Catalogue
2011

DHF

Economy Series

DESIGN HONESTY FUTURE

Features

designed for universal applications

machining of various workpiece materials

micro grain carbide grade

square and ball nose design

diameter range 1 - 20 mm

2, 3 and 4 flute types

non coated types

TiALN coated types

short and long over-all length

cilindrical shaft

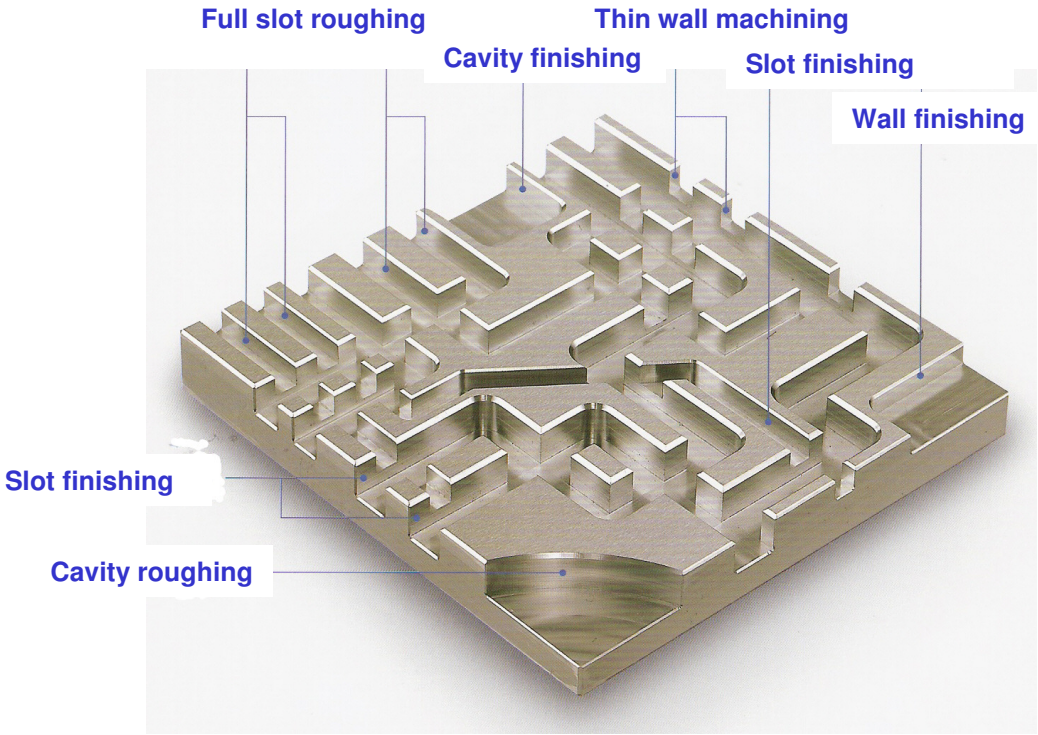
rigid and functional overhang

long flute length

corner chamfer- and corner radius types

25, 30, 35, 45 and 55° helix angles

contineous cutting edges



Icons

Material groups:

P
- Unalloyed steel
- Low alloy steel
- High alloy steel

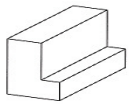
M
- Ferritic / martensitic stainless steel
- Austenetic stainless steel

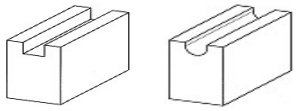
K
- Grey cast iron
- Nodular cast iron
- Malleable cast iron

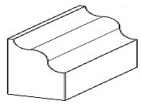
N
- Aluminium alloys
- Copper alloys
- Plastics

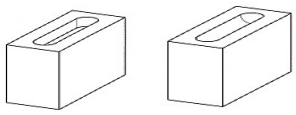
H
- Hardened materials

Applications:


Pheriferal machining


Full slot machining


Contour machining


Plunge machining

Coolant / no coolant

Geometries:

2 flute ball nose end mill

4 flute ball nose end mill

2 flute square end mill

3 flute square end mill

4 flute square end mill

Not coated

TiALN coated

Cutting data

Helix angle

Corner radius

Corner chamfer

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Square types	Ø	No. teeth	Coating	Shank	Page
DE 2T	1.0-16.0	2	TiALN	cilindrical	6
DHE DIE DJE 2T	3.0-12.0	2	TiALN	cilindrical	7
DRA	2.0-12.0	2	TiALN	cilindrical	8
DLRA	4.0-12.0	2	TiALN	cilindrical	9
DE 4T	1.0-20.0	4	TiALN	cilindrical	10
DHE DIE DJE 4T	3.0-20.0	4	TiALN	cilindrical	11
DRD	3.0-12.0	4	TiALN	cilindrical	12
DLRD	6.0-16.0	4	TiALN	cilindrical	13
Ball nose types					
DB 2T	1.0-16.0	2	TiALN	cilindrical	14
DHB DIB 2T	2.0-12.0	2	TiALN	cilindrical	15
DB 4T	2.0-16.0	4	TiALN	cilindrical	16

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Non-ferrous types	Ø	No. teeth	Coating	Shank	Page
Square					
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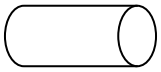
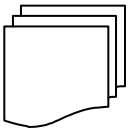
Ball nose					
DBC	1.0-12.0	2	non	cilindrical	19

Tecnical data

Workpiece material groups and parameter guide		20 - 21
Cuting data and formulas		22- 27
Charts		28 - 29

2 flute - 35 ° helix - long cutting edge - short overall length - TiALN coated

DE 2T

P M K H

35°

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Order code	Diameter	Flute length	O.A.L.	Shank diameter
DE0102	1.0	3	50	4
DE0152	1.5	4	50	4
DE0202	2.0	6	50	4
DE0252	2.5	8	50	4
DE0302	3.0	8	50	4
DE0402	4.0	11	50	4
DE0502	5.0	13	50	6
DE0602	6.0	16	50	6
DE0802	8.0	20	60	8
DE1002	10.0	25	75	10
DE1202	12.0	30	75	12
DE1602	16.0	40	100	16

2 flute - 35 ° helix - long cutting edge - long overall length - TiALN coated

DHE
DIE
DJE 2T

P M K H

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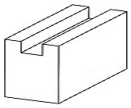
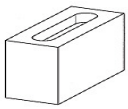

Order code	Diameter	Flute length	O.A.L.	Shank diameter
DHE0302	3.0	8	75	3
DHE0402	4.0	11	75	4
DHE0502	5.0	13	75	6
DHE0602	6.0	16	75	6
DHE0802	8.0	20	75	8
DIE0302	3.0	8	100	3
DIE0402	4.0	11	100	4
DIE0502	5.0	13	100	6
DIE0602	6.0	16	100	6
DIE0802	8.0	20	100	8
DIE1002	10.0	25	100	10
DIE1202	12.0	30	100	12
DJE0602	6.0	16	150	6
DJE0802	8.0	20	150	8
DJE1002	10.0	25	150	10
DJE1202	12.0	30	150	12

2 flute - 35 ° helix - long cutting edge - short overall length - corner radius - TiALN coated

DRA

P M K H

35 °

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Order code	Diam.	Corner rad.	Flute length	O.A.L.	Shank diam.
DRA0205	2.0	0.5	6	50	4
DRA0305	3.0	0.5	8	50	3
DRA0405	4.0	0.5	10	50	4
DRA0410	4.0	1.0	10	50	4
DRA0505	5.0	0.5	13	50	6
DRA0510	5.0	1.0	13	50	6
DRA0605	6.0	0.5	16	50	6
DRA0610	6.0	1.0	16	50	6
DRA0805	8.0	0.5	19	60	8
DRA0810	8.0	1.0	19	60	8
DRA1005	10.0	0.5	25	75	10
DRA1010	10.0	1.0	25	75	10
DRA1015	10.0	1.5	25	75	10
DRA1020	10.0	2.0	25	75	10
DRA1210	12.0	1.0	30	75	12
DRA1220	12.0	2.0	30	75	12

2 flute - 35 ° helix - long cutting edge - long overall length - corner radius - TiALN coated

DLRA

P M K H

35 °

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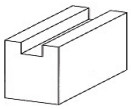
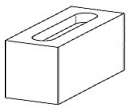

Order code	Diam.	Corner rad.	Flute length	O.A.L.	Shank diam.
DLRA0405	4.0	0.5	11	75	4
DLRA0605	6.0	0.5	16	75	6
DLRA0610	6.0	1.0	16	75	6
DLRA0805	8.0	0.5	19	100	8
DLRA0810	8.0	1.0	19	100	8
DLRA1005	10.0	0.5	25	100	10
DLRA1010	10.0	1.0	25	100	10
DLRA1020	10.0	2.0	25	100	10
DLRA1210	12.0	1.0	30	100	12
DLRA1220	12.0	2.0	30	100	12

4 flute - 35 ° helix - long cutting edge - short overall length - TiALN coated

DE 4T

P M K H

35°

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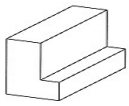
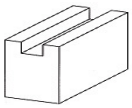

Order code	Diameter	Flute length	O.A.L.	Shank diameter
DE0104	1.0	3	50	4
DE0154	1.5	4	50	4
DE0204	2.0	6	50	4
DE0254	2.5	8	50	4
DE0304	3.0	8	50	4
DE0404	4.0	11	50	4
DE0504	5.0	13	50	6
DE0604	6.0	16	50	6
DE0804	8.0	20	60	8
DE1004	10.0	25	75	10
DE1204	12.0	30	75	12
DE1604	16.0	40	100	16
DE2004	20.0	45	100	20

4 flute - 35 ° helix - long cutting edge - long overall length - TiALN coated

DHE
DIE
DJE 4T

P M K H

35°

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Order code	Diameter	Flute length	O.A.L.	Shank diameter
DHE0304	3.0	8	75	3
DHE0404	4.0	11	75	4
DHE0504	5.0	13	75	6
DHE0604	6.0	16	75	6
DHE0804	8.0	20	75	8
DIE0404	4.0	11	100	4
DIE0604	6.0	16	100	6
DIE0804	8.0	20	100	8
DIE1004	10.0	25	100	10
DIE1204	12.0	30	100	12
DJE0604	6.0	16	150	6
DJE0804	8.0	20	150	8
DJE1004	10.0	25	150	10
DJE1204	12.0	30	150	12
DJE1604	16.0	45	150	16
DJE2004	20.0	50	150	20

4 flute - 35 ° helix - long cutting edge - short overall length - corner radius - TiALN coated

DRD

P M K H

35 °

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Order code	Diam.	Corner rad.	Flute length	O.A.L.	Shank diam.
DRD0305	3.0	0.5	8	50	3
DRD0405	4.0	0.5	10	50	4
DRD0505	5.0	0.5	13	50	6
DRD0510	5.0	1.0	13	50	6
DRD0605	6.0	0.5	16	50	6
DRD0610	6.0	1.0	16	50	6
DRD0805	8.0	0.5	20	60	8
DRD0810	8.0	1.0	20	60	8
DRD1010	10.0	1.0	25	75	10
DRD1020	10.0	2.0	25	75	10
DRD1030	10.0	3.0	25	75	10
DRD1210	12.0	1.0	30	75	12
DRD1220	12.0	2.0	30	75	12
DRD1230	12.0	3.0	30	75	12

4 flute - 35 ° helix - long cutting edge - long overall length - corner radius - TiALN coated

DLRD

P M K H

35 °

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Order code	Diam.	Corner rad.	Flute length	O.A.L.	Shank diam.
DLRD0605	6.0	0.5	16	75	6
DLRD0610	6.0	1.0	16	75	6
DLRD0805	8.0	0.5	19	100	8
DLRD0810	8.0	1.0	19	100	8
DLRD1005	10.0	0.5	25	100	10
DLRD1010	10.0	1.0	25	100	10
DLRD1020	10.0	2.0	25	100	10
DLRD1210	12.0	1.0	30	100	12
DLRD1220	12.0	2.0	30	100	12
DLRD1610	16.0	1.0	45	150	16
DLRD1620	16.0	2.0	45	150	16

2 flute - 30 ° helix - long cutting edge - short overall length - ball nose type - TiALN coated

DB 2T

P M K H

30°

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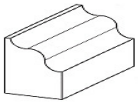
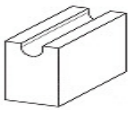
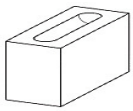

Order code	Diameter	Flute length	O.A.L.	Shank diameter
DB0102	1.0/R0.5	2	50	4
DB0152	1.5/R0.75	3	50	4
DB0202	2.0/R1	4	50	4
DB0252	2.5/R1.25	5	50	4
DB0302	3.0/R1.5	6	50	4
DB0402	4.0/R2	8	50	4
DB0502	5.0/R2.5	10	50	6
DB0602	6.0/R3	12	50	6
DB0802	8.0/R4	16	60	8
DB1002	10.0/R5	20	75	10
DB1202	12.0/R6	24	75	12
DB1602	16.0/R8	32	100	16

2 flute - 30 ° helix - long cutting edge - long overall length - ball nose type - TiALN coated

DHB 2T

DIB

P M K H

30°

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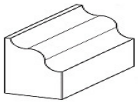

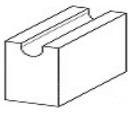

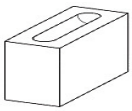

Order code	Diameter	Flute length	O.A.L.	Shank diameter
DHB0202	2.0/R1	4	75	6
DHB0252	2.5/R1.25	5	75	6
DHB0302	3.0/R1.5	6	75	6
DHB0402	4.0/R2	8	75	6
DHB0502	5.0/R2.5	10	75	6
DHB0602	6.0/R3	12	75	6
DHB0802	8.0/R4	16	75	8
DIB0202	2.0/R1	4	100	6
DIB0302	3.0/R1.5	6	100	6
DIB0402	4.0/R2	8	100	6
DIB0602	6.0/R3	12	100	6
DIB0802	8.0/R4	16	100	8
DIB1002	10.0/R5	20	100	10
DIB1202	12.0/R6	24	100	12

4 flute - 30 ° helix - long cutting edge - short overall length - ball nose type - TiALN coated

DB 4T

P M K H

30°

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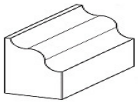
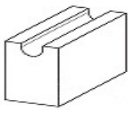
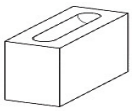

Order code	Diameter	Flute length	O.A.L.	Shank diameter
DB0104	1.0/R0.5	2	50	4
DB0154	1.5/R0.75	3	50	4
DB0204	2.0/R1	4	50	4
DB0304	3.0/R1.5	6	50	4
DB0404	4.0/R2	8	50	4
DB0504	5.0/R2.5	10	50	6
DB0604	6.0/R3	12	50	6
DB0804	8.0/R4	16	60	8
DB1004	10.0/R5	20	75	10
DB1204	12.0/R6	24	75	12
DB1604	16.0/R8	32	100	16

2 flute - 55 ° helix - long cutting edge - short overall length - aluminium type - non coated

DC 2T

N

55 °

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Order code	Diameter	Flute length	O.A.L.	Shank diameter
DC0202	2.0	7	50	6
DC0302	3.0	9	50	6
DC0402	4.0	12	50	6
DC0502	5.0	16	60	6
DC0602	6.0	18	60	6
DC0802	8.0	20	60	8
DC1002	10.0	30	75	10
DC1202	12.0	32	75	12
DC1602	16.0	45	100	16
DC2002	20.0	45	100	20

3 flute - 45 ° helix - long cutting edge - short overall length - aluminium type - non coated

DC 3T

N

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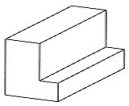
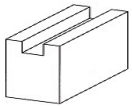
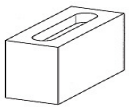




Order code	Diameter	Flute length	O.A.L.	Shank diameter
DC0203	2.0	6	50	6
DC0303	3.0	10	50	6
DC0403	4.0	12	50	6
DC0503	5.0	16	60	6
DC0603	6.0	18	60	6
DC0803	8.0	20	60	8
DC1003	10.0	25	75	10
DC1203	12.0	30	75	12
DC1603	16.0	40	100	16

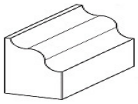
2 flute - 25 ° helix - long cutting edge - short overall length - aluminium ball nose type - non coated

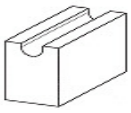
DBC

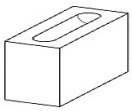
N

25°

Page 20
21
24 - 27

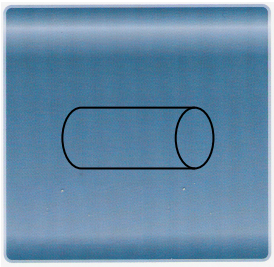






Order code	Diameter	Flute length	O.A.L.	Shank diameter
DBC0102	1.0/R0.5	2	50	4
DBC0152	1.5/R0.75	3	50	4
DBC0202	2.0/R1	4	50	4
DBC0302	3.0/R1.5	6	50	3
DBC0402	4.0/R2	8	50	4
DBC0602	6.0/R3	12	50	6
DBC0802	8.0/R4	16	60	8
DBC1002	10.0/R5	20	75	10
DBC1202	12.0/R6	24	75	12

$$V_c\ av. = \frac{V_c\ min. + V_c\ max.}{2}$$



P

Carbon steels	Examples [DIN/W.Nr]	Cutting speeds [Vc]
< 450 N/mm²	C15 C22 Ck15 St37-3 9SMn28	120 - 160 m/min
< 850 N/mm²	St50-2 16CrMo4 12CrMo19 5	90 - 110 m/min
< 1100 N/mm²	St60-2 St70-2 42CrV6 51CrMoV4	70 - 90 m/min
Low alloy steels		
< 600 N/mm²	100Cr6 42Cr4 51CrV4	80 - 110 m/min
< 1000 N/mm²	31NiCr14 100Cr2 36NiCr6	70 - 90 m/min
< 1300 N/mm²	40CrMn7 35NiCr18 42CrMo4	65 - 80 m/min
High alloy steels		
< 700 N/mm²	X40CrMoV5 X155CrVMo12 1	65 - 80 m/min
< 1200 N/mm²	S-12-1-4-5 S-6-5-2	60 - 75 m/min

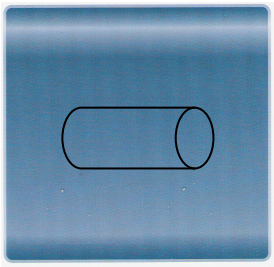
M

Stainless steels	Examples [DIN/W.Nr]	Cutting speeds [Vc]
Ferritic/martensitic	1.4021 1.4305 1.4448 1.4762	70 - 90 m/min
Martensitic	1.4034 1.4057 1.4125	60 - 80 m/min
Austenitic	1.4301 1.4311 1.4404 1.4462	70 - 90 m/min

K

Cast iron	Examples [DIN/W.Nr]	Cutting speeds [Vc]
Grey [<180-HB]	EN-GJL-110 EN-GJL-150	120 - 180 m/min
Grey [<260HB]	EN-GJL-250 EN-GJL-400	100 - 140 m/min
Nodular[<160HB]	EN-GJS-350 EN-GJS-400	80 - 120 m/min
Nodular [<250HB]	EN-GJS-500 EN-GJS-700	60 - 90 m/min
Malleable [<130HB]	EN-GJW-350 EN-GJW-550	80 - 120 m/min
Malleable [<230HB]	EN-GJW-650 EN-GJW-700	70 - 100 m/min

$$Vc\ av. = \frac{Vc\ min. + Vc\ max.}{2}$$



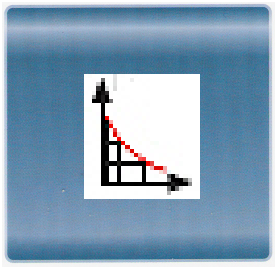
N

Non ferritic materials	Examples [DIN/W.Nr]	Cutting speeds [Vc]
Aluminium alloys		
< 250 N/mm²	Al99.5 AlMg1	300 - 450 m/min
< 350 N/mm²	AlCuSiPb G-AlCu5Ni1 AlZnMgCu0.5	350 - 650 m/min
< 250 N/mm²/< 9% Si	G-AlSi9Mg G-AlSi7Mg	250 - 400 m/min
< 300 N/mm²/< 12% Si	G-AlSi12 G-AlSi10Mg G-AlCu4TiMg	150 - 200 m/min
< 450 N/mm²/< 17% Si	G-AlSi17Cu4 G-AlSi21CuNiMg	70 - 120 m/min
Copper alloys		
Pb > 1%	G-CuSn7ZnPb G-CuPb10Sn	140 - 200 m/min
Brass	CuZn15 CuZn30 G-CuPb20Sn	180 - 240 m/min
Electrolytic copper	CuAl10Ni5Fe4 G-CuAl10Ni G-CuSn12	120 - 180 m/min
Plastics		
Duroplastics	Responal Novodur	90 - 120 m/min
Thermoplastics	Bakelit Pertinax	90 - 120 m/min
Fibrous reïnforced	CFK GFK AFK	100 - 150 m/min
Hard rubber	-	120 - 180 m/min

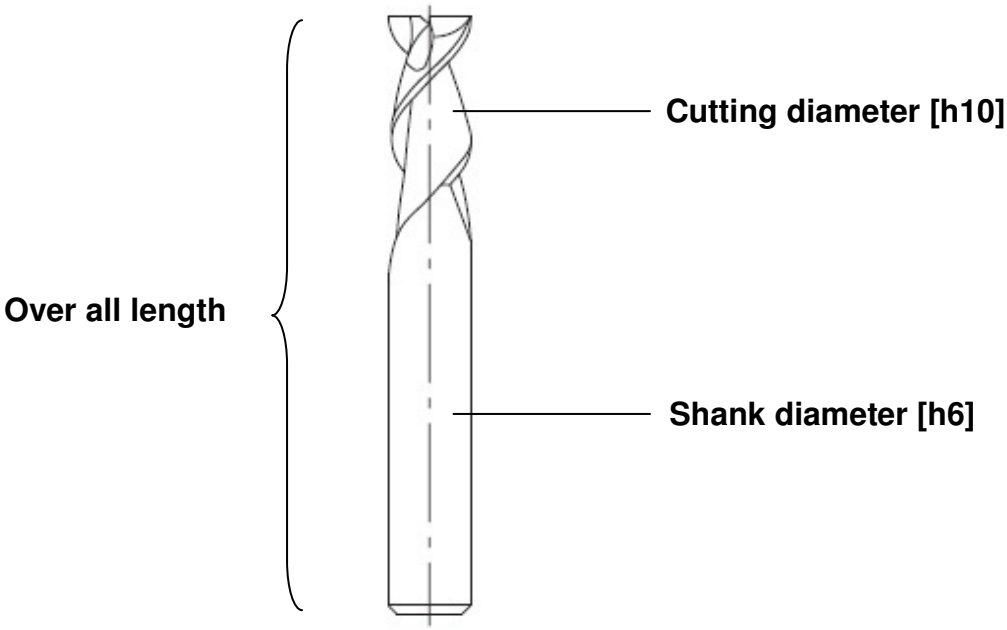
H

Hardened materials	Examples [DIN/W.Nr]	Cutting speeds [Vc]
Tool steels [40-48 HRc]	-	80 - 120 m/min
Tool steels [48-52 HRc]	-	45 - 75 m/min
Tool steels [52-60 HRc]	-	35 - 60 m/min
Tool steels [60-68 HRc]	-	30 - 40 m/min
Hardened cast iron [< 48 HRc]	G-X260NiCr4 2 G-X330NiCr4 2	45 - 65 m/min

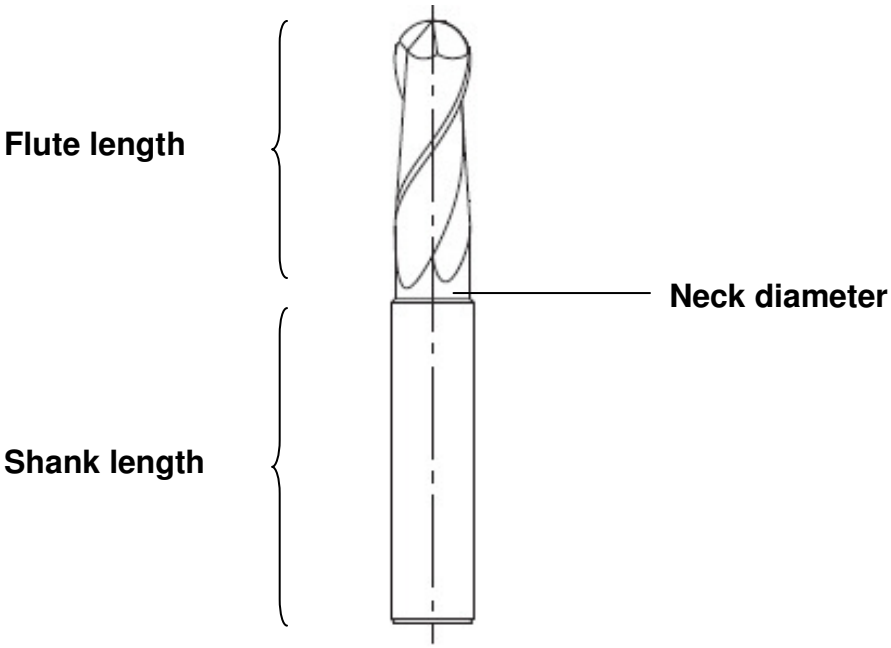
End mill caracteristics



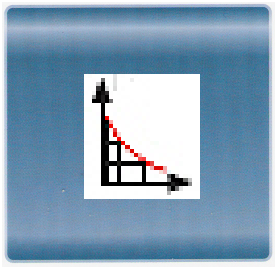
Square configuration



Ball nose configuration

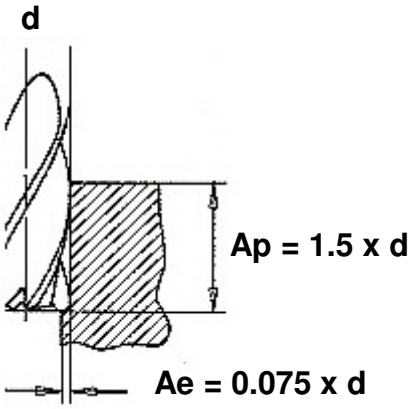


Symbols and formulas



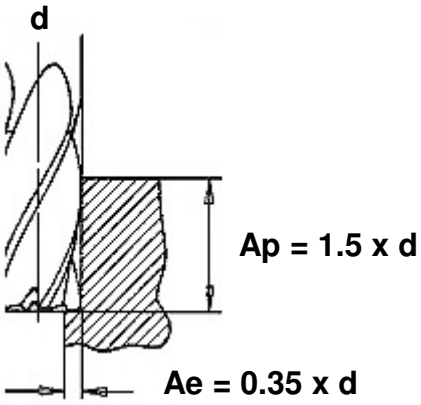
Symbols	Descriptions	Formulas / remarks
Vc	cutting speed in m/min	Vc = π x d x n : 1000
π	the letter/value Pi	3.14
Vf	feed rate in mm/min	Vf = n x fz x z
z	number of teeth [cutting edges]	-
fz	feed per tooth in mm	-
Ap	axial depth of cut in mm	D.O.C.
Ae	radial width of cut in mm	W.O.C.
d	diameter of end mill in mm	-
deff	effective diameter in cut in mm	2 x √Ap x [d - Ap]
n	rotations per minute	n = 1000 x Vc : π x d
Pc	power consumption in kW	Pc = Ap x Ae x Vf x kc : 60 000 000
Mc	torque in Nm	Mc = [d : 2]x fz x z x kc : 8000
Tc	time in contact in minutes	Tc = Lc : Vf
Q	metal removel rate in cm^3/min	Q = Ap x Ae x Vf : 1000
kc	specific cutting force in N/mm^2	see chart
Rth	theoretical surface roughness in µm	Rth = [d : 2] - √ [d^2 - Ae^2] : 4
hm	average chip thickness in mm	hm = fz x √[Ae : d]

Applications versus cutting data fz



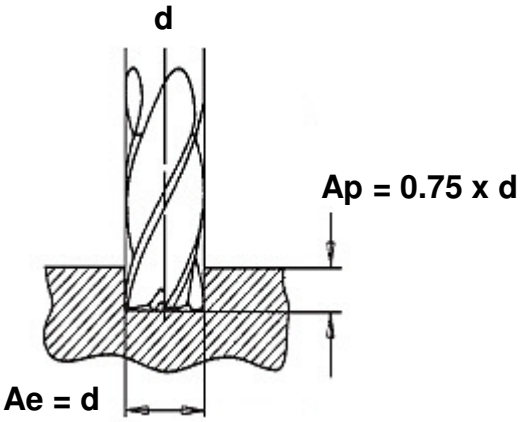
	fz values for >>>>>>>>>>>	Ø 1 – 3	Ø 4 – 6	Ø 8 – 10	Ø 12 – 16	Ø 18 – 20
	carbon steels	0.01-0.03	0.04-0.06	0.06-0.08	0.09-0.12	0.14-0.20
P	low alloy steels	0.01-0.03	0.04-0.05	0.05-0.07	0.08-0.11	0.12-0.18
	high alloy steels	0.01-0.03	0.04-0.05	0.05-0.06	0.07-0.10	0.10-0.16
	ferritic/martensitic	0.01-0.02	0.03-0.04	0.04-0.05	0.05-0.07	0.09-0.12
M	martensitic	0.01-0.02	0.03-0.04	0.04-0.05	0.05-0.07	0.09-0.12
	austenitic	0.01-0.02	0.03-0.05	0.05-0.06	0.06-0.08	0.10-0.14
	grey cast iron	0.01-0.03	0.04-0.06	0.06-0.08	0.09-0.12	0.14-0.20
K	nodular cast iron	0.01-0.03	0.04-0.05	0.05-0.07	0.08-0.11	0.12-0.18
	malleable cast iron	0.01-0.03	0.04-0.05	0.05-0.06	0.07-0.10	0.10-0.16
	aluminium alloys	0.02-0.05	0.05-0.08	0.08-0.12	0.12-0.18	0.20-0.30
N	copper alloys	0.02-0.05	0.05-0.08	0.08-0.12	0.12-0.18	0.20-0.30
	plastics	0.02-0.04	0.04-0.06	0.06-0.08	0.08-0.12	0.12-0.18
H	hardened tool steels	0.01-0.02	0.02-0.03	0.03-0.04	0.04-0.05	0.06-0.08
	hardened cast iron	0.01-0.02	0.02-0.03	0.03-0.04	0.04-0.05	0.06-0.08

Applications versus cutting data fz



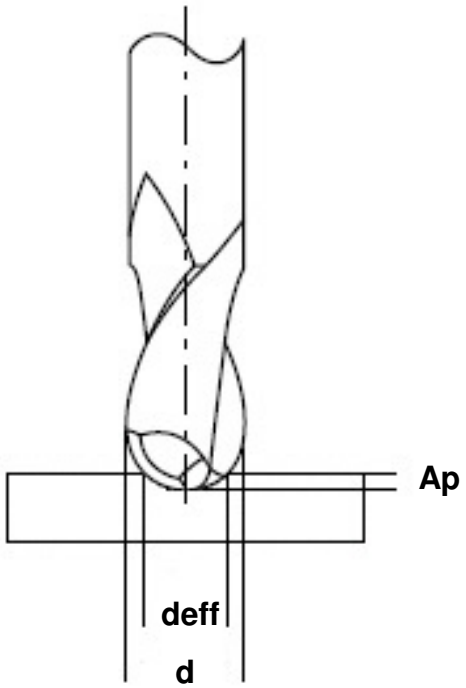
	fz values for >>>>>>>>>>>	Ø 1 – 3	Ø 4 – 6	Ø 8 – 10	Ø 12 – 16	Ø 18 – 20
	carbon steels	0.01-0.02	0.03-0.05	0.05-0.07	0.08-0.11	0.12-0.18
P	low alloy steels	0.01-0.02	0.03-0.04	0.04-0.06	0.07-0.10	0.10-0.16
	high alloy steels	0.01-0.02	0.03-0.04	0.04-0.05	0.06-0.09	0.09-0.14
	ferritic/martensitic	0.01-0.02	0.03-0.04	0.04-0.05	0.05-0.06	0.07-0.10
M	martensitic	0.01-0.02	0.03-0.04	0.04-0.05	0.05-0.06	0.07-0.10
	austenitic	0.01-0.02	0.03-0.05	0.05-0.06	0.06-0.07	0.08-0.12
	grey cast iron	0.01-0.03	0.04-0.06	0.06-0.08	0.09-0.12	0.12-0.18
K	nodular cast iron	0.01-0.03	0.04-0.05	0.05-0.07	0.08-0.11	0.10-0.16
	malleable cast iron	0.01-0.03	0.04-0.05	0.05-0.06	0.07-0.10	0.09-0.14
	aluminium alloys	0.02-0.05	0.05-0.08	0.08-0.12	0.12-0.18	0.20-0.25
N	copper alloys	0.02-0.05	0.05-0.08	0.08-0.12	0.12-0.18	0.20-0.25
	plastics	0.02-0.04	0.04-0.06	0.06-0.08	0.08-0.12	0.12-0.18
H	hardened tool steels	-	-	-	-	-
	hardened cast iron	-	-	-	-	-

Applications versus cutting data fz



	fz values for >>>>>>>>>>>	Ø 1 – 3	Ø 4 – 6	Ø 8 – 10	Ø 12 – 16	Ø 18 – 20
	carbon steels	0.01-0.02	0.02-0.03	0.03-0.06	0.06-0.08	0.08-0.10
P	low alloy steels	0.01-0.02	0.02-0.03	0.03-0.05	0.05-0.07	0.07-0.09
	high alloy steels	0.01-0.02	0.02-0.03	0.03-0.04	0.04-0.06	0.06-0.08
	ferritic/martensitic	0.01-0.02	0.02-0.03	0.03-0.06	0.06-0.08	0.08-0.10
M	martensitic	0.01-0.02	0.02-0.03	0.03-0.05	0.05-0.07	0.07-0.09
	austenitic	0.01-0.02	0.02-0.03	0.03-0.04	0.04-0.06	0.06-0.08
	grey cast iron	0.01-0.03	0.03-0.05	0.05-0.08	0.07-0.09	0.09-0.11
K	nodular cast iron	0.01-0.03	0.03-0.04	0.05-0.07	0.07-0.08	0.08-0.10
	malleable cast iron	0.01-0.03	0.03-0.04	0.05-0.06	0.06-0.07	0.07-0.09
	aluminium alloys	0.01-0.03	0.03-0.04	0.05-0.08	0.07-0.09	0.09-0.11
N	copper alloys	0.01-0.03	0.03-0.04	0.05-0.07	0.07-0.08	0.08-0.10
	plastics	0.01-0.03	0.03-0.04	0.05-0.06	0.06-0.07	0.07-0.09
H	hardened tool steels	-	-	-	-	-
	hardened cast iron	-	-	-	-	-

Applications versus cutting data



fz values for >>>>>>>>>>>>	Ø 1 – 3	Ø 4 – 6	Ø 8 – 10	Ø 12 – 16
finishing	0.01-0.03	0.02-0.05	0.03-0.08	0.06-0.12
roughing	0.03-0.08	0.04-0.10	0.05-0.16	0.05-0.24

Formulas:

$Rth = [d:2] - \sqrt{[d^2 - Ae^2] : 4}$

$Ae = 2 \times \sqrt{Rth \times [d - Rth]}$

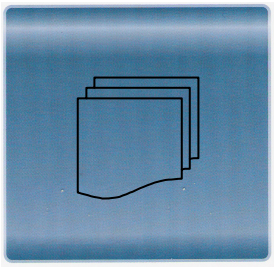
$deff = 2 \times \sqrt{Ap \times [d - Ap]}$

Regular tolerances

	O.D. in µm					
Tolerances	0 – 3	3 - 6	6 - 10	10 – 18	18 – 30	30 – 50
e8	- 14 / - 28	- 20 / - 38	- 25 / - 47	- 32 / - 59	- 40 / - 73	- 50 / - 89
h6	0 / - 6	0 / - 8	0 / - 9	0 / - 11	0 / - 13	0 / - 16
h7	0 / - 10	0 / - 12	0 / - 15	0 / - 18	0 / - 21	0 / - 25
h8	0 / - 14	0 / - 18	0 / - 22	0 / - 27	0 / - 33	0 / - 39
h9	0 / - 25	0 / - 30	0 / - 36	0 / - 43	0 / - 52	0 / - 62
h10	0 / - 40	0 / - 48	0 / - 58	0 / - 70	0 / - 84	0 / - 100
h11	0 / - 60	0 / - 75	0 / - 90	0 / - 110	0 / - 130	0 / - 160
k8	+ 14 / 0	+ 18 / 0	+ 22 / 0	+ 27 / 0	+ 33 / 0	+ 39 / 0
k9	+ 25 / 0	+ 30 / 0	+ 36 / 0	+ 43 / 0	+ 52 / 0	+ 62 / 0
k10	+ 40 / 0	+ 48 / 0	+ 58 / 0	+ 70 / 0	+ 84 / 0	+ 100 / 0

	I.D. in µm					
Tolerances	0 – 3	3 - 6	6 - 10	10 – 18	18 – 30	30 – 50
P9	- 6 / - 31	- 12 / - 40	- 15 / - 51	- 18 / - 61	- 22 / - 74	- 26 / - 88
H6	+ 6 / 0	+ 8 / 0	+ 9 / 0	+ 11 / 0	+ 13 / 0	+ 16 / 0
H7	+ 10 / 0	+ 12 / 0	+ 15 / 0	+ 18 / 0	+ 21 / 0	+ 25 / 0
H8	+ 14 / 0	+ 18 / 0	+ 22 / 0	+ 27 / 0	+ 33 / 0	+ 39 / 0
H9	+ 25 / 0	+ 30 / 0	+ 36 / 0	+ 43 / 0	+ 52 / 0	+ 62 / 0
H10	+ 40 / 0	+ 48 / 0	+ 58 / 0	+ 70 / 0	+ 84 / 0	+ 100 / 0
H11	+ 60 / 0	+ 75 / 0	+ 90 / 0	+ 110 / 0	+ 130 / 0	+ 160 / 0
H12	+ 100 / 0	+ 120 / 0	+ 150 / 0	+ 180 / 0	+ 210 / 0	+ 250 / 0
H13	+ 140 / 0	+ 180 / 0	+ 220 / 0	+ 270 / 0	+ 330 / 0	+ 390 / 0

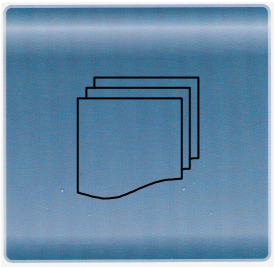
Hardness and tensile strength conversion table



Tensile strength	Vickers hardness	Brinell hardness	Rochwell hardness		
Rm in N/mm²	HV 30 [F98 N]	HB	HRc	HRa	HRb
255	80	76.0	-	-	-
285	90	85.5	-	-	48.0
320	100	95.0	-	-	56.2
350	110	105.0	-	-	62.3
450	140	133.0	-	-	75.0
575	180	171.0	-	-	87.1
675	210	199.0	-	-	93.5
800	250	238.0	22.2	61.6	99.5
900	280	266.0	27.1	63.8	104.0
1030	320	304.0	32.2	66.4	-
1155	360	342.0	34.4	67.6	-
1290	400	380.0	40.8	70.8	-
1350	420	399.0	42.7	71.8	-
1420	440	418.0	44.5	72.8	-
1555	480	456.0	47.7	74.5	-
1595	490	466.0	48.4	74.9	-
1665	510	485.0	49.8	74.9	-
1740	530	504.0	51.1	76.4	-
1810	550	523.0	52.3	77.0	-
2030	610	580.0	55.7	78.9	-
2180	650	618.0	57.8	80.0	-
-	720	-	61.0	81.8	-
-	760	-	62.5	82.6	-
-	800	-	64.0	-	-
-	880	-	66.4	-	-
-	920	-	67.5	-	-
-	940	-	68.0	-	-

Max. load 30 [$F = 9.81 \times 30 \times d^2$] **HB = 0.95 x HV [calculated]**

Approximate Specific cutting force values Kc and fz



Carbon steels	fz = 0.05	0.1	0.16	0.2	0.25	0.3
< 450 N/mm²	2900	2600	2400	2300	2250	2200
< 850 N/mm²	4350	3600	3200	3000	2850	2700
< 1100 N/mm²	3500	3400	3100	2900	2600	2550
Low alloy steels						
< 600 N/mm²	4500	3400	2800	2600	2500	2400
< 1000 N/mm²	3800	3200	2800	2600	2500	2400
< 1300 N/mm²	5400	4500	4000	3800	3600	3400
High alloy steels						
< 700 N/mm²	4000	3300	2900	2800	2600	2500
< 1200 N/mm²	4000	3300	2900	2800	2600	2500

Stainless steels	fz = 0.05	0.1	0.16	0.2	0.25	0.3
Ferritic/martensit.	4000	3600	3300	2900	2750	2600
Martensitic	4000	3600	3300	2900	2750	2600
Austenitic	4600	4000	3700	3500	3400	3300

Cast iron	fz = 0.05	0.1	0.16	0.2	0.25	0.3
Grey c. iron	2500	2400	1850	1750	1650	1600
Nodular c. iron	2150	1800	1600	1500	1400	1350
Malleable c. iron	3650	3200	2900	2800	2700	2600

Aluminium alloys	fz = 0.05	0.1	0.16	0.2	0.25	0.3
< 250 N/mm²	1550	1300	1200	1100	1050	1000
< 12% Si	1650	1400	1300	1200	1150	1100
Copper alloys						
Pb > 1%	1350	1150	1000	950	900	850
Electrolitic Cu	1750	1500	1350	1300	1200	1150

Aluminium alloys	fz = 0.05	0.1	0.16	0.2	0.25	0.3
48 – 52 HRc	5500	4750	4300	4100	4000	3800
52 – 60 HRc	6400	5550	5050	4800	4600	4450
60 – 68 HRc	7300	6350	5800	5500	5300	5100

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