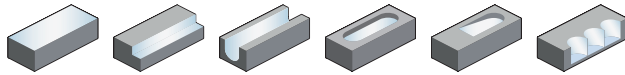


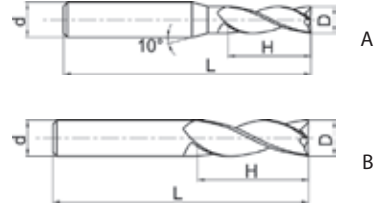
A

## End mill long cutting edge General machining of Al and Al alloys

**AL-3EL**



- Factory standard
- Centre cutting
- Helix angle 45°



Turning

B

Milling

Article	*	Dimensions [mm]				Teeth	Geometry	Grade
		D	d (h6)	H	L			YK30F
AL-3EL-D3.0		3	6	12	60	3	A	●
AL-3EL-D4.0		4	6	16	60	3	A	●
AL-3EL-D5.0		5	6	20	60	3	A	●
AL-3EL-D6.0		6	6	25	75	3	B	●
AL-3EL-D8.0		8	8	32	75	3	B	●
AL-3EL-D10.0		10	10	45	100	3	B	●
AL-3EL-D12.0		12	12	45	100	3	B	●
AL-3EL-D16.0		16	16	65	150	3	B	●
AL-3EL-D20.0		20	20	75	150	3	B	●

● Ex stock   ○ On demand

\* With internal cooling

C

Drilling

### Application field

P	M	K	N	S	H
			✓		

✓ Very suitable

✓ Suitable

D

Technical Information

E

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System code > B258

Cutting data > B422

Nonstandard order > B461

## End mill – AL series

Material group	Composition / structure / heat treatment	Brinell hardness HB	Machining group	Starting values for cutting speed $v_c$ [m/min]								
				AL-1E AL-2E ALG-2E AL-3E				AL-2EL AL-3EL AL-3W				
				Slot milling		Shoulder milling		Slot milling		Shoulder milling		
				$\varnothing$ [mm]	$a_p$ max	$\varnothing$ [mm]	$a_e$ max	$\varnothing$ [mm]	$a_p$ max	$\varnothing$ [mm]	$a_e$ max	
				$0 < x < 12$	$0.5 \times D$	$0 < x \leq 20$	$< 0.5 \times D$	$0 < x < 12$	$0.5 \times D$	$0 < x \leq 20$	$< 0.5 \times D$	
				YK30F / YK40F				YK30F				
				$a_e / D$				$a_e / D$				
				1/1	1/2	1/10	f-group	1/1	1/2	1/10	f-group	
<b>P</b> Unalloyed steel	ca. 0,15 % C	annealed	125	1								
	ca. 0,45 % C	annealed	190	2								
	ca. 0,45 % C	tempered	250	3								
	ca. 0,75 % C	annealed	270	4								
	ca. 0,75 % C	tempered	300	5								
<b>P</b> Low-alloyed steel		annealed	180	6								
		tempered	275	7								
		tempered	300	8								
<b>P</b> High-alloyed steel and high-alloyed tool steel		annealed	200	10								
		hardened and tempered	325	11								
<b>M</b> Stainless steel	ferritic/martensitic	annealed	200	12								
	martensitic	tempered	240	13								
	austenitic	quench hardened	180	14								
	austenitic-ferritic		230	15								
<b>K</b> Grey cast iron	perlitic/ferritic		180	16								
	perlitic (martensitic)		260	17								
<b>K</b> Cast iron with spheroidal graphite	ferritic		160	18								
	perlitic		250	19								
<b>K</b> Malleable cast iron	ferritic		130	20								
	perlitic		230	21								
<b>N</b> Aluminium wrought alloys	cannot be hardened		60	22	920	1100	1200	4	830	990	1080	4
	hardenable	hardened	100	23	555	660	720	4	500	595	650	4
	$\leq 12\% \text{ Si}$ , cannot be hardened		75	24	370	440	480	4	335	400	435	4
	$\leq 12\% \text{ Si}$ , hardenable	hardened	90	25	460	550	600	4	415	495	540	4
<b>N</b> Cast aluminium alloys	$> 12\% \text{ Si}$ , cannot be hardened		130	26	140	165	180	4	125	150	165	4
	machining steel, PB > 1%		110	27	280	330	360	4	250	300	325	4
	CuZn, CuSnZn		90	28	325	385	420	4	295	350	380	4
<b>N</b> Copper and copper alloys (bronze/brass)	CuSn, Pb-free copper, electrolytic copper		100	29	280	330	360	4	250	300	325	4
	<b>S</b> Heat-resistant alloys	Fe-based alloys	annealed	200	30							
hardened			280	31								
Ni or Co base		annealed	250	32								
		hardened	350	33								
<b>S</b> Titanium alloys	pure titanium		$R_m$ 400	35								
	$\alpha$ and $\beta$ alloys	hardened	$R_m$ 1050	36								
<b>H</b> Hardened steel		hardened and tempered	55 HRC	37								
		hardened and tempered	60 HRC	38								
<b>H</b> Hard cast iron		cast	400	39								
<b>H</b> Hardened cast iron		hardened and tempered	55 HRC	40								
<b>X</b> Non-metallic materials	Thermoplasts			41								
	Thermosetting plastics			42								
	Plastic, glass-fibre reinforced GFRP			43								
	Plastic, carbon fibre reinforced CFRP			44								
	Graphite			45								
	Wood			46								

Note: The given cutting values are guide values, which were determined under ideal conditions.  
 The values have to be adapted in individual cases.  
 Feed rate recommendations on page B444.  
 For examples of material for cutting tool groups view page D22.

# AL series

*For machining of aluminium alloys*

- For machining of aluminium alloys.
- Newly developed geometries expand our standard program:
  - ALP for high-speed roughing
  - ALG for finishing with very good surface quality
  - AIR torus mills for ultra high-speed machining
- End mills, ball nose cutters, torus mills and rippers
- Diameter range 1.0–20.0 mm



# Solid carbide milling System code – DIN-ISO series

**5 5 0 1 R 30 2 GM R05 0800**

**1 2 3 4 5 6 7 8 9 10**

**A**

Turning

Type	
Code	Description
5	Milling cutter

Shank type	
Code	Description
1	Shank
5	DIN 6535 HA
6	Weldon shank DIN 6535 HB
7	Whistle Notch DIN 6535 HE
9	Morse taper shank

Cutting edge type	
Code	Description
0	Square shoulder mill
6	Ball nose cutter
8	Torus mill

**1**

**2**

**3**

**B**

Milling

Tool length	
Code	Description
1	DIN 6527 K
2	DIN 6527 L
5	Factory standard ZCC-A
6	Factory standard ZCC-B
8	DIN 6528
9	Factory standard ZCC-D

Rotation direction	
Code	Description
R	Right
L	Left

Helix angle	
Code	Description
20	20°
30	30°
3841	38°/41°
45	45°
55	55°
60	60°

No. of teeth	
Code	Description
2	2
...	
M	Indicated when different diameters have a different number of teeth

**4**

**5**

**6**

**7**

**C**

Drilling

Application	
Code	Description
GM	Semi-finishing
GF	Finishing
HM	Hard machining
MHH	High-speed hard machining
NH	High-performance machining of heat-resistant alloys

Radius [mm]	
Code	Description
R03	0.3
R15	1.5
R30	3.0
...	

Diameter [mm]	
Code	Description
0100	1.0
0800	8.0
2000	20.0
...	

**8**

**9**

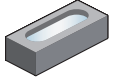
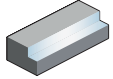
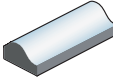
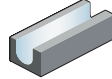
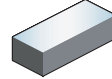
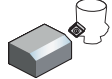

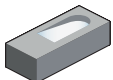
**10**

**D**

Technical Information

**E**

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Machining operations					
					
Groove milling	Square shoulder milling	Profile milling	Slot milling	Face milling	Chamfer milling
					
Plunge milling	Circular milling/Ramping				

# GM – 2 E L P – D12 R0.5 – M08

1      2      3      4      5      6      7      8

Application	
Code	Description
GR	General roughing
GM	Semi-finishing
GF	Finishing
PM	High-performance machining
HM	Hard machining
HH	High-speed hard machining
NM	General machining of non-ferrous metals
AL	General machining of Al and Al alloys
ALP	High-performance machining of Al and Al alloys
ALG	General machining of Al and Al alloys
UM	HSC/HPC machining
VSM	General machining of heat-resistant alloys

No. of teeth

Cutting edge type	
Code	Description
E	Square shoulder mill with protective chamfer
F	Square shoulder mill with sharp cutting edges
B	Ball nose cutter
R	Torus mill
W	Ripper
H	High-feed mill

1      2      3

Cutting edge length	
Code	Description
L	Long
X	Extra long
F	Short

Type	
Code	Description
S	Mini diameter
P	Grounded neck
C	Conical neck

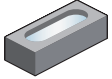
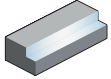
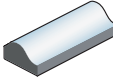
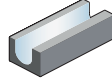
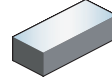
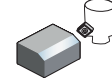

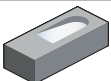
Diameter [mm]	
Code	Description
D3.0	3.0
D8.0	8.0
D20.0	20.0
...	

Radius [mm]	
Code	Description
R0.5	0.5
R1.0	1.5
R3.0	3.0
...	

4      5      6      7

Features	
Code	Description
G	Spiral angle 30°
M	Neck length [mm]
S	Thin shank
AIR	For aerospace industry

8

Machining operations					
					
Groove milling	Square shoulder milling	Profile milling	Slot milling	Face milling	Chamfer milling
					
Plunge milling	Circular milling/ Ramping				

A

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**Coated cemented carbide PVD**

Grade	Grade description
<b>KMG303</b>	PVD coated carbide substrate for universal milling application of steel (up to HRC≤48), stainless steel and cast iron.
<b>KMG405</b>	PVD coated carbide substrate for high performance milling application of steel (up to HRC <55), stainless steel, super alloy material and cast iron. High wear resistance and toughness for a wide application field.
<b>KMG555</b>	PVD coated carbide substrate for hard milling application of steel (HRC 55–68), highest wear resistance and toughness for best cutting result.
<b>KMG309</b>	PVD coated carbide substrate for non ferrous materials. High wear resistance even in abrasive materials.

**Uncoated cemented carbide**

Grade	Grade description
<b>YK30F</b>	Uncoated K30 carbide substrate for steel, stainless steel, cast iron and non ferrous materials.
<b>YK40F</b>	Uncoated K20–K30/N20–N30 carbide substrate for cast iron and non ferrous materials.

**A**

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**B**

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Drilling

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	Products	Solid carbide cutters	Teeth	Ø	Application						Type	Page
					P	M	K	N	S	H		
Machining high hardness steel	HM-4R		4	3.0-12.0						✓	Torus mills	B363
	HM-4RF		4	6.0-12.0						✓	Torus mills	B364
	HM-4RP		4	6.0-16.0						✓	Torus mills	B365
Copper and copper alloys	5502R402NM		2	3.0-20.0				✓			End mills	B368
	NM-2E		2	1.0-12.0				✓			End mills	B369
	NM-2EP		2	5.0				✓			Mini end mills	B370
	NM-4E		4	3.0-12.0				✓			End mills	B371
	NM-2B		2	1.0-12.0				✓			Ball nose cutters	B372
	NM-2BP		2	5.0				✓			Mini ball nose cutters	B373
Aluminium and aluminium alloys	AL-2E		2	1.0-20.0				✓			End mills	B376
	AL-2EL		2	3.0-20.0				✓			End mills	B377
	ALG-2E		2	1.0-20.0				✓			End mills	B378
	ALG-2R		2	6.0-25.0				✓			Torus mills	B390
	AL-3E		3	1.0-20.0				✓			End mills	B379
	AL-3EL		3	3.0-20.0				✓			End mills	B380
	ALG-3E		3	1.0-20.0				✓			End mills	B381
	ALP-3E		3	1.0-20.0				✓			End mills	B382
	ALP-4E		4	3.0-20.0				✓			End mills	B383
	AL-3W		3	6.0-20.0				✓			Rippers	B384
	5565R302NH		2	3.0-16.0				✓			Ball nose cutters	B385
	5566R302NH		2	3.0-16.0				✓			Ball nose cutters	B386
	AL-2B		2	2.0-12.0				✓			Ball nose cutters	B387

✓ Very suitable    ✓ Suitable