

SOLID CARBIDE END MILLS

CATALOGUE

Integ Milling Power

**SOLID CARBIDE
END MILLS**

Catalogue



CHOOSE BY **MATERIAL**



A high-performance solid carbide endmills designed for specific workpiece materials, offering improved productivity, extended tool life, and providing high process security for demanding parts production in industries such as aerospace, automotive, mold and die, and power generation.

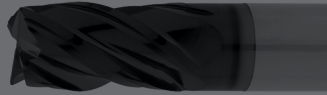
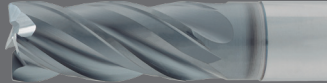
Fresas de metal duro integral de alto desempenho projetadas para materiais de peças específicas, oferecendo produtividade aprimorada, vida útil estendida e alta segurança de processo para produção de peças exigentes em indústrias como aeroespacial, automóvel, moldes e matrizes e geração de energia.

Fresas de carburo integral de alto rendimiento diseñadas para materiales específicos de piezas, ofreciendo productividad mejorada, vida útil prolongada y alta seguridad del proceso para la producción de piezas exigentes en industrias como aeroespacial, automotriz, moldes y matrices, y generación de energía.

NEW

STEEL INTEG > page 7

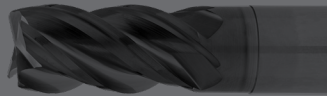
- > Steel specialized end mills
Fresas especiais para aço | Fresas especiales para acero
- > From DC 2mm to 25mm
De DC 2mm a 25mm | Desde DC 2mm hasta 25mm
- > Chamfer or radius geometry
Disponível com geometria em chanfro ou raio | Disponible con geometría en chaflán o radio
- > Short and long version
Disponível em versão curta e longa | Disponible en versión corta y larga



NEW

INOX INTEG > page 10

- > Stainless steel specialized end mills
Fresas especiais para aço inox | Fresas especiales para acero inoxidable
- > From DC 2mm to 20mm
De DC 2mm a 20mm | Desde DC 2mm hasta 20mm
- > Chamfer or radius geometry
Disponível com geometria em chanfro ou raio | Disponible con geometría en chaflán o radio
- > Short version
Disponível em versão curta | Disponible en versión corta



NEW

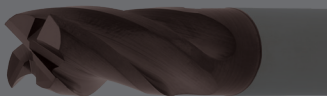
AL INTEG > page 13

- > Aluminium specialized end mills
Fresas especiais para alumínio | Fresas especiales para aluminio
- > From DC 2mm to 20mm
De DC 2mm a 20mm | Desde DC 2mm hasta 20mm
- > Chamfer, radius, ball nose or flat top geometry
Disponível com geometria em chanfro, raio, topo redondo ou topo raso | Disponible con geometría en chaflán, radio, topo redondeado o plano
- > Short version
Disponível em versão curta | Disponible en versión corta



HARD INTEG > page 18

- > Hardened steel specialized end mills
Fresas especiais para aço | Fresas especiales para acero
- > From DC 2mm to 12mm
De DC 2mm a 12mm | Desde DC 2mm hasta 12mm
- > Ball nose or flat top geometry
Disponível com geometria redonda ou topo raso | Disponible con geometría redondeada o plano
- > Short and long version
Disponível em versão curta e longa | Disponible en versión corta y larga



CODIFICATION SYSTEM FOR SOLID CARBIDE END MILLS

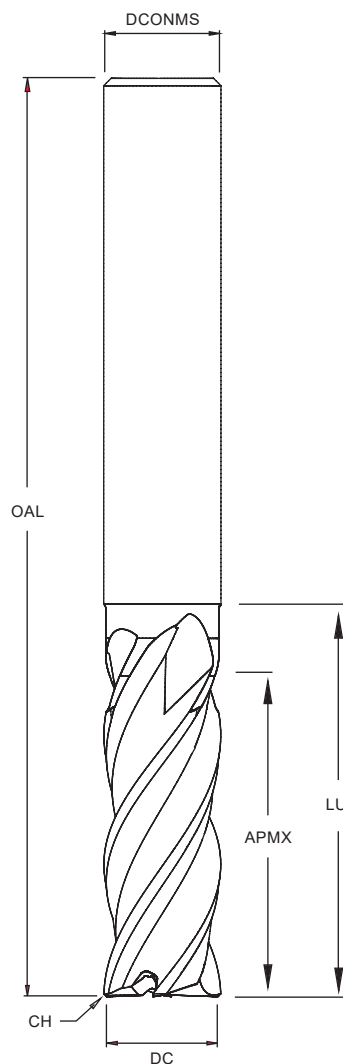
Sistema de codificação para fresas de metal duro para acabamento | Sistema de codificación para fresas de carburo para acabado

Integral Solid Carbide
example:

H	C	35	-	P	S	4	090	22	XR100	90	-	W
1	2	3	4	5	6	7	8	9	10	11	12	

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 XR - Special Radius RO - Rougher
3 - Helix Angle (Suppressed when it is 90°)
... - Degree of helix rounded to nearest 5 degree
4 - Machining Method (Suppressed when it doesn't exist)
HF - High Feed HP - High Performance TS - Trochoidal milling
5 - Application
A - Aluminium S - Stainless steel G - General application H - Hard materials F - Finishing MIN - Micro milling P - Steel
6 - Length of Shank
S - Short length L - Long length XL - Extra long length
7 - Flutes number (NOF)
Example: NOF = 1 ; NOF = 2 ; NOF = 3
8 - Cutting diameter (DC)
Example: 120 = 12,0 mm ; 008 = 0,8 mm
9 - Max cutting depth (APMX)
Example for APMX ≥ 1 mm: 04 = 4 mm ; 06 = 6 mm Example for APMX < 1 mm: 002 = 0,2 mm ; 005 = 0,5 mm
10 - Shank diameter (only on straight flute solid carbide)
Example for corner radius: R150 = 1,5 mm ; R015 = 0,15 mm Example for special radius : XR100 = 1,0 mm Example for conical segment: 18RM120 - $\alpha/2 = 18^\circ$, RM = 1200 mm Example for tangential segment: RM090 - RM = 90 mm
11 - Angle (Only for chamfering end mills)
Example: 90 = 90°
12 - Shank (Suppressed when cylindrical)
W - Weldon

Integral Solid Carbide
technical drawing example



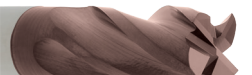
SELECTION GUIDE FOR SOLID CARBIDE END MILLS

Guia de seleção para fresas de metal duro integral | Guía para fresas en carburo monobloque

	DC	NOF	HELIX ANGLE	GEOMETRY	FINISHING	ROUGHING	MATERIAL	DESCRIPTION	PAGE
 STEEL INTEG HC35PS NEW	2-25	4	35° 38°	 Corner chamfer			PK	Steel Specialized End mills	7
 STEEL INTEG HC35ML	1-20	4	35° 38°	 Corner chamfer			PK		8
 STEEL INTEG HR35GL	12-20	4	35° 38°	 Corner radius			PMKS		9
 INOX INTEG HR37SS NEW	2-20	4	38° 39°	 Corner radius			M	Stainless Steel Specialized End mills	10
 INOX INTEG HC40SS	3-20	4	40° 41°	 Corner chamfer			M		11
 INOX INTEG HRO40SS	3-20	4	39° 41°	 Corner chamfer			M		12

SELECTION GUIDE FOR SOLID CARBIDE END MILLS

Guia de seleção para fresas de metal duro integral | Guía para fresas en carburo monobloque

	DC	NOF	HELIX ANGLE	GEOMETRY	FINISHING	ROUGHING	MATERIAL	DESCRIPTION	PAGE
 AL INTEG HR35HPAS NEW	2-20	3	35°	 Corner radius			N	Aluminium Specialized End mills	13
 AL INTEG HF45HPAS NEW	2-20	3	45°	 Square			N		14
 AL INTEG HB50HPAS NEW	2-20	2	50°	 Ball nose			N		15
 AL INTEG HC38AS	2-12	3	38°	 Corner chamfer			N		16
 AL INTEG HF30AS	2-12	1	30°	 Square			N		17
 HARD INTEG HF30HL	4-12	4	30°	 Square			H	Hardened Materials Specialized End mills	18
 HARD INTEG HB30HL	2-12	2	30°	 Ball nose			H		19

NEW HC35PS Corner chamfer



P K



Short



Variable Pitch
4



Variable helix
35° | 38°



Reduced
neck



45°
Corner chamfer



< 48 HRC



		⁽²⁾ Grade code		2A	Dimensions Dimensões Dimensiones (mm)						
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHU910							
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	AMPX	CHW	KCH	LU	OAL
1182241	1182240	HC35PS 4 020 05	4	⊗	2	6	5	0,08	45°	8	57
1182242	1181829	HC35PS 4 030 08	4	⊗	3	6	8	0,10	45°	12	57
1182243	1181749	HC35PS 4 040 08	4	⊗	4	6	8	0,10	45°	12	57
1182244	1181750	HC35PS 4 050 10	4	⊗	5	6	10	0,15	45°	15	57
1182245	1181751	HC35PS 4 060 13	4	⊗	6	6	13	0,20	45°	21	57
1182246	1181834	HC35PS 4 070 19	4	⊗	7	8	19	0,20	45°	27	63
1182247	1181752	HC35PS 4 080 19	4	⊗	8	8	19	0,20	45°	27	63
1182248	1181830	HC35PS 4 090 22	4	⊗	9	10	22	0,20	45°	32	72
1182249	1181753	HC35PS 4 100 22	4	⊗	10	10	22	0,20	45°	32	72
1182250	1181831	HC35PS 4 110 26	4	○	11	12	26	0,20	45°	32	83
1182180	1181828	HC35PS 4 120 26	4	⊗	12	12	26	0,20	45°	38	83
1182251	1181832	HC35PS 4 130 26	4	○	13	14	26	0,20	45°	38	83
1182252	1181754	HC35PS 4 140 26	4	○	14	14	26	0,30	45°	38	83
1182253	1181755	HC35PS 4 160 32	4	⊗	16	16	32	0,30	45°	44	92
1182254	1181756	HC35PS 4 180 32	4	⊗	18	18	32	0,30	45°	44	92
1182255	1181757	HC35PS 4 200 38	4	⊗	20	20	38	0,30	45°	50	104
1182256	1181833	HC35PS 4 250 42	4	○	25	25	42	0,30	45°	58	121

⊗ Stock item | Produto de stock | Itens de stock

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

End mill order code = (1) Geometry Code + (2) Grade Code

Note: For HB (Weldon) end mills, the reference ends with "-W"

Example: "HC35PS 4 030 08-W"

STEEL INTEG Steel Specialized End mills

HC35ML Corner chamfer



P K



Short



Variable Pitch
4



Variable helix
35° | 38°



Reduced
neck



45°
Corner chamfer



< 42 HRC



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

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

End mill order code = (1) Geometry Code + (2) Grade Code

Note: For HB (Weldon) end mills, the reference ends with "-W"

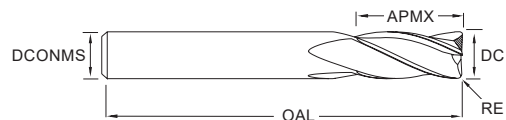
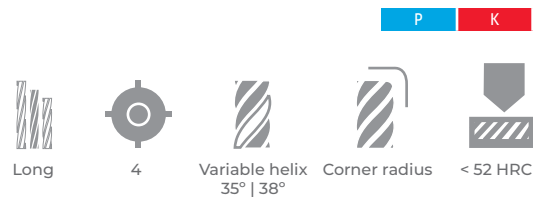
Example: "HC35ML 4 030 08-W"

STEEL INTEG Steel Specialized End mills

HR35GL Corner radius



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



(1) Geometry code	(2) Grade code		T1	Dimensions Dimensões Dimensiones (mm)				
	Reference Referência Referencia	NOF	PHP920	DC	DCONMS	APMX	RE	OAL
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

End mill 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)			V _c (m/min)		
		a _e = 25%	a _e = 40%	a _e = 100%	a _e = 25%	a _e = 40%	a _e = 100%
P	Unalloyed Steel	0,008 x DC	0,005 x DC	0,004 x DC	190	180	150
	Low-Alloyed Steel	0,007 x DC	0,004 x DC	0,003 x DC	180	160	130
	High-Alloyed Steel	0,006 x DC	0,004 x DC	0,003 x DC	160	150	120
K	Malleable Cast Iron	0,008 x DC	0,005 x DC	0,004 x DC	230	210	180
	Grey Cast Iron	0,008 x DC	0,005 x DC	0,004 x DC	230	210	170
	Nodular Cast Iron	0,008 x DC	0,004 x DC	0,004 x DC	210	190	160

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%.

INOX INTEG Stainless Steel Specialized End mills

NEW HR37SS Corner radius



M



Short



Variable Pitch
4



Variable Helix
38° | 39°



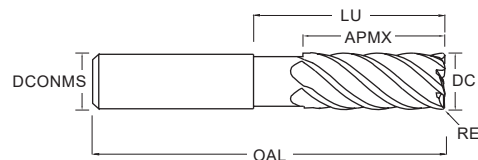
Reduced
Neck



Corner radius



< 42 HRC



		(2) Grade code		1F	Dimensions Dimensões Dimensiones (mm)					
(1) Order code		Reference Referência Referencia	NOF	PHF920						
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	AMPX	RE	LU	OAL
-	1182351	HR37SS 4 020 05 R020-W	4	⊗	2	6	5	0,2	11	57
-	1182352	HR37SS 4 030 08 R020-W	4	⊗	3	6	8	0,2	16	57
-	1182353	HR37SS 4 040 08 R020-W	4	⊗	4	6	8	0,2	19	57
-	1182354	HR37SS 4 050 10 R020-W	4	⊗	5	6	10	0,2	21	57
-	1182355	HR37SS 4 060 13 R030-W	4	⊗	6	6	13	0,3	23	57
-	1182356	HR37SS 4 080 19 R050-W	4	⊗	8	8	19	0,5	31	63
-	1181510	HR37SS 4 100 22 R050-W	4	⊗	10	10	22	0,5	33	72
-	1182357	HR37SS 4 120 26 R100-W	4	⊗	12	12	26	1,0	37	83
-	1182358	HR37SS 4 160 32 R100-W	4	⊗	16	16	32	1,0	44	92
-	1182359	HR37SS 4 200 38 R100-W	4	⊗	20	20	38	1,0	55	104

⊗ Stock item | Produto de stock | Itens de stock

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

End mill order code = (1) Geometry Code + (2) Grade Code

INOX INTEG Stainless Steel Specialized End mills

HC40SS Corner chamfer



M



Short



Variable pitch
4



Variable helix
40° | 41°



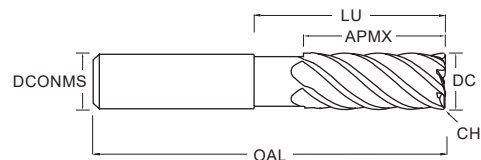
Reduced
neck



45°
Corner chamfer



< 42 HRC



		⁽²⁾ Grade code		Z9	Dimensions Dimensões Dimensiones (mm)						
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHU920							
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	AMPX	CHW	KCH	LU	OAL
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	45°	15	57
1180382	1180489	HC40SS 4 040 11	4	⊗	4	6	11	0,15	45°	17	57
1180383	1180490	HC40SS 4 050 13	4	⊗	5	6	13	0,15	45°	19	57
1180384	1180389	HC40SS 4 060 13	4	⊗	6	6	13	0,15	45°	21	57
1180329	1180491	HC40SS 4 080 19	4	⊗	8	8	19	0,15	45°	27	63
1180385	1180492	HC40SS 4 100 22	4	⊗	10	10	22	0,20	45°	32	72
1180386	1180493	HC40SS 4 120 26	4	⊗	12	12	26	0,20	45°	38	83
1180436	1180494	HC40SS 4 140 26	4	⊗	14	14	26	0,25	45°	38	83
1180387	1180390	HC40SS 4 160 32	4	⊗	16	16	32	0,35	45°	44	92
1180555	1180556	HC40SS 4 180 32	4	⊗	18	18	32	0,45	45°	44	92
1180388	1180455	HC40SS 4 200 38	4	⊗	20	20	38	0,60	45°	54	104

⊗ Stock item | Produto de stock | Itens de stock

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

End mill order code = (1) Geometry Code + (2) Grade Code

INOX INTEG Stainless Steel Specialized End mills

HRO40SS Rougher



Short



4



Variable Helix
39° | 41°



Reduced
Neck



Rougher

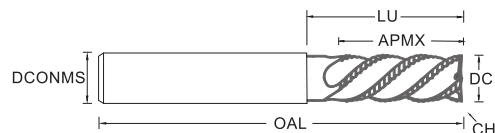


45°
Corner chamfer

M



< 38 HRC



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

⊗ Stock item | Produto de stock | Itens de stock

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End mill 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)			V _c (m/min)		
		a _e = 25%	a _e = 40%	a _e = 100%	a _e = 25%	a _e = 40%	a _e = 100%
M	SS - Ferritic / Martensitic	0,006 x DC	0,005 x DC	0,004 x DC	140	130	110
	SS - Austenitic	0,006 x DC	0,005 x DC	0,003 x DC	130	120	110
	SS - Austenitic-ferritic (Duplex)	0,005 x DC	0,004 x DC	0,003 x DC	120	110	100

Note¹: Feed valid for when the end mill works with its whole ap, for when the end mill 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%.

AL INTEG Aluminium Specialized End mills

NEW HR35HPAS Corner radius



N



Short



Variable Pitch
3



Helix 35°



Corner radius



		⁽²⁾ Grade code		H3	Dimensions Dimensões Dimensiones (mm)				
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHT910					
HA (Cylindrical)	HB (Weldon)				DC	APMX	RE	DCONMS	OAL
1182443	-	HR35HPAS 3 020 04 R050	3	○	2	4	0,5	6	57
1182444	-	HR35HPAS 3 030 06 R050	3	○	3	6	0,5	6	57
1182445	-	HR35HPAS 3 040 08 R050	3	⊗	4	8	0,5	6	57
1182446	-	HR35HPAS 3 050 10 R050	3	○	5	10	0,5	6	57
1182182	-	HR35HPAS 3 060 13 R050	3	⊗	6	13	0,5	6	57
1181710	-	HR35HPAS 3 080 19 R050	3	⊗	8	19	0,5	8	63
1182183	-	HR35HPAS 3 100 22 R050	3	⊗	10	22	0,5	10	72
1182184	-	HR35HPAS 3 120 26 R050	3	⊗	12	26	0,5	12	83
1182447	-	HR35HPAS 3 140 28 R050	3	○	14	28	0,5	14	83
1182292	-	HR35HPAS 3 160 32 R050	3	⊗	16	32	0,5	16	92
1182448	-	HR35HPAS 3 180 36 R050	3	○	18	36	0,5	18	92
1182449	-	HR35HPAS 3 200 40 R050	3	⊗	20	40	0,5	20	104

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

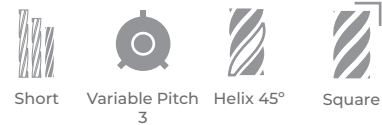
End mill order code = (1) Geometry Code + (2) Grade Code

AL INTEG Aluminium Specialized End mills

NEW HF45HPAS Flat top



N



		⁽²⁾ Grade code		H3	Dimensions Dimensões Dimensiones (mm)			
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHT910				
HA (Cylindrical)	HB (Weldon)				DC	APMX	DCONMS	OAL
1182450	-	HF45HPAS 3 020 04	3	○	2	4	6	57
1182451	-	HF45HPAS 3 030 06	3	○	3	6	6	57
1182333	-	HF45HPAS 3 040 08	3	⊗	4	8	6	57
1182452	-	HF45HPAS 3 050 08	3	○	5	10	6	57
1182334	-	HF45HPAS 3 060 13	3	⊗	6	13	6	57
1182335	-	HF45HPAS 3 080 19	3	⊗	8	19	8	63
1182336	-	HF45HPAS 3 100 22	3	⊗	10	22	10	72
1182337	-	HF45HPAS 3 120 26	3	⊗	12	26	12	83
1182453	-	HF45HPAS 3 140 28	3	○	14	28	14	83
1182338	-	HF45HPAS 3 160 32	3	⊗	16	32	16	92
1182454	-	HF45HPAS 3 180 36	3	○	18	36	18	92
1182455	-	HF45HPAS 3 200 40	3	⊗	20	40	20	104

⊗ Stock item | Produto de stock | Itens de stock

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

End mill order code = (1) Geometry Code + (2) Grade Code

AL INTEG Aluminium Specialized End mills

NEW HB50HPAS Ball nose



N



Short



2



Helix 50°



Reduced neck



Ball nose



		⁽²⁾ Grade code		H3	Dimensions Dimensões Dimensiones (mm)				
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHT910					
HA (Cylindrical)	HB (Weldon)				DC	APMX	DCONMS	LU	OAL
1182456	-	HB50HPAS 2 020 02	2	○	2	2	6	10	57
1182457	-	HB50HPAS 2 030 03	2	○	3	3	6	12	57
1182339	-	HB50HPAS 2 040 04	2	⊗	4	4	6	20	57
1182458	-	HB50HPAS 2 050 05	2	○	5	5	6	25	57
1182340	-	HB50HPAS 2 060 06	2	⊗	6	6	6	25	57
1182341	-	HB50HPAS 2 080 08	2	⊗	8	8	8	30	63
1182342	-	HB50HPAS 2 100 10	2	⊗	10	10	10	35	72
1182343	-	HB50HPAS 2 120 12	2	⊗	12	12	12	40	83
1182459	-	HB50HPAS 2 140 14	2	○	14	14	14	40	83
1182460	-	HB50HPAS 2 160 16	2	○	16	16	16	50	92
1182461	-	HB50HPAS 2 180 18	2	○	18	18	18	50	92
1182462	-	HB50HPAS 2 200 20	2	○	20	20	20	50	104

⊗ Stock item | Produto de stock | Itens de stock

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

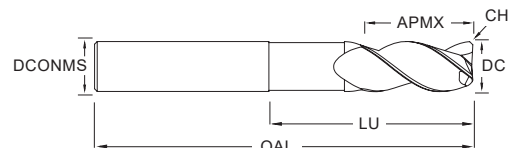
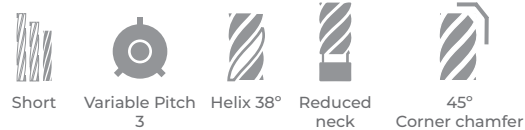
End mill order code = (1) Geometry Code + (2) Grade Code

AL INTEG Aluminium Specialized End mills

HC38AS Corner chamfer



N



		⁽²⁾ Grade code		12	Dimensions Dimensões Dimensiones (mm)						
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PH0920							
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	AMPX	CHW	KCH	LU	OAL
1180401	1180410	HC38AS 3 030 07	3	⊗	3	6	7	0,15	45°	15	57
1180402	1180411	HC38AS 3 040 08	3	⊗	4	6	8	0,15	45°	17	57
1180403	1180412	HC38AS 3 050 10	3	⊗	5	6	10	0,15	45°	19	57
1180404	1180413	HC38AS 3 060 10	3	⊗	6	6	10	0,15	45°	21	57
1180405	1180414	HC38AS 3 080 16	3	⊗	8	8	16	0,15	45°	27	63
1180406	1180415	HC38AS 3 100 19	3	⊗	10	10	19	0,20	45°	32	72
1180407	1180416	HC38AS 3 120 22	3	⊗	12	12	22	0,20	45°	38	83
1180408	1180417	HC38AS 3 160 26	3	⊗	16	16	26	0,35	45°	44	92
1180409	1180418	HC38AS 3 200 32	3	⊗	20	20	32	0,35	45°	54	104

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

End mill order code = (1) Geometry Code + (2) Grade Code

Note: For HB (Weldon) end mills, the reference ends with "-W"

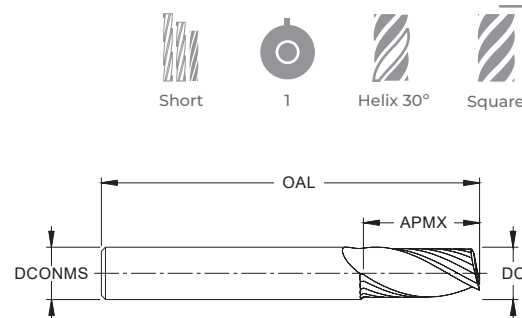
Example: "HC38AS 3 030 07-W PH0920"

AL INTEG Aluminium Specialized End mills

HF30AS Single flute



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



(1) Geometry code	(2) Grade code		12 PH0920	Dimensions Dimensões Dimensiones (mm)			
	Reference Referência Referencia	NOF		DC	DCONMS	APMX	OAL
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

End mill 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 = 40%	ae = 100%	ae = 25%	ae = 40%	ae = 100%
N	Aluminium <6%Si	0,011 x DC	0,009 x DC	0,006 x DC	230	220	190
	Aluminium <12%Si	0,009 x DC	0,008 x DC	0,005 x DC	210	200	180
	Aluminium >12%Si	0,008 x DC	0,007 x DC	0,005 x DC	200	190	170

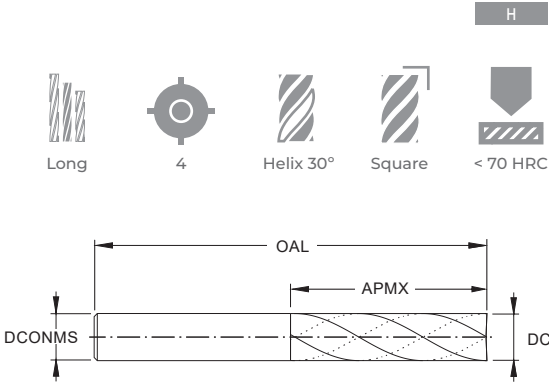
Note¹: Recommended feed values for maximum ap. For reduced ap, consider increasing fz up to 25%.

Note²: Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.

HF30HL Flat top



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



(1) Geometry code	(2) Grade code		X4	Dimensions Dimensões Dimensiones (mm)			
	Reference Referência Referencia	NOF		DC	DCONSMS	APMX	OAL
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

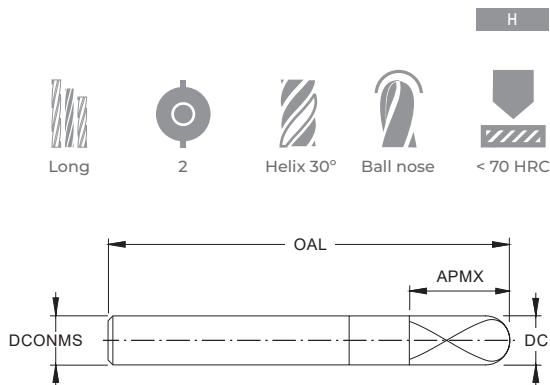
Ⓢ Stock item | Produto de stock | Itens de stock ○ Available under request | Disponível sobre consulta | Disponible bajo consulta End mill order code = (1) Geometry Code + (2) Grade Code

HARD INTEG Hardened Materials Specialized End mills

HB30HL Ball nose



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



(1) Geometry code	(2) Grade code		X4 PHH603	Dimensions Dimensões Dimensiones (mm)			
	Reference Referência Referencia	NOF		DC	DCONMS	APMX	OAL
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

End mill 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 = 10%	ae = 30%	ae = 10%	ae = 30%
H	Hardened Steels	0,006 x DC	0,005 x DC	120	110

CHOOSE BY **APPLICATION**



Exceptional performance solid carbide endmills designed for specific applications. The high quality is a direct outcome of specialized endmill geometry for each type of application, including optimized flute design, specialized edge honing, and wear-resistant coatings.

Fresas de metal duro integral de alto desempenho projetadas para aplicações específicas. A alta qualidade é resultado direto da geometria especializada da fresa para cada tipo de aplicação, incluindo design de flutes otimizado, afiação de aresta especializada e revestimentos resistentes ao desgaste.

Fresas de carburo integral de alto rendimiento diseñadas para aplicaciones específicas. La alta calidad es el resultado directo de la geometría especializada de la fresa para cada tipo de aplicación, incluido el diseño optimizado de las ranuras, el afilado especializado de los bordes y los recubrimientos resistentes al desgaste.

HIFEED INTEG > page 24

- > High feed milling

Fresagem de alto avanço | Fresado de alta avance

- > Special radius roughing endmills

Fresas especiais de raio para desbaste | Fresas especiales de radio para desbaste

NEW



DYN INTEG > page 26

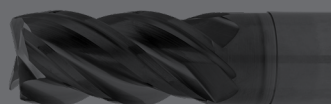
- > Trochoidal milling

Fresagem trocoidal | Fresado trocoidal

- > For steel, stainless steel and superalloys applications

Para aço, aço inoxidável e aplicações em superligas | Para acero, acero inoxidable y aplicaciones en superaleaciones

NEW



RAD INTEG > page 28

- > 5-Axis milling

Fresagem a 5 eixos | Fresado de 5 ejes

- > Conical or tangential end mills

Fresas cónicas e tangenciais | Fresas cónicas ou tangenciais



FIN INTEG > page 30

- > Finishing milling

Dresagem de acabamento | Fresado de acabado

- > Long end mill with corner chamfer

Fresas longas com chanfro nos cantos | Fresa larga con chaflán en las esquinas



MIN INTEG > page 32

- > Micro milling

Microfresagem | Microfresado

- > Ball nose end mills

Fresas de topo redondo | Fresas de topo redondeado



CHAMF INTEG > page 35

- > Chamfer Milling

Fresagem de chanfro | Fresado de chaflán

- > 45° chamfers

Chanfros a 45° | Chaflanes a 45°



CODIFICATION SYSTEM FOR SOLID CARBIDE END MILLS

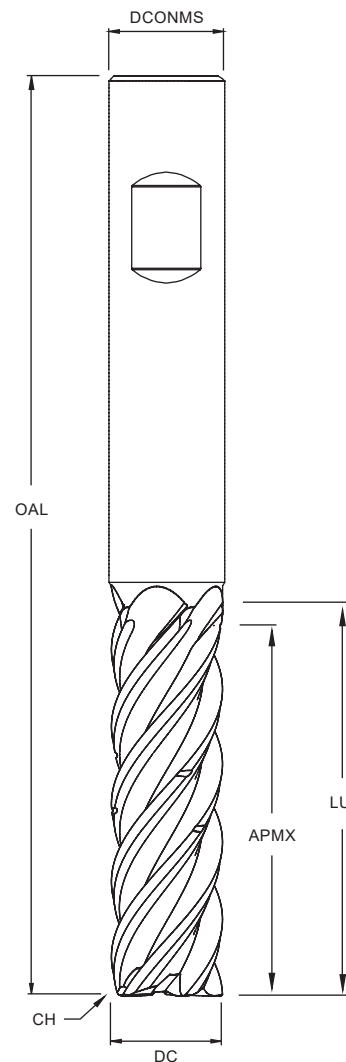
Sistema de codificação para fresas de metal duro para acabamento | Sistema de codificación para fresas de carburo para acabado

Integral Solid Carbide
example:

H	C	40	TS	P	L	5	120	41	XR100	90	-	W
1	2	3	4	5	6	7	8	9	10	11		12

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 XR - Special Radius RO - Rougher	
3 - Helix Angle (Suppressed when it is 90°)	
... - Degree of helix rounded to nearest 5 degree	
4 - Machining Method (Suppressed when it doesn't exist)	
HF - High Feed	HP - High Performance
TS - Trochoidal milling	
5 - Application	
A - Aluminium	S - Stainless steel
G - General application	H - Hard materials
F - Finishing	MIN - Micro milling
P - Steel	
6 - Length of Shank	
S - Short length	
L - Long length	
XL - Extra long length	
7 - Flutes number (NOF)	
Example: NOF = 1 ; NOF = 2 ; NOF = 3	
8 - Cutting diameter (DC)	
Example: 120 = 12,0 mm ; 008 = 0,8 mm	
9 - Max cutting depth (APMX)	
Example for $APMX \geq 1$ mm: 04 = 4 mm ; 06 = 6 mm Example for $APMX < 1$ mm: 002 = 0,2 mm ; 005 = 0,5 mm	
10 - Shank diameter (only on straight flute solid carbide)	
Example for corner radius: R150 = 1,5 mm ; R015 = 0,15 mm Example for special radius : XR100 = 1,0 mm Example for conical segment: 18RM120 - $\alpha/2 = 18^\circ$, RM = 1200 mm Example for tangential segment: RM090 - RM = 90 mm	
11 - Angle (Only for chamfering end mills)	
Example: 90 = 90°	
12 - Shank (Suppressed when cylindrical)	
W - Weldon	

Integral Solid Carbide
technical drawing example



SELECTION GUIDE FOR SOLID CARBIDE END MILLS

Guia de seleção para fresas de metal duro integral | Guía para fresas en carburo monobloque

	DC	NOF	HELIX ANGLE	GEOMETRY	FINISHING	ROUGHING	MATERIAL	DESCRIPTION	PAGE
 HIFEED INTEG HXR30HFGS NEW	3-12	4-5	-	 Special radius			PMKSH	Special radius Roughing End mills	24
 DYN INTEG HR38TSM NEW	6-20	5	38°	 Corner radius			MS	Trochoidal Milling	26
 DYN INTEG HC40TSP	6-20	5	40° 41° 42°	 Corner chamfer			PK		27
 RAD INTEG HXC30GL	8-16	4	30°	 Radial segment			PMKS	Radial Segment End mills	28
 RAD INTEG HXT30GL	6-16	4	30°	 Radial segment			PMKS		28
 FIN INTEG HC45FL	3-20	6	43° 45°	 Corner chamfer			PMKH	Finishing End mills	30
 MIN INTEG HB30MINS	0,4-3,0	2	30°	 Ball nose			PMKSH	Micro Machining End mills	32
 CHAMF INTEG HCHGS	3-20	4	0°	 Conical Top			PMK	Chamferings End mills	35

HIFEED INTEG High Feed End mills

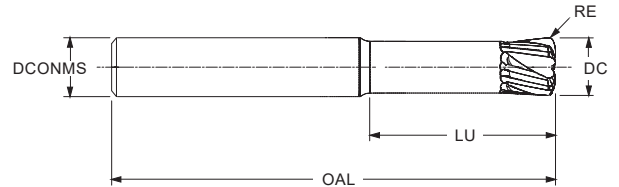
NEW HXR30HFGS Special radius roughing



P M K S H



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



(1) Geometry code	(2) Grade code		2A PHU910	Dimensions Dimensões Dimensiones (mm)						
	Reference Referência Referencia	NOF		DC	DCONMS	APMX	RE	PR*	LU	OAL
1181449	HXR30HFGS 4 030 002 XR020	4	⊗	3	6	0,20	0,20	0,40	9	63
1181450	HXR30HFGS 4 040 003 XR030	4	⊗	4	6	0,30	0,30	0,50	12	63
1181451	HXR30HFGS 4 050 003 XR040	4	⊗	5	6	0,30	0,40	0,60	15	63
1181452	HXR30HFGS 4 060 004 XR050	4	⊗	6	6	0,40	0,50	0,80	24	63
1181453	HXR30HFGS 5 080 004 XR060	5	⊗	8	8	0,40	0,60	0,90	32	75
1181430	HXR30HFGS 5 100 005 XR080	5	⊗	10	10	0,50	0,80	1,20	32	75
1181454	HXR30HFGS 5 120 005 XR100	5	⊗	12	12	0,50	1,00	1,40	36	83

⊗ Stock item | Produto de stock | Itens de stock

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

End mill order code = (1) Geometry Code + (2) Grade Code

*Programming radius

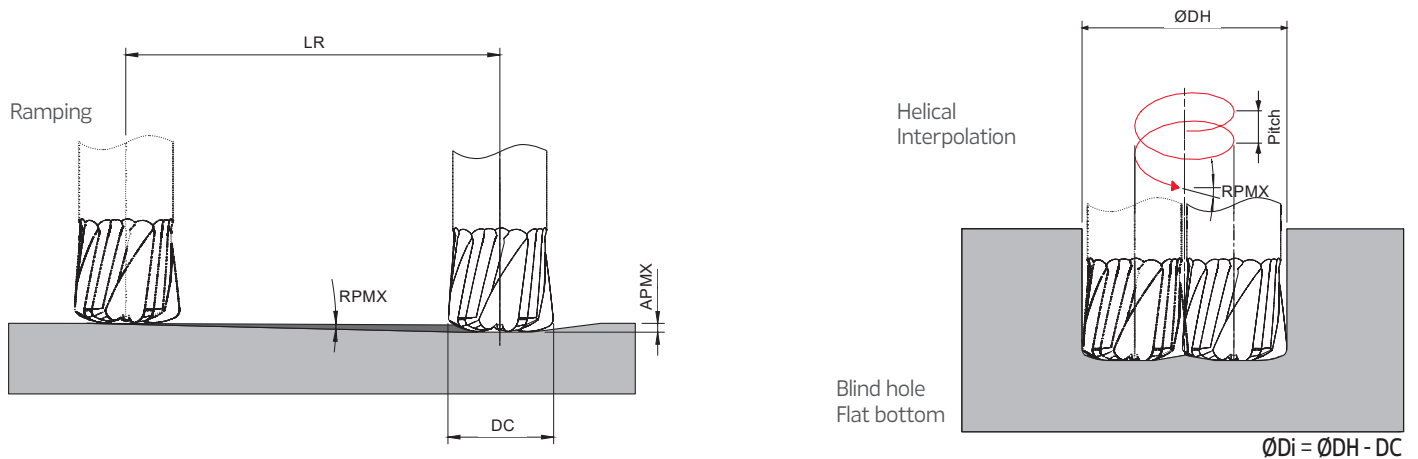
RECOMMENDED CUTTING CONDITIONS Condições de corte recomendadas | Condiciones de corte recomendables

ISO	Workpiece Material	f _z (mm/t)			v _c (m/min)			Plunging	
		a _e = 25%	a _e = 50%	a _e = 100%	a _e = 25%	a _e = 50%	a _e = 100%	f _z (mm/t)	v _c (m/min)
P	Unalloyed Steel	0,044 x DC	0,038 x DC	0,023 x DC	300	280	270	0,004 x DC	160
	Low-Alloyed Steel	0,044 x DC	0,038 x DC	0,023 x DC	280	250	230	0,004 x DC	140
	High-Alloyed Steel	0,040 x DC	0,036 x DC	0,020 x DC	200	180	150	0,004 x DC	120
M	Stainless Steel (Ferritic / Martensitic)	0,035 x DC	0,035 x DC	0,018 x DC	180	160	150	0,003 x DC	110
	Stainless Steel (Austenitic)	0,035 x DC	0,033 x DC	0,018 x DC	120	110	100	0,003 x DC	100
	Stainless Steel (Austenitic/Ferritic/Duplex)	0,033 x DC	0,031 x DC	0,018 x DC	80	70	60	0,003 x DC	60
K	Malleable Cast Iron	0,034 x DC	0,032 x DC	0,021 x DC	170	150	130	0,003 x DC	110
	Grey Cast Iron	0,035 x DC	0,035 x DC	0,021 x DC	220	200	180	0,003 x DC	120
	Nodular Cast Iron	0,034 x DC	0,032 x DC	0,021 x DC	160	140	120	0,003 x DC	110
S	Heat Resistant Super Alloys	0,022 x DC	0,017 x DC	0,014 x DC	40	35	30	0,002 x DC	30
H	Hardened Steels	0,026 x DC	0,021 x DC	0,014 x DC	90	85	70	0,002 x DC	70

Note: Plunge Depth = 2 x DC
Ae Stepover = 0,2 x DC

RAMPING AND HELICAL INTERPOLATION

Descida em rampa e interpolação helicoidal | Bajada en rampa e interpolación circular

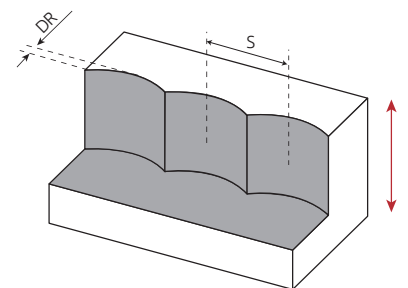


DC	Ramping			Helical Interpolation			Max Angle (°)
	RPMX	APMX	Min LR	ØDHmin	ØDHmax	Max Pitch/Rev.	
3	1,5	0,2	7,6	4,0	-	0,07	1,5
				-	6,0	0,20	1,5
4	1,5	0,3	11,5	5,3	-	0,10	1,5
				-	8,0	0,30	1,3
5	1,5	0,3	11,5	6,7	-	0,10	1,5
				-	10,0	0,30	1,0
6	1,5	0,4	15,3	8,0	-	0,15	1,5
				-	12,0	0,40	1,2
8	1,5	0,4	15,3	10,7	-	0,20	1,5
				-	16,0	0,40	0,9
10	1,5	0,5	19,1	13,3	-	0,25	1,5
				-	20,0	0,50	0,9
12	1,5	0,5	19,1	16,0	-	0,30	1,5
				-	24,0	0,50	0,7

Note: During helical interpolation do not exceed APMX.

PLUNGING Mergulho | Plunge

Cutting Conditions	
Vc (m/min)	fz (mm/t)
70%	35%



S max and DR corresponding cutting diameter DC (mm)							
DR (mm)	DC (mm)						
	3	4	5	6	8	10	12
0,5	1,1	1,3	1,5	1,7	1,9	2,2	2,4
1,0	1,4	1,7	2,0	2,2	2,6	3,0	3,3
1,5	-	-	2,3	2,6	3,1	3,6	4,0
2,0	-	-	-	-	3,5	4,0	4,5
3,0	-	-	-	-	-	4,6	5,2



M S



2xD
3xD



Short
Long



Variable Pitch
5



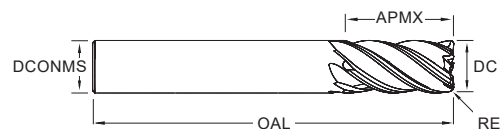
Helix 38°



Corner radius



< 42 HRC



		⁽²⁾ Grade code		4F	Dimensions Dimensões Dimensiones (mm)				
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHF910					
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	APMX	RE	OAL
HR38TSMS									
1182486	1182501	HR38TSMS 5 060 12 R100	5	○	6	6	12	1,00	57
1182477	1182502	HR38TSMS 5 060 12 R050	5	⊗	6	6	12	0,50	57
1182478	1182503	HR38TSMS 5 080 16 R100	5	○	8	8	16	1,00	63
1182479	1182504	HR38TSMS 5 080 16 R050	5	⊗	8	8	16	0,50	63
1182480	1182505	HR38TSMS 5 100 20 R100	5	⊗	10	10	20	1,00	72
1182481	1182506	HR38TSMS 5 100 20 R050	5	○	10	10	20	0,50	72
1182332	1182507	HR38TSMS 5 120 24 R100	5	⊗	12	12	24	1,00	83
1182482	1182508	HR38TSMS 5 120 24 R050	5	○	12	12	24	0,50	83
1182331	1182509	HR38TSMS 5 160 32 R100	5	⊗	16	16	32	1,00	92
1182483	1182510	HR38TSMS 5 160 32 R200	5	○	16	16	32	2,00	92
1182484	1182511	HR38TSMS 5 180 36 R100	5	○	18	18	36	1,00	92
1182485	1182512	HR38TSMS 5 180 36 R200	5	○	18	18	36	2,00	92
1182486	1182513	HR38TSMS 5 200 40 R100	5	○	20	20	40	1,00	104
1182486	1182514	HR38TSMS 5 200 40 R200	5	○	20	20	40	2,00	104
HR38TSM L									
1182488	1182515	HR38TSM L 5 060 18 R100	5	○	6	6	18	1,00	57
1182489	1182516	HR38TSM L 5 060 18 R050	5	⊗	6	6	18	0,50	57
1182490	1182517	HR38TSM L 5 080 24 R100	5	○	8	8	24	1,00	63
1182491	1182518	HR38TSM L 5 080 24 R050	5	⊗	8	8	24	0,50	63
1182492	1182519	HR38TSM L 5 100 30 R100	5	⊗	10	10	30	1,00	72
1182493	1182520	HR38TSM L 5 100 30 R050	5	○	10	10	30	0,50	72
1182494	1182521	HR38TSM L 5 120 36 R100	5	⊗	12	12	36	1,00	83
1182495	1182522	HR38TSM L 5 120 36 R050	5	○	12	12	36	0,50	83
1182390	1182523	HR38TSM L 5 160 48 R100	5	⊗	16	16	48	1,00	100
1182496	1182524	HR38TSM L 5 160 48 R200	5	○	16	16	48	2,00	100
1182497	1182525	HR38TSM L 5 180 54 R100	5	○	18	18	54	1,00	104
1182498	1182526	HR38TSM L 5 180 54 R200	5	○	18	18	54	2,00	104
1182499	1182527	HR38TSM L 5 200 60 R100	5	○	20	20	60	1,00	110
1182500	1182528	HR38TSM L 5 200 60 R200	5	○	20	20	60	2,00	110

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

End mill order code = (1) Geometry Code + (2) Grade Code

Note: For HB (Weldon) end mills, the reference ends with "-W"

Example: "HR38TSM5 5 080 16 R100-W"

DYN INTEG Trochoidal Milling

HC40TSP Corner chamfer



3xD
5xD



Long
Extra long



Variable Pitch
5



Variable Helix
40° | 41° | 42°



Reduced
Neck



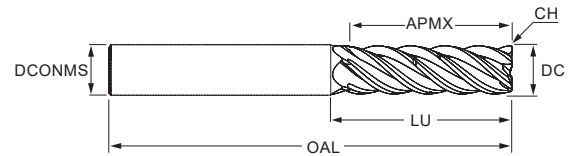
Chip-divider



45°
Corner chamfer



< 50 HRC



		⁽²⁾ Grade code		T1	Dimensions Dimensões Dimensiones (mm)						
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHP920	DC	DCONMS	AMPX	CHW	KCH	LU	OAL
HA (Cylindrical)	HB (Weldon)										
HC40TSP											
1180118	1180456	HC40TSPL 5 060 20	5	⊗	6	6	20	0,15	45°	26	63
1180119	1180457	HC40TSPL 5 080 25	5	⊗	8	8	25	0,15	45°	32	70
1180225	1180458	HC40TSPL 5 100 32	5	⊗	10	10	32	0,20	45°	38	79
1180690	1180689	HC40TSPL 5 120 41	5	⊗	12	12	41	0,20	45°	48	100
1180226	1180460	HC40TSPL 5 160 50	5	⊗	16	16	50	0,25	45°	60	110
1180123	1180461	HC40TSPL 5 180 60	5	⊗	18	18	60	0,30	45°	66	130
1180462	1180463	HC40TSPL 5 200 64	5	⊗	20	20	64	0,35	45°	70	130
HC40TSPXL											
-	1180514	HC40TSPXL 5 060 30	5	⊗	6	6	30	0,15	45°	36	75
1180508	1180515	HC40TSPXL 5 080 40	5	⊗	8	8	40	0,15	45°	46	81
-	1180516	HC40TSPXL 5 100 50	5	⊗	10	10	50	0,20	45°	59	100
-	1180517	HC40TSPXL 5 120 60	5	⊗	12	12	60	0,20	45°	67	120
-	1180520	HC40TSPXL 5 200 100	5	⊗	20	20	100	0,35	45°	104	162

⊗ Stock item | Produto de stock | Itens de stock

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

End mill 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) end mills, 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 = 5,0%	ae = 15%	ae = 30%	ae = 5,0%	ae = 15%	ae = 30%
P	Unalloyed Steel	0,009 x DC	0,009 x DC	0,008 x DC	180	170	170
	Low-Alloyed Steel	0,008 x DC	0,007 x DC	0,007 x DC	160	160	150
	High-Alloyed Steel	0,007 x DC	0,007 x DC	0,006 x DC	140	140	140
M	SS - Ferritic / Martensitic	0,010xDC	0,008xDC	0,006xDC	160	150	120
	SS - Austenitic	0,009xDC	0,007xDC	0,005xDC	150	140	110
	SS - Austenitic-ferritic (Duplex)	0,008xDC	0,005xDC	0,004xDC	130	120	100
K	Malleable Cast Iron	0,009 x DC	0,009 x DC	0,008 x DC	210	210	200
	Grey Cast Iron	0,009 x DC	0,009 x DC	0,008 x DC	210	200	200
	Nodular Cast Iron	0,009 x DC	0,008 x DC	0,007 x DC	190	190	180
S	Heat Resistant Super Alloys	0,005xDC	0,004xDC	0,003xDC	80	60	40

Note¹: Feed valid for when the end mill works with its whole ap, for when the end mill is working with lower depths of cut consider increasing the feed up to 25%.

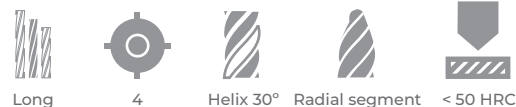
Note²: Cutting speeds selected for an economic use of the tool, for higher productivity consider increasing up to 70%.

RAD INTEG Conical and Tangential Segment End mills

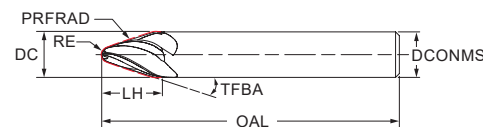
HXC30GL Conical



P M K S



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



(1) Geometry code	(2) Grade code		T1		Y3						
	Reference Referência Referencia	NOF	PHP920	PHH920	Dimensions Dimensões Dimensiones (mm)						
					DC	DCONMS	TFBA	PRFRAD	RE	LH	OAL
1180046	HXC30GL 4 080 10 18RM030	4	⊗	⊗	8	8	18	300	1	10	75
1180047	HXC30GL 4 120 14 18RM045	4	⊗	⊗	12	12	18	450	2	14	83
1180048	HXC30GL 4 160 18 18RM120	4	⊗	⊗	16	16	18	1200	3	18	95
1180049	HXC30GL 4 160 12 28RM080	4	⊗	⊗	16	16	28	800	3	12	95
1180050	HXC30GL 4 160 16 18RM120	4	⊗	⊗	16	16	18	1200	4	16	110
1180051	HXC30GL 4 160 11 28RM080	4	⊗	⊗	16	16	28	800	4	11	110

⊗ Stock item | Produto de stock | Itens de stock

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

End mill order code = (1) Geometry Code + (2) Grade Code

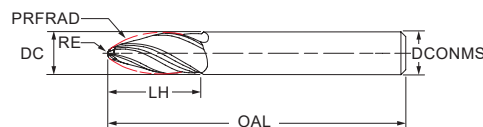
HXT30GL Tangential



P M K S



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



	⁽²⁾ Grade code		T1	Y3	Dimensions Dimensões Dimensiones (mm)						
⁽¹⁾ Geometry code	Reference Referência Referencia	NOF	PHP920	PHH920							
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	

⊗ Stock item | Produto de stock | Itens de stock

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

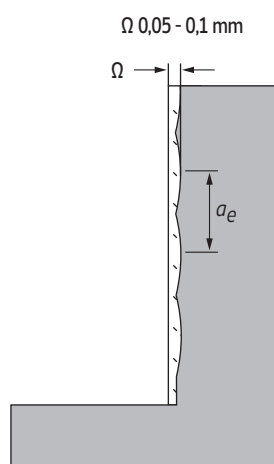
End mill order code = (1) Geometry Code + (2) Grade Code

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

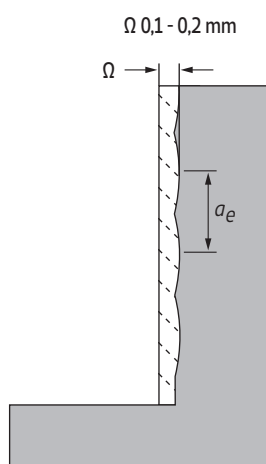
ISO	Material	Grades	
		PHP920	PHH920
P	Unalloyed Steel	✓	
	Low-Alloyed Steel	✓	
	High-Alloyed Steel	✓	
M	Stainless Steel (Ferritic / Martensitic)		✓
	Stainless Steel (Austenitic)		✓
	Stainless Steel (Austenitic/Ferritic/Duplex)		✓
K	Malleable Cast Iron	✓	
	Grey Cast Iron	✓	
	Nodular Cast Iron	✓	
S	Heat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

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

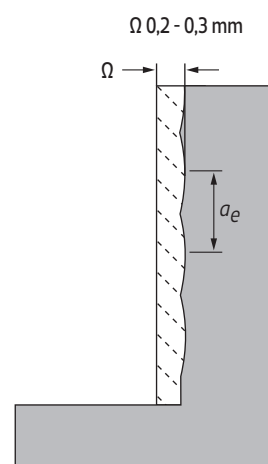
Ω - Allowance
 a_e - Stepover



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 DC	0,006 x DC	0,007 x DC	0,006 x DC	0,005 x DC
	Low-Alloyed Steel	160	0,006 x DC	0,005 x DC	0,006 x DC	0,005 x DC	0,004 x DC
	High-Alloyed Steel	150	0,005 x DC	0,004 x DC	0,005 x DC	0,004 x DC	0,004 x DC
M	Stainless Steel (Ferritic / Martensitic)	120	0,005 x DC	0,004 x DC	0,005 x DC	0,004 x DC	0,004 x DC
	Stainless Steel (Austenitic)	120	0,004 x DC	0,003 x DC	0,004 x DC	0,003 x DC	0,003 x DC
	Stainless Steel (Austenitic/Ferritic/Duplex)	110	0,003 x DC	0,003 x DC	0,003 x DC	0,003 x DC	0,002 x DC
K	Malleable Cast Iron	220	0,007 x DC	0,006 x DC	0,007 x DC	0,006 x DC	0,005 x DC
	Grey Cast Iron	210	0,007 x DC	0,006 x DC	0,007 x DC	0,006 x DC	0,005 x DC
	Nodular Cast Iron	190	0,006 x DC	0,005 x DC	0,006 x DC	0,005 x DC	0,005 x DC
S	Heat Resistant Super Alloys	60	0,003 x DC	0,003 x DC	0,003 x DC	0,003 x DC	0,002 x DC

FIN INTEG Finishing End mills

HC45FL Corner chamfer



P M K H



Long



6



Variable Helix
43° | 45°



Reduced
Neck

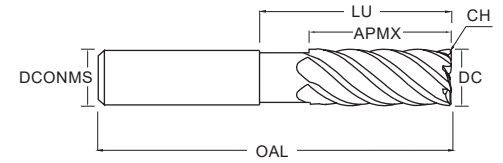


45°
Corner chamfer



< 60 HRC

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



	⁽²⁾ Grade code		T1	X7	Dimensions Dimensões Dimensiones (mm)						
⁽¹⁾ Geometry code	Reference Referência Referencia	NOF	PHP920	PHP603							
					DC	DCONMS	APMX	CHW	KCH	LU	OAL
1180845	HC45FL 6 030 08	6	○	⊗	3	6	8	0,15	45°	15	57
1180846	HC45FL 6 040 11	6	○	⊗	4	6	11	0,15	45°	17	57
1180847	HC45FL 6 050 13	6	○	⊗	5	6	13	0,15	45°	19	57
1180342	HC45FL 6 060 13	6	⊗	⊗	6	6	13	0,15	45°	21	57
1180062	HC45FL 6 080 19	6	⊗	⊗	8	8	19	0,15	45°	28	63
1180344	HC45FL 6 100 22	6	⊗	⊗	10	10	22	0,20	45°	30	72
1180343	HC45FL 6 120 26	6	⊗	⊗	12	12	26	0,20	45°	34	83
1180848	HC45FL 6 160 32	6	○	○	16	16	32	0,35	45°	44	92
1180849	HC45FL 6 200 38	6	○	○	20	20	38	0,60	45°	54	104

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

End mill order code = (1) Geometry Code + (2) Grade Code

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 DC
	Low-Alloyed Steel	170	160	0,007 x DC
	High-Alloyed Steel	140	130	0,005 x DC
M	Stainless Steel (Ferritic / Martensitic)	130	120	0,006 x DC
	Stainless Steel (Austenitic)	120	110	0,005 x DC
	Stainless Steel (Austenitic/Ferritic/Duplex)	90	90	0,004 x DC
K	Malleable Cast Iron	240	230	0,009 x DC
	Grey Cast Iron	240	230	0,009 x DC
	Nodular Cast Iron	200	190	0,008 x DC
H	Hardened Steels	80	-	0,004 x DC

Note¹: Feed valid for when the end mill works with its whole ap, for when the end mill 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%.

MIN INTEG Micro Machining End mills

HB30MINS Short neck



P M K S H



Short



2



Helix 30°



Reduced Neck

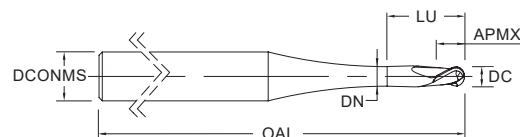


Ball nose



< 70 HRC

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



(1) Geometry code	(2) Grade code		X4 PHH603	Dimensions Dimensões Dimensiones (mm)					
	Reference Referência Referencia	NOF		DC	DCONMS	DN	APMX	LU	OAL
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	2,0	50
1180289	HB30MINS 2 008 01 020	2	⊗	0,8	4	0,78	0,8	2,0	50
1180298	HB30MINS 2 010 02 025	2	⊗	1,0	4	0,95	1,3	2,5	50
1180290	HB30MINS 2 010 01 030	2	⊗	1,0	4	0,95	1,0	3,0	50
1180291	HB30MINS 2 012 02 030	2	⊗	1,2	4	1,15	1,2	3,0	50
1180292	HB30MINS 2 016 02 040	2	⊗	1,6	4	1,55	1,6	4,0	50
1180293	HB30MINS 2 020 02 040	2	⊗	2,0	4	1,94	2,0	4,0	50
1180307	HB30MINS 2 020 03 050	2	⊗	2,0	4	1,95	2,5	5,0	50
1180299	HB30MINS 2 025 03 060	2	⊗	2,5	6	2,45	3,0	6,0	60
1180309	HB30MINS 2 030 04 075	2	⊗	3,0	6	2,95	4,0	7,5	60

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

End mill order code = (1) Geometry Code + (2) Grade Code

MIN INTEG Micro Machining End mills

HB30MINS Medium neck



P M K S H



Short



2



30°



Reduced
Neck

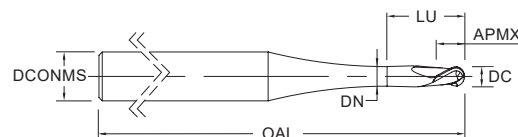


Ball nose



< 70 HRC

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



(1) Geometry code	(2) Grade code		X4 PHH603	Dimensions Dimensões Dimensiones (mm)					
	Reference Referência Referencia	NOF		DC	DCONMS	DN	APMX	LU	OAL
1180305	HB30MINS 2 005 01 025	2	⊗	0,5	4	0,45	0,4	2,5	50
1180308	HB30MINS 2 010 02 050	2	⊗	1,0	4	0,95	1,3	5,0	50
1180336	HB30MINS 2 016 02 080	2	⊗	1,6	4	1,55	1,6	8,0	50
1180310	HB30MINS 2 020 03 100	2	⊗	2,0	4	1,95	2,5	10,0	50
1180311	HB30MINS 2 025 03 125	2	⊗	2,5	6	2,45	3,0	12,5	60
1180301	HB30MINS 2 030 04 150	2	⊗	3,0	6	2,95	4,0	15,0	60

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

End mill order code = (1) Geometry Code + (2) Grade Code

MIN INTEG Micro Machining End mills

HB30MINS Long neck



P M K S H



Short



2



30°



Reduced Neck

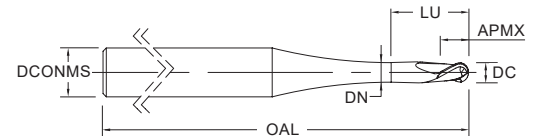


Ball nose



< 70 HRC

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



(1) Geometry code	(2) Grade code		X4 PHH603	Dimensions Dimensões Dimensiones (mm)					
	Reference Referência Referencia	NOF		DC	DCONMS	DN	APMX	LU	OAL
1180306	HB30MINS 2 005 01 040	2	⊗	0,5	4	0,45	0,6	4,0	50
1180300	HB30MINS 2 010 02 080	2	⊗	1,0	4	0,95	1,3	8,0	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	⊗	2,0	4	1,95	2,5	16,0	50
1180312	HB30MINS 2 025 03 200	2	⊗	2,5	6	2,45	3,0	20,0	60
1180313	HB30MINS 2 030 04 240	2	⊗	3,0	6	2,95	4,0	24,0	60

⊗ Stock item | Produto de stock | Itens de stock

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

End mill order code = (1) Geometry Code + (2) Grade Code

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

ISO	Material	Copying					
		fz (mm/t)		Vc (m/min)			
		$\alpha < 15^\circ$	$\alpha > 15^\circ$	AP = 0,05 DC $\alpha < 15^\circ$	AP = 0,25 DC $\alpha < 15^\circ$	AP = 0,05 DC $\alpha > 15^\circ$	AP = 0,25 DC $\alpha > 15^\circ$
P	Unalloyed Steel	0,010 x DC	0,003 x DC	700	340	460	220
	Low-Alloyed Steel	0,009 x DC	0,003 x DC	650	320	430	210
	High-Alloyed Steel	0,008 x DC	0,003 x DC	590	290	390	190
M	Stainless Steel (Ferritic / Martensitic)	0,009 x DC	0,003 x DC	600	300	400	200
	Stainless Steel (Austenitic)	0,008 x DC	0,003 x DC	560	280	370	190
	Stainless Steel (Austenitic/Ferritic/Duplex)	0,007 x DC	0,002 x DC	540	270	360	180
K	Malleable Cast Iron	0,008 x DC	0,003 x DC	650	320	430	210
	Grey Cast Iron	0,008 x DC	0,003 x DC	640	310	420	200
	Nodular Cast Iron	0,007 x DC	0,002 x DC	600	300	400	190
S	Heat Resistant Super Alloys	0,007 x DC	0,002 x DC	230	110	150	80
H	Hardened Steels	0,008 x DC	0,003 x DC	460	230	310	150

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

CHAMF INTEG Chamfering End mills

HCHGS



P M K



Short



4



Helix 0°



Conical Top



< 45 HRC



		⁽²⁾ Grade code		Z9	Dimensions Dimensões Dimensiones (mm)			
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHU920				
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	PRFA	OAL
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

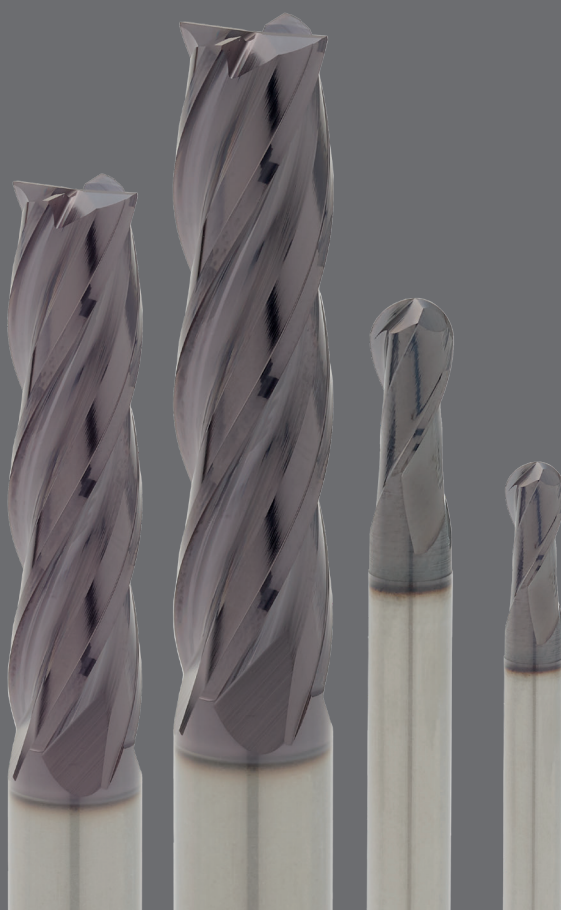
End mill order code = (1) Geometry Code + (2) Grade Code

Note: For HB (weldon) end mills, 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 DC	180
	Low-Alloyed Steel	0,007 x DC	160
	High-Alloyed Steel	0,006 x DC	140
M	Stainless Steel (Ferritic / Martensitic)	0,007 x DC	150
	Stainless Steel (Austenitic)	0,006 x DC	130
	Stainless Steel (Austenitic/Ferritic/Duplex)	0,004 x DC	110
K	Malleable Cast Iron	0,008 x DC	210
	Grey Cast Iron	0,008 x DC	210
	Nodular Cast Iron	0,008 x DC	190

GENERAL INTEG



Solid carbide endmills for a general industrial applications, from roughing to finishing operations.

Fresas de metal duro integral para aplicações industriais gerais, desde operações de desbaste até acabamento.

Fresas de carburo integral para aplicaciones industriales generales, desde operaciones de desbaste hasta acabado.

HF30G > page 40

- > Flat top end mills

Fresas de topo raso | Fresas de topo plano

- > 2 or 4 flutes

2 ou 4 flutes | 2 o 4 ranuras

- > Short and extra long version

Disponível em versão curta e extra longa | Disponible en versión corta y extra larga



HR30G > page 43

- > Corner radius end mills

Fresas de raio de canto | Fresas de radio de esquina

- > 4 flutes

4 flutes | 4 ranuras

- > Short version

Disponível em versão curta | Disponible en versión corta



HB30G > page 44

- > Ball nose end mills

Fresas de topo redondo | Fresas de topo redondeado

- > 2 or 4 flutes

2 ou 4 flutes | 2 o 4 ranuras

- > Short and long version

Disponível em versão curta e longa | Disponible en versión corta y larga



HRO45G > page 46

- > Rougher end mills

Fresas para desbaste | Fresas para desbaste

- > From 3 to 6 flutes

De 3 a 6 flutes | De 3 a 6 ranuras

- > Short version

Disponível em versão curta | Disponible en versión corta



CODIFICATION SYSTEM FOR SOLID CARBIDE END MILLS

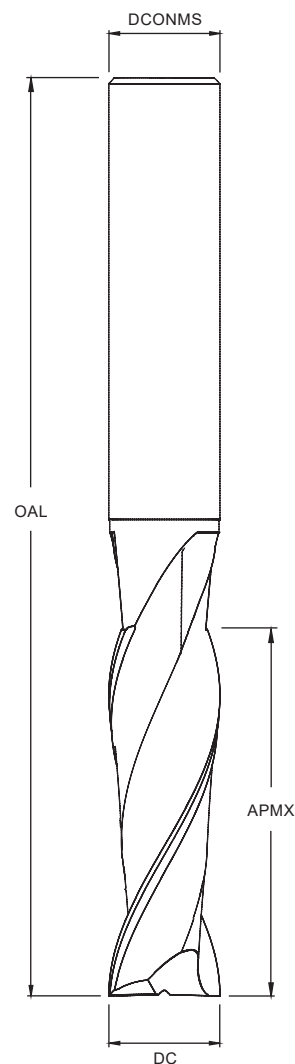
Sistema de codificação para fresas de metal duro para acabamento | Sistema de codificación para fresas de carburo para acabado

Integral Solid Carbide
example:

H	F	30	-	G	S	2	080	19	XR100	90	-	W
1	2	3	4	5	6	7	8	9	10	11	12	

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 XR - Special Radius RO - Rougher	
3 - Helix Angle (Suppressed when it is 90°)	
... - Degree of helix rounded to nearest 5 degree	
4 - Machining Method (Suppressed when it doesn't exist)	
HF - High Feed	HP - High Performance
TS - Trochoidal milling	
5 - Application	
A - Aluminium	S - Stainless steel
G - General application	H - Hard materials
F - Finishing	MIN - Micro milling
P - Steel	
6 - Length of Shank	
S - Short length	
L - Long length	
XL - Extra long length	
7 - Flutes number (NOF)	
Example: NOF = 1 ; NOF = 2 ; NOF = 3	
8 - Cutting diameter (DC)	
Example: 120 = 12,0 mm ; 008 = 0,8 mm	
9 - Max cutting depth (APMX)	
Example for APMX ≥ 1 mm: 04 = 4 mm ; 06 = 6 mm Example for APMX < 1 mm: 002 = 0,2 mm ; 005 = 0,5 mm	
10 - Shank diameter (only on straight flute solid carbide)	
Example for corner radius: R150 = 1,5 mm ; R015 = 0,15 mm Example for special radius : XR100 = 1,0 mm Example for conical segment: 18RM120 - $\alpha/2 = 18^\circ$, RM = 1200 mm Example for tangential segment: RM090 - RM = 90 mm	
11 - Angle (Only for chamfering end mills)	
Example: 90 = 90°	
12 - Shank (Suppressed when cylindrical)	
W - Weldon	

Integral Solid Carbide
technical drawing example



SELECTION GUIDE FOR SOLID CARBIDE END MILLS

Guia de seleção para fresas de metal duro integral | Guía para fresas en carburo monobloque

	DC		HELIX ANGLE	GEOMETRY	FINISHING	ROUGHING	MATERIAL	DESCRIPTION	PAGE
 INTEG HF30GS 2	2-20	2	30°	 Square			PMK	Flat Top End mills	40
 INTEG HF30GS 4	2-20	4	30°	 Square			PMK		41
 INTEG HF30GXL 4	2-12	4	30°	 Square			PMK		42
 INTEG HR30GS 4	3-20	4	30°	 Corner radius			PMK	Round Corner End mills	43
 INTEG HB30GS 2	2-12	2	30°	 Ball nose			PMK	Ball Nose End mills	44
 INTEG HB30GL 2	4-12	2	30°	 Ball nose			PMK		44
 INTEG HB30GS 4	2-12	4	30°	 Ball nose			PMK		45
 INTEG HB30GL 4	2-20	4	30°	 Ball nose			PMK		45
 INTEG HRO45GS	3-20	4 6	45°	 Corner chamfer			PMK	Rougher End mills	46

INTEG General Purpose End mills

HF30GS 2 Flat top



P M K



Short



2



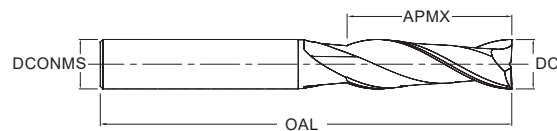
Helix 30°



Square



< 45 HRC



		⁽²⁾ Grade code		T1	Dimensions Dimensões Dimensiones (mm)			
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHP920				
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	APMX	OAL
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

End mill order code = (1) Geometry Code + (2) Grade Code

INTEG General Purpose End mills

HF30GS 4 Flat top



P M K



Short



4



Helix 30°



Square



< 45 HRC



		⁽²⁾ Grade code		T1	Dimensions Dimensões Dimensiones (mm)			
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHP920				
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	APMX	OAL
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

End mill order code = (1) Geometry Code + (2) Grade Code

INTEG General Purpose End mills

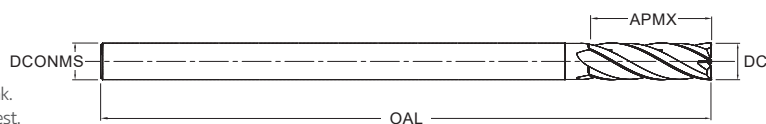
HF30GXL 4 Flat top



P M K



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



(1) Geometry code	(2) Grade code		T1		G4			
	Reference Referência Referencia	NOF	PHP920	PH7920	Dimensions Dimensões Dimensiones (mm)			
					DC	DCONMS	APMX	OAL
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
Disponível bajo consulta

End mill order code = (1) Geometry Code + (2) Grade Code

INTEG General Purpose End mills

HR30GS 4 Corner radius



P M K



Short



4



Helix 30°

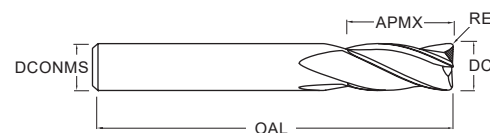


Corner radius



< 45 HRC

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



(1) Geometry code	(2) Grade code		T1	Dimensions Dimensões Dimensiones (mm)				
	Reference Referência Referencia	NOF	PHP920	DC	DCONMS	APMX	RE	OAL
1180231	HR30GS 4 030 12 R025	4	○	3	4	12	0,25	50
1180232	HR30GS 4 030 12 R050	4	○	3	4	12	0,50	50
1180233	HR30GS 4 040 14 R025	4	○	4	4	14	0,25	50
1180234	HR30GS 4 040 14 R050	4	○	4	4	14	0,50	50
1180235	HR30GS 4 050 16 R025	4	○	5	6	16	0,25	50
1180236	HR30GS 4 050 16 R050	4	○	5	6	16	0,50	50
1180237	HR30GS 4 060 19 R050	4	⊗	6	6	19	0,50	50
1180238	HR30GS 4 060 19 R100	4	⊗	6	6	19	1,00	50
1180239	HR30GS 4 070 19 R050	4	○	7	8	19	0,50	63
1180240	HR30GS 4 070 19 R100	4	○	7	8	19	1,00	63
1180241	HR30GS 4 080 20 R050	4	⊗	8	8	20	0,50	63
1180242	HR30GS 4 080 20 R100	4	⊗	8	8	20	1,00	63
1180243	HR30GS 4 090 22 R050	4	○	9	10	22	0,50	75
1180244	HR30GS 4 090 22 R100	4	○	9	10	22	1,00	75
1180245	HR30GS 4 100 22 R100	4	⊗	10	10	22	1,00	75
1180246	HR30GS 4 100 22 R200	4	⊗	10	10	22	2,00	75
1180247	HR30GS 4 120 25 R100	4	⊗	12	12	25	1,00	75
1180248	HR30GS 4 120 25 R200	4	⊗	12	12	25	2,00	75
1180249	HR30GS 4 140 26 R100	4	○	14	14	26	1,00	83
1180250	HR30GS 4 140 26 R200	4	○	14	14	26	2,00	83
1180251	HR30GS 4 160 32 R100	4	⊗	16	16	32	1,00	89
1180252	HR30GS 4 160 32 R200	4	⊗	16	16	32	2,00	89
1180253	HR30GS 4 180 32 R100	4	○	18	18	32	1,00	92
1180254	HR30GS 4 180 32 R200	4	○	18	18	32	2,00	92
1180255	HR30GS 4 200 38 R100	4	⊗	20	20	38	1,00	104
1180256	HR30GS 4 200 38 R200	4	⊗	20	20	38	2,00	104

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

End mill order code = (1) Geometry Code + (2) Grade Code

INTEG General Purpose End mills

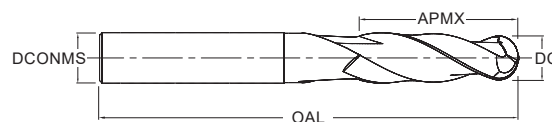
HB30GS 2 Ball nose



P M K



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



(1) Geometry code	(2) Grade code		T1	G4	Dimensions Dimensões Dimensiones (mm)			
	Reference Referência Referencia	NOF	PHP920	PH7920	DC	DCONMS	APMX	OAL
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
Disponível bajo consulta

End mill order code = (1) Geometry Code + (2) Grade Code

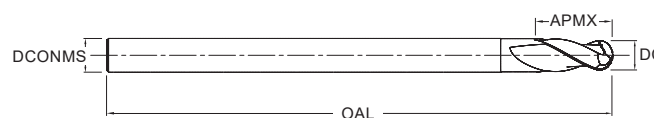
HB30GL 2 Ball nose



P M K



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



(1) Geometry code	(2) Grade code		T1	Dimensions Dimensões Dimensiones (mm)			
	Reference Referência Referencia	NOF	PHP920	DC	DCONMS	APMX	OAL
1180688	HB30GL 2 040 08	2	⊗	4	6	8	75
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
Disponível bajo consulta

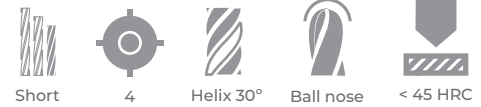
End mill order code = (1) Geometry Code + (2) Grade Code

INTEG General Purpose End mills

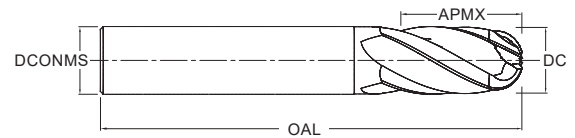
HB30GS 4 Ball nose



P M K



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



(1) Geometry code	(2) Grade code		T1 PHP920	Dimensions Dimensões Dimensiones (mm)			
	Reference Referência Referencia	NOF		DC	DCONMS	APMX	OAL
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

End mill order code = (1) Geometry Code + (2) Grade Code

HB30GL 4 Ball nose



P M K



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



(1) Geometry code	(2) Grade code		T1 PHP920	Dimensions Dimensões Dimensiones (mm)			
	Reference Referência Referencia	NOF		DC	DCONMS	APMX	OAL
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

End mill order code = (1) Geometry Code + (2) Grade Code

INTEG General Purpose End mills

HRO45GS Rougher



P M K



Short



3 - 6



45°



Reduced Neck



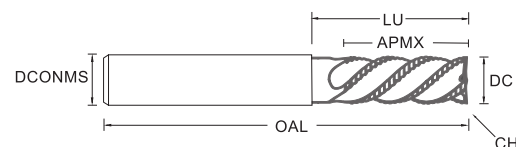
Rougher



45° Corner chamfer



< 45 HRC



		⁽²⁾ Grade code		Z9	Dimensions Dimensões Dimensiones (mm)						
⁽¹⁾ Order code		Reference Referência Referencia	NOF	PHU920							
HA (Cylindrical)	HB (Weldon)				DC	DCONMS	APMX	CHW	KCH	LU	OAL
1180557	1180558	HRO45GS 3 030 08	3	○	3	6	8	0,15	45°	15	57
1180559	1180560	HRO45GS 4 040 11	4	○	4	6	11	0,15	45°	17	57
1180561	1180562	HRO45GS 4 050 13	4	○	5	6	13	0,15	45°	19	57
1180439	1180563	HRO45GS 4 060 13	4	⊗	6	6	13	0,15	45°	21	57
1180440	1180564	HRO45GS 4 080 19	4	⊗	8	8	19	0,15	45°	27	63
1180441	1180565	HRO45GS 4 100 22	4	⊗	10	10	22	0,20	45°	32	72
1180374	1180465	HRO45GS 4 120 26	4	⊗	12	12	26	0,20	45°	38	83
1180566	1180567	HRO45GS 5 160 32	5	⊗	16	16	32	0,35	45°	44	92
1180568	1180569	HRO45GS 6 200 38	6	⊗	20	20	38	0,60	45°	54	104

⊗ Stock item | Produto de stock | Itens de stock

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

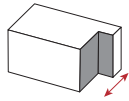
End mill order code = (1) Geometry Code + (2) Grade Code

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

ISO	Material	f _z (mm/t)			V _c (m/min)		
		a _e = 25%	a _e = 40%	a _e = 100%	a _e = 25%	a _e = 40%	a _e = 100%
P	Unalloyed Steel	0,008 x DC	0,007 x DC	0,005 x DC	170	160	140
	Low-Alloyed Steel	0,007 x DC	0,006 x DC	0,004 x DC	150	140	120
	High-Alloyed Steel	0,006 x DC	0,005 x DC	0,004 x DC	130	120	100
M	Stainless Steel (Ferritic / Martensitic)	0,006 x DC	0,005 x DC	0,004 x DC	110	110	90
	Stainless Steel (Austenitic)	0,005 x DC	0,004 x DC	0,003 x DC	100	90	80
	Stainless Steel (Austenitic/Ferritic/Duplex)	0,004 x DC	0,003 x DC	0,002 x DC	80	80	70
K	Malleable Cast Iron	0,008 x DC	0,007 x DC	0,005 x DC	200	190	170
	Grey Cast Iron	0,008 x DC	0,007 x DC	0,005 x DC	200	190	160
	Nodular Cast Iron	0,008 x DC	0,007 x DC	0,004 x DC	180	170	150

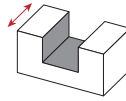
CUTTING PARAMETERS Parâmetros de corte | Parámetros de corte

Side milling



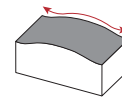
Finishing: $a_e < 0,15 \times D_c$
 Semi-finishing: $0,15 \times D_c < a_e < 0,3 \times D_c$
 Roughing: $a_e > 0,3 \times D_c$

Slotting



$a_e = 100\% \times D_c$

Copying



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

α : Surface inclination angle.

ISO	Material	f_z (mm/t)					
		Side Milling			Slotting	Copying	
		$a_e = 12,5\%$	$a_e = 25\%$	$a_e = 40\%$	$a_e = 100\%$	$\alpha < 15^\circ$	$\alpha > 15^\circ$
P	Unalloyed Steel	$0,009 \times D_c$	$0,008 \times D_c$	$0,005 \times D_c$	$0,004 \times D_c$	$0,012 \times D_c$	$0,004 \times D_c$
	Low-Alloyed Steel	$0,008 \times D_c$	$0,007 \times D_c$	$0,004 \times D_c$	$0,003 \times D_c$	$0,010 \times D_c$	$0,003 \times D_c$
	High-Alloyed Steel	$0,007 \times D_c$	$0,006 \times D_c$	$0,004 \times D_c$	$0,003 \times D_c$	$0,009 \times D_c$	$0,003 \times D_c$
M	Stainless Steel (Ferritic / Martensitic)	$0,007 \times D_c$	$0,006 \times D_c$	$0,004 \times D_c$	$0,003 \times D_c$	$0,009 \times D_c$	$0,003 \times D_c$
	Stainless Steel (Austenitic)	$0,005 \times D_c$	$0,005 \times D_c$	$0,003 \times D_c$	$0,002 \times D_c$	$0,007 \times D_c$	$0,002 \times D_c$
	Stainless Steel (Austenitic/Ferritic/Duplex)	$0,004 \times D_c$	$0,004 \times D_c$	$0,002 \times D_c$	$0,002 \times D_c$	$0,006 \times D_c$	$0,002 \times D_c$
K	Malleable Cast Iron	$0,009 \times D_c$	$0,008 \times D_c$	$0,005 \times D_c$	$0,004 \times D_c$	$0,012 \times D_c$	$0,004 \times D_c$
	Grey Cast Iron	$0,009 \times D_c$	$0,008 \times D_c$	$0,005 \times D_c$	$0,004 \times D_c$	$0,012 \times D_c$	$0,004 \times D_c$
	Nodular Cast Iron	$0,008 \times D_c$	$0,008 \times D_c$	$0,004 \times D_c$	$0,004 \times D_c$	$0,011 \times D_c$	$0,004 \times D_c$

(Note 1) Side milling and slotting feed valid for when the end mill works with its whole a_p , for when the end mill 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	V_c (m/min)							
		Side Milling			Slotting	Copying			
		$a_e = 12,5\%$	$a_e = 25\%$	$a_e = 40\%$	$a_e = 100\%$	$AP = 0,05 DC$ $\alpha < 15^\circ$	$AP = 0,25 DC$ $\alpha < 15^\circ$	$AP = 0,05 DC$ $\alpha > 15^\circ$	$AP = 0,25 DC$ $\alpha > 15^\circ$
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: $n = \frac{V_c \times 1000}{\pi \times 2 \sqrt{a_p(D_c - a_p)}}$

INTEG GRADES

COATINGS

PHP

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



The PHP is the recommended coating for general machining on steel and cast iron.

Because of its smoothness at medium temperatures, the chips are able to flow effortlessly, maintaining the flutes clean and a long tool life even in dry conditions.

PHH

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



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 protect 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.

PHF

- High resistance wear and thermal stability;
- Superior surface quality;
- Suitable for dry and wet machining;
- Color: Red gold;



PHF boasts high resistance to wear, combining this with exceptional adhesion and very homogeneous wear behavior. Additionally, its dense layer structure and high silicon doping contribute to its superior thermal stability, facilitating heat dissipation in the chip and consequently increasing process stability.

PHT

- Optimum chip removal;
- Excellent protection against built-up edges;
- Top performance on aluminum applications;
- Color: Silver;



PHT is a unique nanocrystalline coating, exceptionally dense yet smooth, with maximum adhesion even on sharp cutting edges. It effectively prevents the formation of built-up edges and ensures excellent machining results in non-ferrous metals, even at high operating temperatures.

SUBSTRATE

PH0910

A micrograin substrate that combines wear resistance and toughness.
Higher rigidity contributes to a longer tool life.
Recommended for semi-finishing to roughing on stable to slightly unstable conditions.

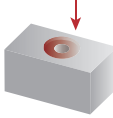
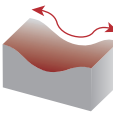
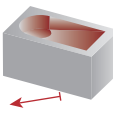
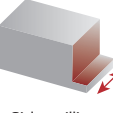
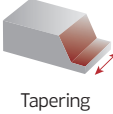
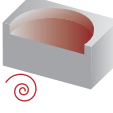
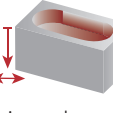
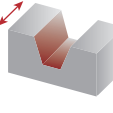
PH0920

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

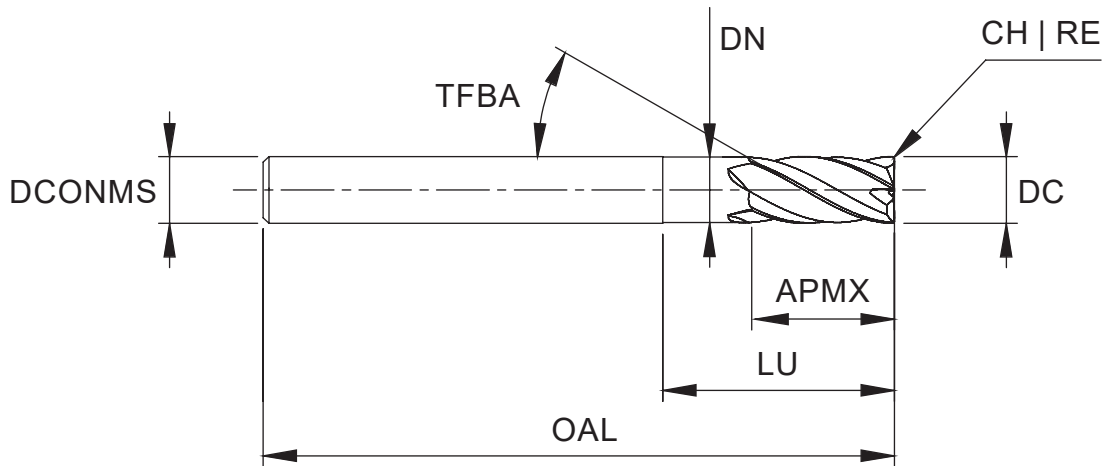
PH0603

Harder grade with extreme wear resistance.
Excellent thermal stability.
Recommended for finishing applications and hardened steels.

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

END MILL ELEMENTS



DCONMS - Shank diameter

DC - Cutting diameter

DN - Neck diameter

CH - Chamfer

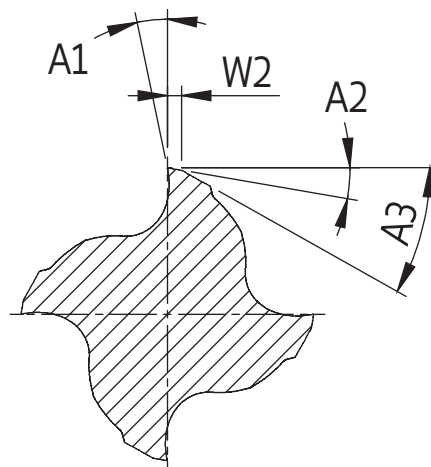
RE - Corner radius

OAL - Total length

LU - Useful length

APMX - Max cutting depth

TFBA - Helix angle



A1 - Rake angle;

A2 - Relief angle 1;

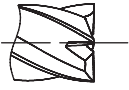
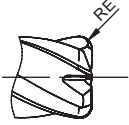
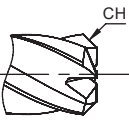
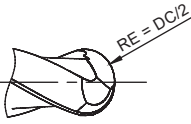
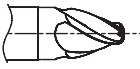
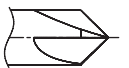
A3 - Relief angle 2;

W1 - Relief width 1;

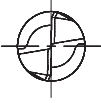
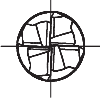
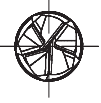
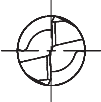
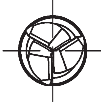
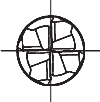
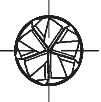
W2 - Relief width 2;

SHAPE OF CORNER

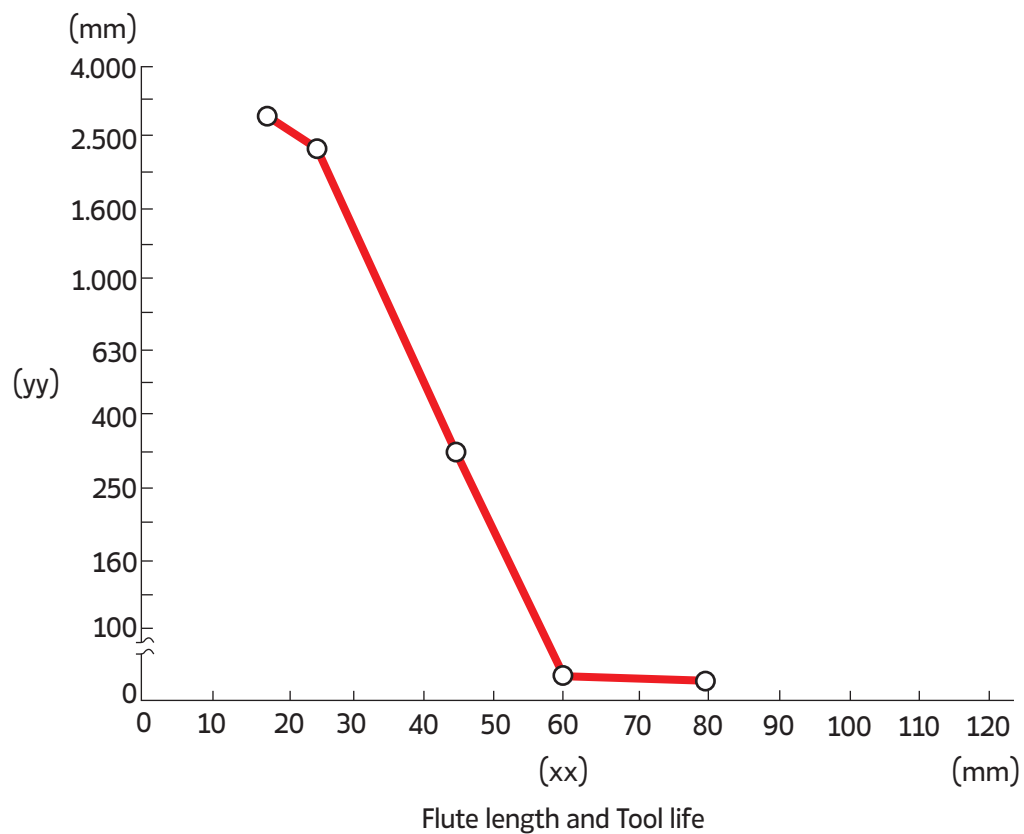
The Shape of Corner directly affect the distribution of cutting forces thus influence life span, productivity and functionality.

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;

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.



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 to use 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:



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.

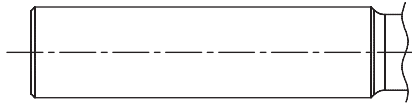
Typically, endmills with a low number of flutes (1-3) are used for machining aluminium and NFM where tool strength is not a concern and for roughing with more traditional milling strategies.

	 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.

SHANK TYPES - DIN 6535

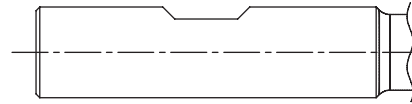
Flat Shank



Cylindrical Shank provides:

- Lower runout;
- Versatility choosing the holder;
- Higher tool life than weldon flat;
 - Pullout may occur;
 - Better tool balance;

Weldon Shank



Weldon Flat provides:

- Strong clamp;
- Pullout revention;
- Higher runout;
- Reduce tool Life;
- Cannot be used in thermic clamping;

RAKE ANGLE

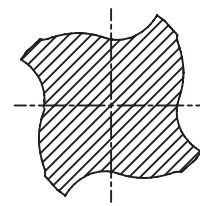
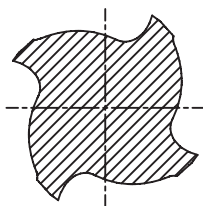
Rake angle is the angle that the endmill cutting face have regarding the work face material. That angle can be positive, neutral or negative, depending of the functionality and needs:

Positive Rake Angle

- 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;

Negative Rake Angle

- 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;



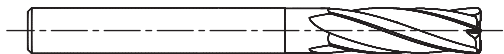
HELIX ANGLE

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.

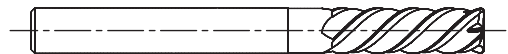
Low helix angle implies higher radial forces, radial tool vibration and in extreme cases may even damage the machine spindle.

Up to 30°



- Lower pullout risk;
- High vibrations;
- Stronger tools;
- Larger chip evacuation;

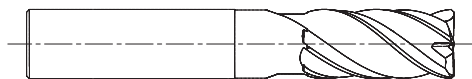
From 30° to 60°



- Lower radial force;
- Better surface finish;
- Faster feed rate;

Irregular Pitch and Variable Helix Angle

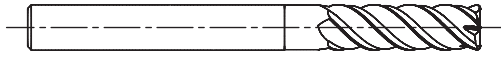
Due to constant angles between helix, harmonic vibrations are formed. Those vibrations might bruise the tool, reducing tool life. For that reason, a simple way to prevent those harmonics is to put helix out of phase, thus inducing a lag between max values of forces.



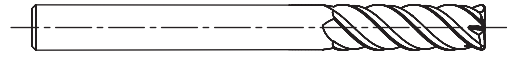
- Reduced chatter due to reduced vibrations;
 - More stability;
 - Enhanced tool Life;
- High speeds due to reduce in chatter;

REDUCED NECK

With Reduced Neck



Without Reduced Neck

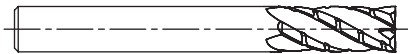


- More Reach and Stability;
- Prevents Rubbing;

CHIP BREAKER AND KNUCKLE ROUGHER

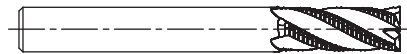
Both have similar geometries, but have completely different functionalities.

Chip Divider End Mill



- Better chip evacuation;
- Good surface finish;
- Enhance cutting performance;
- Prevents the formation of long chips;
- Common for aluminium and endmills with long flutes;

Rougher End Mill



- Smaller chip;
- High metal removal efficient;
- Bad surface finish;
- Allow higher feed at high stepover (>40%) and slotting;

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, they are less prone to chatter. All those serrations produce a variety of vibrations that interfere with one another instead of creating a single ringing tone.

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

TECHNICAL GUIDEBOOK

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;

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.



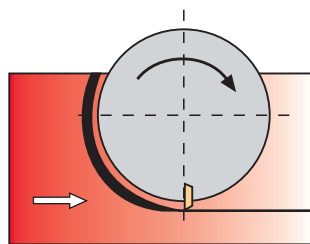
Wet Milling

CLIMB MILLING

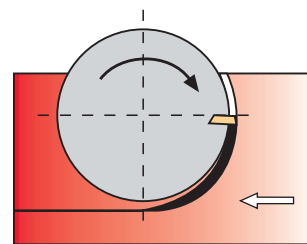
Unlike Conventional Milling, the mill rotation of Climb Milling has the same direction as the feed rate, providing a deflection direction away from the cutting surface and a better surface quality.

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

TROCHOIDAL MILLING



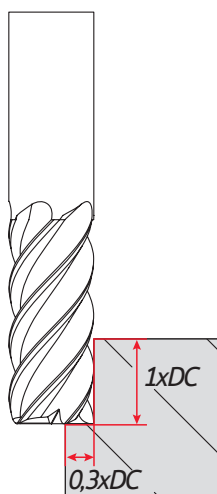
Instead of using a normal tool path, the trochoidal milling uses a spiral like path reducing the tool contact angle.

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.

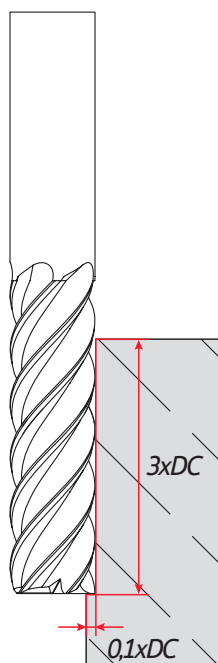
The reduced radial force also induces greater accuracy resulting in more precise and refined details in the machined section.

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.

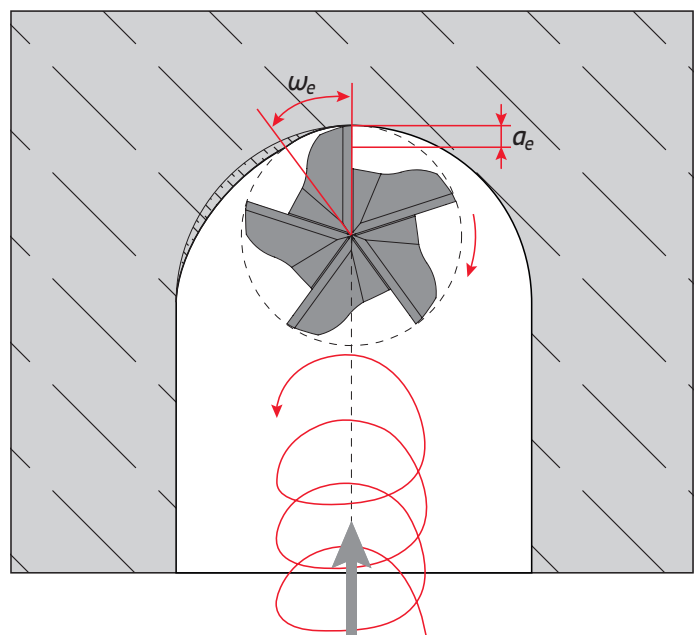
The same tool can also be used across multiple slot sizes provided that the cutter diameter stays from 50% to 70% of the final slot width and the radial depth between 10% and 35% of the cutting tool diameter.



Conventional
milling



Trochoidal
milling

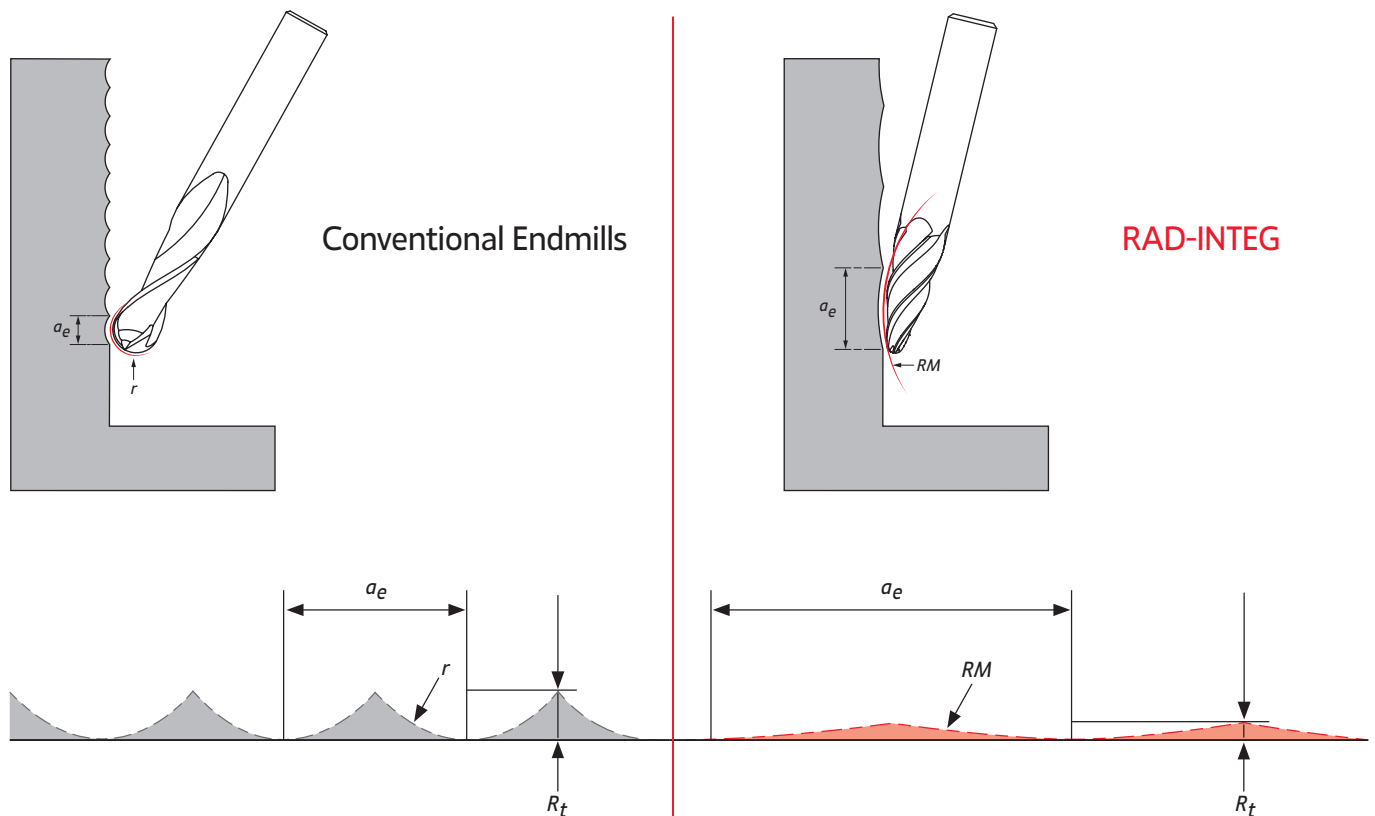


RADIAL SEGMENT EDNMILL

A solution between regular endmill and ball nose are the radial segment. Instead of having a normal cylindrical form, they have a conical shape that provides a better surface and faster machining compared 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.



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

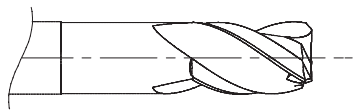
The real key to high performance machining in Aluminium is knowing the proper flute count and helix angle required for your operation.

FLUTE COUNT

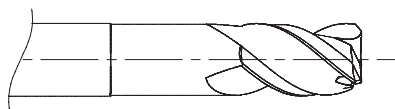
End mills for Aluminium are often available in either 2 flute or 3 flute styles. With higher flute counts, it would become difficult to evacuate chips effectively at the high speeds at which you can run in Aluminium. This is because Aluminium alloys leave a large chip, and chip valleys become smaller 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.

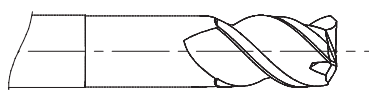
Specialized helix angles for Aluminium are typically either 35°, 40°, or 45°. Variable helix tools are also available and make a great choice for reducing chatter and harmonics while also increasing material removal rates.



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.

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 with proper ones; 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 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; 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 end mill having less number of flutes; Apply 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 an 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 an end mill with smaller helix angle; Shorten the protrusion length; Make small depth of cut;

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; 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;

SOLID CARBIDE END MILLS

CATALOGUE

Integ Milling Power



Check the QrCode for more information



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