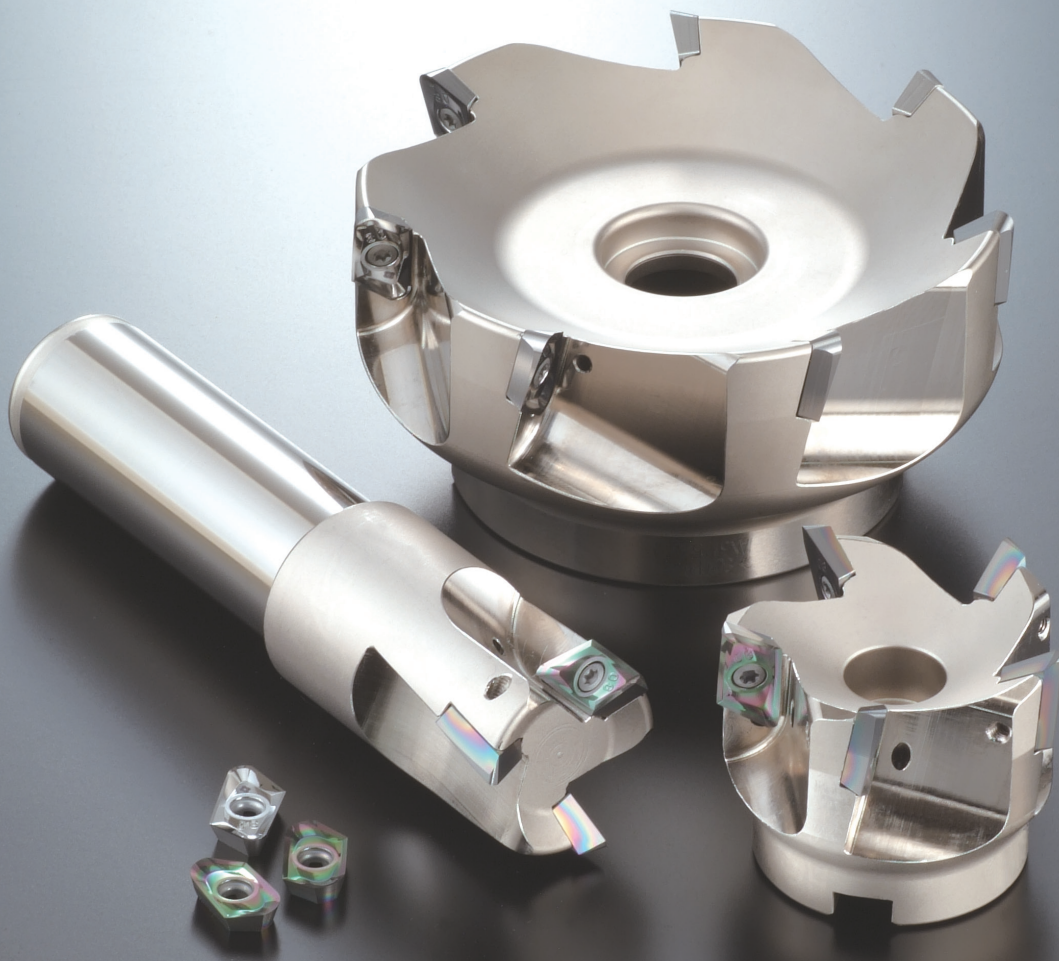


High Speed Milling System for Non Ferrous Metals
and Aluminium Alloys

„Wave Mill“ **WAX 3000/4000** Series

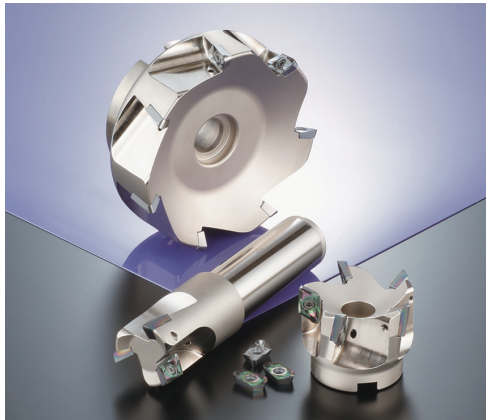
Expansion



- High speed, high efficiency cutter for aluminium alloy
- WAX 3000/4000 diameter ranging from 25 to 125mm
- Versatile, multi-purpose cutter

„Wave Mill“ Series

WAX Type



■ Features

Wave Mill WAX type is a high speed and high efficiency cutter capable of rough milling to finishing of non-ferrous metals such as aluminium alloys.

■ Characteristics

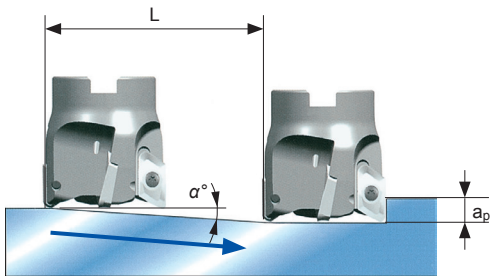
- For ramping (slant milling) and helical milling
- Safety design – prevents dislodging of inserts caused by centrifugal forces
- Coolant supply – coolant holes are a standard feature for the whole series
- Excellent adhesion resistance
 - Top rake face of the insert is lapped finish
 - DLC coat inserts are available for improved adhesion resistance

■ Ramping (Slant Milling)

Maximum ramping angle ($\alpha^{\circ} \max.$) depends on cutter diameter.

Minimum milling length (L min) is the ramping distance required to reach the maximum cutting depth ($a_p \max$) at the maximum ramping angle of that cutter. Minimum milling length (L) for any depth can be calculated by the equation below.

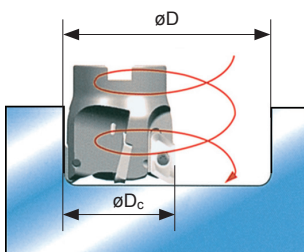
$$L = \frac{a_p}{\tan \alpha} \text{ (mm)}$$



● Ramping (Slant Milling) Angles

Cutter Diameter $\varnothing D_c$ (mm)	Max. Ramping Angle $\alpha^{\circ} \max$	
	WAX 3000 Type	WAX 4000 Type
20	28°	26°
25	17°	
32	12°	18°30'
40	9°	13°
50	7°	9°30'
63	5°	7°
80	3°	5°
100	3°	4°
125	2°	3°

■ Helical Milling



● Helical Milling Diameter

Cutter Diameter $\varnothing D_c$ (mm)	WAX 3000 Type		WAX 4000 Type	
	Min.	Max.	Min.	Max.
20	22	33	27	43
25	29	43		
32	43	57	38	57
40	59	73	54	73
50	79	93	74	93
63	105	119	100	119
80	139	153	134	153
100	179	193	174	193
125	229	243	224	243

■ Recommended Cutting Conditions

Work Material	Aluminium Alloy
Cutting Speed v_c (m/min)	600 - 900 - 1200
Feed Rate f_t (mm/t)	0,05 - 0,15 - 0,25
Grade	DL1000

■ Maximum Permitted Spindle Speed

Cutter Diameter $\varnothing D_c$ (mm)	WAX 3000 Type		WAX 4000 Type	
	$n \max$ (min ⁻¹)	v_c (m/min)	$n \max$ (min ⁻¹)	v_c (m/min)
20	14.000	880	11.000	860
25	29.000	2.200		
32	25.000	2.500	9.000	900
40	23.000	2.900	20.000	2.500
50	20.000	3.100	18.000	2.800
63	18.000	3.500	16.000	3.100
80	16.000	4.000	14.000	3.500
100	14.000	4.400	12.000	3.700
125	13.000	5.100	11.000	4.300

The $n \max$ speeds are set to prevent the inserts from dislodging by centrifugal forces.

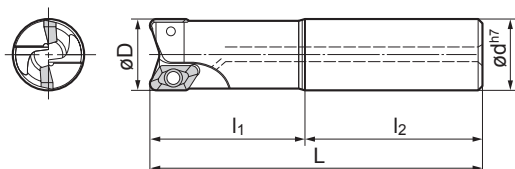
„Wave Mill“ Series

WAX 3000 Type

WAX 3000E / 3000EL



Shank Type
Short Type „E“
Long Type „EL“



Body

(For inserts with nose radius ≤ 3,2mm)

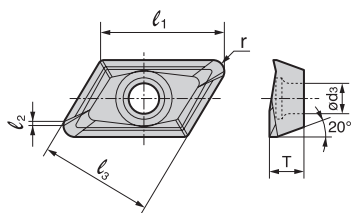
Cat. No.	Stock	Dimensions (mm)						No. of Teeth	Weight (kg)
		ØD	Ød	L	l ₁	l ₂			
WAX 3020E -3.2	●	20	20	130	60	70	1	0,25	
3025E -3.2	●	25	25	140	60	80	2	0,42	
3025EL-3.2	●	25	25	200	60	140	2	0,63	
3032E -3.2	●	32	32	150	70	80	2	0,75	
3032EL-3.2	●	32	32	220	70	150	2	1,2	
WAX 3040E -3.2	●	40	32	160	70	90	3	1,0	
3040EL-3.2	●	40	32	220	70	150	3	1,4	

Body

(For inserts with nose radius ≥ 4,0mm)

Cat. No.	Stock	Dimensions (mm)						No. of Teeth	Weight (kg)
		ØD	Ød	L	l ₁	l ₂			
WAX 3020E -4.0	●	20	20	130	60	70	1	0,25	
3025E -4.0	●	25	25	140	60	80	2	0,42	
3025EL-4.0	●	25	25	200	60	140	2	0,63	
3032E -4.0	●	32	32	150	70	80	2	0,75	
3032EL-4.0	●	32	32	220	70	150	2	1,2	
WAX 3040E -4.0	●	40	32	160	70	90	3	1,0	
3040EL-4.0	●	40	32	220	70	150	3	1,4	

Inserts for WAX 3000 Type



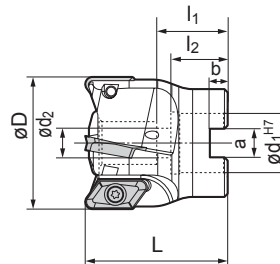
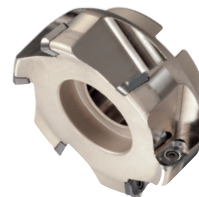
Application		Car-bide	DLC							
High Speed/Light Cut		 								
General Purpose										
Roughing										
Cat. No.		H1	DL1000	Dimensions (mm)						
				ℓ ₁	ℓ ₃	ℓ ₂	r	T	ød ₃	
AECT	160404PEFRA	●	●	18	16,4	1,4	0,4	5	4,4	
	160408PEFRA	●	●	18	16,4	1,0	0,8	5	4,4	
	160412PEFRA	●	●	18	16,4	0,6	1,2	5	4,4	
	160416PEFRA	●	●	17,5	16,4	0,5	1,6	5	4,4	
	160420PEFRA	●	●	17,5	16,4	0,5	2,0	5	4,4	
AECT	160430PEFRA	●	●	17	16,4	0,7	3,0	5	4,4	
	160432PEFRA	●	●	17	16,4	0,5	3,2	5	4,4	
AECT	160440PEFRA	●	●	16,5	16,4	0,5	4,0	5	4,4	
	160450PEFRA	●	●	16	16,4	0,4	5,0	5	4,4	

● Euro stock

WAX 3000 RS



Shell Type



Body

(For inserts with nose radius ≤ 3,2mm)

Cat. No.	Stock	Dimensions (mm)										No. of Teeth	Weight (kg)
		ØD	Ød ₁	L	Ød ₂	a	b	l ₁	l ₂				
WAX3050RS-3.2	●	50	22	50	11	10,4	6,3	26	21	4	0,34		
3063RS-3.2	●	63	22	50	11	10,4	6,3	26	21	5	0,6		
3080RS-3.2	●	80	27	50	13,5	12,4	7	30	23	5	1,0		
3100RS-3.2	●	100	32	63	18	14,4	8	32	26	6	2,2		
3125RS-3.2	●	125	40	63	22	16,4	9	35	29	7	3,5		

Body

(For inserts with nose radius ≥ 4,0mm)

Cat. No.	Stock	Dimensions (mm)										No. of Teeth	Weight (kg)
		ØD	Ød ₁	L	Ød ₂	a	b	l ₁	l ₂				
WAX3050RS-4.0	●	50	22	50	11	10,4	6,3	26	21	4	0,34		
3063RS-4.0	●	63	22	50	11	10,4	6,3	26	21	5	0,6		
3080RS-4.0	●	80	27	50	13,5	12,4	7	30	23	5	1,0		
3100RS-4.0	●	100	32	63	18	14,4	8	32	26	6	2,2		
3125RS-4.0	●	125	40	63	22	16,4	9	35	29	7	3,5		

● Euro stock

Spare Parts

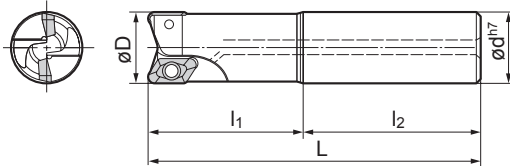
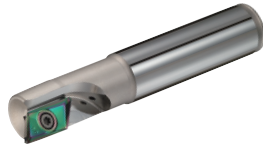
Screw	Spanner	Recommended Tightening Torque (N·m)	Applicable Endmill
		3,0	WAX 3000 E/EL WAX 3000 RS
BFTX0408	TRD15		

„Wave Mill“ Series WAX 4000 Type

WAX 4000E / 4000EL



Shank Type
Short Type „E“
Long Type „EL“



Body

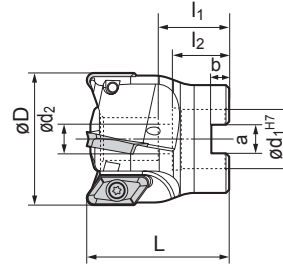
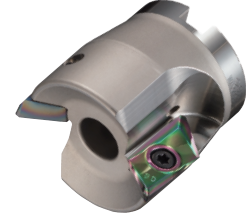
(For inserts with nose radius $\leq 3,2\text{mm}$)

Cat. No.	Stock	Dimensions (mm)						No. of Teeth	Weight (kg)
		ϕD	ϕd	L	l_1	l_2			
WAX 4025E -3.2	○	25	25	140	60	80	1	0,41	
4025EL-3.2	○	25	25	200	60	140	1	0,63	
4032E -3.2	○	32	32	150	70	80	1	0,72	
4032EL-3.2	○	32	32	220	70	150	1	1,2	
WAX 4040E -3.2	○	40	32	160	70	90	2	0,88	
4040EL-3.2	○	40	32	220	70	150	2	1,2	

WAX 4000 RS



Shell Type



Body

(For inserts with nose radius $\leq 3,2\text{mm}$)

Cat. No.	Stock	Dimensions (mm)										No. of Teeth	Weight (kg)
		ϕD	ϕd_1	L	ϕd_2	a	b	l_1	l_2				
WAX4050RS-3.2	○	50	16	50	9	8,4	5,6	23	18	2	0,37		
4063RS-3.2	○	63	22	50	11	10,4	6,3	26	21	3	0,54		
4080RS-3.2	○	80	27	50	13,5	12,4	7	30	23	4	0,81		
4100RS-3.2	○	100	32	63	18	14,4	8	32	26	5	1,7		
4125RS-3.2	○	125	40	63	22	16,4	9	35	29	6	2,6		

Body

(For inserts with nose radius $\geq 4,0\text{mm}$)

Cat. No.	Stock	Dimensions (mm)						No. of Teeth	Weight (kg)
		ϕD	ϕd	L	l_1	l_2			
WAX 4025E -4.0	○	25	25	140	60	80	1	0,41	
4025EL-4.0	○	25	25	200	60	140	1	0,63	
4032E -4.0	○	32	32	150	70	80	1	0,72	
4032EL-4.0	○	32	32	220	70	150	1	1,2	
WAX 4040E -4.0	○	40	32	160	70	90	2	0,88	
4040EL-4.0	○	40	32	220	70	150	2	1,2	

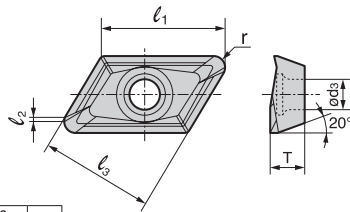
Body

(For inserts with nose radius $\geq 4,0\text{mm}$)

Cat. No.	Stock	Dimensions (mm)										No. of Teeth	Weight (kg)
		ϕD	ϕd_1	L	ϕd_2	a	b	l_1	l_2				
WAX4050RS-4.0	○	50	16	50	9	8,4	5,6	23	18	2	0,37		
4063RS-4.0	○	63	22	50	11	10,4	6,3	26	21	3	0,54		
4080RS-4.0	○	80	27	50	13,5	12,4	7	30	23	4	0,81		
4100RS-4.0	○	100	32	63	18	14,4	8	32	26	5	1,7		
4125RS-4.0	○	125	40	63	22	16,4	9	35	29	6	2,6		

○ Delivery on request

Inserts for WAX 4000 Type



Application	Car-bide	DLC	Dimensions (mm)						
High Speed/Light Cut			ℓ_1	ℓ_3	ℓ_2	r	T	ϕd_3	
General Purpose									
Roughing									
	H1	DL1000							
AECT 220604PEFRA	○	○	24	21,8	1,5	0,4	6,35	6,0	
220608PEFRA	○	○	24	21,8	1,2	0,8	6,35	6,0	
220612PEFRA	○	○	24	21,8	0,8	1,2	6,35	6,0	
220616PEFRA	○	○	24	21,8	0,4	1,6	6,35	6,0	
220620PEFRA	○	○	24	21,8	0,5	2,0	6,35	6,0	
AECT 220630PEFRA	○	○	23	21,8	0,6	3,0	6,35	6,0	
220632PEFRA	○	○	23	21,8	0,5	3,2	6,35	6,0	
AECT 220640PEFRA	○	○	22	21,8	1,2	4,0	6,35	6,0	
220650PEFRA	○	○	22	21,8	0,4	5,0	6,35	6,0	

○ Delivery on request

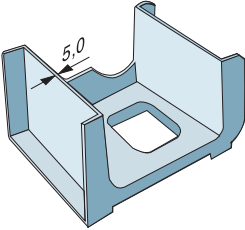
Spare Parts

Screw	Spanner	Recommended Tightening Torque (N·m)	Applicable Endmill
		5,0	
BFTX0509N	TRD20		$\phi 25 \sim \phi 32$
BFTX0511N	TRD20		$\phi 40 \sim \phi 125$

„Wave Mill“ Series WAX Type

Application Example

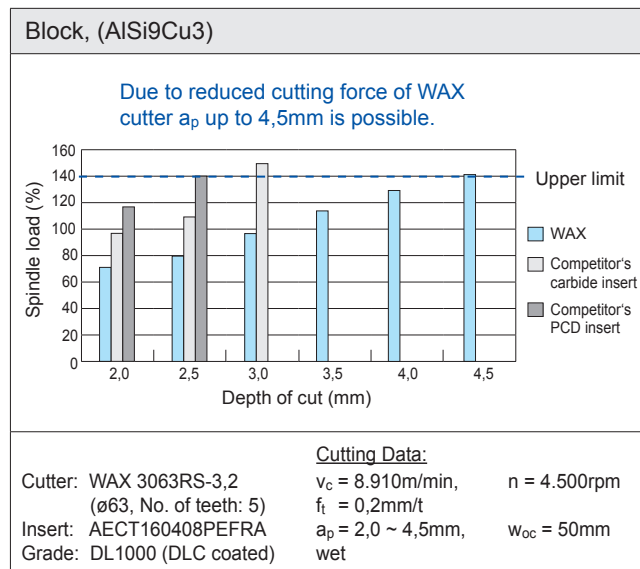
Bracket, AlZn6CuMgZr, 3.4144
200 x 200 x 200mm



Using sharp edged H1 uncoated inserts on this thin walled aluminium section both productivity and surface finish improved with no signs of edge chipping.

Cutter: WAX 3050RS-3,2 ($\phi 50$, No. of teeth: 4)	<u>Cutting Data:</u>	
Insert: AECT160408PEFRA	$v_c = 2.800\text{m/min}$, $n = 18.000\text{rpm}$	
Grade: H1 (uncoated)	$v_f = 9.000\text{mm/min}$, $f_t = 0,125\text{mm/t}$	
	$a_p = 2,5 \sim 3,5\text{mm}$, $w_{oc} = 5,0\text{mm}$	
	wet	

Comparison of Spindle Load by Changing Axial Depth of Cut

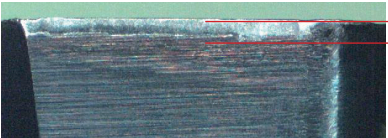


Application



Material: Aluminium alloy	<u>Cutting Data:</u>
Cutter: WAX 3063RS-3,2	$v_c = 1.200\text{m/min}$, $n = 6.000\text{rpm}$
Insert: AECT160420PEFRA	$v_f = 20.000\text{mm/min}$, $f_t = 0,67\text{mm/t}$
Grade: H1 (uncoated)	$a_e = 50 \sim 63\text{mm}$, $a_p = 1,0\text{mm}$
	wet

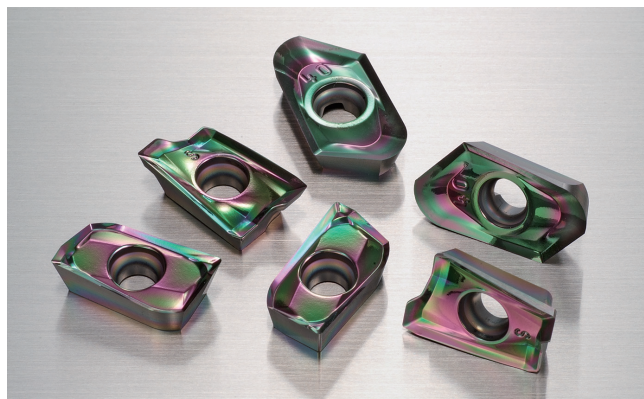
Excellent Wear Resistance

WAX 3000 Type	Competitor's Cutter
	
	
0,042mm	0,101mm
Low wear and in good condition	Chipping

Material: Hard nylon	<u>Cutting Data:</u>
Cutter: WAX 3050RS-3,2	$v_c = 1.256\text{m/min}$, $n = 8.000\text{rpm}$
Insert: AECT160404PEFRA	$v_f = 2.500\text{mm/min}$, $f_t = 0,078\text{mm/t}$
Grade: DL1000	$a_p = 0,2 \sim 0,3\text{mm}$, wet

DLC Coating

DL1000



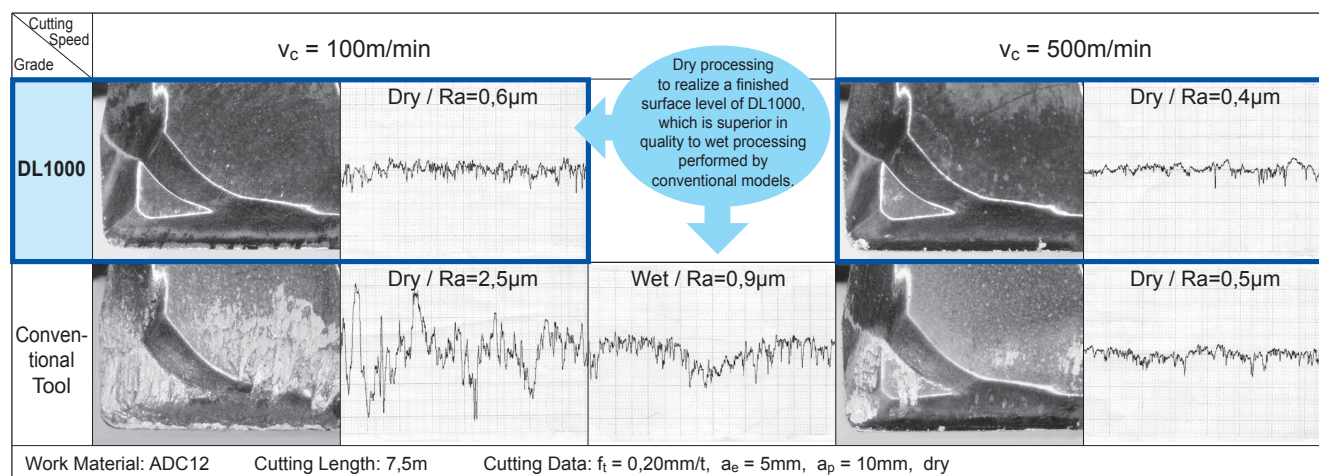
Aluminium processing materials with DLC coating adopted
(DLC: Diamond Like Carbon)

The extremely smooth DLC coating is suitable for Al-alloys with a tendency to built-up edge.
The processing is possible even under dry conditions.

■ Characteristics

- The combination of the hard substrate developed for the Al-alloy and the very smooth DLC coating increases the tool life.
- The K-H1 substrate has a hardness of 92.9 HRA.
- A diamond-like coating with a roughness of $Ra\ 0,01\mu m$ results in a friction coefficient $< 0,1$ and provides excellent adhesion resistance.
- Achieves excellent machining surfaces.
- Possible for use in high-speed and high-efficiency precision machining of aluminum alloys with low silicon content, non-ferrous metals and plastics (MC nylon).

■ DL1000 Application Examples (Adhesion Resistance and Surface Roughness)



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