

IDENTIFICATION

ORDER NUMBER OF END MILLS

VQ 4 S VB R0100 * * *

End Mill Names	Number of Flutes	Flute Length	Features	Dimensions	Others
VQ : SMART MIRACLE end mills	1 : 1flute	ES : Extra short	S : General-use	D**** : Diameter	S** : Shank diameter
VFR : IMPACT MIRACLE REVOLUTION end mills	2 : 2flute	S : Short	U : For stainless steel	ex.	N**** : Neck length
VF : Impact Miracle end mills	3 : 3flute	M : Medium	K : For keyway	D0050 → ϕ 0.5	T**** : Taper angle one side
MF : MS plus end mills	4 : 4flute	J : Semi long	A : For light alloy	D0500 → ϕ 5	L** : Flute length
MP : MS plus end mills	5 : 5flute	L : Long	C : Center cut		A**** : Overall Length
MS : Mstar end mills	6 : 6flute	XL : Long neck	D : For deep cut	R**** : Radius of ball nose	
VC : Miracle end mills	8 : 8flute	X : Taper neck	V : Irregular spiral helix angle	ex.	
CRN : CRN coated end mills	...	SX : Extra long	B : Ball nose	R0050 → R0.5	
DLC : DLC coated end mills		MX : Extra long	VB : Irregular spiral helix angle, Ball nose	R0500 → R5	
DFC : CVD diamond coated end mills			R : Roughing		
DF : Diamond coated end mills			FPR : Fine roughing		
DC : Diamond coated end mills			H : High helix		
CBN : CBN end mills			T : Taper		
CE : Ceramic end mills			TB : Taper ball nose		
C : Carbide end mills			RB : Corner radius		
VA : Violet end mills			CH : Coolant hole		
S : KHAS end mills (High-grade powder high-speed steel)			UR : Multi step radius		
None : Cobalt high-speed steel			3 : 3mm shank		
			6 : 6mm shank		

*Other types are available by special order.

SYMBOL DESCRIPTIONS

Tool Material



Ultra Micro Grain Carbide
Ultra micro grain carbide is used as the substrate material.



Cubic Boron Nitride
Mitsubishi's original CBN is used.



Ceramic
Ceramic is used as the substrate material.



High Hardness Powder Metallurgy HSS
High hardness powder metallurgy HSS is used as the substrate material.



Ultra Micro Grain HSS
Cobalt high speed steel is used as the substrate material.



High Speed Steel
High speed steel is used as the substrate material.

Tolerances



Outside Diameter Tolerance
Indicates diameter tolerance of end mill.



R Tolerance
Indicates the radial tolerance of a ball nose end mill.



R Tolerance
Indicates the radial tolerance of an end mill with a corner radius.



Tolerance of Taper Angle
Indicates the tolerance of the taper angle.



Tolerance of Point Angle
Indicates the tolerance of the point angle.



Shank Diameter Tolerance
Indicates the shank diameter tolerance of end mill.

Angle, Coolant hole, Sharp corner edge and Gash land



Helix Angle
Indicates the helix angle of the end mill.



End Cutting Edge with Coolant Hole



Peripheral Cutting Edge with Coolant Hole



Sharp Corner Edge
Indicates the end mill has a sharp corner edge.



Gash Land
Indicates the end mill cutting edge has a gash land.

Coating



SMART MIRACLE Coating
(Al, Cr)N coating optimum for difficult-to-cut materials.



IMPACT MIRACLE REVOLUTION Coating
A coating which adds the excellent high oxidation temperature of (Al, Cr, Si) N-based films to the nano crystal technology of VF.



IMPACT MIRACLE Coating
Single phase nano crystal coating technology for higher film hardness and heat resistance.



MS PLUS Coating
Offers higher versatility for carbon steel, alloy steel and hardened steel.



(Al, Ti)N Coating
(Al, Ti)N offers higher versatility.



MIRACLE Coating
The original Miracle (Al, Ti)N coating also suitable for dry cutting of carbon steels and hardened steels.



CRN Coating
Newly developed CrN coating for Copper Electrodes machining.



DLC Coating
Hardness similar to that of CVD diamond coating achieved with high adhesion strength. (Jointly developed with SHINMAYWA INDUSTRIES, LTD.)



CVD Diamond Coated End Mills
Suitable for CFRP



CVD Diamond Coated End Mills
High performance coating for hard brittle materials excelling in film adhesion to the substrate.



Diamond Coating
Suitable for graphite machining.



VIOLET Coating
The original Miracle (Al, Ti)N coating achieves longer tool life.

Work Application Range

1st Recommendation



2nd Recommendation



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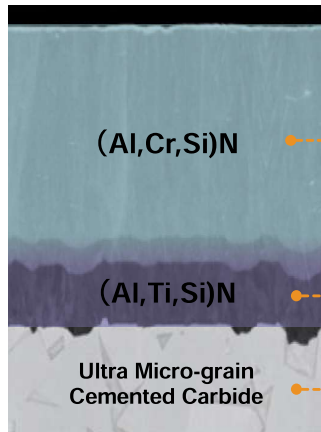
SOLID END MILLS

COATING TECHNOLOGY



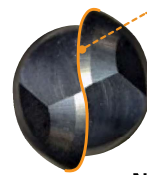
IMPACT MIRACLE REVOLUTION Coating

The combination of the (Al, Cr, Si) N coating (newly-developed), which has a high oxidation temperature and high lubricity, together with the (Al, Ti, Si) N coating, which has better wear resistance and high adhesion, allows hardened steel with even greater strength to be maintained.



★ High Oxidation Temperature
★ High Lubricity

★ Better Wear Resistance
★ High Adhesion



Strong S Curve

New Negative Cutting Edge Shape and Slow Helix Angle Cutting Edge

New ZERO-μ Surface

Newly-developed Surface Reforming Technology



New Ball Geometry for Mirror Finish Cutting



IMPACT MIRACLE Coating

For higher hardness, higher speed and longer tool life!

In comparison with the conventional coating single-phase nano crystal coating technology offers higher coating hardness and heat resistance. When machining hardened steels it can be seen that the IMPACT MIRACLE coating offers a lower friction of coefficient and as such prevents abnormal damage such as chipping.

SOLID END MILLS

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Properties of IMPACT MIRACLE COATING

	IMPACT MIRACLE Single-phase nano coating (Al, Ti, Si)N	(Al, Ti, Si)N	(Al, Ti)N
Hardness (HV)	3700	3200	2800
Oxidation Temperature (°C)	1300	1100	840
Adhesion (N) ¹⁾	100	80	80
Wear Coefficient ²⁾ (800°C)	0.48	0.53	0.58

1) Adhesion : Measured by critical load scratch test.

2) Coefficient of friction : Measured by ball-on-disk method.
(Counter gear : AISI D2 60HRC)



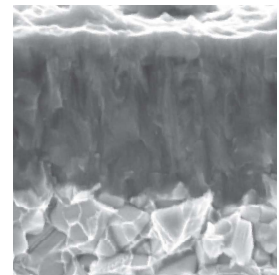
MS plus Coating

Suitable coating for a broad range of workpiece materials such as carbon steel, alloy steel and hardened steel of approx. 50HRC.

Our original coating technology enables a multilayer of (Al, Ti)N and (Al, Cr)N. It allows machining of a wide range of workpiece materials.

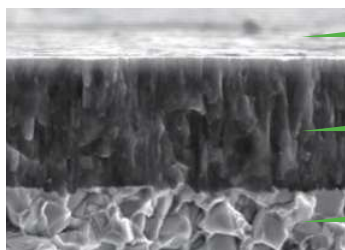
Properties of MS plus coating

	(Al, Ti, Cr)N multilayer	(Al, Ti)N	(Al, Cr)N
Hardness (HV)	3200	2800	3100
Oxidation Temperature (°C)	1100	800	1100
Adhesion (N)	100	80	80



SMART MIRACLE Coating

Newly-developed (Al,Cr)N coating with improved wear resistance. The smoothing treatment of the coating layer reduces the cutting resistance and improves chip discharge significantly. This next-generation coating offers longer tool life and higher efficiency in machining difficult-to-cut materials.



Smoothed Surface "Zero- μ Surface"

Newly Developed (Al,Cr)N Coating

Super Fine Grade Substrate



SMART MIRACLE Coating

ZERO- μ Surface

The original surface treatment technology offers smooth coating layer. A good balance of smooth surface and sharp edge allows smooth chip discharge and reduces the cutting resistance. Machining efficiency and tool life is improved.



DLC Coating

Newly developed DLC coating.

Hardness similar to that of CVD diamond coating achieved with high adhesion strength.

Mitsubishi Materials and SHINMAYWA INDUSTRIES, LTD. have jointly developed a unique DLC coating that has substantially increased "adhesion strength" compared to previous DLC coating.

Diamond Coating (DC)

Proprietary CVD diamond coating produces excellent wear resistance and smooth hole surface.

The newly developed CVD diamond coated carbide material achieves outstanding abrasion resistance and smoothness due to a proprietary fine multilayer diamond crystal control technology. Suitable for cutting hard brittle materials such as cemented carbide.

Diamond Coating (DF)

Diamond coating for non-ferrous and new non-metal materials.

Owing to Mitsubishi's unique plasma chemical vapor deposition (CVD) coating technology, great combination of coating hardness similar to that of natural diamond has been combined with a good adhesion to carbide substrates. DF end mill series suitable for graphite machining.

VIOLET Coating

(Al,Ti)N coating, excellent adhesion strength for HSS tools.

Violet coating is the name of the technology of successfully applying a Miracle type coating to HSS substrate tools. The newly developed technology of applying (Al,Ti)N coating at the low temperatures required for HSS substrates, means that Violet coating has the same level of adhesion strength as Miracle coating. Additionally high film hardness and excellent oxidation resistance properties have also been realised.

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SOLID END MILLS

TOOL NAVI

HOW TO USE TOOL NAVI

3 steps provide the correct tool and cutting data.

STEP1 Choose work material, end mill type and cutting length.

INDEX		Type
Work Material	Carbon Steel Alloy Steel Cast Iron	P
	Square End Mill	J008
	Short	J008
	Medium	J008
	Semi long	J009
	Long neck	J010
	Radius End Mills	
	Short / Medium	J010
	Long neck / Taper neck	J011
	Ball Nose End Mills	
	Short / Medium	J011
	Long neck	J006
	Taper neck	J012
	Hardened Steel	H
	Square End Mill	J013
	Long neck	J013
	Radius End Mills	
	Short / Medium	J013

STEP2 Choose end mill.

SOLID END MILLS									
TOOL NAVI									
Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials	Page
								Upper : 1st Recommendation Under : 2nd Recommendation	
M									
S									
Square End Mill									
Medium (ap=3.5xDC)									
VQMZHJV			DC 1~20	1.6 ~2.5xDC	—	3	F M S P R N	J116	
VQMZHVOH			DC 6~16	1.9 ~2.4xDC	—	3	F M S P R N	J122	
VQMHV			DC 1~25	2 ~2.8xDC	—	4	F M S P R N	J154	
VQSVR			DC 3~20	1.8 ~2.4xDC	—	3	F M S P R N	J362	

STEP3 Choose size and cutting condition.

Size

SOLID END MILLS									
MP2SSB									
Ball nose, Short cut length, 2 flute, Short shank									
Order Number	RE	DC	APAX	LF	DCGN	Flute	Type	Size	Page
MP2SSB0010	0.1	0.2	0.2	40	4	2	1		
MP2SSB0020	0.2	0.4	0.4	40	4	2	1		
MP2SSB0030	0.3	0.6	0.6	40	4	2	1		
MP2SSB0040	0.4	0.8	0.8	40	4	2	1		
MP2SSB0050	0.5	1	1	40	4	2	1		
MP2SSB0060	0.6	1.2	1.2	40	4	2	1		
MP2SSB0070	0.7	1.5	1.5	40	4	2	1		
MP2SSB0080	0.8	1.8	1.8	40	4	2	1		
MP2SSB0090	1	2	2	40	4	2	1		
MP2SSB0100	1.5	3	3	40	4	2	1		
MP2SSB0120	2	4	4	40	4	2	1		
MP2SSB0150	2.5	5	5	40	4	2	1		
MP2SSB0200	3	6	6	50	6	2	2		
MP2SSB0250	4	8	8	60	8	2	2		
MP2SSB0300	5	10	10	70	10	2	2		
MP2SSB0400	6	12	12	80	12	2	2		

Cutting conditions

SOLID END MILLS									
MP2SSB									
Ball nose, Short cut length, 2 flute, Short shank									
RECOMMENDED CUTTING CONDITIONS									
Work Material	Feed (mm/min)	Spindle Speed (rpm)	Depth of Cut (mm)	Feed per Tooth (mm/tooth)	Feed per Flute (mm/flute)	Feed per Revolution (mm/rev)	Feed per Revolution (mm/rev)	Feed per Revolution (mm/rev)	Feed per Revolution (mm/rev)
Carbon Steel	0.1~0.2	1000~1500	0.1~0.2	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03
Alloy Steel	0.1~0.2	1000~1500	0.1~0.2	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03
Cast Iron	0.1~0.2	1000~1500	0.1~0.2	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03
Hardened Steel	0.1~0.2	1000~1500	0.1~0.2	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03	0.02~0.03

INDEX

Carbon Steel Alloy Steel Cast Iron	P	Square End Mill Short J008 Medium J008 Semi long J009 Long neck J010 Radius End Mills Short / Medium J010 Long neck / Taper neck J011 Ball Nose End Mills Short / Medium J011 Long neck J012 Taper neck J012
Hardened Steel	H	Square End Mill Medium J013 Long neck J013 Radius End Mills Short / Medium J013 Long neck / Taper neck J014 Ball Nose End Mills Short / Medium J014 Long neck / Taper neck J015
Austenitic Stainless Steel	M	Square End Mill Medium J016 Semi long J017 Long neck J017
Ti Alloy Heat Resistant Alloys	S	Radius End Mills Short / Medium J017 Ball Nose End Mills Short / Medium J018 Long neck J018
Ti Alloy Heat Resistant Alloys	S	Ceramic Radius End Mills Short J018 Barrel End Mills Medium J018
Copper Alloy Aluminium Alloy	N	Square End Mill Short J019 Medium J019 Semi long J019 Long neck J020 Radius End Mills Short / Medium J020 Long neck J020 Ball Nose End Mills Short / Medium J021 Long neck J021 Tapered flute J021
Graphite FRP	G	Square End Mill Semi long J022 Long neck J022 Radius End Mills Long neck J022 Ball Nose End Mills Short / Medium J022 Long neck J023 Taper neck J023

TOOL NAVI

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
P									
Square End Mill									
Short (ap=1.5xDC)									
MS2ES			DC 3-12	0.5 -1xDC	-	2	F R	P H M S N	J066
MS2SS			DC 0.1-12	1.5xDC	-	2	F R	P H M S N	J048
MS3ES			DC 3-12	0.5 -1xDC	-	3	F R	P H M S N	J114
MS4EC			DC 3-14	0.5 -1xDC	-	4	F R	P H M S N	J152
MS4SC			DC 1-12	1.5xDC	-	4	F R	P H M S N	J142
MSSH D			DC 3-20	1.5xDC	-	4	F R	P H M S N	J136
Medium (ap=3xDC)									
MS2MS			DC 0.2-20	2xDC	-	2	F R	P H M S N	J049
MS2JS			DC 0.1-12	3xDC	-	2	F R	P H M S N	J054
MPMHV			DC 1-22	2.5xDC	-	4	F R	P M H S N	J130

* ap : Depth of Cut
* DC : Cutting Diameter



Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
VQMHZV		 	DC 1-20	1.6 ~2.5xDC	-	3			J116
MSMHZD		 	DC 1-20	1.6 ~2.5xDC	-	3			J112
VQMHV		 	DC 1-25	2 ~2.8xDC	-	4			J154
MSMHD		 	DC 2-25	2 ~3.1xDC	-	4			J137
VQSVR		 	DC 3-20	1.8 ~2.4xDC	-	3 4			J362

Semi long (ap~4xDC)

MS2LS		 	DC 0.2-12	4xDC	-	2			J056
MPJHV		 	DC 1-20	3.3 ~4xDC	-	4			J134
VQJHV		 	DC 1-20	3.3 ~4xDC	-	4			J158
MSJHD		 	DC 2-20	2.8 ~4xDC	-	4			J140
MS4JC		 	DC 1-12	4xDC	-	4			J146

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SOLID END MILLS

TOOL NAVI

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
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P

Square End Mill

Long neck (ap-30xDC)

VQXL		   	DC 0.2-1.0	1.4 -1.6xDC	2.5 -6xDC	3 4			J160
VF2XL		   	DC 0.1-3	1.5 -1.7xDC	2.5 -12.5xDC	2			J072
MS2XL		   	DC 0.2-6	1.3 -1.6xDC	2.5 -30xDC	2			J058
MS2XL6		   	DC 0.3-2.5	1.5 -2.7xDC	2.5 -5xDC	2			J062
MS4XL		   	DC 1-10	1xDC	2.7 -16.2xDC	4			J148

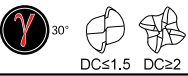
Radius End Mills

Short / Medium (ap-2.8xDC)

MS2MRB		   	DC 1-12	2xDC	-	2			J274
MPMHVRB		   	DC 1-20	2.5xDC	-	4			J284
VQMHVRB		   	DC 2-20	2 -2.8xDC	-	4			J297
MS4MRB		   	DC 3-20	1.9 -2.8xDC	-	4			J294

* ap : Depth of Cut * DC : Cutting Diameter
* RE : Ball Nose End Mill Radius



Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
Short / Medium (ap=2.8xDC)									
VFHVRB		 	DC 1-16	1 -1.6xDC	-	4			J306
VCPSRB [High precision]		 	DC 0.6-12	1xDC	-	2 4			J318
Long neck (ap=12xDC) / Taper neck (ap=50xDC)									
MPXLRB		 	DC 0.2-6	1xDC	2.5 -12xDC	2 4			J288
VFHVRB		 	DC 1-12	1 -1.6xDC	2.6 -50xDC	4			J312
CBN2XLRB		 	DC 0.5-2	0.6xDC	3 -6xDC	2			J280
Ball Nose End Mills									
Short / Medium (ap=3xDC)									
MP2SSB		 	RE 0.1-6	1xDC	-	2			J196
MP2SB		 	RE 0.1-6	1.5 -1.7xDC	-	2			J197
MP2MB		 	RE 0.25-6	1.8 -3xDC	-	2			J198
MP2SDB		 	RE 0.5-6	1 -2xDC	-	2			J200
VQ4SVB		 	RE 1-6	1.5xDC	-	4			J270

TOOL NAVI

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
P									
Ball Nose End Mills									
Long neck (ap-20xDC)									
MP2XLB			RE 0.05-3	0.7 -1xDC	1.2 -20xDC	2			J202
VF2XLB			RE 0.1-3	0.8xDC	2.5 -20xDC	2			J222
VF2XLBS			RE 0.2-1	0.8xDC	2.5 -12xDC	2			J220
VF2WB			RE 1-3	220°	2 -3xDC	2			J219
CBN2XLB			RE 0.2-1	0.6 -0.8xDC	0.85 -4xDC	2			J236
Taper neck (ap-70xDC)									
MP3XB			RE 0.5-6	0.8 -1.5xDC	3.3 -50xDC	3			J254
VF3XB			RE 0.4-2.5	0.6 -0.9xDC	6.7 -70xDC	3			J260

* ap : Depth of Cut
 * DC : Cutting Diameter
 * RE : Ball Nose End Mill Radius

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
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H

Square End Mill

Medium (ap=3.5xDC)

VF2MD		   	DC 0.5-6	2.5xDC	-	2	F     R    	 	J068
VF4MD		   	DC 1-20	2.5xDC	-	4	F     R    	 	J164
VFSD		    	DC 1-12	2xDC	-	4 6	F     R    	 	J190
VFMD		    	DC 1-25	2 -3.5xDC	-	4 6	F     R    	 	J191

Long neck (ap=12.5xDC)

VF2XL		   	DC 0.1-3	1.5 -1.7xDC	2.5 -12.5xDC	2	F     R    	 	J072
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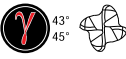
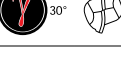
Radius End Mills

Short / Medium (ap=3.3xDC)

VFHVRB		  	DC 1-16	1 -1.6xDC	-	4	F     R    	   	J306
VCPSRB [High precision]		   	DC 0.6-12	1xDC	-	2 4	F     R    	   	J318
VFSDRB		   	DC 3-12	1xDC	-	6	F     R    	 	J346
VFMDRB		   	DC 3-20	2.2 -3.3xDC	-	6	F     R    	 	J348

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SOLID END MILLS

TOOL NAVI

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
H									
Radius End Mills									
Short / Medium (ap=3,3xDC)									
VFFDRB		  DC≤6 DC≥8	DC 3-12	0.06DC	-	4 6	F  R 		J316
Long neck (ap=6xDC) / Taper neck (ap=50xDC)									
VFHVRB		 	DC 1-12	1 -1.6xDC	2.6 -50xDC	4	F  R 		J312
CBN2XLRB		 	DC 0.5-2	0.6xDC	3 -6xDC	2	F  R 		J280
Ball Nose End Mills									
Short / Medium (ap=3xDC)									
VFR2SB		  RE < 0.3 RE ≥ 0.3	RE 0.1-10	1 -2xDC	-	2	F  R 		J212
VFR2SBF		 	RE 0.5-3	1 -2xDC	-	2	F  R 		J214
 VFR2SSB		 	RE 0.5-6	1xDC	-	2	F  R 		J210
MP2SSB		 	RE 0.1-6	1xDC	-	2	F  R 		J196
MP2SB		 	RE 0.1-6	1.5 -1.7xDC	-	2	F  R 		J197
MP2MB		 	RE 0.25-6	1.8 -3xDC	-	2	F  R 		J198

* ap : Depth of Cut
 * DC : Cutting Diameter
 * RE : Ball Nose End Mill Radius



Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
MP2SDB		 	RE 0.5-6	1 -2xDC	-	2			J200
VF4MB		 	RE 0.5-6	1.8 -3xDC	-	4			J272
Long neck (ap-20xDC) / Taper neck (ap-70xDC)									
MP2XLB		 	RE 0.05-3	0.7 -1xDC	1.2 -20xDC	2			J202
VF2XLB		 	RE 0.1-3	0.8xDC	2.5 -20xDC	2			J222
VF2XLBS		 	RE 0.2-1	0.8xDC	2.5 -12xDC	2			J220
MP3XB		 	RE 0.5-6	0.8 -1.5xDC	3.3 -50xDC	3			J254
VF3XB		 	RE 0.4-2.5	0.6 -0.9xDC	6.6 -70xDC	3			J260
CBN2XLB		 	RE 0.2-1	0.6 -0.8xDC	0.85 -4xDC	2			J236

TOOL NAVI

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
M									
S									
Square End Mill									
Medium (ap-3.5xDC)									
VQMHZV			DC 1-20	1.6 -2.5xDC	-	3			J116
VQMHZVOH			DC 6-16	1.9 -2.4xDC	-	3			J122
VQMHV			DC 1-25	2 -2.8xDC	-	4			J154
VQSVR			DC 3-20	1.8 -2.4xDC	-	3 4			J362
VFMHVCH			DC 16,20	2.2xDC	-	4			J167
VF6MHV			DC 6-20	1.9 -2.4xDC	-	6			J189
VQ6MHVCH			DC 10-20	1.9 -2.2xDC	-	6			J188
VF8MHVCH			DC 16,20	1.9 -2xDC	-	8			J194
VFSFPRCH			DC 16,20	1.9 -2.1xDC	-	4			J367

* ap : Depth of Cut
* DC : Cutting Diameter



Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
VF6SVRCH			DC 16,20	1.9 ~2.1xDC	-	6	F R	M S P	J369
VFMFPR			DC 5-20	2.8 ~3.5xDC	-	4	F R	M S P	J368
Semi long (ap~4xDC)									
VQJHV			DC 1-20	3.3 ~4xDC	-	4	F R	M S P N	J158
Long neck (ap~6xDC)									
VQXL			DC 0.2-1.0	1.4 ~1.67xDC	2.5 ~6xDC	3 4	F R	M S P N	J160
Radius End Mills									
Short / Medium (ap~2.8xDC)									
VQMHVRB			DC 2-20	2 ~2.8xDC	-	4	F R	M S P N	J297
VQMHVRBF			DC 6-16	2.2 ~2.4xDC	-	4	F R	M S P N	J302
VFMHVRBCH			DC 16,20	2.2 ~2.3xDC	-	4	F R	M S P	J304
VQT5MVRB			DC 16-25	2.2 ~2.3xDC	-	5	F R	M S	J340
VF6MHVRB			DC 6-20	1.9 ~2.4xDC	-	6	F R	M S P	J344
VQ6MHVRBCH			DC 10-20	1.9 ~2.2xDC	-	6	F R	M S P N	J342

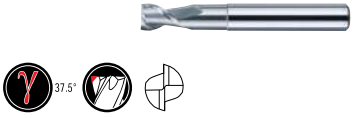
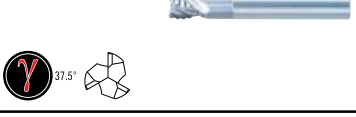
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SOLID END MILLS

TOOL NAVI

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
M									
S									
Radius End Mills									
Short / Medium (ap=3xDC)									
VF8MHVRBCH				DC 16,20	1.9 ~2xDC	-	8	F  R  M S P	J350
Ball Nose End Mills									
Short / Medium (ap=1.5xDC)									
VQ4SVB				RE 1-6	1.5xDC	-	4	F  R  M S P N	J270
Long neck (ap=3xDC)									
VF2WB				RE 1-3	-	2 ~3xDC	2	F  R  M S P H	J219
S									
Ceramic Radius End Mills									
Short (ap=0.75xDC)									
CE4SRB				DC 6-12	0.75xDC	-	4	F  R  S	J338
CE6SRB				DC 6-12	0.75xDC	-	6	F  R  S	J338
Barrel End Mills									
Medium (ap=2.6xDC)									
 VQT6UR				DC 8-12	2 ~2.6xDC	-	6	F  R  S M N	J358

* ap : Depth of Cut
 * DC : Cutting Diameter
 * RE : Ball Nose End Mill Radius

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
N									
Square End Mill									
Short (ap=2xDC)									
C2SA			DC 3-20	0.9 -2xDC	-	2	F  R 	N	J102
C3SA			DC 10-26	0.8 -1.3xDC	-	3	F  R 	N	J128
CSRA			DC 10-25	1.1 -1.3xDC	-	3	F  R 	N	J372
Medium (ap=3.2xDC)									
CRN2MS			DC 0.2-12	2 -3.2xDC	-	2	F  R 	N	J084
C2MHA			DC 3-25	1.5 -3xDC	-	2	F  R 	N	J108
CMRA			DC 3-25	1.8 -2.8xDC	-	3	F  R 	N	J374
Semi long (ap=4xDC)									
CRN4JC			DC 3-12	2.5 -4xDC	-	4	F  R 	N	J174

SOLID END MILLS

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Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
N									
Square End Mill									
Long neck (ap-16xDC)									
CRN2XL		  	 DC 0.2-6	1.5 -1.7xDC	2.5 -16xDC	2	F  R 		J086
Radius End Mills									
Short / Medium (ap-2.4xDC)									
CRN2MRB		 	 DC 6-12	2.2 -2.4xDC	-	2	F  R 		J277
C3SARB		 	 DC 12-25	0.8 -1.3xDC	-	3	F  R 		J282
CSRARB		 	 DC 10-25	1.1 -1.3xDC	-	3	F  R 		J370
Long neck (ap-13xDC)									
CRN2XLRB		  	 DC 0.5-6	1.5 -1.6xDC	5 -13xDC	2	F  R 		J278

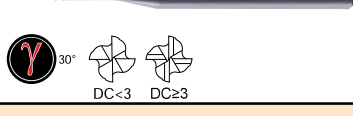
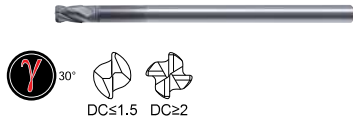
* ap : Depth of Cut
 * DC : Cutting Diameter
 * RE : Ball Nose End Mill Radius

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
Ball Nose End Mills									
Short / Medium (ap=3xDC)									
CRN2MB			RE 0.2-6	1.8 -3xDC	-	2	F  R 	N	J230
DC2SB			RE 0.1-3	0.6 -0.7xDC	-	2	F  R 	N * For hard brittle materials	J238
Long neck (ap=20xDC)									
CRN2XLB			RE 0.1-3	1xDC	2.5 -20xDC	2	F  R 	N	J232
DC2XLB			RE 0.1-3	0.6xDC	1.7 -5xDC	2	F  R 	N * For hard brittle materials	J240
Tapered flute (ap=20xDC)									
C4LATB			RE 0.5-2	6.7 -20xDC	-	4	F  R 	N	J356

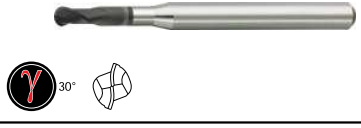
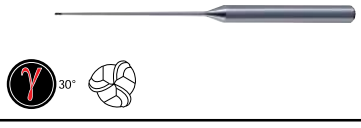
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SOLID END MILLS

TOOL NAVI

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
G									
Square End Mill									
Semi long (ap=4xDC)									
DF4JC			DC 3-12	3 ~4xDC	-	4	F     R    	 	J176
DFC4JC			DC 6-12	2.5 ~3.8xDC	-	4	F     R    		J180
DFCJRT			DC 6-12	2.5 ~3.8xDC	-	10 12	F     R    		J195
Long neck (ap=10.7xDC)									
DF4XL			DC 1-12	1.5xDC	2.5 ~10.7xDC	4	F     R    	 	J177
Radius End Mills									
Long neck (ap=30xDC)									
DFPSRB			DC 0.5-12	1.3 ~1.5xDC	3.3 ~30xDC	2 4	F     R    	 	J335
Ball Nose End Mills									
Short / Medium (ap=5xDC)									
DF2MB			RE 3-6	4.6 ~5xDC	-	2	F     R    	 	J244

* ap : Depth of Cut
 * DC : Cutting Diameter
 * RE : Ball Nose End Mill Radius

Product Name	Coating or Substrate	End Mills	Size Range	ap	Neck Length	Flutes	Finish / Rough	Work Materials Upper : 1st Recommendation Under : 2nd Recommendation	Page
Long neck (ap-40xDC)									
DF2XLB			RE 0.1-3	1.2 -1.5xDC	2.5 -40xDC	2	F  R 	 	J246
NEW DF2XLBF			RE 0.3-1.5	0.8 -1.5xDC	5 -20xDC	2	F  R 	 	J250
Taper neck (ap-50xDC)									
DF3XB			RE 0.5-2	1.5xDC	20 -50xDC	3	F  R 	 	J266