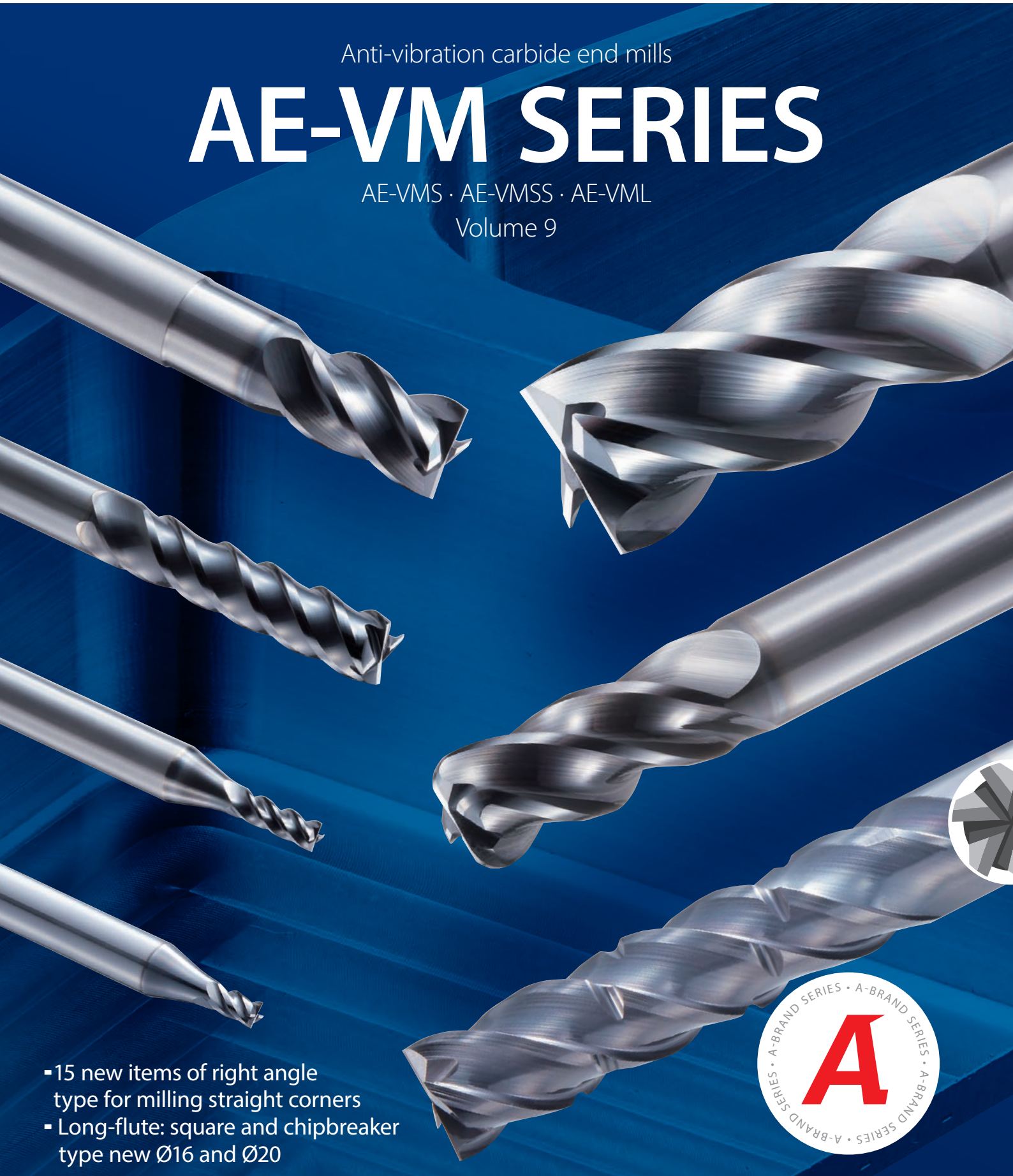
Anti-vibration carbide end mills

AE-VM SERIES

AE-VMS · AE-VMSS · AE-VML

Volume 9



- 15 new items of right angle type for milling straight corners
- Long-flute: square and chipbreaker type new Ø16 and Ø20

A-BRAND SERIES · A-BRAND SERIES · A-BRAND SERIES · A-BRAND SERIES

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AE-VMS Short

AE-VMSS Stub

AE-VML Long

AE-VML Chipbreaker Type

SELECTION CHART

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	Right Angle Page 12	 NEW	Slot Milling	Side Milling	Helical Milling	Contour Milling	Ramping	
	Radius Page 10-11		Slot Milling	Side Milling	Helical Milling	Side Milling	Ramping	Copying
AE-VMSS Stub	Square Page 13-14		Slot Milling	Side Milling	Helical Milling	Contour Milling	Ramping	
	Right Angle Page 15	 NEW	Slot Milling	Side Milling	Helical Milling	Contour Milling	Ramping	
	Long Neck Page 16		Slot Milling	Side Milling	Helical Milling	Contour Milling	Ramping	Deep Side

	Cutting edge shape		Application					
AE-VML Long	Square Page 17		Trochoidal	Side Milling	Helical Milling	Deep Side		
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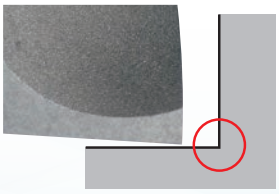
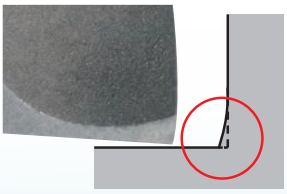
Right angle type for milling straight corners

Right angle implies "straight angle." The right angle type end mill features a unique geometry that maintains a consistent cutting diameter even with a gash land.

Ability to mill straight corners while maintaining cutting edge rigidity.

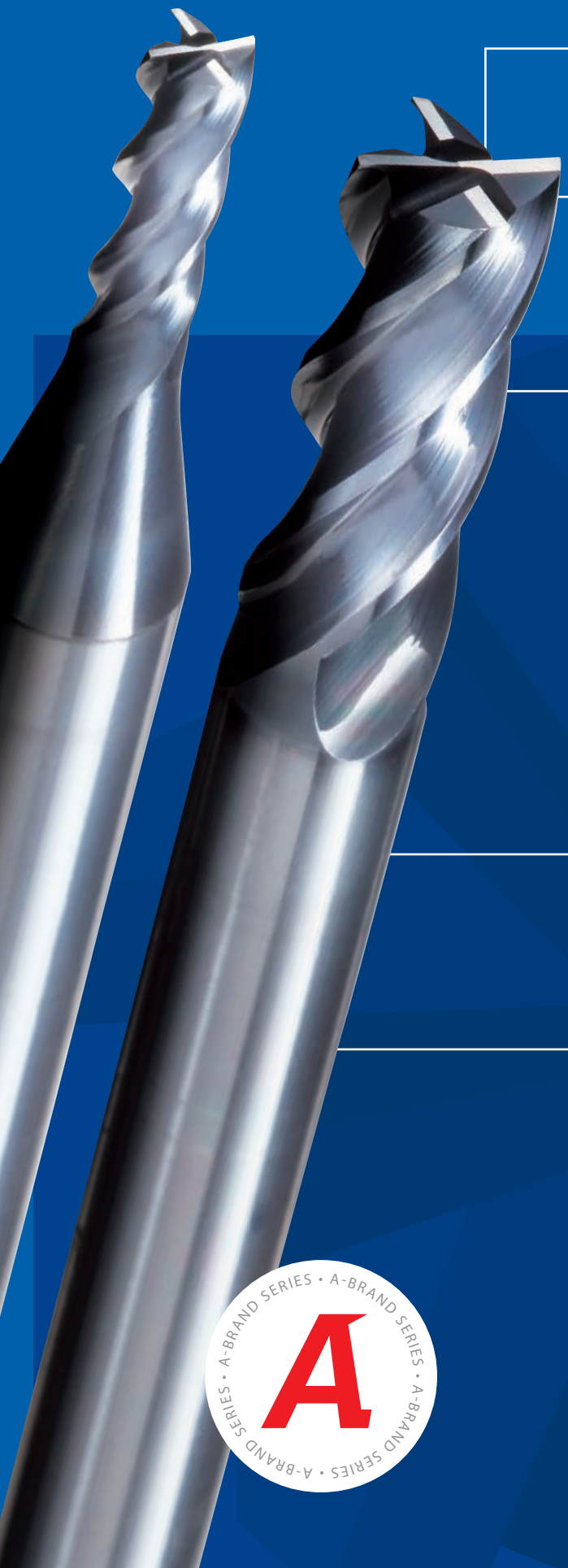


Right Angle Type



Square Type

KEY FEATURES: AE-VMS • AE-VMSS

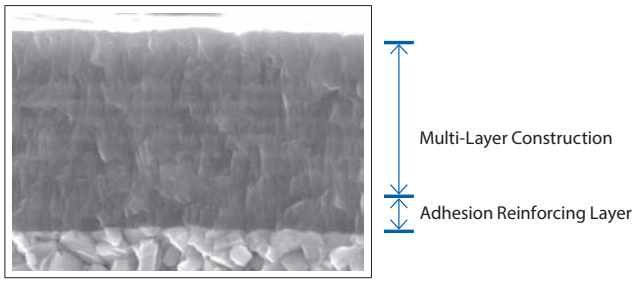


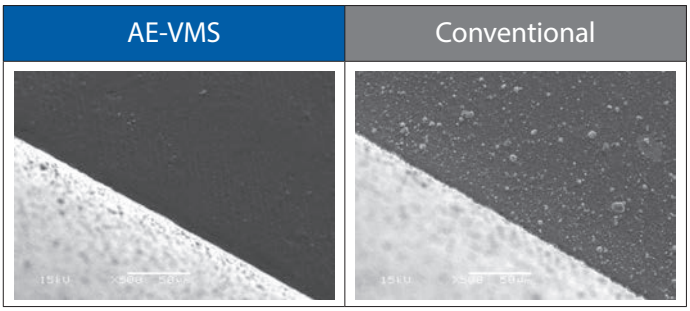
1. Duarise coating
2. Positive rake angle
3. New flute form
4. High rigidity
5. Solid carbide

A-BRAND SERIES • A-BRAND SERIES • A-BRAND SERIES • A-BRAND SERIES

Duarise coating

The new duarise coating provides excellent lubricity, superior friction-resistance and high oxidation temperature. Multi-layer construction minimizes the thermal cracks that often occurred while using water-soluble oil.





Smoothing surface coating treatment made an excellent quality of surface finishing.

Positive rake angle

A stable performance is gathered by reducing cutting forces as a result of a sharp and positive rake angle.

New flute form

The new flute form with its excellent chip evacuation properties enables stable milling and the suppression of burrs.

Figure 1. 10% lower cutting force versus the competitors

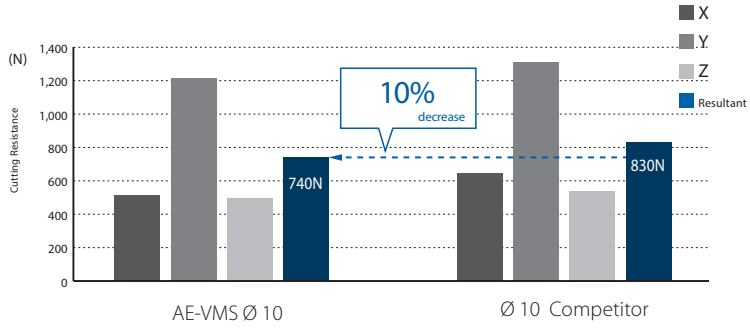
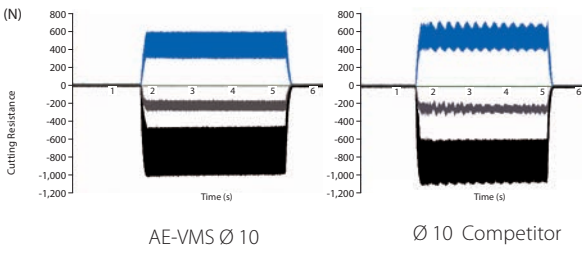
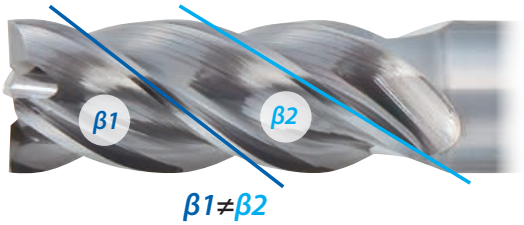
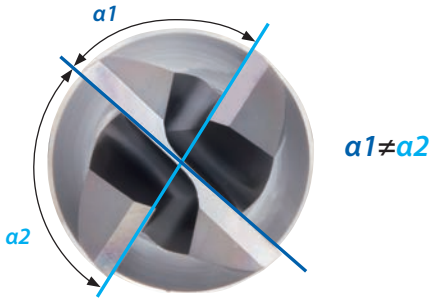


Figure 2. Stable performance even when the overhang length is L/D=4



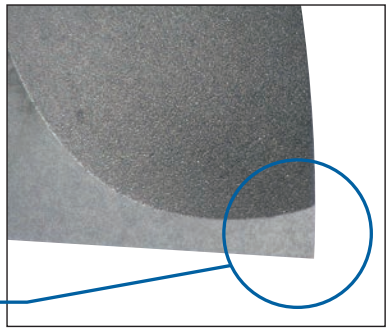
High rigidity

The unequal spacing of teeth and variable-lead geometry enables stable and high efficiency milling and the suppression of vibration.

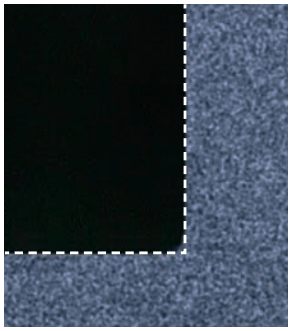
Variable Leads	Unequal Spacing Teeth
	

Milling straight corners with a unique cutting edge

Gash land for enhancing chipping resistance



With gash land



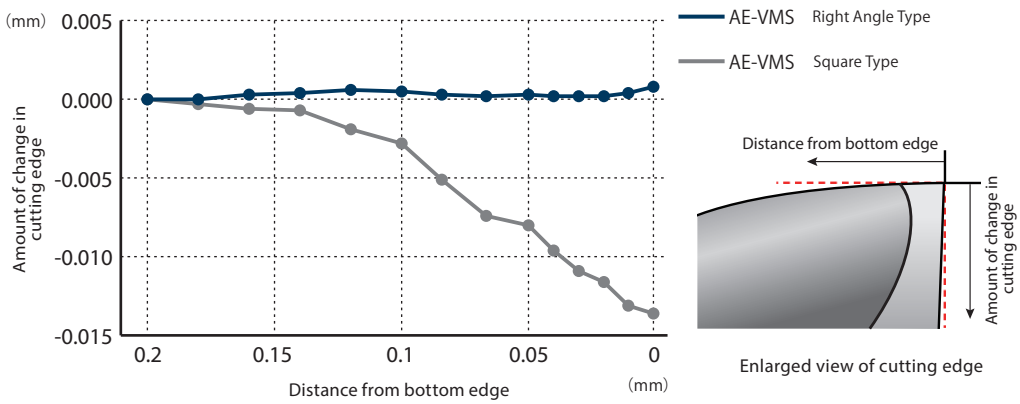
Straight corner with no uncut residue

Ability to mill straight corners while maintaining cutting edge rigidity

AE-VMS Right Angle Type	AE-VMS Square Type
	

Although the right angle type end mill includes a gash land, it is able to mill straight corners due to its unique geometry that maintains a consistent cutting diameter.

Measured value of change in cutting edge of Ø6 end mill

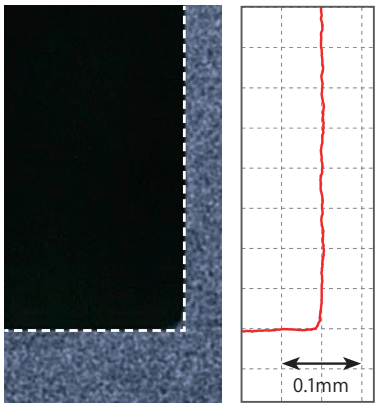


* The values measured are internal data. The amount of change in the cutting edge may vary depending on the individual product.

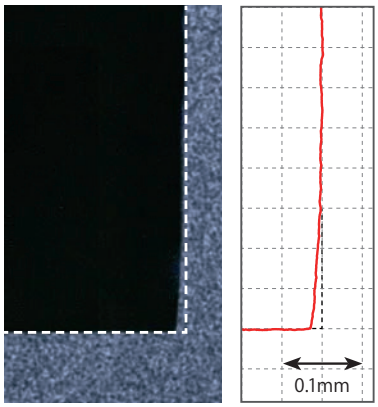
High milling quality
Straight corner

The milling of straight corners with no uncut residue is made possible by a unique cutting edge

Tool	AE-VMS Ø 3 - Right Angle
Work Material	S50C
Milling Method	Side Milling
Cutting Speed	Vc=91m/min (9.660min-1)
Feed	Vf=1.160mm/min (0,03mm/t)
Depth of Cut	ap=4,5mm(1,5D) ae=0,6mm(0,2D)
Coolant	Air Blow



AE-VMS
Right Angle Type

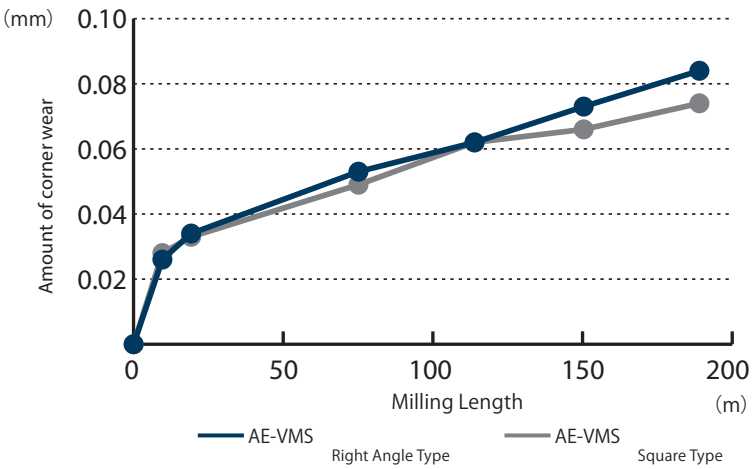


AE-VMS
Square Type

Stable Performance
Cutting edge rigidity

Normal progress of wear without chipping due to the gash land

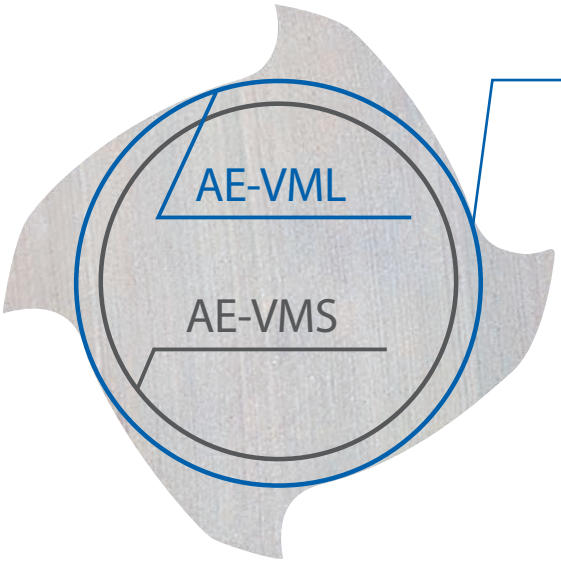
Tool	AE-VMS Ø 6 - Right Angle
Work Material	S50C
Milling Method	Side Milling
Cutting Speed	Vc=130 m/min (6.900min-1)
Feed	Vf=1.380mm/min (0,05mm/t)
Depth of Cut	ap=9mm(1,5D) ae=1,2mm(0,2D)
Coolant	Air Blow



KEY FEATURES: AE-VML

1. Duarise coating
2. Microrelief geometry
3. For high-speed side milling
4. Long flutes
5. Solid carbide

AE-VML: ULTIMATE SIDE MILLING EFFICIENCY



High Rigidity

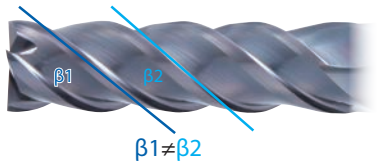
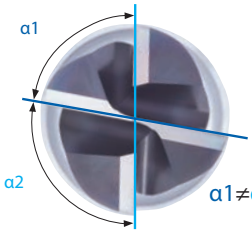
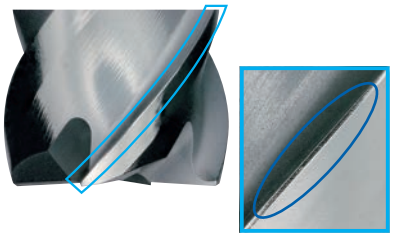
High-speed side milling is made possible by the large thick core design. The web taper geometry, where the thickness of core changes from the cutting edge to the shank, greatly improves tool rigidity, thereby prevents the machining surface from tilting

High Helix

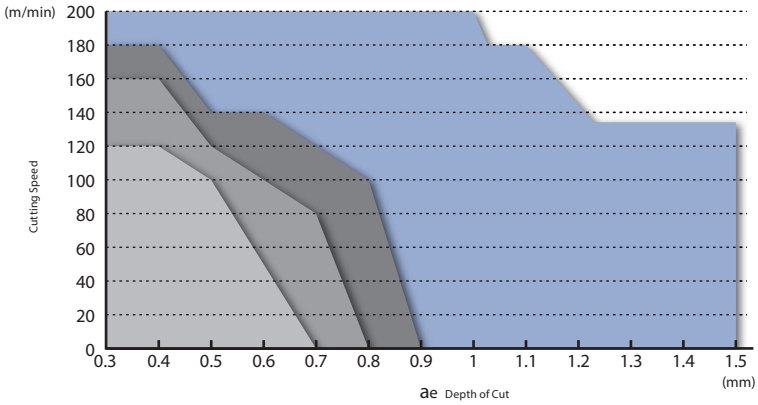
Reduces cutting force to enable stable milling

Suppression of vibration

The combination of variable lead, unequal spacing teeth and microrelief geometry contributes to stable and high efficiency milling performance.

Variable Leads	Unequal Spacing Teeth	Microrelief
		

Chattering is greatly suppressed even during high-speed, high-depth milling, resulting in unrivaled high efficiency performance.



AE-VML Ø10×40

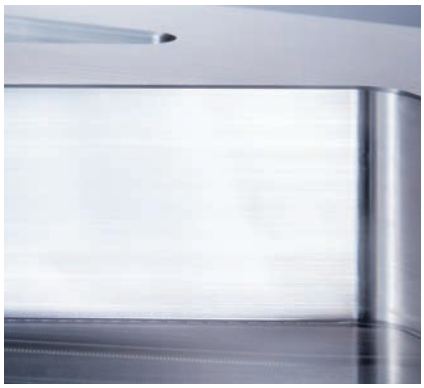
A Competitor

B Competitor

C Competitor

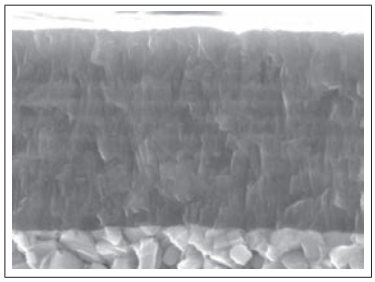
S50C
Work Material

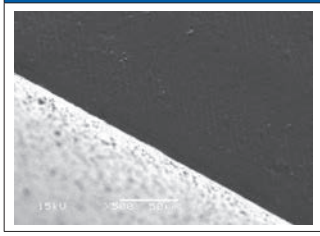
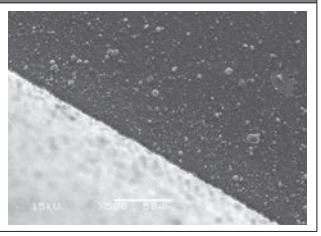
(ap) 40mm
Depth of Cut



DUARISE Coating

Provides excellent lubricity, superior friction-resistance and high oxidation temperature. Multi-layer construction minimizes the thermal cracks that often occurred while using watersoluble oil.



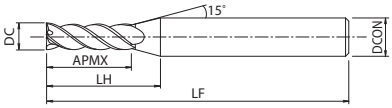
AE-VMS	Conventional
	

Smoothing surface coating treatment made an excellent quality of surface finishing.

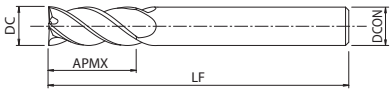
AE-VMS

Milling | Solid carbide

Type 1



Type 2



- First choice in quality and performance
- Carbide end mill with Duarise coating
- Wide variety in applications and work materials
- 4 flutes, variable helix and unequal spacing

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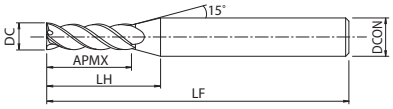
EDP	ZEFP	DC	R	LF	APMX	DCON	Type	Price
8555830	4	3	-	60	8	6	1	
8556050	4	3	0,2	60	8	6	1	
8556060	4	3	0,5	60	8	6	1	
8555840	4	4	-	60	11	6	1	
8556070	4	4	0,2	60	11	6	1	
8556080	4	4	0,5	60	11	6	1	
8556090	4	4	1	60	11	6	1	
8555850	4	5	-	60	13	6	1	
8556100	4	5	0,2	60	13	6	1	
8556110	4	5	0,5	60	13	6	1	
8556120	4	5	1	60	13	6	1	
8555860	4	6	-	60	13	6	2	
8556130	4	6	0,3	60	13	6	2	
8556140	4	6	0,5	60	13	6	2	
8556150	4	6	1	60	13	6	2	
8555880	4	8	-	70	19	8	2	
8556160	4	8	0,3	70	19	8	2	
8556170	4	8	0,5	70	19	8	2	
8556180	4	8	1	70	19	8	2	
8556190	4	8	1,5	70	19	8	2	
8556200	4	8	2	70	19	8	2	
8555900	4	10	-	80	22	10	2	
8556210	4	10	0,3	80	22	10	2	
8556220	4	10	0,5	80	22	10	2	
8556230	4	10	1	80	22	10	2	
8556240	4	10	1,5	80	22	10	2	
8556250	4	10	2	80	22	10	2	
8556260	4	10	3	80	22	10	2	
8555920	4	12	-	90	26	12	2	
8556270	4	12	0,5	90	26	12	2	
8556280	4	12	1	90	26	12	2	
8556290	4	12	1,5	90	26	12	2	
8556300	4	12	2	90	26	12	2	
8556310	4	12	3	90	26	12	2	

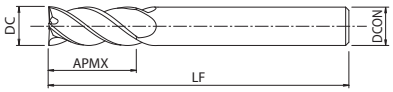
AE-VMS

Milling | Solid carbide

Type 1



Type 2



- First choice in quality and performance
- Carbide end mill with Duarise coating
- Wide variety in applications and work materials
- 4 flutes, variable helix and unequal spacing

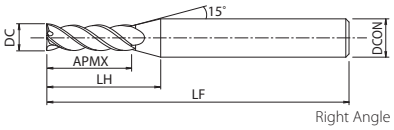
page 19

EDP	ZEFP	DC	R	LF	APMX	DCON	Type	Price
8555960	4	16	-	100	32	16	2	
8557300	4	16	0,5	100	32	16	2	
8557301	4	16	1	100	32	16	2	
8557302	4	16	2	100	32	16	2	
8557303	4	16	2,5	100	32	16	2	
8557304	4	16	3	100	32	16	2	
8557305	4	16	4	100	32	16	2	
8556000	4	20	-	110	40	20	2	
8557310	4	20	0,5	110	40	20	2	
8557311	4	20	1	110	40	20	2	
8557312	4	20	2	110	40	20	2	
8557313	4	20	2,5	110	40	20	2	
8557314	4	20	3	110	40	20	2	
8557315	4	20	4	110	40	20	2	
8557316	4	20	5	110	40	20	2	
8556010	4	25	-	120	50	25	2	
8557321	4	25	1	120	50	25	2	
8557322	4	25	2	120	50	25	2	
8557324	4	25	3	120	50	25	2	
8557325	4	25	4	120	50	25	2	
8557326	4	25	5	120	50	25	2	

AE-VMS RA NEW

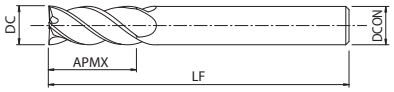
Milling | Solid carbide

Type 1



Right Angle

Type 2



Right Angle

- First choice in quality and performance
- Carbide end mill with Duarise coating
- Wide variety in applications and work materials
- 4 flutes, variable helix and unequal spacing
- With right angle for milling straight corners

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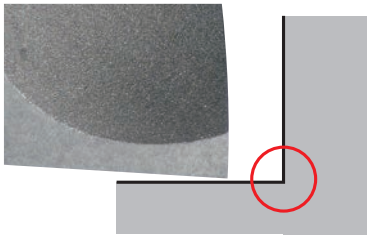
EDP	ZEFP	DC	LF	APMX	LH	DCON	Type	Price
8555730	4	3 -RA	60	8	15,9	6	1	
8555740	4	4 -RA	60	11	17,1	6	1	
8555750	4	5 -RA	60	13	17,2	6	1	
8555760	4	6 -RA	60	13	-	6	2	

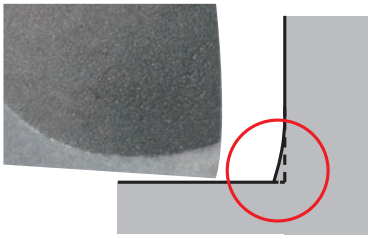
Right angle type for milling straight corners

Right Angle Type
AE-VMSS,VMS(-RA)



Straight corners with no uncut residue

Square Type
AE-VMSS,VMS



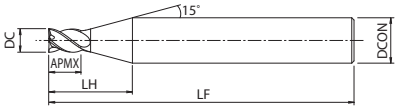
Choose the right angle type for milling straight corners!

Choose the square type for high processing efficiency!

AE-VMSS

Milling | Solid carbide

Type 1



Type 2

- First choice in quality and performance
- Carbide end mill with Duarise coating
- Wide variety in applications and work materials
- 4 flutes, variable helix and unequal spacing
- Anti-vibration stub carbide end-mill, square type, stub length

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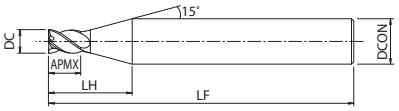
EDP	ZEFP	DC	LF	APMX	LH	DCON	Type	Price
8556410	4	1	40	1,5	7,9	4	1	
8556411	4	1,1	40	1,7	8	4	1	
8556412	4	1,2	40	1,8	7,9	4	1	
8556413	4	1,3	40	2	7,9	4	1	
8556414	4	1,4	40	2,1	8	4	1	
8556415	4	1,5	40	2,3	7,8	4	1	
8556416	4	1,6	40	2,4	7,9	4	1	
8556417	4	1,7	40	2,6	7,7	4	1	
8556418	4	1,8	40	2,7	7,6	4	1	
8556419	4	1,9	40	2,9	7,7	4	1	
8556420	4	2	40	3	8,2	4	1	
8556421	4	2,1	40	3,2	8,2	4	1	
8556422	4	2,2	40	3,3	8,1	4	1	
8556423	4	2,3	40	3,5	8,1	4	1	
8556424	4	2,4	40	3,6	8	4	1	
8556425	4	2,5	40	3,8	8	4	1	
8556426	4	2,6	40	3,9	8,5	4	1	
8556427	4	2,7	40	4,1	8,5	4	1	
8556428	4	2,8	40	4,2	8,4	4	1	
8556429	4	2,9	40	4,4	8,4	4	1	
8556430	4	3	45	4,5	12,2	6	1	
8556431	4	3,1	45	4,7	12,2	6	1	
8556432	4	3,2	45	4,8	12,2	6	1	
8556433	4	3,3	45	5	12,2	6	1	
8556434	4	3,4	45	5,1	12,1	6	1	
8556435	4	3,5	45	5,3	12,1	6	1	
8556436	4	3,6	45	5,4	12	6	1	
8556437	4	3,7	45	5,6	12	6	1	
8556438	4	3,8	45	5,7	11,9	6	1	
8556439	4	3,9	45	5,9	11,9	6	1	
8556440	4	4	45	6	11,9	6	1	
8556441	4	4,1	45	6,2	12,1	6	1	
8556442	4	4,2	45	6,3	12	6	1	
8556443	4	4,3	45	6,5	12	6	1	
8556444	4	4,4	45	6,6	11,9	6	1	
8556445	4	4,5	45	6,8	11,9	6	1	
8556446	4	4,6	45	6,9	11,8	6	1	
8556447	4	4,7	45	7,1	11,9	6	1	
8556448	4	4,8	45	7,2	11,8	6	1	
8556449	4	4,9	45	7,4	11,8	6	1	
8556450	4	5	45	7,5	11,7	6	1	
8556451	4	5,1	45	7,7	11,7	6	1	
8556452	4	5,2	45	7,8	11,6	6	1	
8556453	4	5,3	45	8	11,6	6	1	
8556454	4	5,4	45	8,1	11,5	6	1	

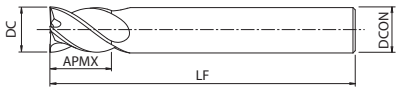
AE-VMSS

Milling | Solid carbide

Type 1



Type 2



- First choice in quality and performance
- Carbide end mill with Duarise coating
- Wide variety in applications and work materials
- 4 flutes, variable helix and unequal spacing
- Anti-vibration stub carbide end-mill, square type, stub length

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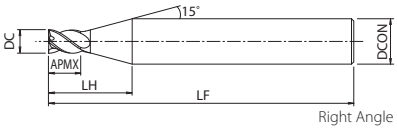
EDP	ZEFP	DC	LF	APMX	LH	DCON	Type	Price
8556455	4	5,5	45	8,3	11,6	6	1	
8556456	4	5,6	45	8,4	11,5	6	1	
8556457	4	5,7	45	8,6	11,5	6	1	
8556458	4	5,8	45	8,7	11,4	6	1	
8556459	4	5,9	45	8,9	11,4	6	1	
8556460	4	6	45	9	-	6	2	
8556465	4	6,5	60	9,8	14,9	8	1	
8556470	4	7	60	10,5	14,7	8	1	
8556475	4	7,5	60	11,3	14,6	8	1	
8556480	4	8	60	12	-	8	2	
8556485	4	8,5	70	12,8	17,9	10	1	
8556490	4	9	70	13,5	17,7	10	1	
8556495	4	9,5	70	14,3	17,6	10	1	
8556500	4	10	70	15	-	10	2	
8556505	4	10,5	75	15,8	20,9	12	1	
8556510	4	11	75	16,5	20,7	12	1	
8556515	4	11,5	75	17,3	20,6	12	1	
8556520	4	12	75	18	-	12	2	

AE-VMSS RA NEW

Milling | Solid carbide

Type 1



Right Angle

Type 2

Right Angle

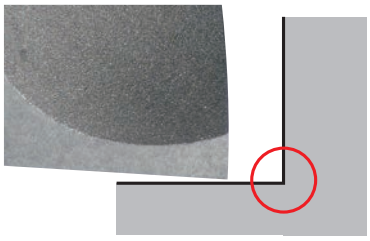
- First choice in quality and performance
- Carbide end mill with Duarise coating
- Wide variety in applications and work materials
- 4 flutes, variable helix and unequal spacing
- Anti-vibration stub carbide end-mill, stub length
- With right angle for milling straight corners

page 21

EDP	ZEFP	DC	LF	APMX	LH	DCON	Type	Price
8556550	4	1 - RA	40	1.5	7.9	4	1	
8556555	4	1,5 - RA	40	2.3	7.8	4	1	
8556560	4	2 - RA	40	3	8.2	4	1	
8556565	4	2,5 - RA	40	3.8	8	4	1	
8556570	4	3 - RA	45	4.5	12.2	6	1	
8556575	4	3,5 - RA	45	5.3	12.1	6	1	
8556580	4	4 - RA	45	6	11.9	6	1	
8556585	4	4,5 - RA	45	6.8	11.9	6	1	
8556590	4	5 - RA	45	7.5	11.7	6	1	
8556595	4	5,5 - RA	45	8.3	11.6	6	1	
8556600	4	6 - RA	45	9	–	6	2	

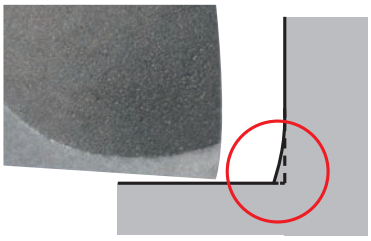
Right angle type for milling straight corners

Right Angle Type
AE-VMSS,VMS(-RA)



Straight corners with no uncut residue

Square Type
AE-VMSS,VMS

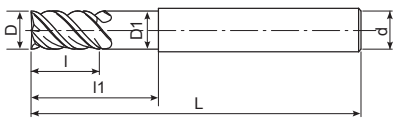


Choose the right angle type for milling straight corners!

Choose the square type for high processing efficiency!

AE-VMSS

Milling | Solid carbide



- First choice in quality and performance
- Carbide end mill with Duarise coating
- Wide variety in applications and work materials
- 4 flutes, variable helix and unequal spacing
- Long neck type

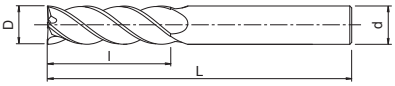
page 21

EDP	Z	D	l1	L	l	D1	d	Price
8556618	4	6	18	60	9	5,8	6	
8556630	4	6	30	70	9	5,8	6	
8556724	4	8	24	70	12	7,7	8	
8556740	4	8	40	80	12	7,7	8	
8556830	4	10	30	80	15	9,7	10	
8556850	4	10	50	100	15	9,7	10	
8556936	4	12	36	90	18	11,7	12	
8556960	4	12	60	110	18	11,7	12	

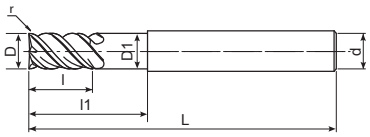
AE-VML NEW SIZES

Milling | Solid carbide

Type 1



Type 2



- First choice in quality and performance
- 4 flutes, square type, also with radius
- Anti-vibration long carbide end mill
- For side milling, length of cut up to 4xD

P ~45 HRC | P ~55 HRC | M ~35 HRC | K ~350 HB | N | S | H ~60 HRC

A | CARBIDE | DUARISE | 42° ~44° | 0~-0.02 | SHRINK FIT

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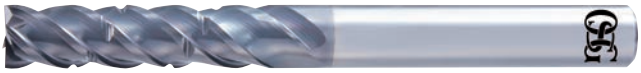
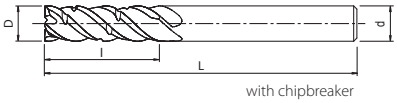
EDP	Z	D	R	L	l	l1	D1	d	LxD	Type	Price
8556320	4	6	-	70	19	-	-	6	3xD	1	
8556336	4	6	0,3	70	19	-	-	6	3xD	1	
8556337	4	6	0,5	70	19	-	-	6	3xD	1	
8556338	4	6	1	70	19	-	-	6	3xD	1	
8556322	4	8	-	80	25	-	-	8	3xD	1	
8556339	4	8	0,3	80	25	-	-	8	3xD	1	
8556340	4	8	0,5	80	25	-	-	8	3xD	1	
8556341	4	8	1	80	25	-	-	8	3xD	1	
8556342	4	8	1,5	80	25	-	-	8	3xD	1	
8556343	4	8	2	80	25	-	-	8	3xD	1	
8556324	4	10	-	90	31	-	-	10	3xD	1	
8556344	4	10	0,3	90	31	-	-	10	3xD	1	
8556345	4	10	0,5	90	31	-	-	10	3xD	1	
8556346	4	10	1	90	31	-	-	10	3xD	1	
8556347	4	10	1,5	90	31	-	-	10	3xD	1	
8556348	4	10	2	90	31	-	-	10	3xD	1	
8556349	4	10	3	90	31	-	-	10	3xD	1	
8556326	4	12	-	100	38	-	-	12	3xD	1	
8556350	4	12	0,5	100	38	-	-	12	3xD	1	
8556351	4	12	1	100	38	-	-	12	3xD	1	
8556352	4	12	1,5	100	38	-	-	12	3xD	1	
8556353	4	12	2	100	38	-	-	12	3xD	1	
8556354	4	12	3	100	38	-	-	12	3xD	1	
NEW 8556374	5	16	-	125	50	-	-	16	3xD	1	
NEW 8556376	5	20	-	135	62	-	-	20	3xD	1	
8556328	4	6	-	70	24	-	-	6	4xD	1	
8556355	4	6	0,3	70	24	-	-	6	4xD	1	
8556356	4	6	0,5	70	24	-	-	6	4xD	1	
8556357	4	6	1	70	24	-	-	6	4xD	1	
8556330	4	8	-	90	32	-	-	8	4xD	1	
8556358	4	8	0,3	90	32	-	-	8	4xD	1	
8556359	4	8	0,5	90	32	-	-	8	4xD	1	
8556360	4	8	1	90	32	-	-	8	4xD	1	
8556361	4	8	1,5	90	32	-	-	8	4xD	1	
8556362	4	8	2	90	32	-	-	8	4xD	1	
8556332	4	10	-	100	40	-	-	10	4xD	1	
8556363	4	10	0,3	100	40	-	-	10	4xD	1	
8556364	4	10	0,5	100	40	-	-	10	4xD	1	
8556365	4	10	1	100	40	-	-	10	4xD	1	
8556366	4	10	1,5	100	40	-	-	10	4xD	1	
8556367	4	10	2	100	40	-	-	10	4xD	1	
8556368	4	10	3	100	40	-	-	10	4xD	1	
8556334	4	12	-	110	48	-	-	12	4xD	1	
8556369	4	12	0,5	110	48	-	-	12	4xD	1	
8556370	4	12	1	110	48	-	-	12	4xD	1	
8556371	4	12	1,5	110	48	-	-	12	4xD	1	
8556372	4	12	2	110	48	-	-	12	4xD	1	
8556373	4	12	3	110	48	-	-	12	4xD	1	
NEW 8556378	5	16	-	140	64	-	-	16	4xD	1	
NEW 8556380	5	20	-	155	80	-	-	20	4xD	1	
48330162	4	16	1	150	64	100	15,5	16	4xD	2	
48330202	4	20	1	150	80	100	19,4	20	4xD	2	

AE-VML NEW SIZES

Milling | Solid carbide





with chipbreaker

- First choice in quality and performance
- 4 flutes, square type, also with radius
- Anti-vibration long carbide end mill
- For side milling, length of cut up to 4xD
- Chipbreaker

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EDP	Z	D	R	l1	L	l	D1	d	Price
8556321	4	6	-	-	70	19	-	6	
8556329	4	6	-	-	70	24	-	6	
8556323	4	8	-	-	80	25	-	8	
8556331	4	8	-	-	90	32	-	8	
8556325	4	10	-	-	90	31	-	10	
8556333	4	10	-	-	100	40	-	10	
8556327	4	12	-	-	100	38	-	12	
8556335	4	12	-	-	110	48	-	12	
NEW 8556375	5	16	-	-	125	50	-	16	
NEW 8556379	5	16	-	-	140	64	-	16	
NEW 8556377	5	20	-	-	135	62	-	20	
NEW 8556381	5	20	-	-	155	80	-	20	

CUTTING CONDITIONS

AE-VMS

Square Type / Right Angle Type *

Slot Milling

* For right angle type, please use 70% of the speed and feed shown in the table below as reference.

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	100 (80-120) (m/min)		90 (70-110) (m/min)		80 (60-100) (m/min)		70 (50-80) (m/min)		70 (60-80) (m/min)		60 (50-70) (m/min)		25 (20-30) (m/min)	
Ø	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)
3	10.600	930	9.600	690	8.500	510	7.400	470	8.540	430	7.430	410	3.180	160
4	8.000	960	7.200	720	6.400	510	5.600	490	6.410	460	5.570	440	2.390	170
5	6.400	1.020	5.700	800	5.100	610	4.500	560	5.120	490	4.460	470	1.910	180
6	5.300	1.060	4.800	900	4.200	670	3.700	370	4.270	480	3.710	460	1.590	180
8	4.000	910	3.600	720	3.200	640	2.800	370	2.750	450	2.390	430	1.190	200
10	3.200	840	2.900	700	2.500	550	2.200	350	2.200	420	1.910	400	950	180
12	2.700	810	2.400	670	2.100	550	1.900	330	1.830	420	1.590	400	800	180
16	2.000	600	1.800	500	1.600	420	1.200	310	1.140	260	990	250	500	110
20	1.600	480	1.400	390	1.300	340	900	250	920	270	800	260	400	120
25	1.300	390	1.100	310	1.000	260	600	170	730	250	640	240	250	90
Depth of cut			ap: 1D				Dc: Dc≤6 → ap: 0,5D; 6<Dc → ap: 1D				ap: 0,25D			

Side Milling

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	130 (100-150) (m/min)		120 (100-150) (m/min)		100 (80-120) (m/min)		80 (60-100) (m/min)		80 (70-90) (m/min)		70 (60-80) (m/min)		30 (25-40) (m/min)	
Ø	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)
3	13.800	1.660	12.700	1.070	10.600	760	8.000	480	9.760	510	8.490	480	4.240	220
4	10.400	1.830	9.600	1.150	8.000	800	6.000	530	7.320	550	6.370	530	3.180	240
5	8.300	1.990	7.600	1.220	6.400	900	4.800	560	5.860	560	5.090	540	2.550	250
6	6.900	2.070	6.400	1.540	5.300	1.060	4.200	640	4.880	580	4.240	550	2.120	250
8	5.200	1.770	4.800	1.540	4.000	1.040	3.200	610	3.200	450	2.790	430	1.590	230
10	4.100	1.640	3.800	1.370	3.200	900	2.500	580	2.560	430	2.230	410	1.270	220
12	3.500	1.400	3.200	1.280	2.700	760	2.100	530	2.140	420	1.860	400	1.060	210
16	2.600	1.250	2.400	1.060	2.000	640	1.400	450	1.370	410	1.190	400	700	210
20	2.100	1.010	1.900	840	1.600	510	1.100	370	1.100	390	950	380	560	200
25	1.700	820	1.500	660	1.300	420	900	310	880	510	760	490	320	190
Depth of cut							ap: 1,5D; ae: 0,2D							

1. The above milling condition is a guideline for the overhang length is 3×D.
2. Use a rigid and precise machine and holder.
3. The rotational speed is calculated by the median of the recommended cutting speed. Adjustment may be necessary depending on the rigidity of the workpiece fixture and machine.
4. Please use a suitable fluid with high smoke retardant properties.
5. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
6. Please use water-soluble oil when machining stainless steel.
7. Reduce speed and feed as well as depth of cut when high precision is required.
8. Adjust the speed and feed accordingly when the overhang length is longer than specified.

CUTTING CONDITIONS

Milling | Endmills | Cutting conditions

AE-VMS

Radius Type

Slot Milling

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	100 (80-120) (m/min)		90 (70-110) (m/min)		80 (60-100) (m/min)		70 (50-80) (m/min)		70 (60-80) (m/min)		60 (50-70) (m/min)		25 (20-30) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
3	10.600	790	9.600	590	8.500	410	7.400	380	8.540	430	7.430	410	3.180	160
4	8.000	820	7.200	610	6.400	410	5.600	390	6.410	460	5.570	440	2.390	170
5	6.400	870	5.700	680	5.100	490	4.500	450	5.120	490	4.460	470	1.910	180
6	5.300	1.010	4.800	860	4.200	600	3.700	330	4.270	480	3.710	460	1.590	180
8	4.000	870	3.600	680	3.200	580	2.800	330	2.750	450	2.390	430	1.190	200
10	3.200	800	2.900	660	2.500	500	2.200	320	2.200	420	1.910	400	950	180
12	2.700	770	2.400	640	2.100	490	1.900	300	1.830	420	1.590	400	800	180
16	2.000	570	1.800	480	1.600	370	1.200	290	1.140	260	990	250	500	110
20	1.600	460	1.400	370	1.300	300	900	230	920	270	800	260	400	120
25	1.300	370	1.100	290	1.000	230	600	150	730	250	640	240	250	90
Depth of cut	ap: 1D						Dc: Dc≤6 → ap: 0,5D; 6<Dc → ap: 1D				ap: 0,25D			

Side Milling

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	130 (100-150) (m/min)		120 (100-150) (m/min)		100 (80-120) (m/min)		80 (60-100) (m/min)		80 (70-90) (m/min)		70 (60-80) (m/min)		30 (25-40) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
3	13.800	1.660	12.700	1.070	10.600	760	8.000	480	9.760	510	8.490	480	4.240	220
4	10.400	1.830	9.600	1.150	8.000	800	6.000	530	7.320	550	6.370	530	3.180	240
5	8.300	1.990	7.600	1.220	6.400	900	4.800	560	5.860	560	5.090	540	2.550	250
6	6.900	2.070	6.400	1.540	5.300	1.060	4.200	640	4.880	580	4.240	550	2.120	250
8	5.200	1.770	4.800	1.540	4.000	1.040	3.200	610	3.200	450	2.790	430	1.590	230
10	4.100	1.640	3.800	1.370	3.200	900	2.500	580	2.560	430	2.230	410	1.270	220
12	3.500	1.400	3.200	1.280	2.700	760	2.100	530	2.140	420	1.860	400	1.060	210
16	2.600	1.250	2.400	1.060	2.000	640	1.400	450	1.370	410	1.190	400	700	210
20	2.100	1.010	1.900	840	1.600	510	1.100	370	1.100	390	950	380	560	200
25	1.700	820	1.500	660	1.300	420	900	310	880	510	760	490	320	190
Depth of cut	ap: 1,5D; ae: 0,2D													

1. The above milling condition is a guideline for the overhang length is 3×D.
2. Use a rigid and precise machine and holder.
3. The rotational speed is calculated by the median of the recommended cutting speed. Adjustment may be necessary depending on the rigidity of the workpiece fixture and machine.
4. Please use a suitable fluid with high smoke retardant properties.
5. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
6. Please use water-soluble oil when machining stainless steel.
7. Reduce speed and feed as well as depth of cut when high precision is required.
8. Adjust the speed and feed accordingly when the overhang length is longer than specified.

Fix rate cutting condition

DC≥Ø6

	Work Material	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Ø	L/D	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
Side Milling	4	80%		70%		70%		60%		60%		50%		50%	
	5	70%		60%		60%		50%		50%		50%		50%	
Slotting	4	90%		90%		80%		70%		70%		60%		60%	
	5	80%		80%		70%		70%		70%		60%		60%	

CUTTING CONDITIONS

AE-VMSS

Square Type / Right Angle Type*

Slot milling

* For right angle type, please use 70% of the speed and feed shown in the table below as reference.

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	100 (80-120) (m/min)		90 (70-110) (m/min)		80 (60-100) (m/min)		70 (50-80) (m/min)		70 (60-80) (m/min)		60 (50-70) (m/min)		25 (20-30) (m/min)	
Ø	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)
1	28.700	570	25.500	460	22.300	360	19.100	340	25.620	320	22.280	300	9.550	120
1,5	19.100	610	17.000	480	14.900	420	12.700	360	16.980	360	14.850	340	6.370	130
2	14.300	630	12.700	510	11.100	440	9.600	380	12.810	360	11.140	350	4.770	140
2,5	11.500	780	10.200	570	8.900	460	7.600	430	10.190	410	8.910	390	3.820	150
3	10.600	930	9.600	690	8.500	510	7.400	470	8.540	430	7.430	410	3.180	160
4	8.000	960	7.200	720	6.400	510	5.600	490	6.410	460	5.570	440	2.390	170
5	6.400	1.020	5.700	800	5.100	610	4.500	560	5.120	490	4.460	470	1.910	180
6	5.300	1.060	4.800	900	4.200	670	3.700	370	4.270	480	3.710	460	1.590	180
8	4.000	910	3.600	720	3.200	640	2.800	370	2.750	450	2.390	430	1.190	200
10	3.200	840	2.900	700	2.500	550	2.200	350	2.200	420	1.910	400	950	180
12	2.700	810	2.400	670	2.100	550	1.900	330	1.830	420	1.590	400	800	180
Depth of cut	ap: 1D						Dc: Dc≤6 → ap: 0,5D; Dc>6 → ap: 1D				ap: 0,25D			

Side milling

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	130 (100-150) (m/min)		120 (100-150) (m/min)		100 (80-120) (m/min)		80 (60-100) (m/min)		80 (70-90) (m/min)		70 (60-80) (m/min)		30 (25-40) (m/min)	
Ø	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)	S (min⁻¹)	F (mm/min)
1	38.200	840	28.700	690	25.500	510	22.300	450	29.280	370	25.460	350	12.730	160
1,5	25.500	920	21.200	760	17.000	540	14.900	460	19.520	410	16.980	400	8.490	180
2	19.900	1.430	17.500	840	14.300	630	11.100	470	14.640	440	12.730	420	6.370	190
2,5	15.900	1.590	14.000	900	11.500	690	8.900	480	11.710	480	10.190	460	5.039	210
3	13.800	1.660	12.700	1.070	10.600	760	8.000	480	9.760	510	8.490	480	4.240	220
4	10.400	1.830	9.600	1.150	8.000	800	6.000	530	7.320	550	6.370	530	3.180	240
5	8.300	1.990	7.600	1.220	6.400	900	4.800	560	5.860	560	5.090	540	2.550	250
6	6.900	2.070	6.400	1.540	5.300	1.060	4.200	640	4.880	580	4.240	550	2.120	250
8	5.200	1.770	4.800	1.540	4.000	1.040	3.200	610	3.200	450	2.790	430	1.590	230
10	4.100	1.640	3.800	1.370	3.200	900	2.500	580	2.560	430	2.230	410	1.270	220
12	3.500	1.400	3.200	1.280	2.700	760	2.100	530	2.140	420	1.860	400	1.060	210
Depth of cut	ap: 1,5D; ae: 0,2D													

1. The above milling condition is a guideline for the overhang length is 3×D.
2. Use a rigid and precise machine and holder.
3. The rotational speed is calculated by the median of the recommended cutting speed. Adjustment may be necessary depending on the rigidity of the workpiece fixture and machine.
4. Please use a suitable fluid with high smoke retardant properties.
5. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
6. Please use water-soluble oil when machining stainless steel.
7. Reduce speed and feed as well as depth of cut when high precision is required.
8. Adjust the speed and feed accordingly when the overhang length is longer than specified.

CUTTING CONDITIONS

Milling | Endmills | Cutting conditions

AE-VMSS

Long Neck Type

Side milling

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	105 (80-120) (m/min)		95 (70-110) (m/min)		70 (50-90) (m/min)		60 (40-80) (m/min)		60 (50-70) (m/min)		50 (40-60) (m/min)		30 (20-35) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
6	5.520	1.660	5.120	1.230	3.710	740	2.940	450	3.420	410	2.970	390	1.480	180
8	4.160	1.420	3.840	1.230	2.800	730	2.240	430	2.240	320	1.950	300	1.110	160
10	3.280	1.310	3.040	1.100	2.240	630	1.750	410	1.790	300	1.560	290	890	150
12	2.800	1.120	2.560	1.020	1.890	530	1.470	370	1.500	290	1.300	280	740	150
Depth of cut	ap: 1,5D; ae: 0,2D													

1. Use a rigid and precise machine and holder.
2. The rotational speed is calculated by the median of the recommended cutting speed. Adjustment may be necessary depending on the rigidity of the workpiece fixture and machine.
3. Please use a suitable fluid with high smoke retardant properties.
4. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
5. Please use water-soluble oil when machining stainless steel.
6. Reduce speed and feed as well as depth of cut when high precision is required.

Fix rate cutting condition

DC≥Ø6

	Work Material	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Ø	L/D	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
Side Milling	4	80%		70%		70%		60%		60%		50%		50%	
	5	70%		60%		60%		50%		50%		50%		50%	
Slotting	4	90%		90%		80%		70%		70%		60%		60%	
	5	80%		80%		70%		70%		70%		60%		60%	

CUTTING CONDITIONS

Milling | Endmills | Cutting conditions

AE-VML

Long Type (Applies to square / radius / chipbreaker type)

ae=0.05D • Standard side milling 3D

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	160 (140-180) (m/min)		150 (130-170) (m/min)		140 (120-160) (m/min)		125 (100-140) (m/min)		115 (90-130) (m/min)		105 (80-120) (m/min)		85 (70-90) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
6	8.500	2.480	8.000	2.180	7.400	2.010	6.600	1.660	6.100	1.530	5.600	1.400	4.500	1.080
8	6.400	1.870	6.000	1.630	5.600	1.520	5.000	1.260	4.600	1.160	4.200	1.050	3.400	820
10	5.100	1.730	4.800	1.440	4.500	1.350	4.000	1.120	3.700	1.040	3.300	920	2.700	720
12	4.200	1.430	4.000	1.200	3.700	1.110	3.300	920	3.000	840	2.800	780	2.200	590
16	3.180	1.590	2.990	1.350	2.790	1.260	2.490	1.000	2.290	920	2.090	840	1.690	630
20	2.550	1.280	2.390	1.080	2.230	1.000	1.990	800	1.830	730	1.670	670	1.350	510
Depth of cut							ap: 3D	ae: 0,05D						

1. Use a rigid and precise machine and holder.
2. The rotational speed is calculated by the median of the recommended cutting speed. Adjustment may be necessary depending on the rigidity of the workpiece fixture and machine.
3. Please use a suitable fluid with high smoke retardant properties.
4. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
5. Please use water-soluble coolant when machining stainless steel.

ae=0.1D • High efficiency side milling 3D

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V	
Cutting Speed	220 (200-240) (m/min)		170 (150-190) (m/min)		135 (110-150) (m/min)		130 (110-150) (m/min)		120 (100-140) (m/min)		110 (90-130) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
6	11.700	3.180	9.000	2.270	7.200	1.810	6.900	1.600	6.400	1.480	5.800	1.340
8	8.800	2.390	6.800	1.710	5.400	1.360	5.200	1.210	4.800	1.120	4.400	1.020
10	7.000	2.240	5.400	1.510	4.300	1.200	4.100	1.070	3.800	990	3.500	910
12	5.800	1.860	4.500	1.260	3.600	1.010	3.500	910	3.200	830	2.900	750
16	4.380	1.970	3.380	1.350	2.690	1.080	2.590	910	2.390	840	2.190	770
20	3.500	1.580	2.710	1.080	2.150	860	2.070	720	1.910	670	1.750	610
Depth of cut							ap: 3D	ae: 0,1D				

ae=0.15D • High efficiency side milling 3D

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V	
Cutting Speed	140 (120-160) (m/min)		100 (80-120) (m/min)		90 (70-110) (m/min)		85 (60-100) (m/min)		75 (50-90) (m/min)		65 (40-80) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
6	7.400	1.860	5.600	1.300	4.800	1.110	4.500	950	4.000	840	3.400	720
8	5.600	1.410	4.200	970	3.600	840	3.400	720	3.000	640	2.600	550
10	4.500	1.350	3.300	860	2.900	750	2.700	650	2.400	580	2.100	510
12	3.700	1.110	2.800	730	2.400	620	2.300	550	2.000	480	1.700	410
16	2.790	1.120	1.990	700	1.790	630	1.690	570	1.490	510	1.290	420
20	2.230	890	1.590	560	1.430	500	1.350	460	1.190	400	1.040	340
Depth of cut							ap: 3D	ae: 0,15D				

ae≤0.2D • High efficiency side milling 3D

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V	
Cutting Speed	100 (80-120) (m/min)		80 (60-100) (m/min)		70 (50-90) (m/min)		65 (40-80) (m/min)		55 (30-70) (m/min)		45 (20-60) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
6	5.300	1.230	4.200	890	3.700	780	3.500	670	2.900	560	2.400	460
8	4.000	930	3.200	680	2.800	590	2.600	500	2.200	420	1.800	350
10	3.200	900	2.500	600	2.200	530	2.100	460	1.800	390	1.400	310
12	2.700	760	2.100	500	1.900	460	1.700	370	1.500	330	1.200	260
16	1.990	800	1.590	560	1.390	490	1.290	420	1.090	350	900	270
20	1.590	640	1.270	440	1.110	390	1.040	340	880	290	720	220
Depth of cut							ap: 3D	ae: 0,20D				

CUTTING CONDITIONS

Milling | Endmills | Cutting conditions

AE-VML

Long type (Applies to square / radius / chipbreaker type)

ae=0.05D • Standard side milling 4D

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V		Ni-Based Alloy Inconel 718	
Cutting Speed	140 (120-160) (m/min)		130 (110-150) (m/min)		120 (100-140) (m/min)		115 (90-130) (m/min)		105 (80-120) (m/min)		95 (70-110) (m/min)		75 (60-80) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
6	7.400	2.010	6.900	1.740	6.400	1.610	6.100	1.420	5.600	1.300	5.000	1.160	4.000	880
8	5.600	1.520	5.200	1.310	4.800	1.210	4.600	1.070	4.200	980	3.800	880	3.000	660
10	4.500	1.440	4.100	1.230	3.800	1.140	3.700	960	3.300	860	3.000	780	2.400	590
12	3.700	1.180	3.500	1.050	3.200	960	3.100	810	2.800	730	2.500	650	2.000	500
16	2.790	1.330	2.590	1.170	2.390	1.080	2.290	860	2.090	780	1.890	710	1.490	520
20	2.230	1.060	2.070	930	1.910	860	1.830	690	1.670	630	1.510	570	1.190	420
Depth of cut	ap: 4D, ae: 0,05D													

1. Use a rigid and precise machine and holder.
2. The rotational speed is calculated by the median of the recommended cutting speed. Adjustment may be necessary depending on the rigidity of the workpiece fixture and machine.
3. Please use a suitable fluid with high smoke retardant properties.
4. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
5. Please use water-soluble coolant when machining stainless steel.

ae=0.1D • High efficiency side milling 4D

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V	
Cutting Speed	200 (180-220) (m/min)		160 (140-180) (m/min)		130 (110-150) (m/min)		125 (100-140) (m/min)		115 (90-130) (m/min)		105 (80-120) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
6	10.600	2.670	8.500	1.970	6.900	1.600	6.600	1.400	6.100	1.290	5.600	1.190
8	8.000	2.020	6.400	1.480	5.200	1.210	5.000	1.060	4.600	980	4.200	890
10	6.400	1.920	5.100	1.330	4.100	1.070	4.000	950	3.700	890	3.300	790
12	5.300	1.590	4.200	1.090	3.500	910	3.300	790	3.000	720	2.800	670
16	3.980	1.690	3.180	1.190	2.590	970	2.490	870	2.290	800	2.090	730
20	3.180	1.350	2.550	960	2.070	780	1.990	700	1.830	640	1.670	580
Depth of cut	ap: 4D, ae: 0,1D											

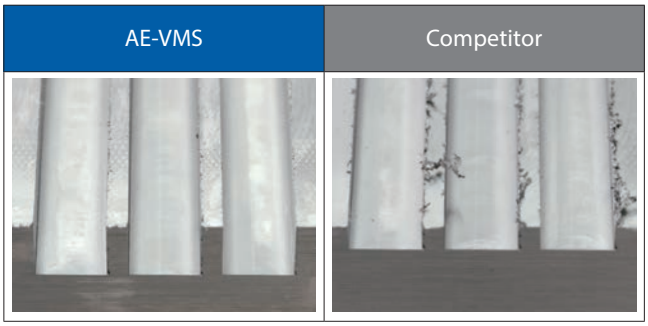
ae=0.15D • High efficiency side milling 4D

	Mild Steel • Carbon Steel • Cast Iron SS400 • S55C • FC250 ~750N/mm²		Alloy Steel • Tool Steel SCM • SKS • SKD ~30HRC		Prehardened Steel • Hardened Steel PX5 • NAK80 30~45HRC		Stainless Steel SUS304 • SUS420 ≤200HB		Precipitation Stainless Steel SUS630		Titanium Alloy Ti-6Al-4V	
Cutting Speed	135 (110-150) (m/min)		115 (100-140) (m/min)		85 (60-100) (m/min)		75 (50-90) (m/min)		65 (50-80) (m/min)		55 (40-70) (m/min)	
Ø	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)	S (min^{-1})	F (mm/min)
6	7.200	1.670	6.100	1.290	4.500	950	4.000	770	3.400	650	2.900	560
8	5.400	1.250	4.600	980	3.400	720	3.000	580	2.600	500	2.200	430
10	4.300	1.200	3.700	890	2.700	650	2.400	530	2.100	460	1.800	400
12	3.600	1.010	3.100	740	2.300	550	2.000	440	1.700	370	1.500	330
16	2.690	1.080	2.290	800	1.690	590	1.490	480	1.290	420	1.090	330
20	2.150	860	1.830	640	1.350	470	1.190	390	1.040	340	880	260
Depth of cut	ap: 4D, ae: ≤0,15D											

Suppression of Burrs

Great surface finish without vibration and minimal burrs.

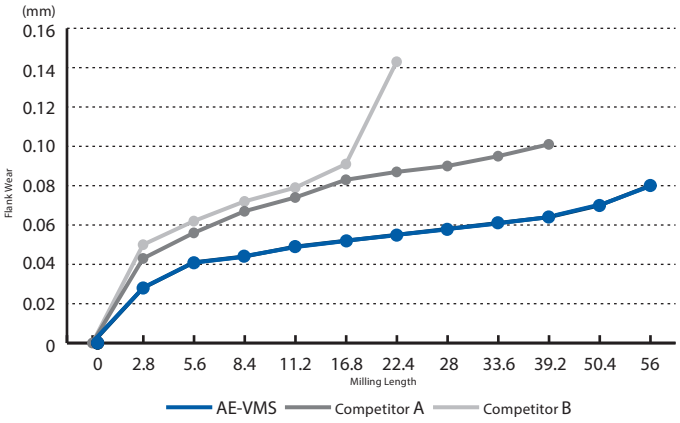
Tool	AE-VMS Ø 10	Competitor Ø 10
Work Material	SUS316	
Cutting Speed	69m/min (2.200 min^{-1})	
Feed Rate	350mm/min (0,04mm/t)	
Depth of Cut	ap = 10mm	ap=5mm
Coolant	Water Soluble	
Machine	Vertical Machining Center	
M.R.R.	35 cm^3/min	17,5 cm^3/min



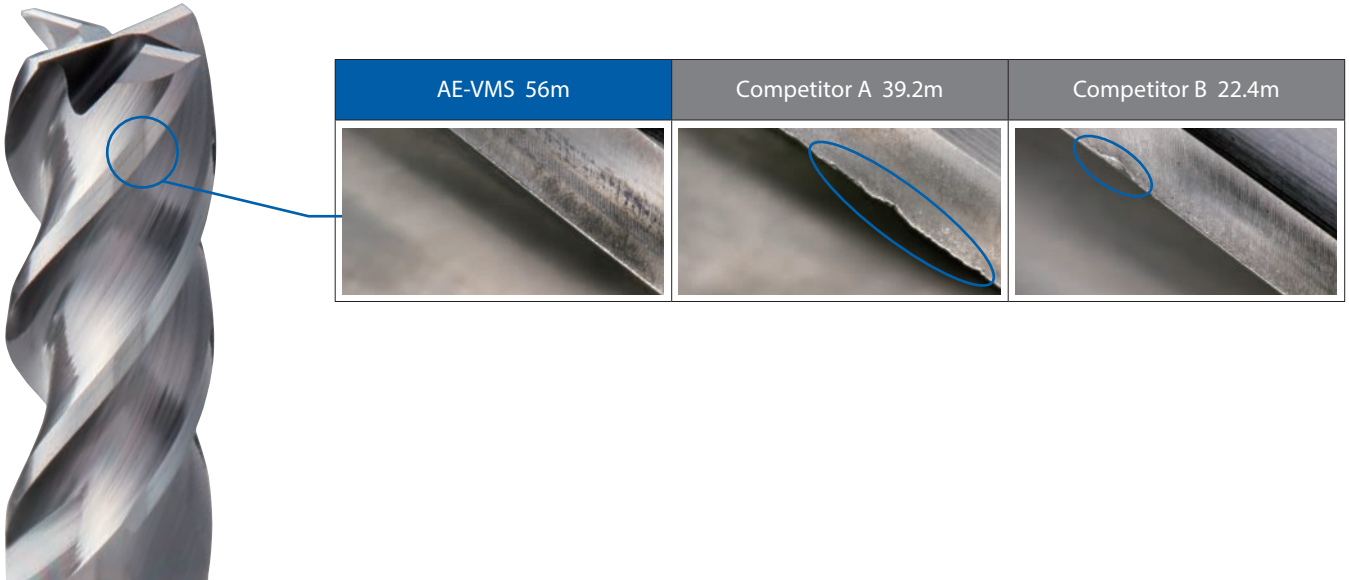
Stable Performance

Consistent tool wear with no chipping even in stainless steel slot milling.

Tool	AE-VMS Ø 10
Work Material	SUS304
Cutting Speed	70m/min (2.250 min^{-1})
Feed Rate	475mm/min (0,053mm/t)
Depth of Cut	ap = 10mm
Coolant	Water Soluble
Machine	Vertical Machining Center



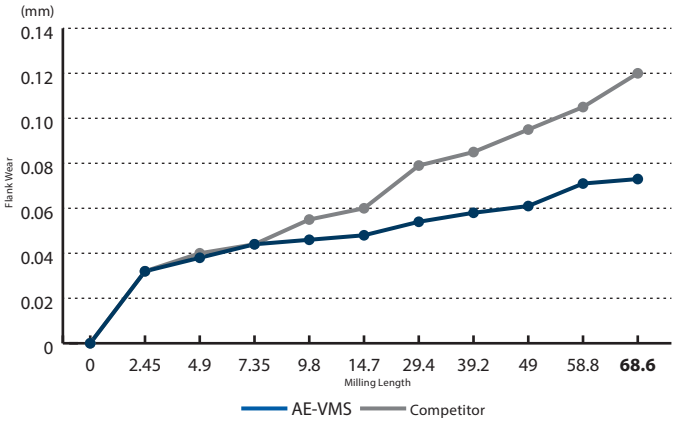
Cutting edge wear comparison



Stable performance

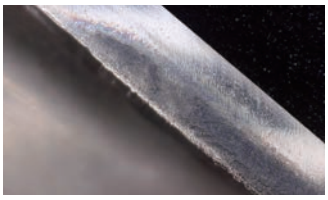
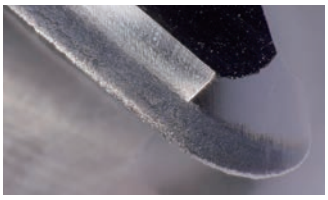
Stable performance even in slotting

Tool	AE-VMS Ø 6 X R1
Work Material	SUS304
Milling method	Slot milling
Cutting Speed	80m/min (4.200 min^{-1})
Feed Rate	830mm/min (0,049 mm/t)
Depth of Cut	ap = 3mm
Coolant	Water Soluble
Machine	Horizontal Machining Center



Wear comparison

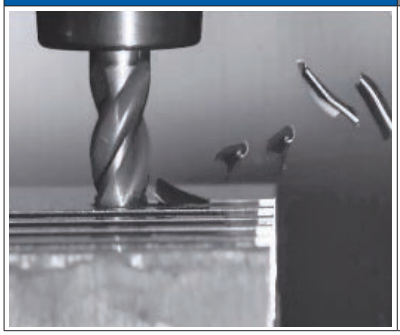
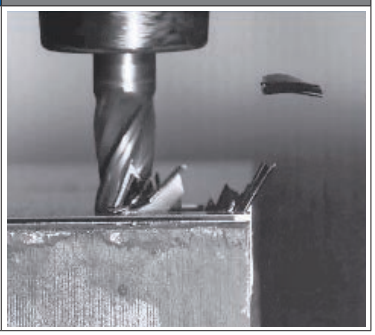
Wear comparison after milling 68,6

Peripheral cutting edge		Corner radius	
AE-VMS	Competitor	AE-VMS	Competitor
			

High efficiency

Trouble-free chip evacuation even in high-speed slotting

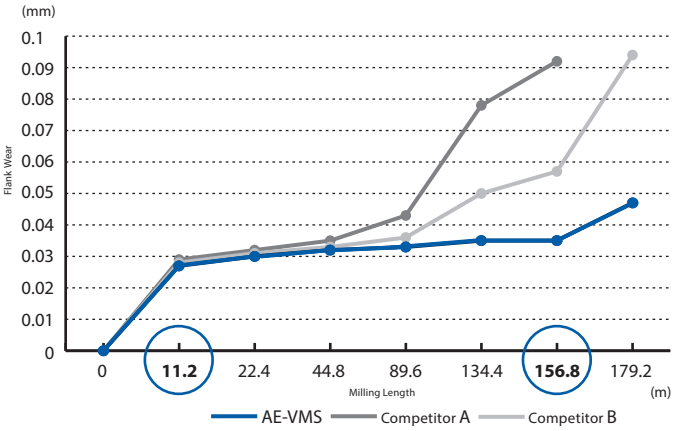
Tool	AE-VMS Ø 10 X R1
Work Material	SCM440
Milling method	Slot milling
Cutting Speed	90m/min (2.900 min^{-1})
Feed Rate	660mm/min (0,057 mm/t)
Depth of Cut	ap = 10mm
Coolant	None
Machine	Vertical Machining Center

AE-VMS	Competitor
	

Suppression of Burrs

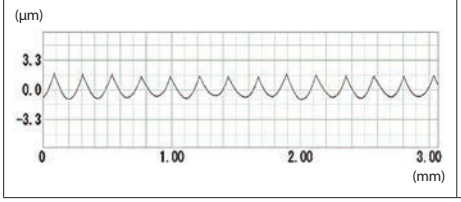
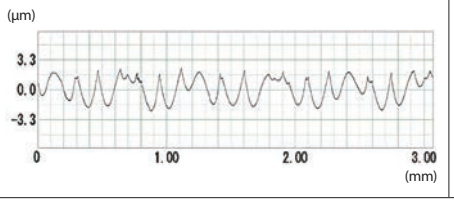
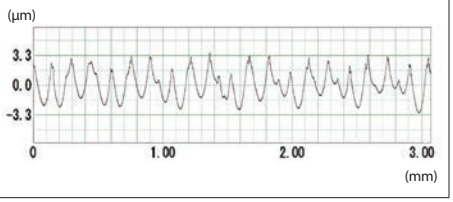
Suppression of cutting heat generation minimizes tool wear

Tool	AE-VMS Ø 6
Work Material	SCM440
Cutting Speed	140m/min (7.500 min^{-1})
Feed Rate	1.800mm/min (0,06mm/t)
Depth of Cut	ap = 9mm ae= 1,2mm
Coolant	Air Blow
Machine	Vertical Machining Center



Surface roughness comparison

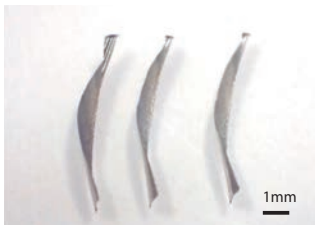
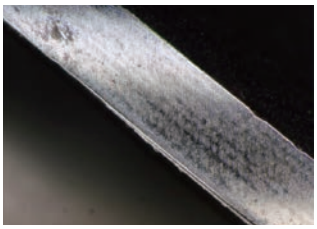
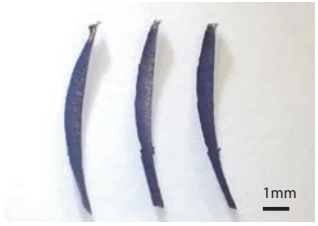
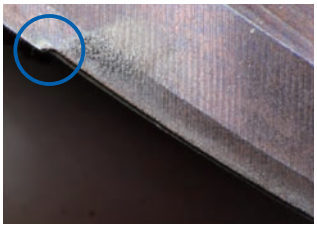
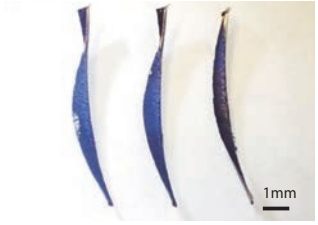
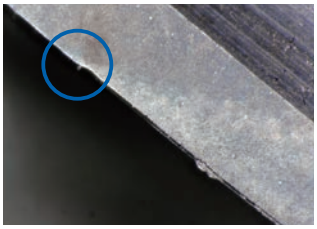
Surface roughness after milling 11,2m

AE-VMS (Ra: 0.6377µm)	Competitor A (Ra: 1.0747µm)	Competitor B (Ra: 1.2304µm)
		

Tool condition comparison

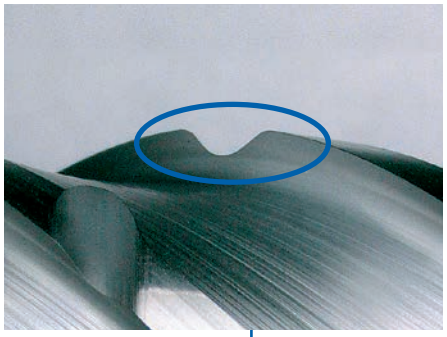
Tool condition after milling 156,8m

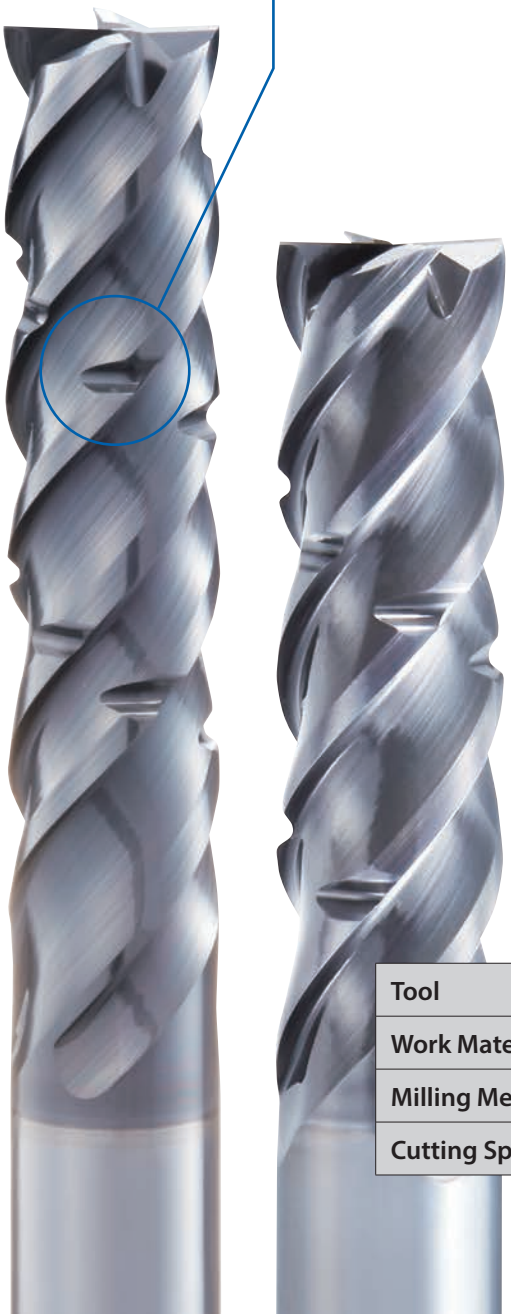
(m)

	Cutting Chips		Wear Comparison	
AE-VMS		Brown about 500°C		No Cutting Edge Recession
Competitor A		Purple about 600°C		Excessive Cutting Edge Recession
Competitor B		Blue about 700°C		Minimal Cutting Edge Recession

AE-VML: WITH CHIPBREAKER

Minimizes chipping with unique R profiles at the edge of the chipbreaker.





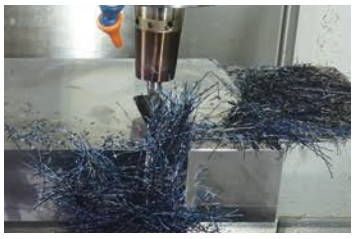
Troubled by long and stringy chip accumulation

Large chip accumulation can be problematic for long-hour and high chip removal side milling, trochoidal milling, and pocket milling with long flute length end mills.

Breaks chips into small pieces!

Enables continuous machine operation

The chipbreaker (-N) creates small chips that can be easily evacuated by air or cutting oil.
For high-quality machined surfaces, we recommend the AE-VML square type without chipbreaker.

With chipbreaker added	No chipbreaker
	
	

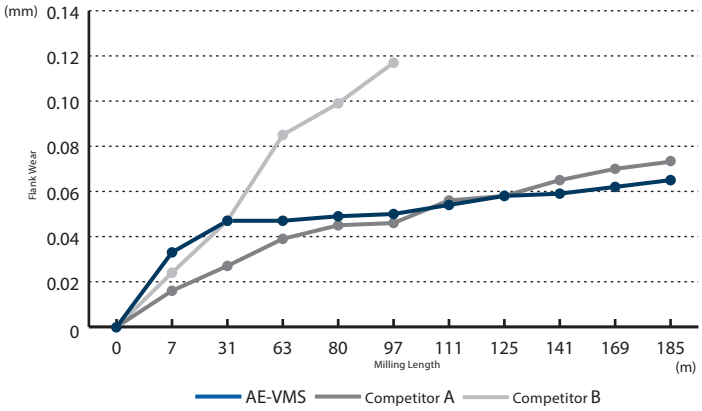
Tool	AE-VML φ10×40-N With chipbreaker
Work Material	NAK80(40HRC)
Milling Method	Trochoidal
Cutting Speed	120m/min 3,800min^{-1}

Feed Rate	1,140mm/min0.075mm/t
Depth of Cut	ap=40mm ae=0.5mm
Coolant	Air blow
Machine	BT50 Vertical Machining Center

Stable performance

Stable performance even at 4D depth of cut

Tool	AE-VML Ø 10 x 40
Work Material	S50C
Milling Method	Side milling
Cutting Speed	130m/min (4,200min^{-1})
Feed Rate	1.200mm/min (0,07mm/t)
Depth of Cut	ap=40mm ae=0.5mm
Coolant	Air Blow
Machine	Horizontal Machining Center



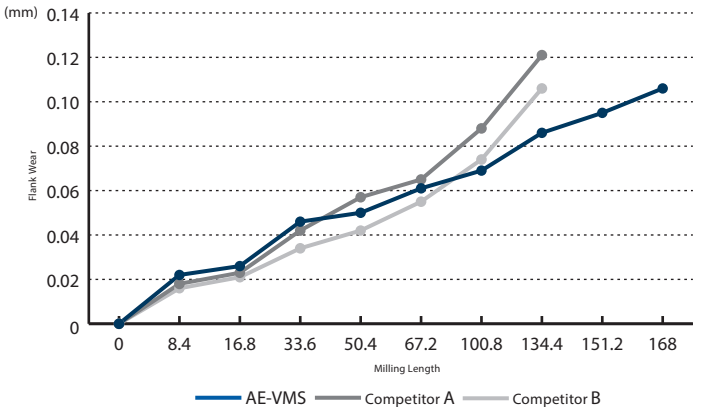
Wear comparison of the peripheral cutting edge

AE-VML 185m	Competitor 185m	Competitor 97m
		

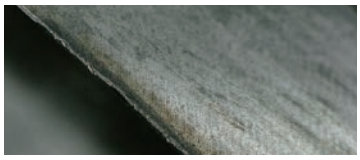
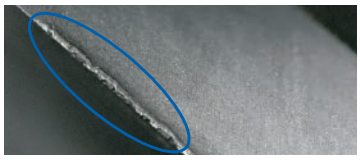
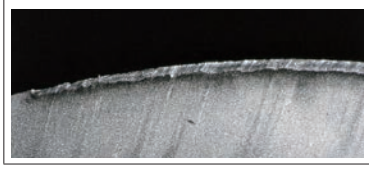
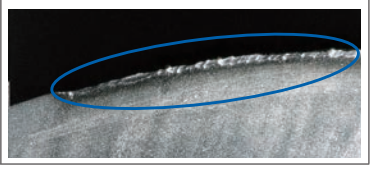
Long tool life

DUARISE coating greatly reduces tool wear progression even with the use of water-soluble coolant.

Tool	AE-VML Ø 10 x 31
Work Material	SCM440(30HRC)
Milling Method	Side milling
Cutting Speed	180m/min (5.700min^{-1})
Feed Rate	1.400mm/min (0,06mm/t)
Depth of Cut	ap=25mm ae=1mm
Coolant	Water Soluble
Machine	Vertical Machining Center



Wear comparison of the peripheral cutting edge

AE-VML 168m	Competitor 134,4m	Competitor 134,4m
		
		

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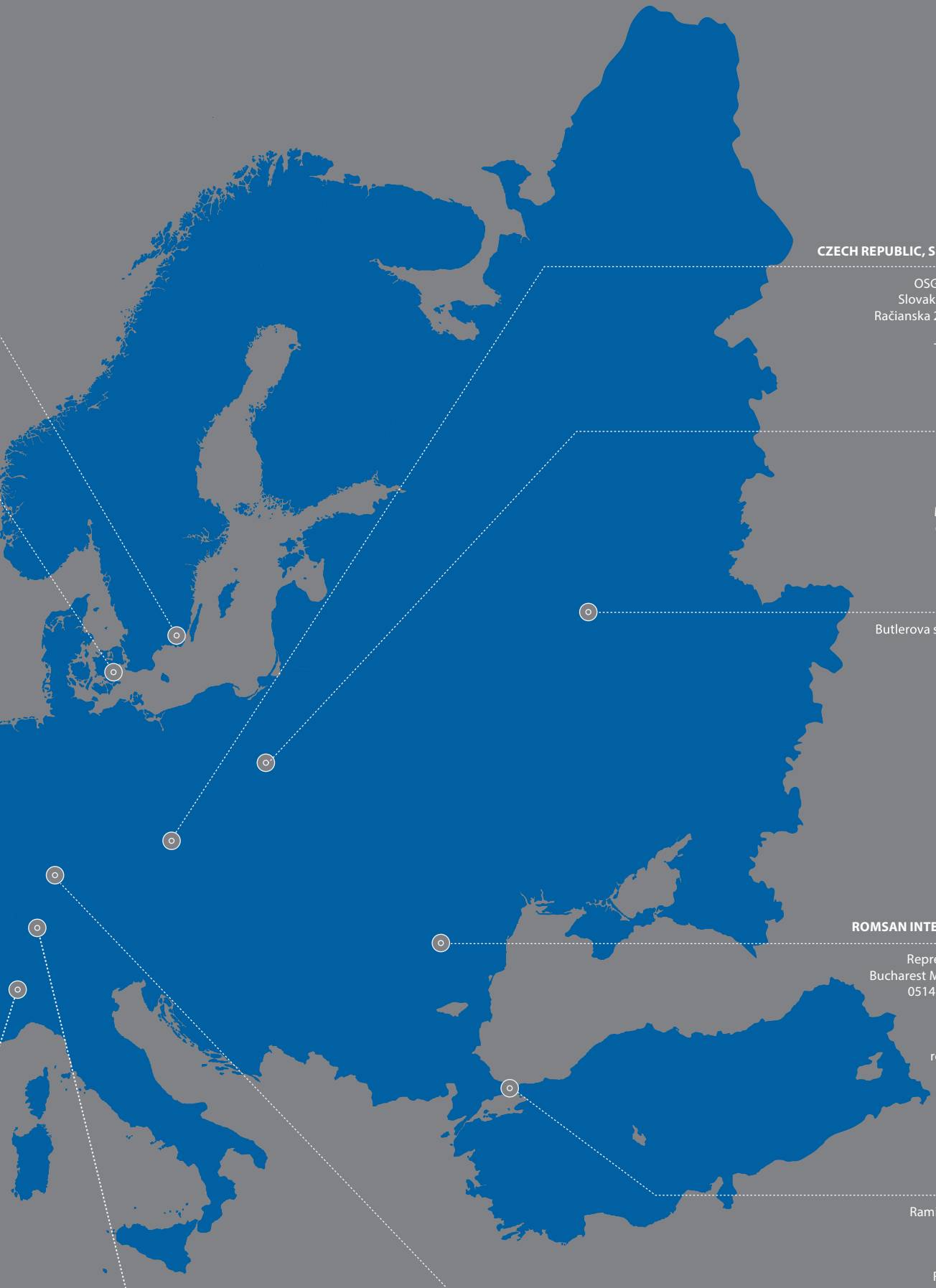

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