mills
	 Tapering	Grind a surface at a time, normally the surface has an angle with the tool path. • Radial Segmented
	 Helical Interpolation	Grind the surface in a continuous curve. • Choose according to geometry
	 Plunging and recessing	Grind in a closed boundary. • Choose according to geometry

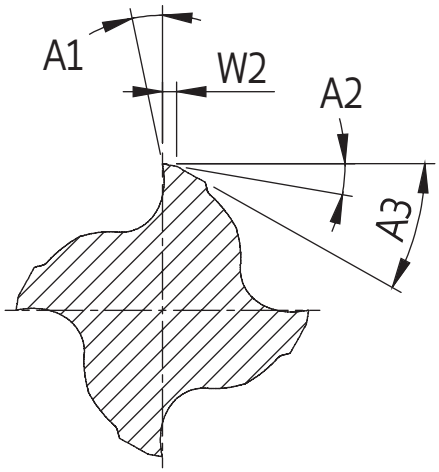
TWO SURFACES	 Slotting	Grind between two surfaces, normally perpendicular to the tool path. • Cylindrical End Mills
	 Ribbing	Grind between two surfaces, normally with an angle between them. • Radial Segmented

NEW

END MILL ELEMENTS



d - Shank diameter;
Dc - Cutting diameter;
d1 - Neck diameter;
R - Corner radius;
CH - Chamfer;
L - Total length;
L1 - Useful length;
L2 - Shank length;
ap - Max cutting depth;
H - Helix angle;

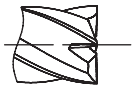
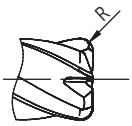
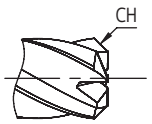
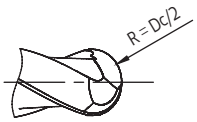
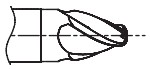
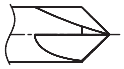


A1 - Rake angle;
A2 - Relief angle 1;
A3 - Relief angle 2;
W1 - Relief width 1;
W2 - Relief width 2;

NEW

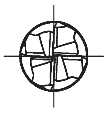
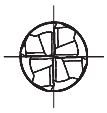
SHAPE OF CORNER

The Shape of Corner directly affect the distribution of cutting forces thus influence life span, productivity and functionality.

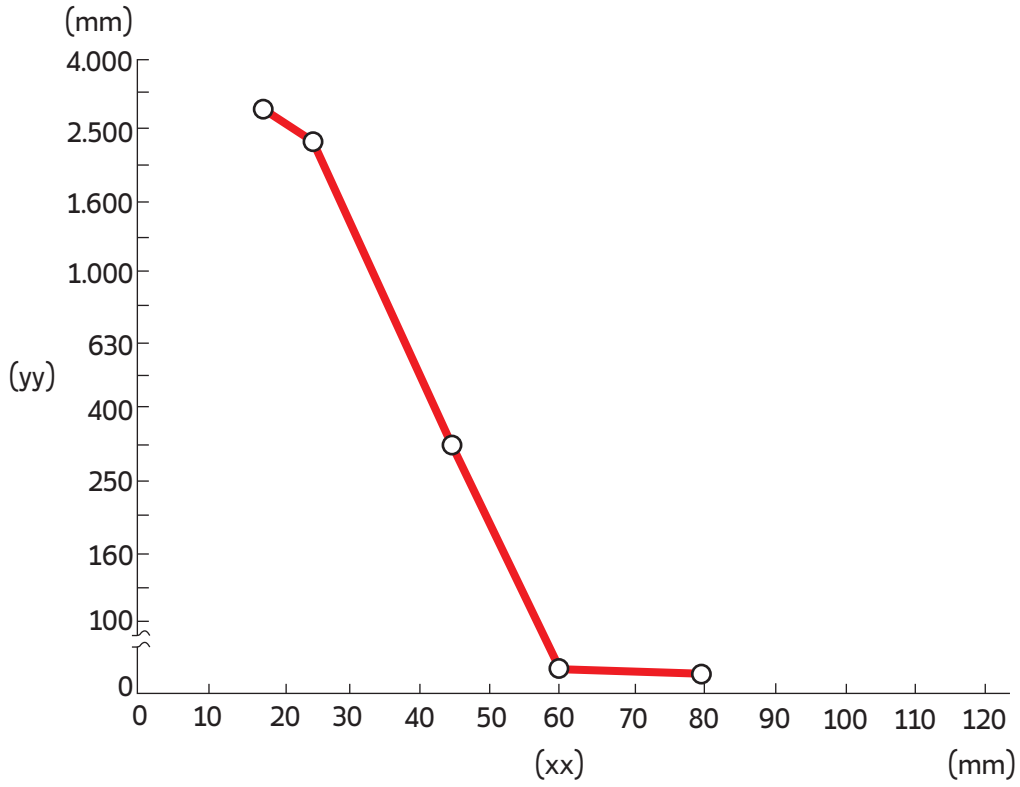
Square	 Square		• Recommended for side milling; • When sharp corners are required;
Corner Radius	 Corner radius		• Commonly used for profiling and irregular surface machining;
Corner Chamfer	 Corner chamfer		• Protected edge geometry; • Recommended for Shouldering;
Ball Nose	 Ball nose		• Recommended for profiling and irregular surface machining;
Radial Segment	 Radial Segment		• For higher productivity in hard to read surfaces; • Balance between ball nose accessibility and straight tool finishing;
Conical Top	 Conical Top		• For Chamfering;

NEW

KINDS OF SHAPES OF END CUTTING EDGES

	2 - Flutes	3 - Flutes	4 - Flutes	6 - Flutes
Center cut				
Center eyed				

In brief, deflection increases twice if the flute length increases by 25%, or it decreases one-half if the mill diameter increases by 20%. The following shows the effect of flute length on cutting life of tools, indicating that it is recommended to use a tool with as high stiffness as possible to obtain high efficiency cutting. The long shank type end mill has short flute length and long shank with high stiffness compared with the long flute length type, and is suited to deep contouring.



Flute length and Tool life

NEW

BALLNOSED ENDMILLS

Endmills that are largely used for what's called "2 1/2D" machining, sometimes called "Prismatic" machining. This is machining where the Z or height of the surface doesn't change in smoothly flowing contours. It may drop down for a pocket or two, but the floors of the pockets and the top of the part are generally smooth planes punctuated by holes and more pockets. The vast majority of parts have this characteristic, but for those that don't, you'll be doing true "3D" machining, and to do that, you'll want touse a Ballnosed Endmill.

Ballnoses create scallops whose size depends on the diameter of the ballnose, the depth of cut, and the stepover between successive passes:

NEW

NUMBER OF FLUTES

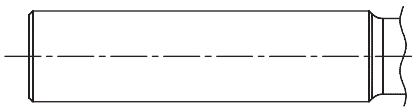
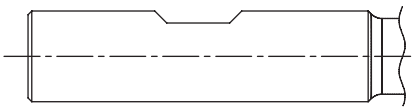
The flute number count is of great importance to the operation at hand. The ideal number of flutes varies greatly depending on the material and application.
Endmills with a higher number of flutes tend to have a larger core which make the tool stronger. Tool strength is an important parameter specially for machining ferrous materials. On the other hand, by increasing the core diameter, the flute depth decreases. This lack of space on the flute prevents the tool from removing large quantities of material per flute, as it would risk the chips jamming the flute and breaking the tool. Of course, this decrease in material removal per flute is compensated to some degree by the increase in number of flutes and therefore increase in feed (feed = #flutes x fz).
Endmills with a high flute count are better for finishing operations. This is because the tool is stronger and vibrates less and more cutting edges are in contact with the material at the same time. At finishing operations there is usually no problem related to chip evacuation.
Typically, endmills with a low number of flutes (1-3) are used for machining aluminium and NFM where tool strength is not a concern and for roughing with more traditional milling strategies.

	 1	 2	 3	 4	 5	 6 +
Chip evacuation	★★★★★	★★★★★	★★★★	★★★★	★★★	★★
Feed rate	★★	★★	★★★	★★★	★★★★	★★★★★
Flute Capacity	★★★★★	★★★★★	★★★★	★★★	★★	★
Surface Quality	★	★★	★★★	★★★★	★★★★★	★★★★★
Tool Strength	★★★	★★★	★★★★	★★★★	★★★★★	★★★★★

		2 - Flutes	3 - Flutes	4 - Flutes	6 - Flutes
Feature	Advantage	Chip disposability is excellent. Suitable for sinking. Low cutting resistance.	Chip disposability is excellent. Suitable for sinking.	High rigidity.	High rigidity. Superior cutting edge durability.
	Fault	Low rigidity.	Diameter is not easily measured.	Chip disposability is poor.	Chip disposability is poor.
Usage		Slotting, side milling, sinking, etc. Wide range of use.	Slotting, side milling, heavy cutting, finishing.	Shallow slotting, side milling, finishing.	High hardness material, Shallow slotting, side milling.

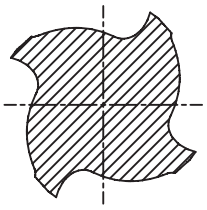
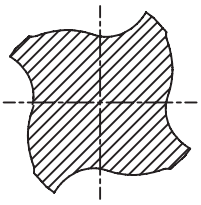
NEW

SHANK TYPES - DIN 6535

Flat Shank	Weldon Shank
	
Cylindrical Shank provides: • Lower runout; • Versatility choosing the holder; • Higher tool life than weldon flat; • Pullout may occur; • Better tool balance;	Weldon Flat provides: • Strong clamp; • Pullout revention; • Higher runout; • Reduce tool Life; • Cannot be used in thermic clamping;

RAKE ANGLE

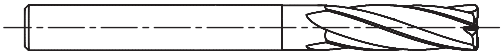
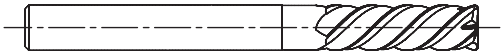
Rake angle is the angle that the endmill cutting face have regarding the work face material. That angle can be positive, neutral or negative, depending of the functionality and needs:

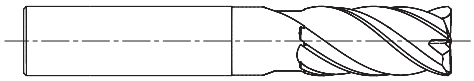
Positive Rake Angle	Negative Rake Angle
• Good for soft / ductile work material; • Lower cutting forces; • Chip continuous and less deformed; • Tool life reduces due to sharper helix; • Worse defects may occur due to impact during machining;	• Good for Hard/Brittle work material; • Stronger tool thus a harder to worn out and a higher tool life; • Sustains higher vibrations than a tool with positive rake angle; • Higher feed and depth of cut but worse finished surface;
	

NEW

HELIX ANGLE

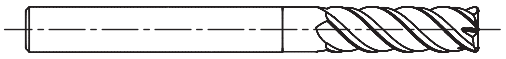
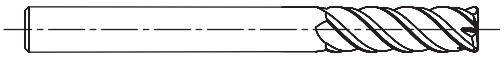
While working, endmill are being exposed to axial and radial forces, depending of cutting process and orientation.
Axial force tends to press the end mill against the holder or pull it out of the holder, while the radial forces cause tools to bend thus creating cyclical vibrations.
Low helix angle implies higher radial forces, radial tool vibration and in extreme cases may even damage the machine spindle.

Up to 30º	From 30º to 60º
	
• Lower pullout risk; • High vibrations; • Stronger tools; • Larger chip evacuation;	• Lower radial force; • Better surface finish; • Faster feed rate;

Irregular Pitch and Variable Helix Angle	
Due to constant angles between helix, harmonic vibrations are formed. Those vibrations might bruise the tool, reducing tool life. For that reason, a simple way to prevent those harmonics is to put helix out of phase, thus inducing a lag between max values of forces.	
	• Reduced chatter due to reduced vibrations; • More stability; • Enhanced tool Life; • High speeds due to reduce in chatter;

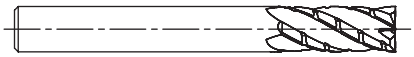
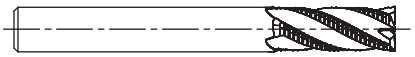
NEW

REDUCED NECK

With Reduced Neck	Without Reduced Neck
	
• More Reach and Stability; • Prevents Rubbing;	

CHIP BREAKER AND KNUCKLE ROUGHER

Both have similar geometries, but have completely different functionalities.

Chip Divider End Mill	Rougher End Mill
	
• Better chip evacuation; • Good surface finish; • Enhace cutting performance; • Prevents the formation of long chips; • Common for aluminium and endmills with long flutes;	• Smaller chip; • High metal removal efficient; • Bad surface finish; • Allow higher feed at high stepover (>40%) and sloting;

Roughing endmills like the one pictured have little serrations in the teeth. These serrations do a couple of useful things. First, they break up the chips making it easier to clear them out of the cavity during cutting in. Second, the are less prone to chatter. All those serrations produce a variety of vibrations that interfere with one another instead of creation a single ringing tone.

Roughing endmills are not very expensive and can provide a nice step up in productivity.

NEW

HOLDER

Depending of the Holder, you can obtain different runout, cutting speed, rigidity, versatility and tool switching/setting. There are some variant, but the basic clamping types are Collet, Side Lock, Hydraulic and Heat Shrink.

	Collet Chuck	Weldon Chuck	Hydraulic Expansion Chuck	Shrink Chuck
				
Setting	▲▲▲▲	▲▲▲	▲▲▲▲▲	▲
Rigidity	▲▲▲	▲▲▲▲▲	▲▲▲▲	▲▲▲▲▲
Versatility	▲▲▲▲▲	▲	▲▲▲▲	▲▲▲
Runout	▲▲▲▲	▲	▲▲▲▲▲	▲▲▲▲▲
Pullout	▲▲	▲▲▲▲▲	▲▲▲▲	▲▲▲▲
	• Versatile; • Low Cutting Speed;	• Weldon Clamper; • Prevent Pullout;	• High Speed; • Bulky by design;	• Requires a Heat Shrink Machine; • Slow Tool Switching; • Metal's Thermal expansion dependent;

NEW

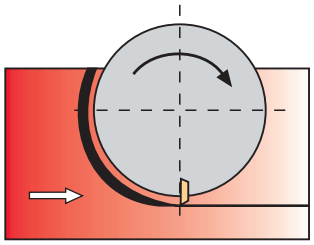
DRY AND WET MILLING

The main difference between dry and wet milling is the presence of a cold fluid, usually a cooling lubricant, that, as the name suggest, help cooling and lubricating the endmill while machining, providing a better material removal rate.
In other hand, the misuse of coolant can induce a cyclical thermal shock along the mill, resulting in fatigue decreasing the normal tool life span.
For that reason, coolant should only be used for Aluminium, titanium and heat resistant alloys.
As a half measure approach, minimum quantity lubrication using air can be used as a coolant, providing a better chip removal while increasing tool life span.

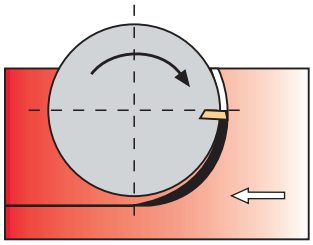
Wet Milling

CLIMB MILLING

Unlike Conventional Milling, the mill rotation of Climb Milling has the same direction as the feed rate, providing a deflection direction away from the cutting surface and a better surface quality.
Furthermore, Chip thickness starts at the maximum, that way, the heat generated from grinding is directed to the chip, providing a tool life increase.
However, in some cases, Conventional Milling is still preferable due to the chip thickness start at zero and increases to the maximum at the end of cut, for example in harder metals is easier to machine using this technique.



Conventional Milling

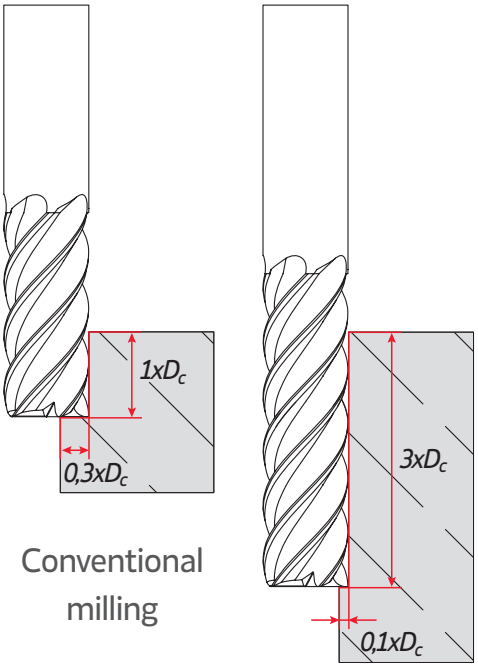


Climb Milling

NEW

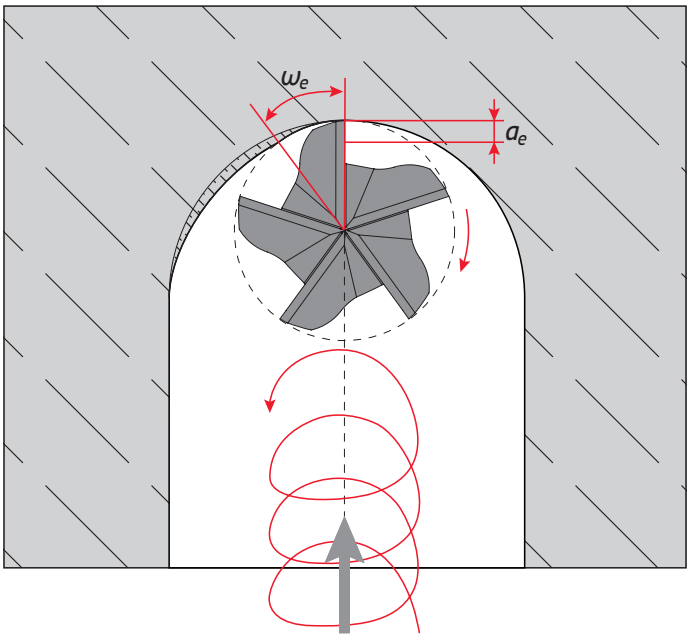
TROCHOIDAL MILLING

Instead of using a normal tool path, the trochoidal milling uses a spiral like path reducing the tool contact angle.
With the reduced contact engagement, there is also a reduction in the load and wear on the tool and spindle, that decrease the amount of heat produced that is distributed across the tool's cutting edge.
The reduced radial force also induces greater accuracy resulting in more precise and refined details in the machined section.
All those facts can be summarized in lower cutting forces that reduce and redistribute heat along the tool, thus improving tool life, and faster cycle times while improving machining accuracy.
The same tool can also be used across multiple slot sizes provided that the cutter diameter stays from 50% to 70% of the final slot width and the radial depth between 10% and 35% of the cutting tool diameter.



Conventional milling

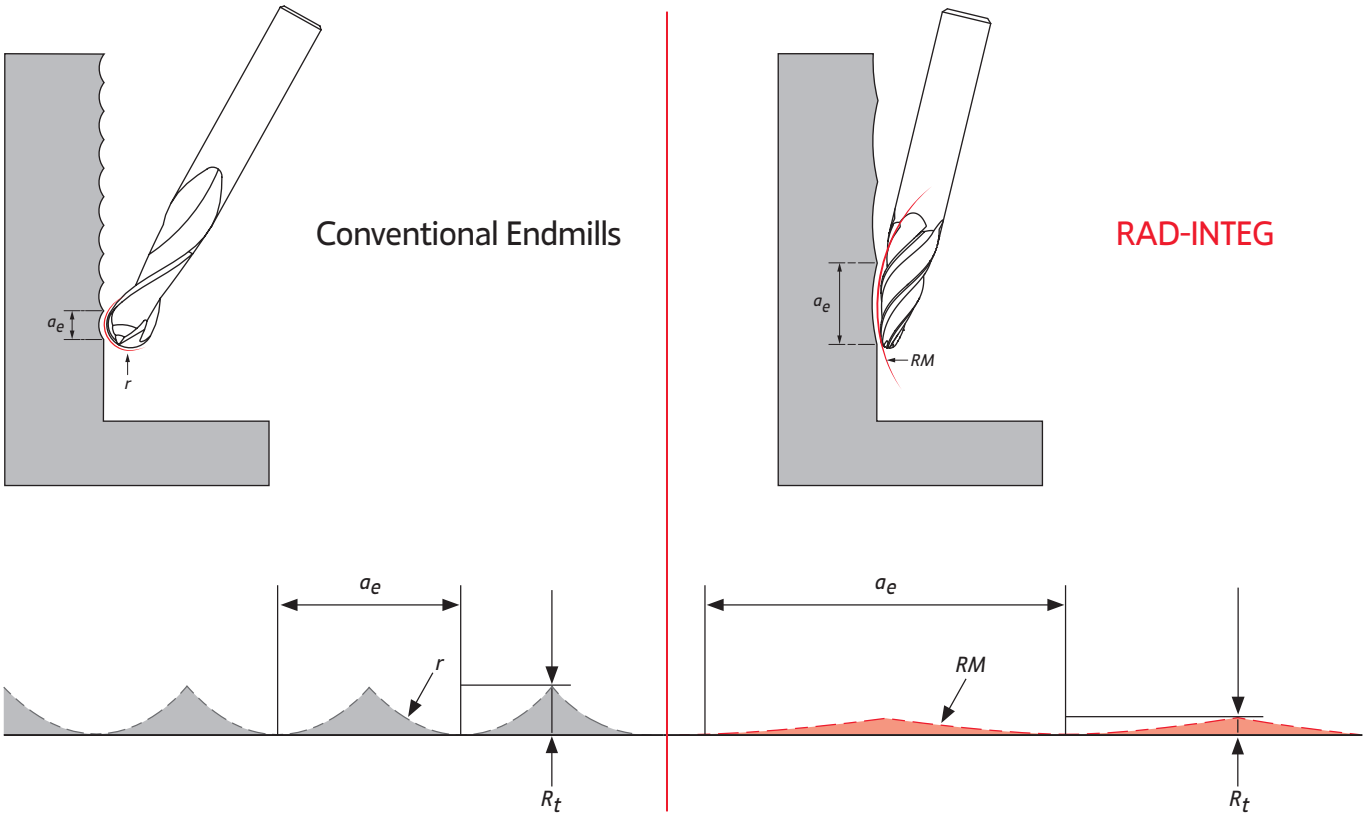
Trochoidal milling



NEW

RADIAL SEGMENT EDNMILL

A solution between regular endmill and ball nose are the radical segment. Instead of having a normal cylindrical form, they have a conical shape that provides a better surface and faster machining compered to regular and ball nose endmills. To put it in context, a normal radial segment with a diameter of 8mm can machine a radius of 300mm.
Some advantage of radial segment endmill are an up to 80% time saving compared to normal ball nose endmill, a better surface quality due to a large side cutting radius, a longer tool life due to lower cutting forces and a better accessibility for difficult areas.
Provides higher productivity and better finishing even at higher stepover and while maintaining the same allowance.



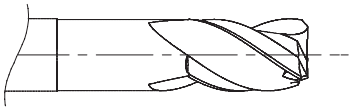
NEW

ALUMINIUM MACHINING APPLICATION

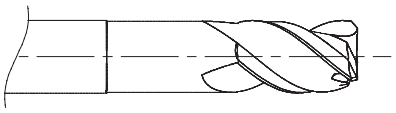
Aluminium is a highly formable, workable, lightweight material. Parts made from this material can be found in nearly every industry. Additionally, Aluminium has become a popular choice for prototypes due to its low-cost and flexibility. Aluminium is available in two basic forms: Cast and Wrought. Wrought Aluminium is typically stronger, more expensive, and contains a lower percentage of outside elements in its alloys. Wrought Aluminium is also more heat-resistant than Cast and has a higher level of machinability.
Cast Aluminium has less tensile strength but with a higher flexibility. It costs less, and has higher percentages of outside elements (silicon, magnesium, etc.) in its alloys, making it more abrasive than Wrought
The real key to high performance machining in Aluminium is knowing the proper flute count and helix angle required for your operation.

FLUTE COUNT

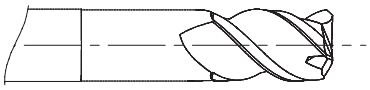
End mills for Aluminium are often available in either 2 flute or 3 flute styles. With higher flute counts, it would become difficult to evacuate chips effectively at the high speeds at which you can run in Aluminium. This is because Aluminium alloys leave a large chip, and chip valleys become smaller with each additional flute on an end mill.
The helix angle of a tool is measured by the angle formed between the centerline of the tool and a straight line tangent along the cutting edge. Cutting tools for Aluminium typically feature higher helix angles than standard end mills. Specialized helix angles for Aluminium are typically either 35°, 40°, or 45°. Variable helix tools are also available and make a great choice for reducing chatter and harmonics while also increasing material removal rates.



35° Helix



40° Helix



45° Helix

A helix angle of 35° or 40° is a good choice for traditional roughing and slotting applications. A 45° helix angle is the preferred choice for finishing, but also for High Efficiency Milling toolpaths as the high helix angle wraps around the tool faster and makes for a more aggressive cut.

NEW

TROUBLE SHOOTING FOR END MILLING

Symptoms of Troubles	Probable Causes	Remedies
Chatter during cutting	Low-angled cutting edge due to too high peripheral flank angle and rake angle; The work piece is not attached securely; Insufficient stiffness of machine and chuck; Too high cutting speed and feed speed;	Mend the flank angle and rake angle properly; Fix the work piece firmly; Replace the machine and chuck witch properones; Change cutting conditions;
Breakage during cutting	The end mill lacks firmness; Too high feed speed; Too large depth of cut; Excessively long protrusion; Worn-out cutting edge; The flute is longer than it need to be;	Use a tool designed to have high stiffness; Decrease the feed rate; Make small depth of cut; Shorten the protrusion length; Perform re-grinding in early stage of wear; Replace the end mill with a new one having shorter flute length;
Broken cutting edge during cutting	The work piece is not fixed firmly; Too high feed speed; Low-angled cutting edge; Lack in toghtening of chuck; Too large depth of cut; Insufficient stiffness of machine;	Fix a work piece firmly; Decrease the feed rate; Grind the angle properly; Perform chucking of a toll reliably; Make small depth of cut; Replace the machine witch a proper one;
Serious wear and burning	Too high cutting speed; Excessively small peripheral flank angle; Hardness of the work material is too high;	Slow done the revolution number; Modify the flank angle properly; Apply surface treatment to a tool to be used;
Poor cutting quality	Excessively worn-out cutting edge; A tool to be used is not suited to the work material; Too small rake angle;	Perform re-grinding; Use a tool specially designed for the work; Modify the rake angle properly;
Chip clogging	Too large amount of chips are produced; Small chip pocket; Insufficient application of cutting fluid; Improper shape of chip pocket;	Adjust the feed speed and depth of cut; Use an en mill having less number of flutes; Aplly a large amount of cutting fluid to work material; Modify the chip pocket to have a proper shape;
Burr on the finished surface	Seriously worn-out peripheral flank; Mistake in selection of cutting conditions; Improper peripheral flank angle and rake angle;	Perform re-grinding in early stage of wear; Re-examine cutting conditions; Modify the angle properly;
Insufficient roughness of finished surface	Too high feed speed; Too slow cutting speed; Excessively worn-out cutting edge; Chips bite the work material; Too small medium to low gradient of end cutting edges;	Decrease the feed rate; Use and end mill with smaller helix angle; Shorten the protrusion length; Make small depth of cut;
Inclination of slot	Too high feed speed; Too large helix angle; Too long overhang; Too large depth of cut;	Decrease the feed rate; Use and end mill with smaller helix angle; Shorten the protrusion length; Make small depth of cut;

NEW

TROUBLE SHOOTING FOR END MILLING

Symptoms of Troubles	Probable Causes	Remedies
Poor dimensional precision	Insufficient precision of machine and chuck; Too long flute length; Insufficient stiffness of machine and chuck;	Repair the machine and chuck; Use an end mill with proper flute length; Change the machine and chuck;
Chatter during cutting	The end mill lacks firmness; Too high feed speed; Too large depth of cut; Excessively long protrusion; Worn-out cutting edge; The flute is longer than it need to be;	Use a tool designed to have high stiffness; Decrease the feed rate; Make small depth of cut; Shorten the protrusion length; Perform re-grinding in early stage of wear; Replace the end mill with a new one having shorter flute length;
Broken cutting edge during cutting	The work piece is not fixed firmly; Too high feed speed; Low-angle cutting edge; Lack in tightening of chuck; Too large depth of cut; Insufficient stiffness of machine;	Fix a work piece firmly; Decrease the feed rate; Grind the angle properly; Perform chucking of a tool reliably; Make small depth of cut; Replace the machine with a proper one;
Serious wear and burning	Too high cutting speed; Excessively small peripheral flank angle; Hardness of the work material is too high;	Slow down the revolution number; Modify the flank angle properly; Aplly surface treatment to a tool to be used;
Poor cutting quality	Excessively worn-out cutting edge; A tool to be used is not suited to the work material; Too small rake angle;	Perform re-grinding; Ise a tool specially designed for the work; Modify the rake angle properly;

INTEG GRADES

NEW

COATINGS

PHP

- Unmatched coating adhesion;
- Smoothest surface;
- Suitable for dry and wet machining;
- Color: Black;

Product of the latest coating technology, the PHP is the number one coating for machining steel and cast iron.
Because of its smoothness at medium temperatures, the chips are able to flow effortlessly, maintaining the flutes clean and the tool life long even in dry conditions.

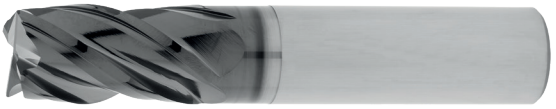
PHH

- Highest thermal stability;
- Smooth surface;
- High performance in dry machining;
- Color: Light brown;

A prime coating for prime endmills, the PHH is the recommended coating for Hardened steels, as well as stainless steels and HRSA.
Because of its high performance at high temperatures the coating successfully insulates the cutting edges allowing the tool to work for long periods of time.

PHU

- High thermal shock resistance;
- Carefully engineered surface quality;
- Suitable for dry and wet machining;
- Color: Grey;



Combining both excellent thermal resistance and excellent surface quality, the PHU coating is recommended for stainless steels, while also being suitable for steels and cast iron.
Because of its surface quality and thermal resistance it is able to prevent built-up-edge in both low-alloy steels and stainless steels, making it a very versatile coating.

SUBSTRATE

PH...920

- Universal substrate with great balance between toughness and wear resistance;
- Great heat dissipation;
- Recommended for semi-finishing to roughing on most materials;

PH...603

- Harder grade with extreme wear resistance;
- Great stability;
- Recommended for finishing applications and Hardened steels;

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