DIA EDGE

TOOL NEWS

2023.4 Update
B231G

For Machining of Hardened Steel

İMPACT MIRACLE End Mill Series

IMPACT MIRACLE REVOLUTION

Series Expansion

Revolutionary Machining of Hardened Steel

New coating provides outstanding tool life

MITSUBISHI MATERIALS CORPORATION

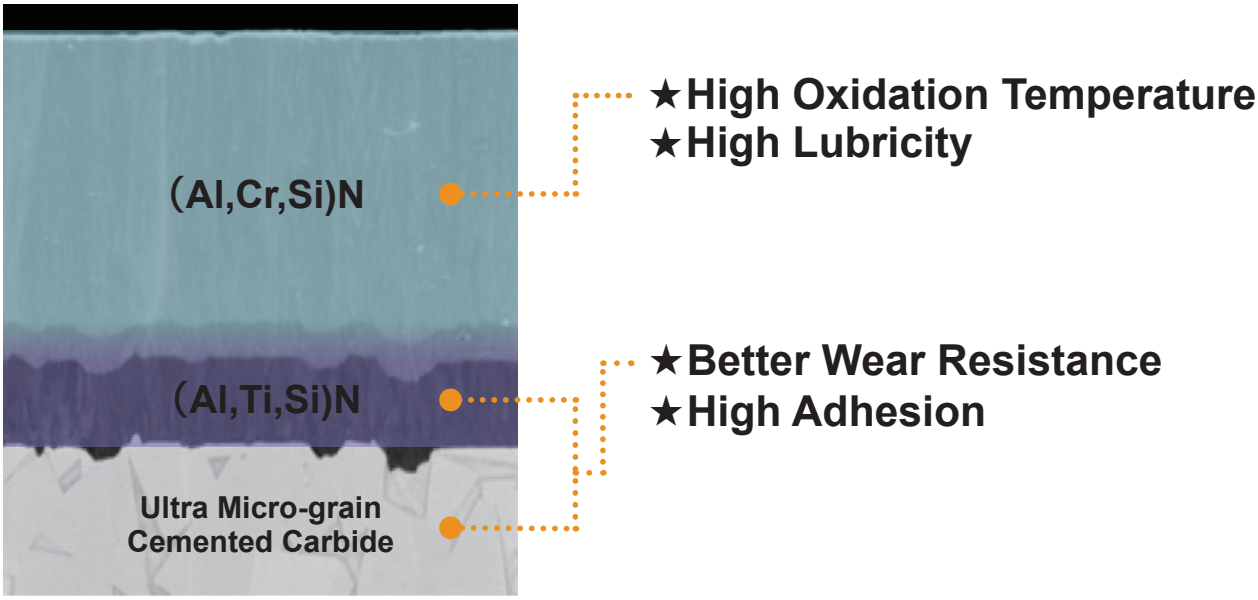
For Machining of Hardened Steel

iMPACT MIRACLE End Mill Series

IMPACT MIRACLE REVOLUTION

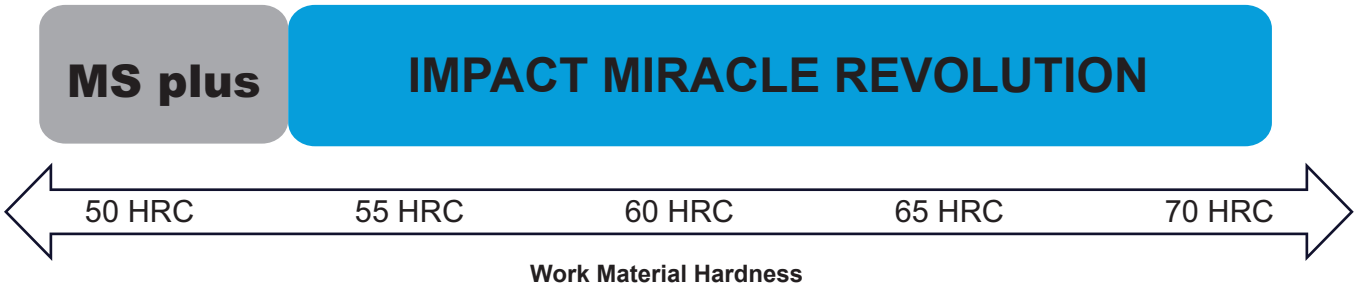
IMPACT MIRACLE REVOLUTION Coating

A combination of the newly developed (Al, Cr, Si) N coating with improved lubricity and a high oxidisation temperature, together with the (Al, Ti, Si) N coating layer that displays excellent wear and adhesion to other coating layers, enables efficient and reliable machining of hardened steels.



Due to manufacturing adjustments, differences in the colour of the coating for different diameters may occur. This has no adverse effect on performance.

Selection According to the Hardness of the Workpiece Material.



SERIES SELECTION CHART

(mm)

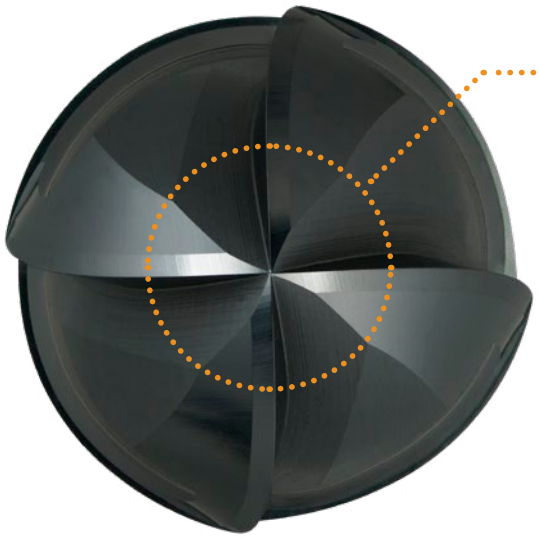
No. of Flutes	Type	Specifications	Shape	Corner Radius RE		Dia. DC		Depth of Cut APMX	Size	Workpiece Material			Page
										P	H		
				Min.	Max.	Min.	Max.	Max. DC		Tool Steel ≤45HRC	Hardened Steel ≤55HRC	Hardened Steel >55HRC	
Ball Nose													
2	**VFR2SSB**	Strong S Curve Short Shank Type		0.5	6.0	1.0	12.0	12	12	○	◎	◎	P.8
2	**VFR2SB**	Strong S Curve		0.1	10.0	0.2	20.0	38	36	○	◎	◎	P.9
2	**VFR2SBF**	For Mirror Finishes		0.5	3.0	1.0	6.0	12	8	○	◎	◎	P.11
2	**VFR2XLB**	Long Neck Type For Machining of Vertical Walls		0.1	3.0	0.2	6.0	6	74	○	◎	◎	P.13
4	NEW **VFR4MB**	For High Speed and High Efficiency machining		0.5	6.0	1.0	12.0	22	9	○	◎	◎	P.6
Corner Radius													
4	**VFRPSRB**	Completely Seamless Curved R Edge DC≥1.5 For High Precision Machining. 1.5≤DC≤5		0.05	3.0	0.5	12.0	18	97	○	◎	◎	P.17

Ball nose, Medium cut length, 4-Flute

VFR4MB NEW

Higher efficiencies from increased feed rates when finish machining.

Shorter machining times while maintaining good surface finishes.



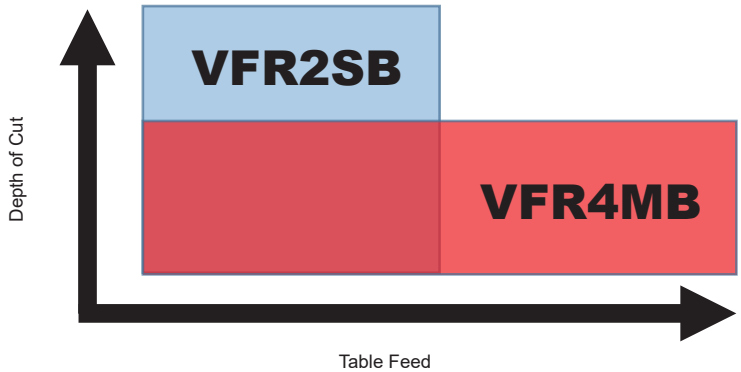
Versatile 4-flute design

All 4 flutes extend from the centre to the periphery. This enables high feeds at any cutting angle and negates the need to calculate different machining conditions.

Angle of Inclination

Correct Use of 2- and 4-Flute Geometries

2-flute geometries usually have a larger chip pocket and are better for rough machining with greater depths of cut that produce a larger volume of chips.
4-flute geometries can increase efficiency and reduce wear when used for finishing at small depths of cut. Additionally, using a 4-flute geometry is advantageous when machining harder materials at reduced depths of cut.

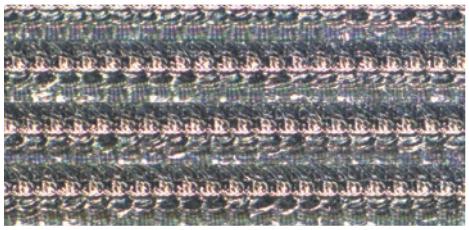


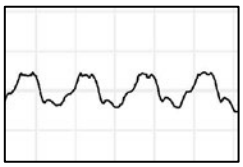
Cutting Performance

Comparison of the Surface Finish - Machining ASP23 (62HRC)

The 4-flute type is superior for high efficiency machining, but when used at the same feed rate as a 2-flute type, the quality of the finished surface can be improved.

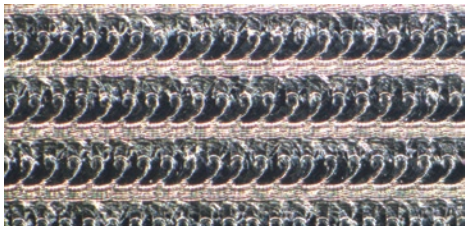
VFR4MB

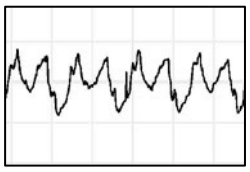




Ra:0.27
Rz:1.01

2-Flute conventional product



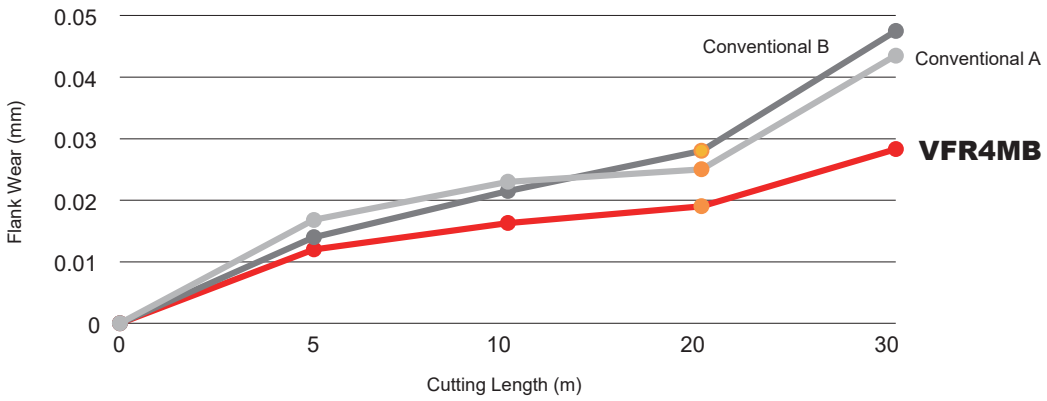


Ra:0.32
Rz:1.62

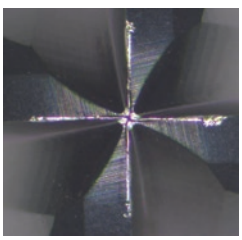
<Cutting Conditions>
Workpiece Material : ASP23(62HRC)
Tool : VFR4MBR0400 DC=8mm
Revolution : n=12000min^{-1}
Table Feed : f=3600mm/min
Depth of Cut : ap=0.2mm
ae=0.8mm
Overhang Length : 20mm
Cutting Mode : Air blow
Down(climb) Cut

Comparison of Wear Resistance Surface - Machining HAP72 (69HRC)

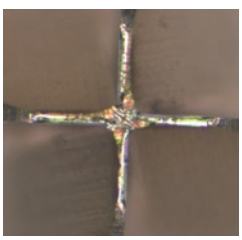
IMPACT MIRACLE REVOLUTION end mills demonstrate excellent wear resistance even when machining high hardness workpiece materials.



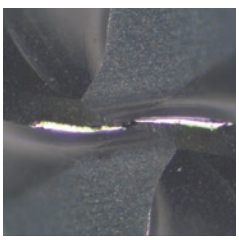
Taken after a cutting length of 20 m



VFR4MB



Conventional A



Conventional B

<Cutting Conditions>
Workpiece Material : HAP72(69HRC)
Tool : VFR4MBR0100 DC=2mm
Revolution : n=16000min^{-1}
Table Feed : f=1200mm/min
Depth of Cut : ap=0.06mm
ae=0.2mm
Overhang Length : 17mm
Cutting Mode : Air blow
Down(climb) Cut
Machine : Vertical MC

Application Example

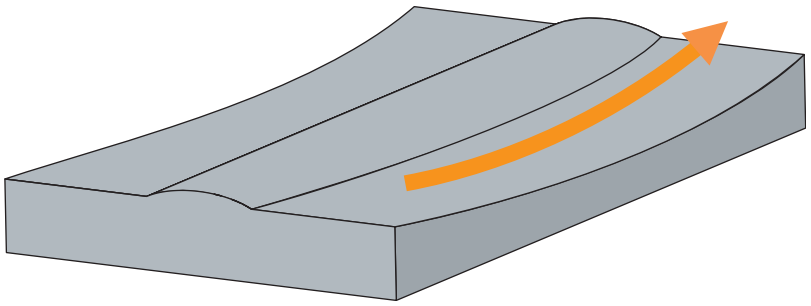
Ball nose, Medium cut length, 4-Flute

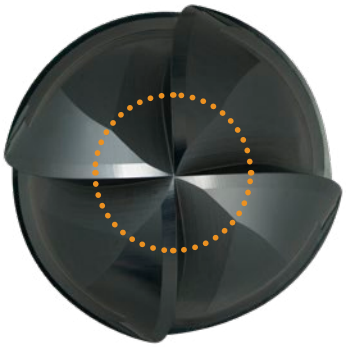
VFR4MB

High efficiency and high precision finishing of press mould parts (60HRC)

Issues from Customer

①Issue with machining efficiency due to the curvature of the workpiece material so a corner radius end mill cannot be used.
②A 4-flute type was used to machine, but at the tip, the chip discharge was poor and resulted in a torn surface finish. The tool was changed to a 2-flute type.
③The 2-flute type showed excessive wear after a long cut length and necessitated a tool change because the surface finish accuracy could not be maintained.

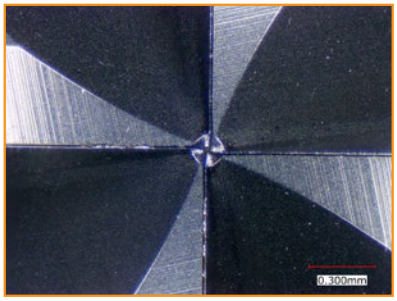




<Cutting Conditions>

Workpiece Material	: JIS SKD11(60HRC)
Revolution	: n=6000 min^{-1}
Table Feed	: f=2800 mm/min
Depth of Cut	: ap=0.02 mm
	ae=Setting surface roughness 6.3z
Cutting Mode	: Dry Cutting
Machine	: Vertical MC(BBT50)
Cutting Time	: 120 min

Results after machining for 120m



VFR4MB **End Cutting Edge Condition**
Flank Wear : 17μm

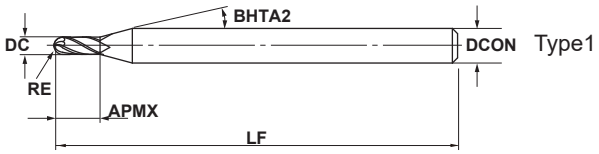
Comments from Customer Evaluation

· VFR4MB showed almost no wear and no change in surface roughness even though the tip was overworked on the contours of a press mould.
· By making it possible to machine with a single end mill, the costs were reduced and the time problems which required a tool change every 2 hours of machining or more were resolved. In addition, the feed rate could be increased by 1.5 which shortened the machining time.

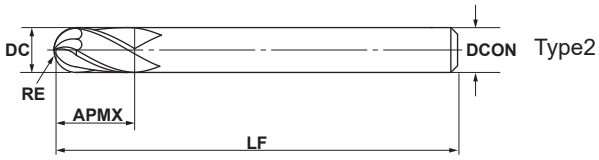
VFR4MB NEW

Ball nose, Medium cut length, 4-Flute

Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-Hardened Steel,Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Titanium Alloy, Heat Resistant Alloy	Copper Alloy	Aluminium Alloy
	○	◎	◎				



Type1



Type2

RE				
±0.010				
DCON=6	8≤DCON≤10	DCON=12		
0 - 0.008	0 - 0.009	0 - 0.011		

● The 4 flute geometry with a cutting edge extending to the centre achieves a long tool life and enables high efficiency machining.

(mm)

Order Number	RE	DC	APMX	LF	BHTA2	DCON	* No.F	Stock	Type
VFR4MBR0050	0.5	1	2.5	50	15	6	4	●	1
VFR4MBR0100	1	2	6	60	15	6	4	●	1
VFR4MBR0150	1.5	3	8	70	15	6	4	●	1
VFR4MBR0200	2	4	8	70	15	6	4	●	1
VFR4MBR0250	2.5	5	12	80	15	6	4	●	1
VFR4MBR0300	3	6	12	80	—	6	4	●	2
VFR4MBR0400	4	8	14	90	—	8	4	●	2
VFR4MBR0500	5	10	18	100	—	10	4	●	2
VFR4MBR0600	6	12	22	110	—	12	4	●	2

* Number of Flutes

RE = Corner Radius
DC = Cutting Dia.
APMX = Depth of Cut Max.
LF = Functional Length
BHTA2 = Body Half Taper Angle
DCON = Connection Dia.

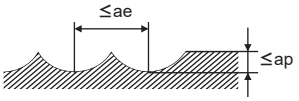
● : **Inventory maintained in Japan.**

VFR4MB

Ball nose, Medium cut length, 4-Flute

Recommended Cutting Conditions

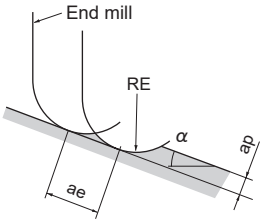
(mm)

Workpiece Material	Hardened Steel (45－55HRC)						Hardened Steel (55－65HRC)						Hardened Steel (65－70HRC)					
R **RE**	α≤15°		α>15°		Depth of cut ap	Depth of cut ae	α≤15°		α>15°		Depth of cut ap	Depth of cut ae	α≤15°		α>15°		Depth of cut ap	Depth of cut ae
	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)			Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)			Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)		
0.5	40000	8000	40000	3800	0.06	0.10	40000	5600	40000	3100	0.05	0.10	40000	4700	32000	1700	0.03	0.10
1.0	40000	9600	40000	5600	0.11	0.20	40000	8000	28000	3100	0.10	0.20	24000	5000	16000	1200	0.06	0.20
1.5	40000	12000	32000	5600	0.13	0.30	32000	7700	19000	2900	0.12	0.30	16000	4200	11000	1100	0.07	0.30
2.0	32000	11000	24000	4700	0.15	0.40	24000	6200	14000	2500	0.13	0.40	12000	3100	8000	1000	0.08	0.40
2.5	25000	9000	19000	3800	0.20	0.50	19000	5300	12000	2200	0.15	0.50	9600	2700	6000	780	0.08	0.50
3.0	21000	8400	15000	3400	0.25	0.60	16000	4800	9600	2000	0.20	0.60	8000	2300	5000	780	0.09	0.60
4.0	16000	6400	12000	2600	0.30	0.80	12000	3600	7200	1600	0.20	0.80	6000	1900	4000	620	0.09	0.80
5.0	13000	5200	9600	2200	0.50	1.00	10000	3200	5800	1300	0.20	1.00	4800	1500	3000	550	0.10	1.00
6.0	9000	3600	7200	1700	0.50	1.20	7000	2200	4300	940	0.30	1.20	3600	1100	2200	400	0.10	1.20
Depth of cut																		

Note 1) If the depth of cut is shallow, the revolution and feed rate can be increased.
Please reduce the feed rate when the surface finish is important.

Note 2) If the rigidity of the machine or the workpiece materials installation is very low, or chattering and noise are generated, please adjust the revolution, feed rate and depth of cut.

Note 3) α is the inclination angle of the machined surface.

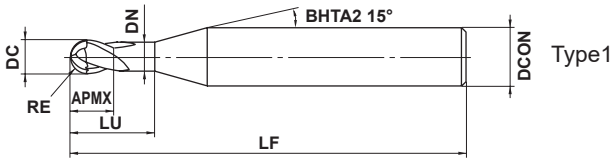


ae:Pick Feed

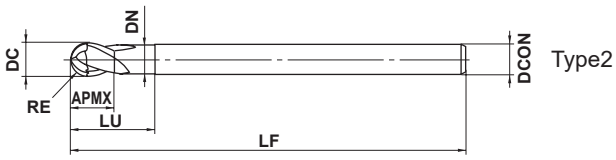
VFR2SSB

Ball nose, Short cut length, Short shank, 2-Flute

Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-Hardened Steel,Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Titanium Alloy, Heat Resistant Alloy	Copper Alloy	Aluminium Alloy
	○	◎	◎				



Type1



Type2

RE≤6				
±0.005				
4≤DCON≤6	8≤DCON≤10	DCON=12		
0 - 0.005	0 - 0.006	0 - 0.008		

● Optimisation of the flute geometry, helix and rake angles have improved the overall edge strength.

(mm)

Order Number	RE	DC	APMX	LU	DN	LF	DCON	* No.F	Stock	Type
VFR2SSBR0050S04	0.5	1	1	2	0.94	40	4	2	●	1
VFR2SSBR0050	0.5	1	1	2	0.94	40	6	2	●	1
VFR2SSBR0075S04	0.75	1.5	1.5	3	1.44	40	4	2	●	1
VFR2SSBR0075	0.75	1.5	1.5	3	1.44	40	6	2	●	1
VFR2SSBR0100	1	2	2	4	1.9	45	6	2	●	1
VFR2SSBR0150	1.5	3	3	6	2.9	45	6	2	●	1
VFR2SSBR0200	2	4	4	8	3.9	45	6	2	●	1
VFR2SSBR0250	2.5	5	5	10	4.9	50	6	2	●	1
VFR2SSBR0300	3	6	6	12	5.85	50	6	2	●	2
VFR2SSBR0400	4	8	8	14	7.85	60	8	2	●	2
VFR2SSBR0500	5	10	10	18	9.7	70	10	2	●	2
VFR2SSBR0600	6	12	12	22	11.7	75	12	2	●	2

* Number of Flutes

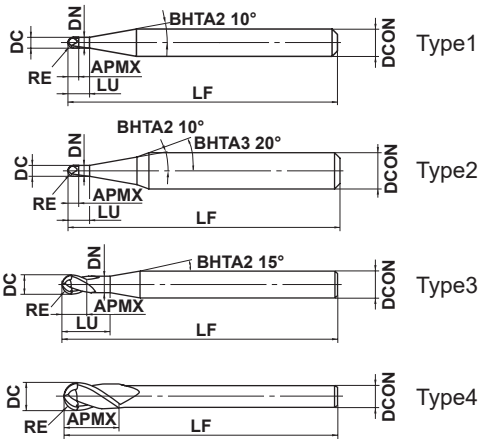
RE = Corner Radius
DC = Cutting Dia.
APMX = Depth of Cut Max.
LU = Usable Length
DN = Neck Dia.
LF = Functional Length
DCON = Connection Dia.

● : **Inventory maintained in Japan.**

VFR2SB

Ball nose, Short cut length, 2-Flute

Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-Hardened Steel,Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Titanium Alloy, Heat Resistant Alloy	Copper Alloy	Aluminium Alloy
	○	◎	◎				



RE≤6	RE>6			
±0.005	±0.010			
DCON=3	4≤DCON≤6	8≤DCON≤10	DCON=12	DCON=20
0 - 0.004	0 - 0.005	0 - 0.006	0 - 0.008	0 - 0.009

h5

●Optimisation of the flute geometry, helix and rake angles have improved the overall edge strength.

(mm)

Order Number	RE	DC	APMX	LU	DN	LF	DCON	* No.F	Stock	Type
VFR2SBR0010	0.1	0.2	0.2	0.4	0.17	45	4	2	●	1
VFR2SBR0010S06	0.1	0.2	0.2	0.4	0.17	50	6	2	●	2
VFR2SBR0015	0.15	0.3	0.3	0.6	0.27	45	4	2	●	1
VFR2SBR0015S06	0.15	0.3	0.3	0.6	0.27	50	6	2	●	2
VFR2SBR0020	0.2	0.4	0.4	0.8	0.36	45	4	2	●	1
VFR2SBR0020S06	0.2	0.4	0.4	0.8	0.36	50	6	2	●	2
VFR2SBR0030	0.3	0.6	0.6	1.2	0.56	45	4	2	●	3
VFR2SBR0030S06	0.3	0.6	0.6	1.2	0.56	50	6	2	●	3
VFR2SBR0040	0.4	0.8	0.8	1.6	0.76	45	4	2	●	3
VFR2SBR0040S06	0.4	0.8	0.8	1.6	0.76	50	6	2	●	3
VFR2SBR0050	0.5	1	1	2	0.94	45	4	2	●	3
VFR2SBR0050S06	0.5	1	1	2	0.94	50	6	2	●	3
VFR2SBR0060	0.6	1.2	1.2	2.4	1.14	45	4	2	●	3
VFR2SBR0060S06	0.6	1.2	1.2	2.4	1.14	50	6	2	●	3
VFR2SBR0070	0.7	1.4	1.4	2.8	1.34	45	4	2	●	3
VFR2SBR0070S06	0.7	1.4	1.4	2.8	1.34	50	6	2	●	3
VFR2SBR0075	0.75	1.5	1.5	3	1.44	45	4	2	●	3
VFR2SBR0075S06	0.75	1.5	1.5	3	1.44	50	6	2	●	3
VFR2SBR0080	0.8	1.6	1.6	3.2	1.54	45	4	2	●	3
VFR2SBR0080S06	0.8	1.6	1.6	3.2	1.54	50	6	2	●	3
VFR2SBR0090	0.9	1.8	1.8	3.6	1.74	45	4	2	●	3
VFR2SBR0090S06	0.9	1.8	1.8	3.6	1.74	50	6	2	●	3
VFR2SBR0100	1	2	2	4	1.9	50	4	2	●	3
VFR2SBR0100S06	1	2	2	4	1.9	60	6	2	●	3
VFR2SBR0125S06	1.25	2.5	2.5	5	2.4	60	6	2	●	3
VFR2SBR0150	1.5	3	3	6	2.9	70	6	2	●	3
VFR2SBR0150S03	1.5	3	3	—	—	60	3	2	●	4
VFR2SBR0200	2	4	4	8	3.9	70	6	2	●	3
VFR2SBR0200S04	2	4	4	—	—	60	4	2	●	4
VFR2SBR0250	2.5	5	5	10	4.9	80	6	2	●	3
VFR2SBR0300	3	6	12	—	—	80	6	2	●	4
VFR2SBR0400	4	8	14	—	—	90	8	2	●	4
VFR2SBR0500	5	10	18	—	—	100	10	2	●	4
VFR2SBR0600	6	12	22	—	—	110	12	2	●	4
VFR2SBR0800	8	16	30	—	—	140	16	2	●	4
VFR2SBR1000	10	20	38	—	—	160	20	2	●	4

* Number of Flutes

RE = Corner Radius
DC = Cutting Dia.
APMX = Depth of Cut Max.
LU = Usable Length
DN = Neck Dia.
LF = Functional Length
DCON = Connection Dia.

● : **Inventory maintained in Japan.**

Ball nose, Short cut length, Short shank, 2-Flute **VFR2SSB**

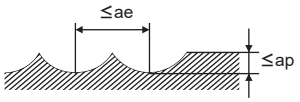
Ball nose, Short cut length, 2-Flute **VFR2SB**

Recommended Cutting Conditions

(mm)

Workpiece Material	Hardened Steel (45－55HRC) JIS SKD61 etc.						Hardened Steel (55－62HRC) JIS SKD11 etc.						Hardened Steel (62－70HRC) JIS SKS, SKH etc.					
R **RE**	α≤15°		α>15°		Depth of cut ap	Depth of cut ae	α≤15°		α>15°		Depth of cut ap	Depth of cut ae	α≤15°		α>15°		Depth of cut ap	Depth of cut ae
	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)			Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)			Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)		
R 0.1	40000	320	40000	240	0.003	0.02	40000	320	40000	160	0.003	0.02	40000	320	40000	160	0.002	0.02
R 0.15	40000	640	40000	560	0.01	0.03	40000	640	40000	400	0.007	0.03	40000	640	40000	400	0.005	0.03
R 0.2	40000	1600	40000	1200	0.02	0.04	40000	1400	40000	1000	0.015	0.04	40000	1200	40000	1000	0.01	0.04
R 0.3	40000	3200	40000	1600	0.03	0.06	40000	2800	40000	1200	0.025	0.06	40000	2000	40000	1200	0.02	0.06
R 0.4	40000	6400	40000	2400	0.05	0.08	40000	4000	40000	1600	0.04	0.08	40000	2800	40000	1600	0.03	0.08
R 0.5	40000	8000	40000	3200	0.06	0.10	40000	5600	40000	2400	0.05	0.10	40000	3600	32000	1300	0.04	0.10
R 0.75	40000	9600	40000	4000	0.09	0.15	40000	7200	32000	2500	0.075	0.15	32000	4500	21000	1200	0.05	0.15
R 1	40000	9600	39000	4700	0.11	0.20	40000	8000	24000	2400	0.1	0.20	24000	3800	16000	1000	0.07	0.20
R 1.25	40000	10400	32000	4500	0.12	0.25	37000	8100	19000	2300	0.11	0.25	19000	3400	13000	1000	0.08	0.25
R 1.5	40000	12000	27000	4300	0.13	0.30	32000	7700	16000	2200	0.12	0.30	16000	3200	11000	880	0.09	0.30
R 2	32000	10880	20000	3600	0.15	0.40	24000	6200	12000	1900	0.13	0.40	12000	2400	8000	800	0.1	0.40
R 2.5	25000	9000	16000	2900	0.20	0.50	19000	5300	9600	1700	0.15	0.50	9600	2100	6000	600	0.1	0.50
R 3	21000	8400	13000	2600	0.25	0.60	16000	4800	8000	1600	0.2	0.60	8000	1700	5000	600	0.11	0.60
R 4	16000	6400	10000	2000	0.30	0.80	12000	3600	6000	1200	0.2	0.80	6000	1400	4000	480	0.11	0.80
R 5	13000	5200	8000	1700	0.50	1.00	10000	3200	4800	960	0.2	1.00	4800	1100	3000	420	0.12	1.00
R 6	9000	3600	6000	1300	0.50	1.20	7000	2200	3600	720	0.3	1.20	3600	860	2200	310	0.12	1.20
R 8	6000	2400	4000	1000	0.50	1.60	5000	1600	2500	500	0.3	1.60	2500	650	1500	240	0.15	1.60
R10	4500	1800	3000	780	0.50	2.00	4000	1300	1800	360	0.3	2.00	1800	470	1000	160	0.15	2.00

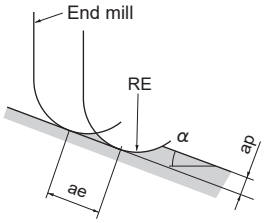
Depth of cut



Note 1) If the rigidity of the machine or the workpiece materials installation is very low, or chattering and noise are generated, please adjust the revolution, feed rate and depth of cut.

Note 2) If the rigidity of the machine or the work materials installation is very low, or chattering and noise are generated, reduce the revolution and feed rate proportionately.

Note 3) α is the inclination angle of the machined surface.

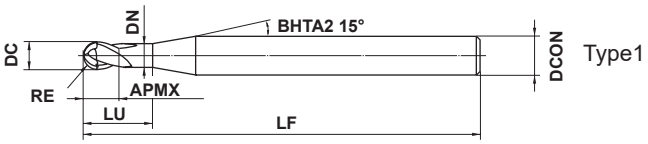


ae:Pick Feed

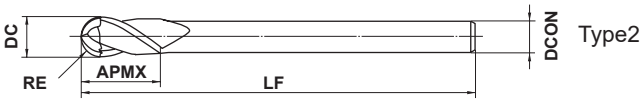
VFR2SBF

Ball nose, Short cut length, 2-Flute, For mirror finishing

Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-Hardened Steel,Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Titanium Alloy, Heat Resistant Alloy	Copper Alloy	Aluminium Alloy
	○	◎	◎				



Type1



Type2

RE≤3				
±0.010				
4≤DCON≤6				
0 - 0.005				

● New ball nose geometry for mirror finishing.

(mm)

Order Number	RE	DC	APMX	LU	DN	LF	DCON	* No.F	Stock	Type
VFR2SBFR0050	0.5	1	1	2	0.94	45	4	2	●	1
VFR2SBFR0075	0.75	1.5	1.5	3	1.44	45	4	2	●	1
VFR2SBFR0100	1	2	2	4	1.9	60	6	2	●	1
VFR2SBFR0125	1.25	2.5	2.5	5	2.4	60	6	2	●	1
VFR2SBFR0150	1.5	3	3	6	2.9	70	6	2	●	1
VFR2SBFR0200	2	4	4	8	3.9	70	6	2	●	1
VFR2SBFR0250	2.5	5	5	10	4.9	80	6	2	●	1
VFR2SBFR0300	3	6	12	—	—	80	6	2	●	2

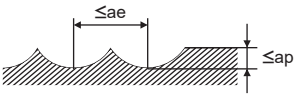
* Number of Flutes

RE = Corner Radius
DC = Cutting Dia.
APMX = Depth of Cut Max.
LU = Usable Length
DN = Neck Dia.
LF = Functional Length
DCON = Connection Dia.

● : **Inventory maintained in Japan.**

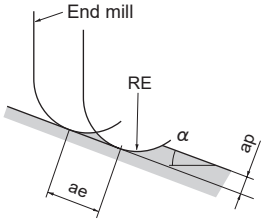
Recommended Cutting Conditions

(mm)

Workpiece Material	Carbon Steel, Alloy Steel (180—280HB) Alloy Steel (≤350HB), Pre-hardened Steel (35— 45HRC) Hardened Steel (45— 52HRC), Hardened Steel (55— 62HRC) JIS S45C, SCM440, SKD, SKT, NAK, PX5, SKD61, SKT4, SKD11 etc.						Hardened Steel (62—70HRC) SKS, SKH etc.					
R **RE**	$\alpha \leq 15°$		$\alpha > 15°$		Depth of cut ap	Depth of cut ae	$\alpha \leq 15°$		$\alpha > 15°$		Depth of cut ap	Depth of cut ae
	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)			Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)		
R 0.5	40000	800	40000	800	0.007	0.007	40000	560	40000	560	0.005	0.005
R 0.75	40000	800	40000	800	0.009	0.009	40000	560	40000	560	0.007	0.007
R 1.0	35000	1050	35000	1050	0.011	0.011	35000	700	35000	700	0.009	0.009
R 1.25	35000	1050	35000	1050	0.013	0.013	35000	700	35000	700	0.011	0.011
R 1.5	35000	1050	35000	1050	0.015	0.015	35000	700	35000	700	0.013	0.013
R 2.0	25000	1000	25000	1000	0.017	0.017	25000	750	25000	750	0.015	0.015
R 2.5	25000	1000	25000	1000	0.020	0.020	25000	750	25000	750	0.015	0.015
R 3.0	25000	1000	25000	1000	0.020	0.020	25000	750	25000	750	0.015	0.015
Depth of cut												

Note 1) The tools are recommended for use only when finishing.
Note 2) Air blowing or oil mist are recommended as coolants.
Note 3) Note the following points when using the tools:
- Avoid using equipment abruptly without proper preparation. After sufficiently energizing equipment, ensure that there will be no changes to the depth of cut due to elongation of the main axis during machining etc.
- If the tools are used immediately after rough machining of a surface, large uneven areas (cusp heights) will cause deflection of the tools and waviness of the machined surface. Therefore, it is recommended to add a medium finish machining process which uses the same value of ae as indicated in the table above.

Note 4) α is the inclination angle of the machined surface.

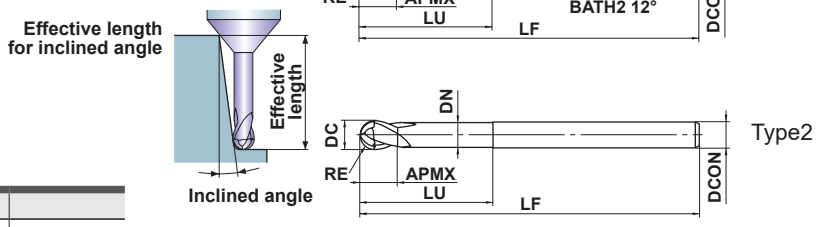


ae:Pick Feed

VFR2XLB

Ball nose, Long neck, 2-Flute

Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-Hardened Steel,Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Titanium Alloy, Heat Resistant Alloy	Copper Alloy	Aluminium Alloy
	○	◎	◎				



RE				
±0.005				
4≤DCON≤6				
h5 0 -0.005				

●Precise machining of vertical walls is possible due to a back taper and a strong, seamless ball nose cutting edge geometry.

(mm)

Order Number	RE	DC	APMX	LU	DN	B2	LF	DCON	No.F*	Stock	Type	Effective length for inclined angle			
												0.5°	1°	2°	3°
VFR2XLBR0010N005	0.1	0.2	0.15	0.5	0.18	11.5°	50	4	2	●	1	0.5	0.5	0.6	0.7
VFR2XLBR0010N010	0.1	0.2	0.15	1	0.18	10.9°	50	4	2	●	1	1	1.1	1.2	1.3
VFR2XLBR0015N010	0.15	0.3	0.24	1	0.28	10.9°	50	4	2	●	1	1	1.1	1.2	1.3
VFR2XLBR0015N015	0.15	0.3	0.24	1.5	0.28	10.4°	50	4	2	●	1	1.6	1.6	1.8	2
VFR2XLBR0015N020	0.15	0.3	0.24	2	0.28	9.9°	50	4	2	●	1	2.1	2.2	2.4	2.6
VFR2XLBR0020N010	0.2	0.4	0.3	1	0.37	11°	50	4	2	●	1	1	1.1	1.2	1.3
VFR2XLBR0020N015	0.2	0.4	0.3	1.5	0.37	10.4°	50	4	2	●	1	1.5	1.6	1.7	1.9
VFR2XLBR0020N020	0.2	0.4	0.3	2	0.37	9.9°	50	4	2	●	1	2.1	2.2	2.3	2.6
VFR2XLBR0020N025	0.2	0.4	0.3	2.5	0.37	9.5°	50	4	2	●	1	2.6	2.7	2.9	3.3
VFR2XLBR0020N030	0.2	0.4	0.3	3	0.37	9.1°	50	4	2	●	1	3.1	3.2	3.5	3.9
VFR2XLBR0020N040	0.2	0.4	0.3	4	0.37	8.4°	50	4	2	●	1	4.2	4.3	4.7	5.2
VFR2XLBR0025N015	0.25	0.5	0.37	1.5	0.47	10.4°	50	4	2	●	1	1.5	1.6	1.7	1.9
VFR2XLBR0025N020	0.25	0.5	0.37	2	0.47	9.9°	50	4	2	●	1	2.1	2.1	2.3	2.6
VFR2XLBR0025N025	0.25	0.5	0.37	2.5	0.47	9.5°	50	4	2	●	1	2.6	2.7	2.9	3.2
VFR2XLBR0025N030	0.25	0.5	0.37	3	0.47	9.1°	50	4	2	●	1	3.1	3.2	3.5	3.9
VFR2XLBR0025N040	0.25	0.5	0.37	4	0.47	8.3°	50	4	2	●	1	4.1	4.3	4.7	5.2
VFR2XLBR0030N020	0.3	0.6	0.45	2	0.57	9.9°	50	4	2	●	1	2.1	2.2	2.4	2.6
VFR2XLBR0030N020S06	0.3	0.6	0.45	2	0.57	10.6°	50	6	2	●	1	2.1	2.2	2.4	2.6
VFR2XLBR0030N030	0.3	0.6	0.45	3	0.57	9°	50	4	2	●	1	3.1	3.3	3.6	4
VFR2XLBR0030N030S06	0.3	0.6	0.45	3	0.57	9.9°	50	6	2	●	1	3.1	3.3	3.6	4
VFR2XLBR0030N040	0.3	0.6	0.45	4	0.57	8.2°	50	4	2	●	1	4.2	4.4	4.8	5.3
VFR2XLBR0030N050	0.3	0.6	0.45	5	0.57	7.6°	50	4	2	●	1	5.2	5.5	6	6.6
VFR2XLBR0030N060	0.3	0.6	0.45	6	0.57	7.1°	50	4	2	●	1	6.3	6.6	7.2	7.9
VFR2XLBR0040N030	0.4	0.8	0.6	3	0.77	8.9°	50	4	2	●	1	3.1	3.3	3.6	3.9
VFR2XLBR0040N040	0.4	0.8	0.6	4	0.77	8.2°	50	4	2	●	1	4.2	4.4	4.8	5.2
VFR2XLBR0040N060	0.4	0.8	0.6	6	0.77	6.9°	50	4	2	●	1	6.3	6.5	7.2	7.9
VFR2XLBR0040N080	0.4	0.8	0.6	8	0.77	6°	50	4	2	●	1	8.4	8.7	9.5	10.6
VFR2XLBR0050N030	0.5	1	0.75	3	0.96	8.7°	50	4	2	●	1	3.2	3.4	3.7	4.1
VFR2XLBR0050N030S06	0.5	1	0.75	3	0.96	9.8°	50	6	2	●	1	3.2	3.4	3.7	4.1
VFR2XLBR0050N040	0.5	1	0.75	4	0.96	7.9°	50	4	2	●	1	4.3	4.5	4.9	5.4
VFR2XLBR0050N040S06	0.5	1	0.75	4	0.96	9.2°	50	6	2	●	1	4.3	4.5	4.9	5.4
VFR2XLBR0050N060	0.5	1	0.75	6	0.96	6.7°	50	4	2	●	1	6.3	6.5	7.2	7.9

* Number of Flutes

● : Inventory maintained in Japan.

(mm)

Order Number	RE	DC	APMX	LU	DN	B2	LF	DCON	No.F*	Stock	Type	Effective length for inclined angle			
												0.5°	1°	2°	3°
VFR2XLBR0050N060S06	0.5	1	0.75	6	0.96	8.2°	50	6	2	●	1	6.3	6.5	7.2	7.9
VFR2XLBR0050N080	0.5	1	0.75	8	0.96	5.8°	50	4	2	●	1	8.5	8.9	9.7	10.7
VFR2XLBR0050N100	0.5	1	0.75	10	0.96	5.1°	50	4	2	●	1	10.6	11.1	12.1	13.4
VFR2XLBR0050N120	0.5	1	0.75	12	0.96	4.6°	50	4	2	●	1	12.7	13.2	14.5	16
VFR2XLBR0075N060	0.75	1.5	1.1	6	1.44	6.3°	50	4	2	●	1	6.3	6.6	7.2	7.9
VFR2XLBR0075N060S06	0.75	1.5	1.1	6	1.44	8°	50	6	2	●	1	6.3	6.6	7.2	7.9
VFR2XLBR0075N080	0.75	1.5	1.1	8	1.44	5.4°	50	4	2	●	1	8.4	8.8	9.6	10.6
VFR2XLBR0075N080S06	0.75	1.5	1.1	8	1.44	7.2°	50	6	2	●	1	8.4	8.8	9.6	10.6
VFR2XLBR0075N100	0.75	1.5	1.1	10	1.44	4.7°	50	4	2	●	1	10.5	11	12	13.2
VFR2XLBR0075N120	0.75	1.5	1.1	12	1.44	4.2°	50	4	2	●	1	12.6	13.1	14.4	15.9
VFR2XLBR0075N140	0.75	1.5	1.1	14	1.44	3.8°	50	4	2	●	1	14.7	15.3	16.8	18.5
VFR2XLBR0075N160	0.75	1.5	1.1	16	1.44	3.4°	60	4	2	●	1	16.8	17.5	19.2	21.2
VFR2XLBR0100N060	1	2	1.5	6	1.94	5.8°	50	4	2	●	1	6.3	6.6	7.1	7.8
VFR2XLBR0100N060S06	1	2	1.5	6	1.94	7.8°	50	6	2	●	1	6.3	6.6	7.1	7.8
VFR2XLBR0100N080	1	2	1.5	8	1.94	4.8°	50	4	2	●	1	8.4	8.8	9.5	10.5
VFR2XLBR0100N080S06	1	2	1.5	8	1.94	6.9°	50	6	2	●	1	8.4	8.8	9.5	10.5
VFR2XLBR0100N100	1	2	1.5	10	1.94	4.2°	50	4	2	●	1	10.5	10.9	11.9	13.1
VFR2XLBR0100N100S06	1	2	1.5	10	1.94	6.2°	50	6	2	●	1	10.5	10.9	11.9	13.1
VFR2XLBR0100N120	1	2	1.5	12	1.94	3.6°	50	4	2	●	1	12.6	13.1	14.3	15.8
VFR2XLBR0100N120S06	1	2	1.5	12	1.94	5.6°	50	6	2	●	1	12.6	13.1	14.3	15.8
VFR2XLBR0100N160	1	2	1.5	16	1.94	2.9°	60	4	2	●	1	16.8	17.5	19.1	*
VFR2XLBR0100N160S06	1	2	1.5	16	1.94	4.7°	60	6	2	●	1	16.8	17.5	19.1	21.1
VFR2XLBR0100N200	1	2	1.5	20	1.94	2.4°	60	4	2	●	1	20.9	21.8	23.9	*
VFR2XLBR0100N200S06	1	2	1.5	20	1.94	4°	60	6	2	●	1	20.9	21.8	23.9	26.4
VFR2XLBR0125N100	1.25	2.5	1.9	10	2.4	3.5°	60	4	2	●	1	10.4	10.8	11.8	12.9
VFR2XLBR0125N150	1.25	2.5	1.9	15	2.4	2.5°	60	4	2	●	1	15.6	16.3	17.8	*
VFR2XLBR0150N100	1.5	3	2.3	10	2.9	5.5°	60	6	2	●	1	10.4	10.8	11.7	12.9
VFR2XLBR0150N120	1.5	3	2.3	12	2.9	4.9°	60	6	2	●	1	12.5	13	14.1	15.5
VFR2XLBR0150N160	1.5	3	2.3	16	2.9	4°	70	6	2	●	1	16.7	17.3	18.9	20.8
VFR2XLBR0150N200	1.5	3	2.3	20	2.9	3.4°	70	6	2	●	1	20.8	21.7	23.7	26.1
VFR2XLBR0150N250	1.5	3	2.3	25	2.9	2.8°	70	6	2	●	1	26.1	27.2	29.7	*
VFR2XLBR0150N300	1.5	3	2.3	30	2.9	2.5°	70	6	2	●	1	31.3	32.6	35.7	*
VFR2XLBR0200N100	2	4	3	10	3.9	4.5°	70	6	2	●	1	10.4	10.8	11.6	12.7
VFR2XLBR0200N120	2	4	3	12	3.9	3.9°	70	6	2	●	1	12.5	12.9	14	15.4
VFR2XLBR0200N160	2	4	3	16	3.9	3.1°	70	6	2	●	1	16.6	17.3	18.8	20.7
VFR2XLBR0200N200	2	4	3	20	3.9	2.6°	70	6	2	●	1	20.8	21.7	23.6	*
VFR2XLBR0200N250	2	4	3	25	3.9	2.1°	70	6	2	●	1	26	27.1	29.6	*
VFR2XLBR0200N300	2	4	3	30	3.9	1.8°	70	6	2	●	1	31.2	32.6	*	*
VFR2XLBR0250N200	2.5	5	3.8	20	4.9	1.5°	70	6	2	●	1	20.8	21.6	*	*
VFR2XLBR0250N250	2.5	5	3.8	25	4.9	1.2°	70	6	2	●	1	26	27.1	*	*
VFR2XLBR0300N180	3	6	6	18	5.85	—	80	6	2	●	2	*	*	*	*
VFR2XLBR0300N300	3	6	6	30	5.85	—	80	6	2	●	2	*	*	*	*

* Number of Flutes

* No interference

RE = Corner Radius
DC = Cutting Dia.
APMX = Depth of Cut Max.
LU = Usable Length
DN = Neck Dia.
LF = Functional Length
DCON = Connection Dia.

VFR2XLB

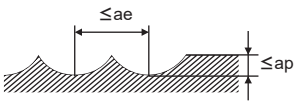
Ball nose, Long neck, 2-Flute

Recommended Cutting Conditions

(mm)

Workpiece Material		Hardened Steel (45－55HRC)				Hardened Steel (55－70HRC)			
R **RE**	Neck length **LU**	Revolution (min^{-1})	Feed Rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**	Revolution (min^{-1})	Feed Rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**
0.1	**0.5**	40000	300	0.003	0.01	40000	300	0.002	0.01
0.1	**1**	40000	300	0.002	0.01	40000	300	0.002	0.01
0.15	**1**	40000	500	0.007	0.015	40000	500	0.005	0.015
0.15	**1.5**	40000	500	0.005	0.015	40000	500	0.003	0.015
0.15	**2**	40000	500	0.003	0.015	40000	500	0.002	0.015
0.2	**1**	40000	1400	0.015	0.02	40000	1400	0.01	0.02
0.2	**1.5**	40000	1000	0.01	0.02	40000	1000	0.006	0.02
0.2	**2**	40000	1000	0.01	0.02	40000	1000	0.006	0.02
0.2	**2.5**	40000	700	0.005	0.02	40000	700	0.003	0.02
0.2	**3**	40000	700	0.005	0.02	40000	700	0.003	0.02
0.2	**4**	40000	600	0.004	0.02	40000	500	0.003	0.02
0.25	**1.5**	40000	2000	0.02	0.025	40000	2000	0.015	0.025
0.25	**2**	40000	2000	0.02	0.025	40000	2000	0.015	0.025
0.25	**2.5**	40000	1500	0.015	0.025	40000	1500	0.01	0.025
0.25	**3**	40000	1200	0.015	0.025	40000	1200	0.01	0.025
0.25	**4**	36000	900	0.1	0.025	36000	900	0.007	0.025
0.3	**2**	40000	2800	0.03	0.03	40000	2800	0.02	0.03
0.3	**3**	40000	2800	0.03	0.03	40000	2800	0.02	0.03
0.3	**4**	35000	2000	0.02	0.03	35000	2000	0.015	0.03
0.3	**5**	30000	1000	0.01	0.03	30000	1000	0.007	0.03
0.3	**6**	30000	800	0.008	0.03	30000	800	0.005	0.03
0.4	**3**	40000	3000	0.04	0.04	40000	3000	0.03	0.04
0.4	**4**	40000	3000	0.02	0.04	40000	3000	0.015	0.04
0.4	**6**	30000	1600	0.02	0.04	30000	1600	0.01	0.04
0.4	**8**	25000	1000	0.01	0.04	25000	1000	0.007	0.04
0.5	**3**	40000	4000	0.05	0.05	40000	4000	0.04	0.05
0.5	**4**	40000	4000	0.05	0.05	40000	4000	0.04	0.05
0.5	**6**	35000	2000	0.03	0.05	35000	2000	0.02	0.05
0.5	**8**	30000	1600	0.02	0.05	30000	1600	0.01	0.05
0.5	**10**	20000	1000	0.01	0.05	20000	1000	0.01	0.05
0.5	**12**	20000	1000	0.01	0.05	20000	800	0.008	0.05
0.75	**6**	40000	5000	0.07	0.075	40000	4000	0.06	0.075
0.75	**8**	40000	5000	0.07	0.075	40000	3500	0.06	0.075
0.75	**10**	40000	4500	0.06	0.075	40000	2400	0.06	0.075
0.75	**12**	32000	3400	0.04	0.075	32000	2000	0.04	0.075
0.75	**14**	16000	1500	0.04	0.075	16000	1200	0.03	0.075
0.75	**16**	13000	1200	0.03	0.075	13000	1200	0.02	0.075
1	**6**	40000	6000	0.1	0.1	40000	3400	0.1	0.1
1	**8**	40000	5000	0.1	0.1	40000	3000	0.1	0.1
1	**10**	40000	5000	0.08	0.1	40000	3000	0.07	0.1
1	**12**	40000	5000	0.08	0.1	40000	2600	0.05	0.1
1	**16**	32000	3500	0.05	0.1	32000	1700	0.03	0.1
1	**20**	10000	1000	0.04	0.1	10000	1000	0.03	0.1
1.25	**10**	36000	5000	0.12	0.25	36000	2600	0.11	0.25
1.25	**15**	36000	4600	0.08	0.25	36000	2000	0.075	0.25

Depth of Cut



Note 1) When the inclination angle of machined surface is large, or machining with large cutting load such as in a corner area, reduce the revolution and feed rate.

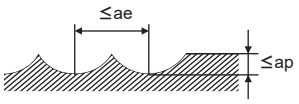
Note 2) If the depth of cut is shallow, the revolution and feed rate can be increased.

Note 3) Cutting conditions may differ considerably due to the tool overhang, depth of cut and machine tool condition. Please use the table above as a reference starting point.

(mm)

Workpiece Material		Hardened Steel (45－55HRC)				Hardened Steel (55－70HRC)			
R **RE**	Neck length **LU**	Revolution (min^{-1})	Feed Rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**	Revolution (min^{-1})	Feed Rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**
1.5	**10**	32000	5100	0.15	0.3	32000	2200	0.15	0.3
1.5	**12**	32000	5100	0.13	0.3	32000	2200	0.13	0.3
1.5	**16**	32000	4500	0.1	0.3	32000	1800	0.1	0.3
1.5	**20**	27000	3800	0.1	0.3	27000	1600	0.06	0.3
1.5	**25**	21000	2700	0.08	0.3	21000	1200	0.06	0.3
1.5	**30**	9000	1000	0.08	0.3	9000	700	0.05	0.3
2	**10**	24000	4800	0.2	0.4	24000	2200	0.2	0.4
2	**12**	24000	4800	0.2	0.4	24000	2200	0.2	0.4
2	**16**	24000	3800	0.15	0.4	24000	1500	0.15	0.4
2	**20**	24000	3800	0.15	0.4	24000	1500	0.15	0.4
2	**25**	24000	3800	0.15	0.4	24000	1100	0.1	0.4
2	**30**	24000	3000	0.1	0.4	24000	1100	0.08	0.4
2.5	**20**	19000	3400	0.2	0.5	19000	1400	0.2	0.5
2.5	**25**	19000	3400	0.2	0.5	19000	1400	0.2	0.5
3	**18**	16000	3500	0.25	0.6	16000	1000	0.2	0.6
3	**30**	16000	3500	0.2	0.6	16000	1000	0.2	0.6

Depth of Cut

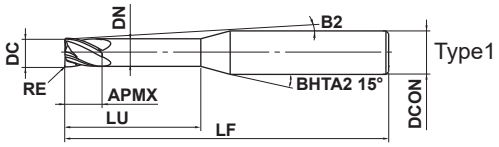


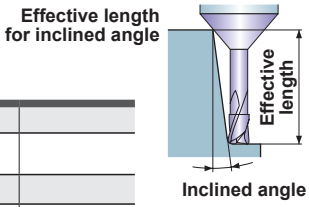
Note 1) When the inclination angle of machined surface is large, or machining with large cutting load such as in a corner area, reduce the revolution and feed rate.
Note 2) If the depth of cut is shallow, the revolution and feed rate can be increased.
Note 3) Cutting conditions may differ considerably due to the tool overhang, depth of cut and machine tool condition. Please use the table above as a reference starting point.

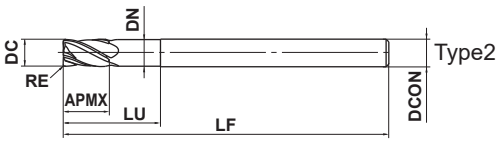
VFRPSRB

Conner radius, Short cut length, 4-Flute

Carbon Steel, Alloy Steel, Cast Iron (<30HRC)	Tool Steel, Pre-Hardened Steel,Hardened Steel (≤45HRC)	Hardened Steel (≤55HRC)	Hardened Steel (>55HRC)	Austenitic Stainless Steel	Titanium Alloy, Heat Resistant Alloy	Copper Alloy	Aluminium Alloy
	○	◎	◎				







0.5≤DC≤6	6<DC≤12			
±0.005	±0.007			
0.5≤DC≤6	6<DC≤12			
0 - 0.01	0 - 0.015			
DCON=6	8≤DCON≤10	DCON=12		
0 - 0.005	0 - 0.006	0 - 0.008		

● Completely seamless curved R edge. DC≥1.5

● The wiper edge and strong back taper achieve high precision machining. 1.5≤DC≤5

(mm)

Order Number	DC	RE	APMX	LU	DN	B2	LF	DCON	No.F*	Stock	Type	Effective length for inclined angle			
												0.5°	1°	2°	3°
VFRPSRBD0050R005N020	0.5	0.05	0.5	2	0.47	12.6	50	6	4	●	1	2.1	2.2	2.3	2.5
VFRPSRBD0050R010N020	0.5	0.1	0.5	2	0.47	12.7	50	6	4	●	1	2.1	2.2	2.3	2.5
VFRPSRBD0060R005N020	0.6	0.05	0.6	2	0.57	12.5	50	6	4	●	1	2.1	2.2	2.4	2.6
VFRPSRBD0060R010N020	0.6	0.1	0.6	2	0.57	12.5	50	6	4	●	1	2.1	2.2	2.3	2.6
VFRPSRBD0060R010N040	0.6	0.1	0.6	4	0.57	10.8	50	6	4	●	1	4.2	4.4	4.7	5.1
VFRPSRBD0060R020N020	0.6	0.2	0.6	2	0.57	12.6	50	6	4	●	1	2.1	2.2	2.2	2.6
VFRPSRBD0080R005N040	0.8	0.05	0.8	4	0.77	10.7	50	6	4	●	1	4.2	4.4	4.7	5.1
VFRPSRBD0080R010N040	0.8	0.1	0.8	4	0.77	10.7	50	6	4	●	1	4.2	4.4	4.7	5.1
VFRPSRBD0080R020N040	0.8	0.2	0.8	4	0.77	10.8	50	6	4	●	1	4.2	4.4	4.7	5.1
VFRPSRBD0080R030N040	0.8	0.3	0.8	4	0.77	10.8	50	6	4	●	1	4.2	4.4	4.7	5
VFRPSRBD0100R005N040	1	0.05	1	4	0.96	10.4	50	6	4	●	1	4.3	4.5	4.9	5.4
VFRPSRBD0100R010N040	1	0.1	1	4	0.96	10.4	50	6	4	●	1	4.3	4.5	4.9	5.4
VFRPSRBD0100R010N060	1	0.1	1	6	0.96	9.1	50	6	4	●	1	6.4	6.7	7.3	7.9
VFRPSRBD0100R020N040	1	0.2	1	4	0.96	10.5	50	6	4	●	1	4.3	4.5	4.7	5.3
VFRPSRBD0100R020N060	1	0.2	1	6	0.96	9.2	50	6	4	●	1	6.4	6.7	7.3	7.8
VFRPSRBD0100R030N040	1	0.3	1	4	0.96	10.5	50	6	4	●	1	4.3	4.5	4.6	5.3
VFRPSRBD0100R040N040	1	0.4	1	4	0.96	10.6	50	6	4	●	1	4.3	4.5	4.5	5.3
VFRPSRBD0150R010N040	1.5	0.1	1.5	4	1.42	10.2	50	6	4	●	1	4.2	4.4	4.8	5.2
VFRPSRBD0150R010N060	1.5	0.1	1.5	6	1.42	8.8	50	6	4	●	1	6.3	6.6	7.1	7.7
VFRPSRBD0150R010N100	1.5	0.1	1.5	10	1.42	6.9	50	6	4	●	1	10.5	10.9	11.7	12.7
VFRPSRBD0150R020N040	1.5	0.2	1.5	4	1.42	10.2	50	6	4	●	1	4.2	4.4	4.6	5.2
VFRPSRBD0150R020N060	1.5	0.2	1.5	6	1.42	8.8	50	6	4	●	1	6.3	6.6	7.1	7.7
VFRPSRBD0150R020N100	1.5	0.2	1.5	10	1.42	7	50	6	4	●	1	10.5	10.9	11.7	12.6
VFRPSRBD0150R030N040	1.5	0.3	1.5	4	1.42	10.3	50	6	4	●	1	4.2	4.4	4.5	5.2
VFRPSRBD0150R030N060	1.5	0.3	1.5	6	1.42	8.9	50	6	4	●	1	6.3	6.6	7.1	7.6
VFRPSRBD0150R030N100	1.5	0.3	1.5	10	1.42	7	50	6	4	●	1	10.5	10.9	11.7	12.6
VFRPSRBD0150R050N040	1.5	0.5	1.5	4	1.42	10.5	50	6	4	●	1	4.2	4.4	4.3	5.1
VFRPSRBD0150R050N060	1.5	0.5	1.5	6	1.42	9	50	6	4	●	1	6.3	6.6	7.1	7.6
VFRPSRBD0150R050N100	1.5	0.5	1.5	10	1.42	7.1	50	6	4	●	1	10.5	10.9	11.7	12.6
VFRPSRBD0200R010N060	2	0.1	2	6	1.9	8.4	50	6	4	●	1	6.3	6.6	7.1	7.6
VFRPSRBD0200R010N100	2	0.1	2	10	1.9	6.5	50	6	4	●	1	10.5	10.9	11.7	12.6
VFRPSRBD0200R010N150	2	0.1	2	15	1.9	5.1	50	6	4	●	1	15.7	16.2	17.4	18.8
VFRPSRBD0200R020N060	2	0.2	2	6	1.9	8.4	50	6	4	●	1	6.3	6.6	7.1	7.6
VFRPSRBD0200R020N100	2	0.2	2	10	1.9	6.5	50	6	4	●	1	10.5	10.9	11.7	12.6

* Number of Flutes

RE = Corner Radius **LU** = Usable Length **DCON** = Connection Dia.

DC = Cutting Dia. **DN** = Neck Dia.

APMX = Depth of Cut Max. **LF** = Functional Length

● : **Inventory maintained in Japan.**

(mm)

Order Number	DC	RE	APMX	LU	DN	B2	LF	DCON	No.F*	Stock	Type	Effective length for inclined angle			
												0.5°	1°	2°	3°
VFRPSRBD0200R020N150	2	0.2	2	15	1.9	5.1	50	6	4	●	1	15.7	16.2	17.4	18.8
VFRPSRBD0200R030N060	2	0.3	2	6	1.9	8.5	50	6	4	●	1	6.3	6.6	7	7.6
VFRPSRBD0200R030N100	2	0.3	2	10	1.9	6.6	50	6	4	●	1	10.5	10.8	11.6	12.6
VFRPSRBD0200R030N150	2	0.3	2	15	1.9	5.1	50	6	4	●	1	15.7	16.2	17.4	18.8
VFRPSRBD0200R030N200	2	0.3	2	20	1.9	4.2	60	6	4	●	1	20.8	21.5	23.1	25
VFRPSRBD0200R050N060	2	0.5	2	6	1.9	8.6	50	6	4	●	1	6.3	6.5	7	7.5
VFRPSRBD0200R050N100	2	0.5	2	10	1.9	6.6	50	6	4	●	1	10.5	10.8	11.6	12.5
VFRPSRBD0200R050N150	2	0.5	2	15	1.9	5.2	50	6	4	●	1	15.6	16.2	17.4	18.7
VFRPSRBD0200R050N200	2	0.5	2	20	1.9	4.2	60	6	4	●	1	20.8	21.5	23.1	24.9
VFRPSRBD0250R030N080	2.5	0.3	2.5	8	2.35	6.9	50	6	4	●	1	8.3	8.6	9.2	10
VFRPSRBD0250R030N150	2.5	0.3	2.5	15	2.35	4.7	50	6	4	●	1	15.6	16.1	17.3	18.7
VFRPSRBD0250R050N080	2.5	0.5	2.5	8	2.35	7	50	6	4	●	1	8.3	8.6	9.2	9.9
VFRPSRBD0250R050N150	2.5	0.5	2.5	15	2.35	4.7	50	6	4	●	1	15.6	16.1	17.3	18.6
VFRPSRBD0250R100N080	2.5	1	2.5	8	2.35	7.3	50	6	4	●	1	8.3	8.6	9.1	9.8
VFRPSRBD0300R010N100	3	0.1	3	10	2.85	5.5	60	6	4	●	1	10.4	10.8	11.6	12.5
VFRPSRBD0300R010N150	3	0.1	3	15	2.85	4.2	60	6	4	●	1	15.6	16.1	17.3	18.7
VFRPSRBD0300R020N100	3	0.2	3	10	2.85	5.5	60	6	4	●	1	10.4	10.8	11.6	12.5
VFRPSRBD0300R020N150	3	0.2	3	15	2.85	4.2	60	6	4	●	1	15.6	16.1	17.3	18.7
VFRPSRBD0300R020N200	3	0.2	3	20	2.85	3.4	60	6	4	●	1	20.7	21.5	23.1	24.9
VFRPSRBD0300R030N100	3	0.3	3	10	2.85	5.6	60	6	4	●	1	10.4	10.8	11.5	12.5
VFRPSRBD0300R030N150	3	0.3	3	15	2.85	4.2	60	6	4	●	1	15.6	16.1	17.3	18.7
VFRPSRBD0300R030N200	3	0.3	3	20	2.85	3.4	60	6	4	●	1	20.7	21.5	23	24.9
VFRPSRBD0300R050N100	3	0.5	3	10	2.85	5.6	60	6	4	●	1	10.4	10.7	11.5	12.4
VFRPSRBD0300R050N150	3	0.5	3	15	2.85	4.2	60	6	4	●	1	15.6	16.1	17.3	18.6
VFRPSRBD0300R050N200	3	0.5	3	20	2.85	3.4	60	6	4	●	1	20.7	21.4	23	24.8
VFRPSRBD0300R100N100	3	1	3	10	2.85	5.8	60	6	4	●	1	10.4	10.7	11.4	12.3
VFRPSRBD0300R100N150	3	1	3	15	2.85	4.3	60	6	4	●	1	15.5	16.1	17.2	18.5
VFRPSRBD0300R100N200	3	1	3	20	2.85	3.5	60	6	4	●	1	20.7	21.4	22.9	24.7
VFRPSRBD0400R010N120	4	0.1	4	12	3.85	3.6	60	6	4	●	1	12.5	12.9	13.9	15
VFRPSRBD0400R010N200	4	0.1	4	20	3.85	2.4	60	6	4	●	1	20.7	21.5	23.1	*
VFRPSRBD0400R020N120	4	0.2	4	12	3.85	3.7	60	6	4	●	1	12.5	12.9	13.9	15
VFRPSRBD0400R020N200	4	0.2	4	20	3.85	2.4	60	6	4	●	1	20.7	21.5	23.1	*
VFRPSRBD0400R030N120	4	0.3	4	12	3.85	3.7	60	6	4	●	1	12.5	12.9	13.8	15
VFRPSRBD0400R030N200	4	0.3	4	20	3.85	2.4	60	6	4	●	1	20.7	21.5	23	*
VFRPSRBD0400R030N300	4	0.3	4	30	3.85	1.7	70	6	4	●	1	31.1	32.2	*	*
VFRPSRBD0400R050N120	4	0.5	4	12	3.85	3.7	60	6	4	●	1	12.5	12.9	13.8	14.9
VFRPSRBD0400R050N200	4	0.5	4	20	3.85	2.5	60	6	4	●	1	20.7	21.4	23	*
VFRPSRBD0400R050N300	4	0.5	4	30	3.85	1.7	70	6	4	●	1	31.1	32.1	*	*
VFRPSRBD0400R100N120	4	1	4	12	3.85	3.8	60	6	4	●	1	12.4	12.8	13.7	14.8
VFRPSRBD0400R100N200	4	1	4	20	3.85	2.5	60	6	4	●	1	20.7	21.4	22.9	*
VFRPSRBD0400R100N300	4	1	4	30	3.85	1.7	70	6	4	●	1	31.1	32.1	*	*
VFRPSRBD0500R050N150	5	0.5	5	15	4.85	1.7	60	6	4	●	1	15.6	16.1	*	*
VFRPSRBD0500R100N150	5	1	5	15	4.85	1.8	60	6	4	●	1	15.5	16.1	*	*
VFRPSRBD0600R010N180	6	0.1	9	18	5.85	—	70	6	4	●	2	*	*	*	*
VFRPSRBD0600R020N180	6	0.2	9	18	5.85	—	70	6	4	●	2	*	*	*	*
VFRPSRBD0600R030N180	6	0.3	9	18	5.85	—	70	6	4	●	2	*	*	*	*
VFRPSRBD0600R050N180	6	0.5	9	18	5.85	—	70	6	4	●	2	*	*	*	*
VFRPSRBD0600R100N180	6	1	9	18	5.85	—	70	6	4	●	2	*	*	*	*
VFRPSRBD0600R200N180	6	2	9	18	5.85	—	70	6	4	●	2	*	*	*	*
VFRPSRBD0800R020N240	8	0.2	12	24	7.85	—	90	8	4	●	2	*	*	*	*
VFRPSRBD0800R030N240	8	0.3	12	24	7.85	—	90	8	4	●	2	*	*	*	*
VFRPSRBD0800R050N240	8	0.5	12	24	7.85	—	90	8	4	●	2	*	*	*	*

* Number of Flutes

* No interference

VFRPSRB

Conner radius, Short cut length, 4-Flute

(mm)

Order Number	DC	RE	APMX	LU	DN	B2	LF	DCON	No.F*	Stock	Type	Effective length for inclined angle			
												0.5°	1°	2°	3°
VFRPSRBD0800R100N240	8	1	12	24	7.85	—	90	8	4	●	2	*	*	*	*
VFRPSRBD0800R200N240	8	2	12	24	7.85	—	90	8	4	●	2	*	*	*	*
VFRPSRBD1000R030N300	10	0.3	15	30	9.7	—	100	10	4	●	2	*	*	*	*
VFRPSRBD1000R050N300	10	0.5	15	30	9.7	—	100	10	4	●	2	*	*	*	*
VFRPSRBD1000R100N300	10	1	15	30	9.7	—	100	10	4	●	2	*	*	*	*
VFRPSRBD1000R200N300	10	2	15	30	9.7	—	100	10	4	●	2	*	*	*	*
VFRPSRBD1000R300N300	10	3	15	30	9.7	—	100	10	4	●	2	*	*	*	*
VFRPSRBD1200R050N360	12	0.5	18	36	11.7	—	110	12	4	●	2	*	*	*	*
VFRPSRBD1200R100N360	12	1	18	36	11.7	—	110	12	4	●	2	*	*	*	*
VFRPSRBD1200R200N360	12	2	18	36	11.7	—	110	12	4	●	2	*	*	*	*
VFRPSRBD1200R300N360	12	3	18	36	11.7	—	110	12	4	●	2	*	*	*	*

* Number of Flutes

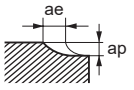
* No interference

RE = Corner Radius
DC = Cutting Dia.
APMX = Depth of Cut Max.
LU = Usable Length
DN = Neck Dia.
LF = Functional Length
DCON = Connection Dia.

● : **Inventory maintained in Japan.**

Recommended Cutting Conditions

(mm)

Workpiece Material			Hardened Steel (45－55HRC)				Hardened Steel (55－65HRC)				Hardened Steel (65－70HRC)			
Dia. **DC**	Corner Radius **RE**	Usable Length **LU**	Revolution (min^{-1})	Feed Rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**	Revolution (min^{-1})	Feed rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**	Revolution (min^{-1})	Feed rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**
0.5	**0.05**	**2**	25000	1000	0.005	0.1	19000	760	0.004	0.08	13000	510	0.003	0.08
0.5	**0.1**	**2**	25000	1000	0.008	0.1	19000	760	0.006	0.08	13000	510	0.005	0.08
0.6	**0.05**	**2**	21000	1000	0.005	0.1	16000	760	0.004	0.08	11000	510	0.003	0.08
0.6	**0.1**	**2**	21000	1000	0.008	0.1	16000	760	0.006	0.08	11000	510	0.005	0.08
0.6	**0.1**	**4**	18000	890	0.006	0.1	16000	760	0.005	0.08	11000	510	0.004	0.08
0.6	**0.2**	**2**	24000	1100	0.01	0.1	19000	890	0.008	0.08	16000	760	0.006	0.08
0.8	**0.05**	**4**	16000	760	0.015	0.12	12000	570	0.01	0.1	7900	380	0.01	0.1
0.8	**0.1**	**4**	16000	760	0.02	0.12	12000	570	0.015	0.1	7900	380	0.01	0.1
0.8	**0.2**	**4**	20000	950	0.03	0.12	16000	760	0.025	0.1	12000	570	0.02	0.1
0.8	**0.3**	**4**	20000	950	0.03	0.12	16000	760	0.025	0.1	12000	570	0.02	0.1
1	**0.05**	**4**	13000	1000	0.015	0.15	9500	760	0.01	0.12	6400	510	0.01	0.12
1	**0.1**	**4**	13000	1000	0.02	0.15	9500	760	0.015	0.12	6400	510	0.015	0.12
1	**0.1**	**6**	11000	890	0.015	0.12	6400	510	0.01	0.1	6400	510	0.01	0.1
1	**0.2**	**4**	16000	1300	0.03	0.15	9500	760	0.025	0.12	6400	510	0.02	0.12
1	**0.2**	**6**	13000	1000	0.02	0.12	6400	510	0.02	0.1	6400	510	0.015	0.1
1	**0.3**	**4**	16000	1300	0.03	0.15	9500	760	0.025	0.12	6400	510	0.02	0.12
1	**0.4**	**4**	16000	1300	0.04	0.15	9500	760	0.03	0.12	6400	510	0.025	0.12
1.5	**0.1**	**4**	14000	1700	0.025	0.23	11000	920	0.015	0.2	7200	570	0.01	0.2
1.5	**0.1**	**6**	11000	1400	0.025	0.18	9200	730	0.015	0.16	5700	460	0.01	0.16
1.5	**0.1**	**10**	11000	1400	0.025	0.18	9200	730	0.015	0.16	5700	460	0.01	0.16
1.5	**0.2**	**4**	14000	1700	0.05	0.23	11000	920	0.035	0.2	7200	570	0.025	0.2
1.5	**0.2**	**6**	11000	1400	0.05	0.18	9200	730	0.035	0.16	5700	460	0.025	0.16
1.5	**0.2**	**10**	11000	1400	0.05	0.18	9200	730	0.035	0.16	5700	460	0.025	0.16
1.5	**0.3**	**4**	16000	1900	0.075	0.23	13000	1000	0.05	0.2	8000	640	0.035	0.2
1.5	**0.3**	**6**	13000	1500	0.075	0.18	10000	810	0.05	0.16	6400	510	0.035	0.16
1.5	**0.3**	**10**	13000	1500	0.075	0.18	10000	810	0.05	0.16	6400	510	0.035	0.16
1.5	**0.5**	**4**	16000	1900	0.08	0.23	13000	1000	0.055	0.2	8000	640	0.04	0.2
1.5	**0.5**	**6**	13000	1500	0.08	0.18	10000	810	0.055	0.16	6400	510	0.04	0.16
1.5	**0.5**	**10**	13000	1500	0.08	0.18	10000	810	0.055	0.16	6400	510	0.04	0.16
2	**0.1**	**6**	11000	1700	0.025	0.3	8600	1000	0.02	0.28	5400	640	0.015	0.28
2	**0.1**	**10**	8600	1400	0.025	0.24	6900	830	0.02	0.22	4300	520	0.015	0.22
2	**0.1**	**15**	6400	1000	0.02	0.18	5200	620	0.015	0.17	3200	390	0.01	0.17
2	**0.2**	**6**	11000	1700	0.055	0.3	8600	1000	0.035	0.28	5400	640	0.025	0.28
2	**0.2**	**10**	8600	1400	0.055	0.24	6900	830	0.035	0.22	4300	520	0.025	0.22
2	**0.2**	**15**	6400	1000	0.04	0.18	5200	620	0.025	0.17	3200	390	0.02	0.16
2	**0.3**	**6**	12000	1900	0.08	0.3	6900	1100	0.055	0.28	6000	420	0.04	0.27
2	**0.3**	**10**	9500	1500	0.08	0.24	7600	920	0.055	0.22	4800	570	0.04	0.22
2	**0.3**	**15**	7200	1100	0.065	0.18	5700	690	0.045	0.17	3600	430	0.03	0.16
2	**0.3**	**20**	7200	1100	0.065	0.18	5700	690	0.045	0.17	3600	430	0.03	0.16
2	**0.5**	**6**	12000	1900	0.085	0.3	9500	1100	0.06	0.28	6000	720	0.04	0.27
2	**0.5**	**10**	9500	1500	0.085	0.24	7600	920	0.06	0.22	4800	570	0.04	0.22
2	**0.5**	**15**	7200	1100	0.07	0.18	5700	690	0.045	0.17	3600	430	0.035	0.16
2	**0.5**	**20**	7200	1100	0.07	0.18	5700	690	0.045	0.17	3600	430	0.035	0.16
2.5	**0.3**	**8**	9500	1900	0.08	0.38	7600	1400	0.055	0.35	4800	860	0.04	0.34
2.5	**0.3**	**15**	7600	1500	0.08	0.3	6100	1100	0.055	0.28	3800	690	0.04	0.27
2.5	**0.5**	**8**	9500	1900	0.09	0.38	7600	1400	0.06	0.35	4800	860	0.04	0.34
2.5	**0.5**	**15**	7600	1500	0.09	0.3	6100	1100	0.06	0.28	3800	690	0.04	0.27
2.5	**1**	**8**	9500	1900	0.15	0.33	7600	1400	0.09	0.31	4800	860	0.065	0.31
Depth of Cut														

Note 1) The cutting conditions above are a guide only to machining with cutting edges with a corner radius. When machining with peripheral cutting edges, use the minimum feed rate as a guide.

Note 2) If depth of cut is shallow, the revolution and feed rate can be increased.

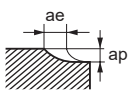
Note 3) For profile machining such as moulds, machining conditions may differ considerably depending on the workpiece geometry, machining methods and depth of cut. Reduce the feed rate especially when machining the corner sections of a workpiece.

Note 4) If the rigidity of the machine or the workpiece materials installation is very low, or chattering and noise are generated, please adjust the revolution, feed rate and depth of cut.

VFRPSRB

Conner radius, Short cut length, 4-Flute

(mm)

Workpiece Material			Hardened Steel (45－55HRC)				Hardened Steel (55－65HRC)				Hardened Steel (65－70HRC)			
Dia. **DC**	Corner Radius **RE**	Usable Length **LU**	Revolution (min^{-1})	Feed Rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**	Revolution (min^{-1})	Feed rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**	Revolution (min^{-1})	Feed rate (mm/min)	Depth of Cut **ap**	Width of Cut **ae**
3	**0.1**	**10**	8100	1900	0.025	0.6	6500	1200	0.02	0.55	4100	730	0.015	0.55
3	**0.1**	**15**	6500	1600	0.025	0.48	5200	940	0.02	0.44	3200	580	0.015	0.44
3	**0.2**	**10**	8100	1900	0.055	0.6	6500	1200	0.04	0.55	4100	730	0.025	0.55
3	**0.2**	**15**	6500	1600	0.055	0.48	5200	940	0.04	0.44	3200	580	0.025	0.44
3	**0.2**	**20**	6500	1600	0.055	0.48	5200	940	0.04	0.44	3200	580	0.025	0.44
3	**0.3**	**10**	9000	2200	0.085	0.6	7200	1300	0.055	0.55	4500	810	0.04	0.55
3	**0.3**	**15**	7200	1700	0.085	0.48	5800	1000	0.055	0.44	3600	650	0.04	0.44
3	**0.3**	**20**	7200	1700	0.085	0.48	5800	1000	0.055	0.44	3600	650	0.04	0.44
3	**0.5**	**10**	9000	2200	0.09	0.6	7200	1300	0.06	0.55	4500	810	0.045	0.55
3	**0.5**	**15**	7200	1700	0.09	0.48	5800	1000	0.06	0.44	3600	650	0.045	0.44
3	**0.5**	**20**	7200	1700	0.09	0.48	5800	1000	0.06	0.44	3600	650	0.045	0.44
3	**1**	**10**	9000	2200	0.15	0.54	7200	1300	0.1	0.5	4500	810	0.07	0.5
3	**1**	**15**	7200	1700	0.15	0.43	5800	1000	0.1	0.4	3600	650	0.07	0.4
3	**1**	**20**	7200	2000	0.15	0.43	5800	1000	0.1	0.4	3600	650	0.07	0.4
4	**0.1**	**12**	6100	1700	0.25	0.8	4900	970	0.02	0.74	3000	610	0.015	0.73
4	**0.1**	**20**	4900	1400	0.25	0.6	3900	780	0.02	0.6	2400	490	0.015	0.58
4	**0.2**	**12**	6100	1700	0.055	0.8	4900	970	0.04	0.74	3000	610	0.025	0.73
4	**0.2**	**20**	4900	1400	0.055	0.6	3900	780	0.04	0.6	2400	490	0.025	0.58
4	**0.3**	**12**	6800	1900	0.085	0.8	5400	1100	0.055	0.75	3400	680	0.04	0.73
4	**0.3**	**20**	5400	1500	0.085	0.6	4300	870	0.055	0.6	2700	540	0.04	0.58
4	**0.3**	**30**	4100	1100	0.065	0.5	3200	650	0.045	0.45	2000	410	0.035	0.44
4	**0.5**	**12**	6800	1900	0.09	0.8	5400	1100	0.06	0.75	3400	680	0.045	0.74
4	**0.5**	**20**	5400	1500	0.09	0.65	4300	870	0.06	0.6	2700	540	0.045	0.58
4	**0.5**	**30**	4100	1100	0.075	0.5	4300	650	0.05	0.45	2000	410	0.035	0.44
4	**1**	**12**	6800	1900	0.15	0.7	5400	1100	0.1	0.66	3400	680	0.07	0.66
4	**1**	**20**	5400	1500	0.15	0.55	4300	870	0.1	0.53	2700	540	0.07	0.53
4	**1**	**30**	4100	1100	0.1	0.4	3200	650	0.075	0.4	2000	410	0.055	0.4
5	**0.5**	**15**	6400	1800	0.1	1.3	5100	1000	0.065	1.2	3200	640	0.045	1.1
5	**1**	**15**	6400	1800	0.15	1.1	5100	1000	0.1	1	3200	640	0.075	1
6	**0.1**	**18**	4800	1500	0.03	1.5	3800	920	0.02	1.4	2400	570	0.015	1.3
6	**0.2**	**18**	4800	1500	0.06	1.5	3800	920	0.04	1.4	2400	570	0.03	1.3
6	**0.3**	**18**	5300	1700	0.09	1.5	4200	1000	0.06	1.4	2700	640	0.045	1.3
6	**0.5**	**18**	5300	1700	0.1	1.5	4200	1000	0.065	1.4	2700	640	0.045	1.3
6	**1**	**18**	5300	1700	0.15	1.4	4200	1000	0.1	1.2	2700	640	0.075	1.2
6	**2**	**18**	5300	1700	0.3	1.3	4200	1000	0.2	1.1	2700	640	0.15	1.1
8	**0.2**	**24**	3600	1100	0.06	2	2900	690	0.04	1.8	1800	430	0.03	1.8
8	**0.3**	**24**	4000	1300	0.09	2	3200	760	0.06	1.8	2000	480	0.045	1.8
8	**0.5**	**24**	4000	1300	0.095	2	3200	760	0.065	1.8	2000	480	0.045	1.8
8	**1**	**24**	4000	1300	0.15	1.8	3200	760	0.1	1.7	2000	480	0.075	1.6
8	**2**	**24**	4000	1300	0.3	1.7	3200	760	0.2	1.6	2000	480	0.15	1.5
10	**0.3**	**30**	3200	1000	0.09	2.5	2500	610	0.06	2.3	1600	380	0.045	2.3
10	**0.5**	**30**	3200	1000	0.095	2.5	2500	610	0.065	2.3	1600	380	0.045	2.3
10	**1**	**30**	3200	1000	0.15	2.3	2500	610	0.1	2.1	1600	380	0.075	2
10	**2**	**30**	3200	1000	0.3	2.1	2500	610	0.2	2	1600	380	0.15	1.9
10	**3**	**30**	3200	1000	0.45	1.9	2500	610	0.3	1.7	1600	380	0.2	1.7
12	**0.5**	**36**	2700	950	0.1	3	2100	510	0.065	2.8	1300	320	0.05	2.7
12	**1**	**36**	2700	950	0.15	2.7	2100	510	0.1	2.5	1300	320	0.075	2.4
12	**2**	**36**	2700	950	0.3	2.6	2100	510	0.2	2.4	1300	320	0.15	2.3
12	**3**	**36**	2700	950	0.45	2.3	2100	510	0.3	2.1	1300	320	0.2	2
Depth of Cut														

Memo

Memo

Revolutionary Machining of Hardened Steel

VFR2SSB/VFR2SB

Ball Nose End Mill, 2-Flute

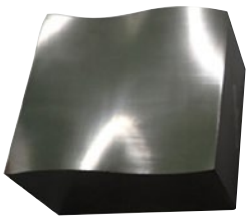
New Cutting Edge : Optimisation of the flute geometry, helix and rake angles have improved the edge strength in all areas.
Carbide Substrate : High grade carbide ideal for machining hardened materials.

VFR2SBF

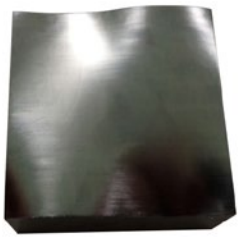
Ball Nose End Mill, For mirror finishing, 2-Flute

Cutting Example

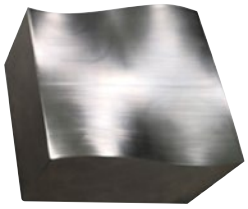
VFR2SB



ASP23
(62 HRC)



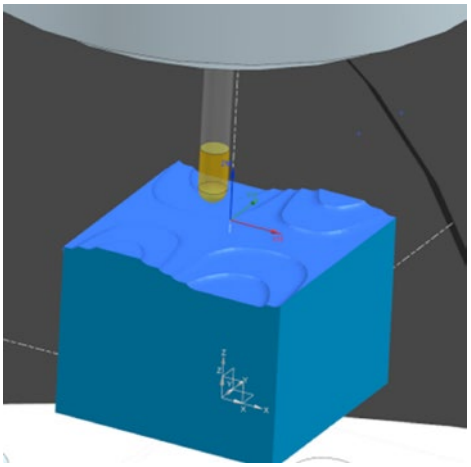
AISI M2
(64 HRC)



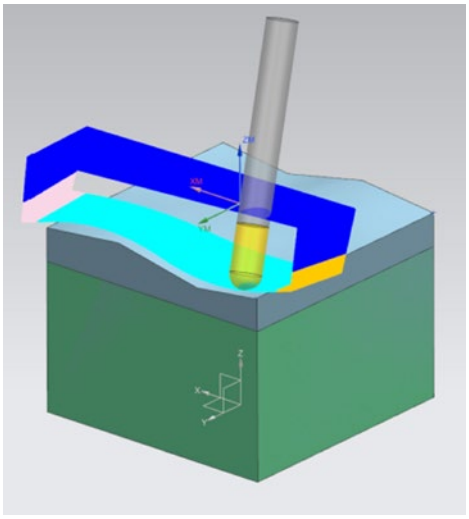
HAP72
(68 HRC)

<Cutting Conditions>
Workpiece Material : High Speed Steel
50 mm x 50 mm x 30 mm
Tool : VFR2SBR0300
Cutting Mode : Air Blow
Machine : Vertical MC

Rough Machining Path



Medium and Finish Machining Path (Tilt Angle 30°)



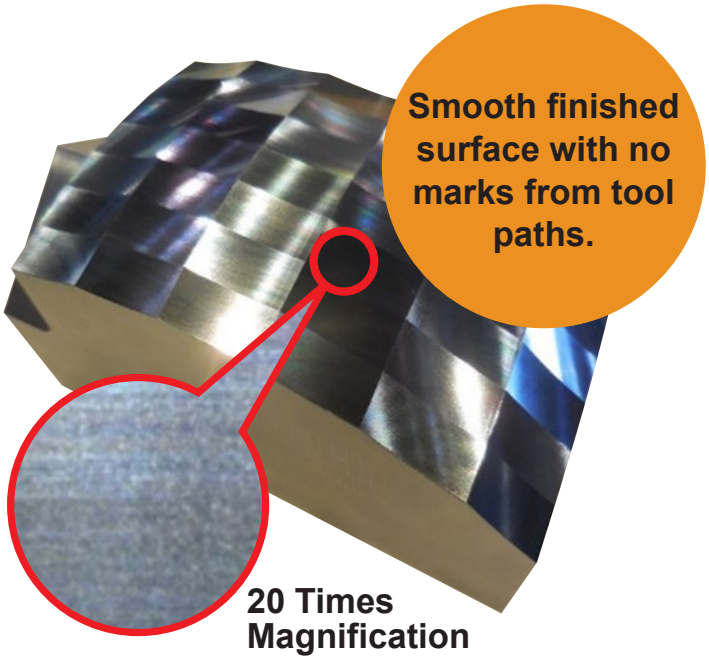
Cutting Time : 234 min
Tools Used : 4

(mm)

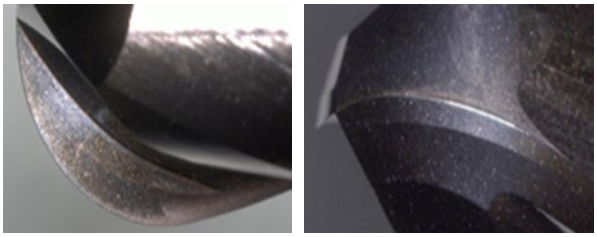
Process	RE	n (min^{-1})	vf (mm/min)	ap	ae	Finishing Allowance	Cutting Time (h:m:s)	Number of Tools
Rough Machining	**R 3.0**	12000	1600	0.35	1.0	0.2	1:01:45	2
Medium Finish Machining	**R 3.0**	8000	500	0.3	0.1	0.05	0:49:15	1
Finish Machining	**R 3.0**	12000	700	0.1	0.035	—	2:03:19	1

VFR2SBF

Workpiece : Pre-hardened Steel

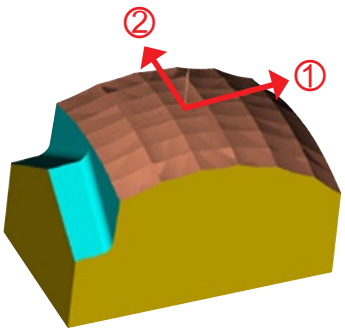


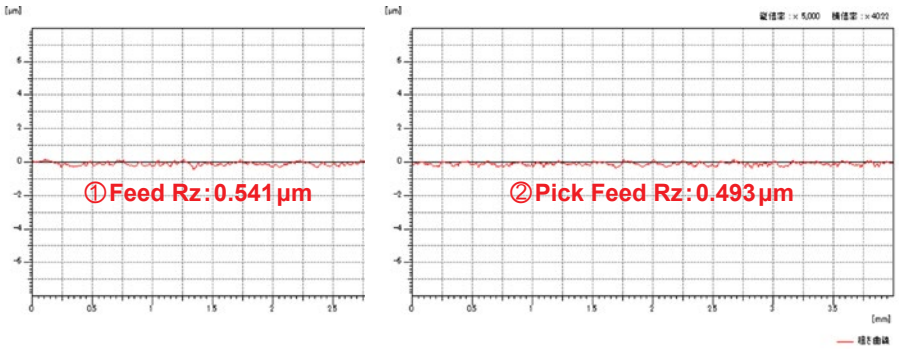
By using 5-axis machining, cutting at the tip of the ball nose can be avoided



Excellent tool conditions after 31 hours of finish machining.

A surface roughness of Rz: 0.8μm or lower can be achieved.





Cutting Conditions Holder : HSK-A63

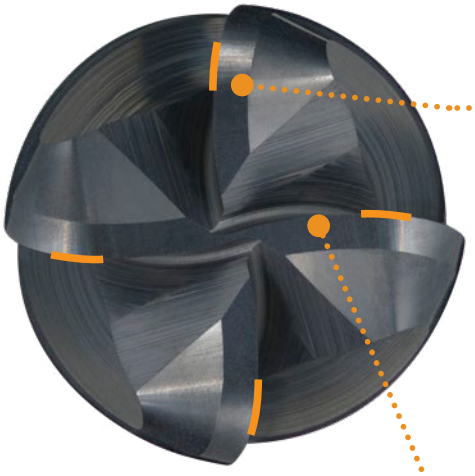
(mm)

Process	Order Number	Coolant	n (min^{-1})	vc (m/min)	vf (mm/min)	fz (mm/t.)	ap	ae	Finishing Allowance	Cutting Time (h :m)
Rough Machining Side Finish Machining	VQMHVRBD1600R500	Air Blow	3000 2000	150 100	1800 240	0.15 0.03	32 —	1 —	0.2 0	0:24
Chamfer and Medium Finish Machining	MP2SBR0300	Air Blow	13000	245	2600	0.1	Along the Surface p0.1		0.03	0:46
Finish Machining	VFR2SBFR0300	MQL	20000	375	600	0.015	Along the Surface p0.015		0	31:10

Precision-Corner Radius End Mill, 4-Flute

VFRPSRB

A seamless edge geometry that is resistant to chipping, together with a wiper edge and strong back taper enables high precision machining.



Equipped with a wiper edge of DC≥1.5mm

Improves the surface finish of the bottom machined face.

Optimal Seamless Shape of DC≥1.5mm

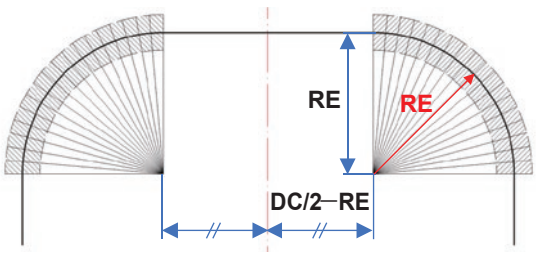
Suppresses chipping.

Strong Back Taper of 1.5≤DC≤5mm

Reduces chatter and vibration when machining vertical walls.

High Precision Corner Radius Accuracy

The corner radius of VFRPSRB is measured as follows, based on the absolute centre of the corner radius.



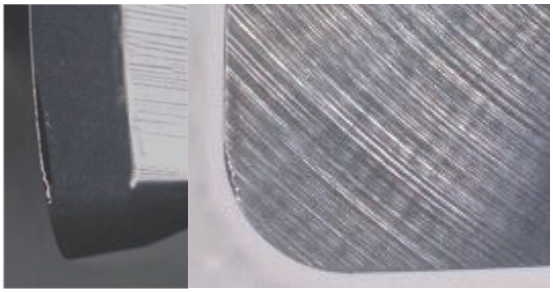
DC : Cutting Dia.
RE : Corner Radius

VFRPSRB	0.5≤DC≤6 mm : ±0.005 8≤DC≤12 mm : ±0.007	Conventional Precision Radius	±0.01

Completely Seamless Curved R Edge, DC≥1.5mm

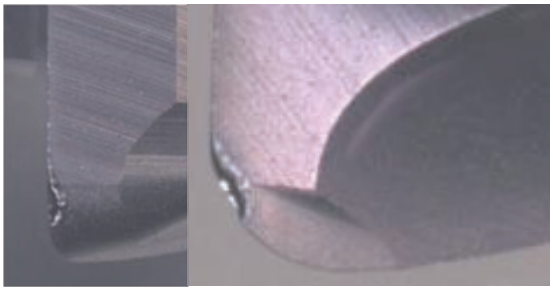
A stable machining surface is achieved by a seamless blend between the radius and flank geometry.

VFRPSRB



Due to the seamless geometry, chipping is suppressed and wear progress is stabilised.

Conventional

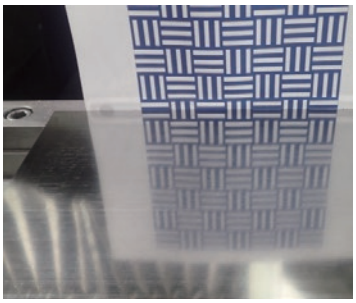


Chipping occurs because the stress is concentrated on the joint between the flank and corner edge geometry.

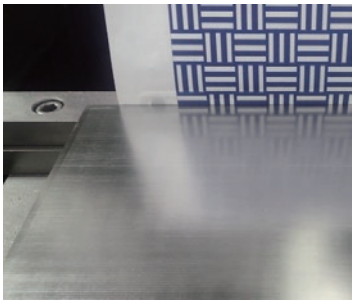
Equipped with a Wiper Edge, DC≥1.5mm

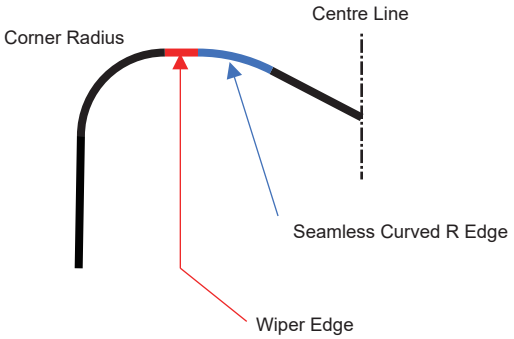
A smooth surface finish is possible by utilising a wiper edge.

VFRPSRB



Conventional

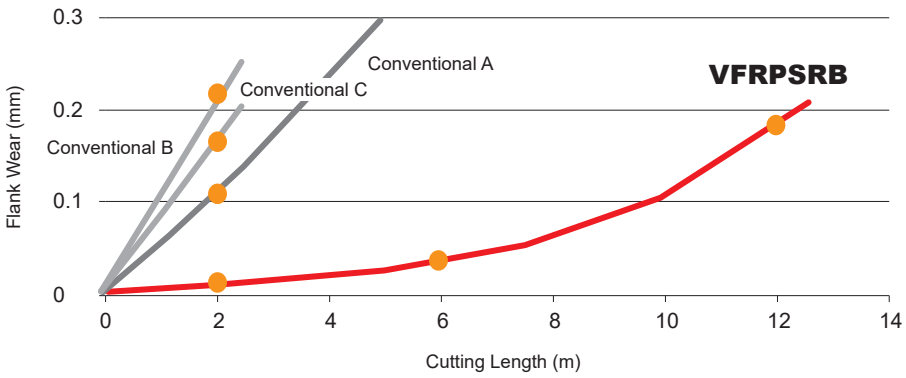


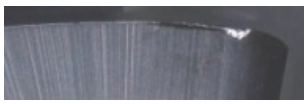
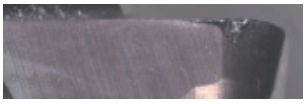


Cutting Performance

Wear Resistance Comparison - Machining High Speed Tool Steel (68HRC)

Excellent wear resistance when machining high-hardness steel.



	After Machining 2m	After Machining 6m	After Machining 12m
VFRPSRB			
Conventional A			
Conventional B			
Conventional C			

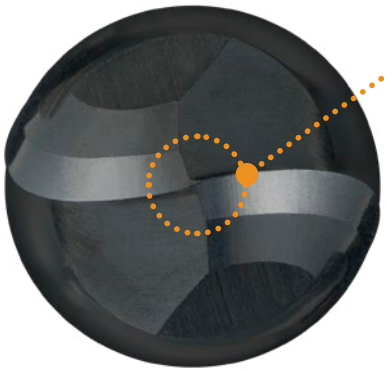
<Cutting Conditions>

Workpiece Material	: Powder High Speed Tool Steel (68HRC)
Tool	: VFRPSRBD0600R050N180
Revolution	: n=5500 min^{-1}
Table Feed	: f=660 mm/min
Feed per Tooth	: 0.03 mm/t.
Depth of Cut	: ap=0.1 mm
	ae=0.1 mm
Overhang Length	: 18 mm
Cutting Mode	: Air blow
Machine	: Vertical MC (BT30)

Ball Nose End Mill, Long Neck, 2-Flute

VFR2XLB

Precise machining of vertical walls is possible due to a back taper and a strong, seamless ball nose cutting edge geometry.



Ball Nose Optimisation

Ideal centre flute geometry for finish machining.

Rake Angle Optimisation

Optimum geometry provides a sharp edge together with fracture resistance that enables excellent surface finishes.

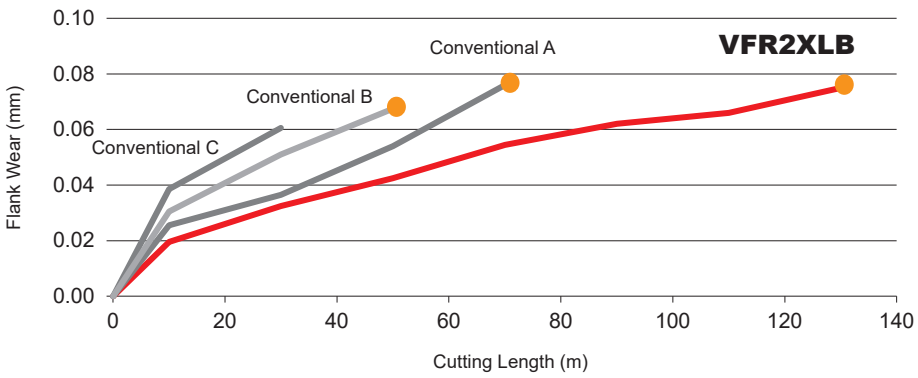
Strong Back Taper

Reduces chatter and vibration when machining vertical walls.

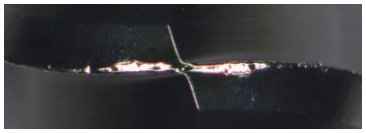
Cutting Performance

Wear Resistance Comparison - Machining ASP23 (62HRC)

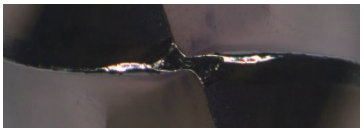
Greatly improved wear resistance for high precision machining.



<Cutting Conditions>
Workpiece Material : ASP23 (62HRC)
Tool : VFR2XLBR0100N120
Revolution : n=16000min^{-1}
Table Feed : f=1600mm/min
Feed per Tooth : 0.05mm/t.
Depth of Cut : ap=0.05mm×10
ae=0.1mmx10
Overhang Length : 18mm
Cutting Mode : Air blow
Machine : Vertical MC (HSK-E32)



VFR2XLB



Conventional A

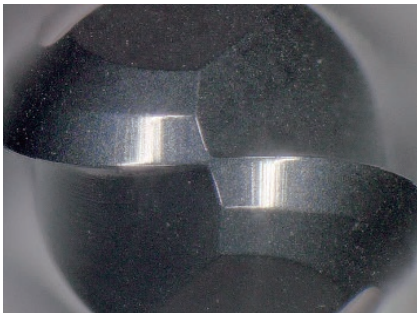
Conventional B

Cutting Performance

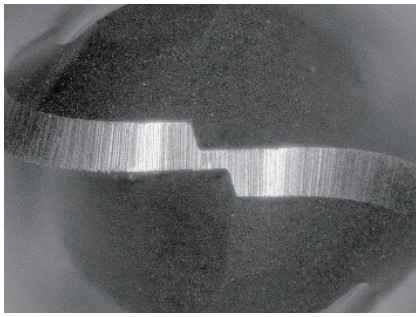
Cutting Edge Geometry for Finishing

Sharp but strong cutting edge enables good surface finishes.

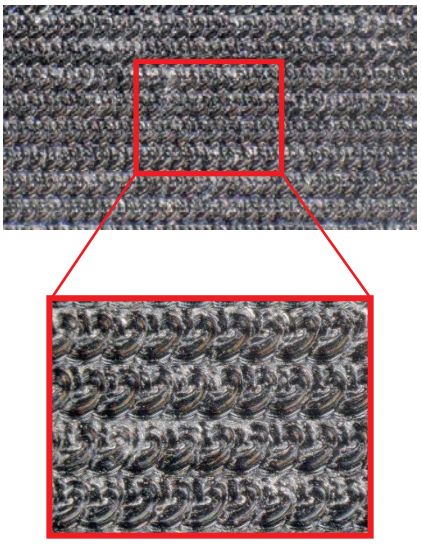
VFR2XLB



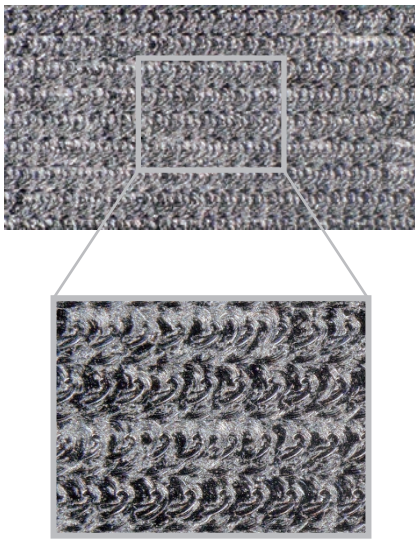
Conventional



Comparison of Surface Finishes

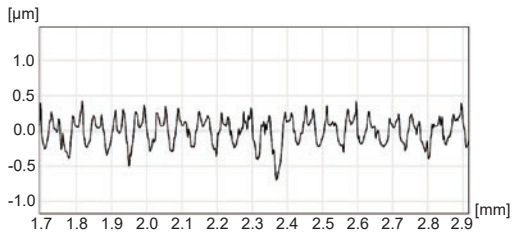


Sharp edges leave a uniform finish.

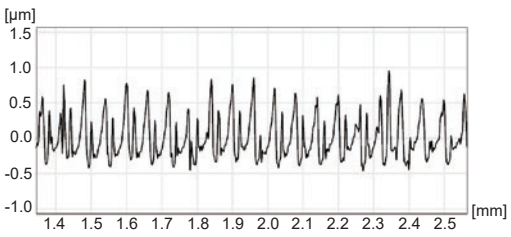


A dull edge leaves an undefined finish.

Comparison of Surface Roughness (Feed Side)



Ra=0.174μm, Rz=1.12μm



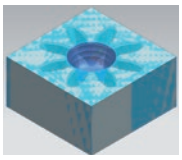
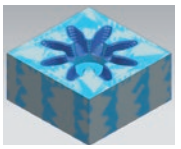
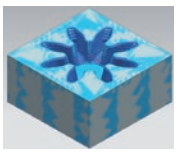
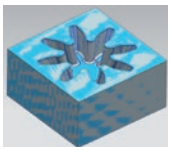
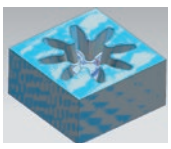
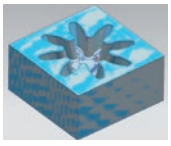
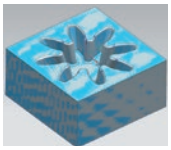
Ra=0.240μm, Rz=2.01μm

Application Example

Machining of a Bevel Gear Mould

Ideal for machining high-hardness precision, cold forging moulds of 65HRC or higher.

(mm)

No.	Process	Tools Used	**vc** (m/min)	**n** (min^{-1})	**vf** (mm/min)	**ap**	**ae**	Next Process Finishing Allowance	3D Model Post Machining
1	Rough Machining (Central Helical)	**VFR2SBR0400**	80	3,200	130	3	0.6	0.1	
2	Rough Pocket Milling①	**VFR2SBR0200**	80	6,300	250	0.9	0.3	0.2	
3	Rough Pocket Milling②	**VFR2XLBR0150N100**	60	6,300	190	0.9	0.15	0.2	
4	Semi-finish Machining	**VFR2XLBR0100N100**	80	12,700	250	0.2	0.1	0.1	
5	Deep Wall Finish Machining	**VFR2XLBR0100N100**	80	12,700	250	0.1	0.03	0	
6	Bottom Face Finish Machining	**VFRPSRBD0300R050N100**	40	4,500	270	0.1	0.1	0	
7	Upper Surface Milling	**VFRPSRBD0600R050N180**	40	2,100	500	0.02	0.5	0	
8	Chamfering	**VC2CD0600**	50	2,700	110	0.5	0.2	0	

<Cutting Conditions>
Workpiece Material : SKH51
50×50×25
Machine : Vertical MC (HSK-E32)

Application Example

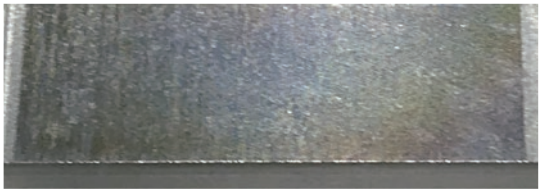
Comparison of Surface Finishes - Machining of Dies Used for Plastic Moulding

Ideal surface finishes of dies can be achieved.

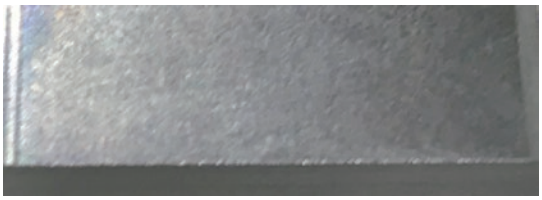
Workpiece Material : Steel die used for plastic moulding (M340 58HRC)

(mm)

Process	Tools Used	n (min^{-1})	vf (mm/min)	ap	ae	Coolant
Semi-finish Machining	**VFR2XLBR0050N040**	18000	900	0.02	0.02	MQL
	VFR2XLBR0100N060	17500	1200	0.03	0.1	
Finish Machining	**VFR2XLBR0050N040**	18000	900	0.02	0.02	
	VFR2XLBR0100N060	17500	1200	0.03	0.08	



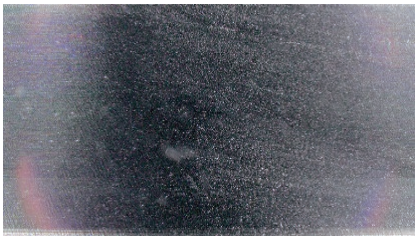
VFR2XLB Has a smooth surface



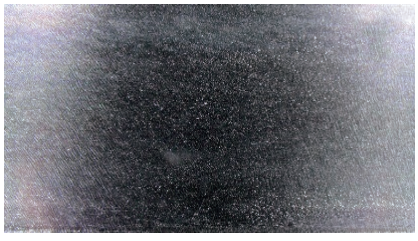
Conventional

Comparison of Surface Finishes - Machining SKD11

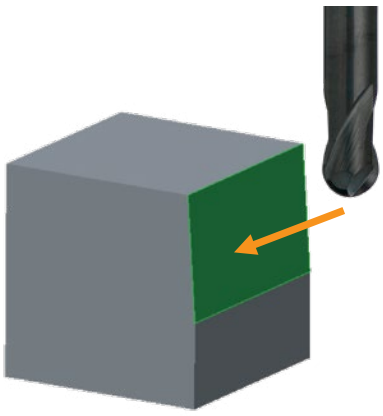
Excellent surface finish compared to those machined by conventional tools.



VFR2XLB



Conventional A cloudy surface finish

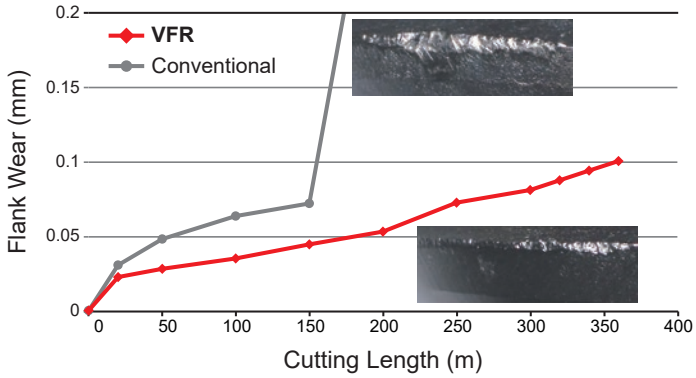


Cutting Form : 1° Taper Cutting

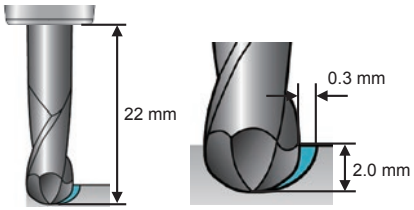
<Cutting Conditions>
Workpiece Material : JIS SKD11 (60HRC)
Tool : VFR2XLBR0100N100
Revolution : n=19000 min^{-1}
Table Feed : f=680 mm/min
Depth of Cut : ap=0.02 mm
ae=0.02 mm
Overhang Length : 16 mm
Cutting Mode : Air blow
Machine : Vertical MC (HSK-E32)

Cutting Performance

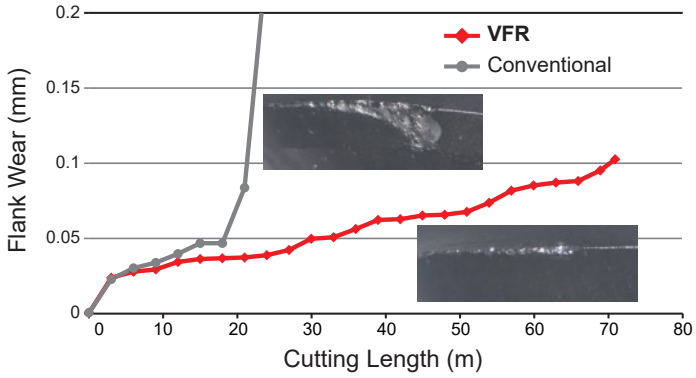
JIS SKD61 (52HRC)



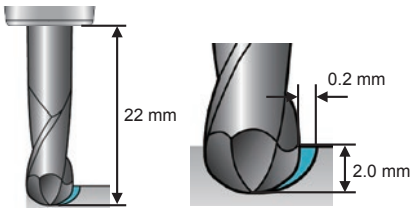
<Cutting Conditions>
Workpiece Material : JIS SKD61 (52HRC)
Tool : VFR2SBR0300
Revolution : n=17000 min^{-1}
Table Feed : vf=1700 mm/min
Feed per Tooth : fz=0.05 mm/t.
Depth of Cut : ap=2 mm, ae=0.3 mm
Overhang Length : 22 mm
Cutting Mode : Air blow
Machine : Vertical MC (HSK-A63)



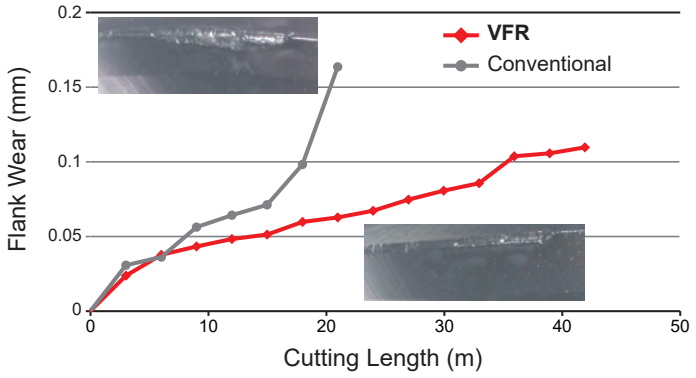
JIS SKD11 (60HRC)



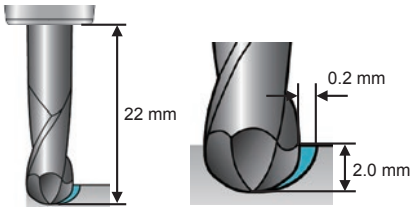
<Cutting Conditions>
Workpiece Material : JIS SKD11 (60HRC)
Tool : VFR2SBR0300
Revolution : n=5400 min^{-1}
Table Feed : vf=540 mm/min
Feed per Tooth : fz=0.05 mm/t.
Depth of Cut : ap=2 mm, ae=0.2 mm
Overhang Length : 22 mm
Cutting Mode : Air Blow
Machine : Vertical MC (HSK-A63)



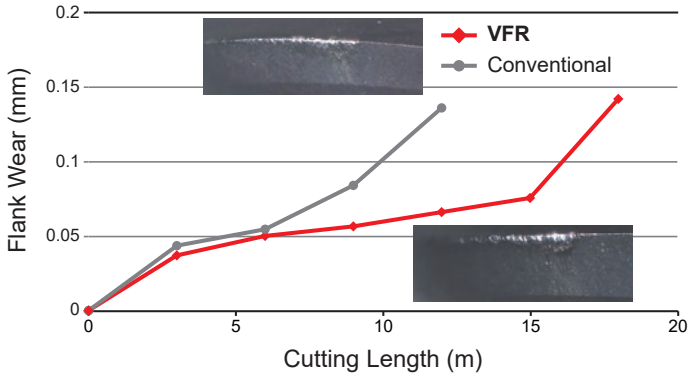
ASP23 (62HRC)



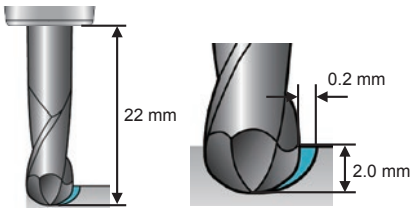
<Cutting Conditions>
Workpiece Material : ASP23 (62HRC)
Tool : VFR2SBR0300
Revolution : n=5400 min^{-1}
Table Feed : vf=540 mm/min
Feed per Tooth : fz=0.05 mm/t.
Depth of Cut : ap=2 mm, ae=0.2 mm
Overhang Length : 22 mm
Cutting Mode : Air Blow
Machine : Vertical MC (HSK-A63)



JIS SKH51 (64HRC)

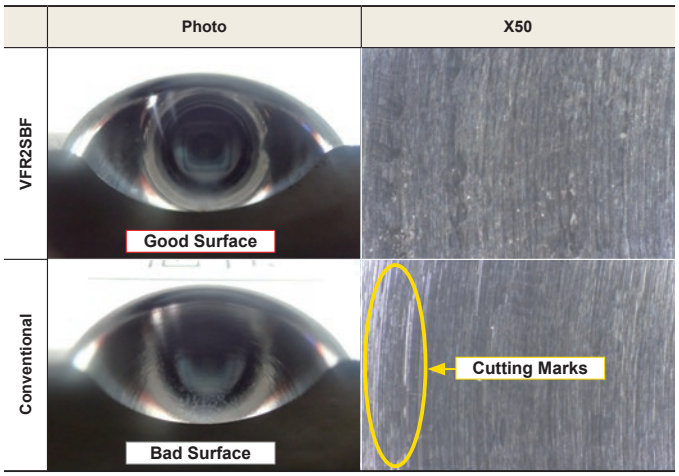


<Cutting Conditions>
Workpiece Material : JIS SKH51 (64HRC)
Tool : VFR2SBR0300
Revolution : n=5400 min^{-1}
Table Feed : vf=540 mm/min
Feed per Tooth : fz=0.05 mm/t.
Depth of Cut : ap=2 mm, ae=0.2 mm
Overhang Length : 22 mm
Cutting Mode : Air Blow
Machine : Vertical MC (HSK-A63)

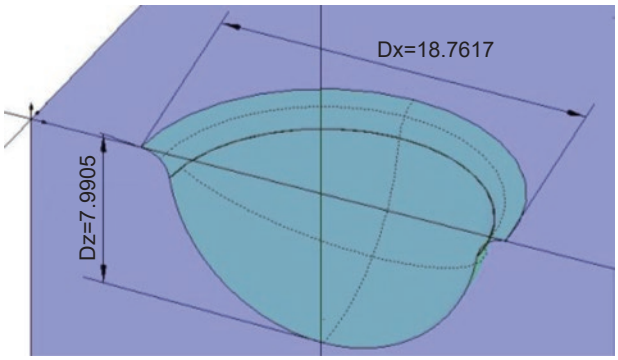


Cutting Performance

STAVAX (52 HRC) Comparison of Machined Surface



Model Shape



<Cutting Conditions>

Workpiece Material	: STAVAX (52HRC)	Feed per Tooth	: fz=0.02 mm/t.
Tool	: VFR2SBFR0300	Depth of Cut	: ap=0.02 mm, ae=0.02 mm
Revolution	: n=32000 min^{-1}	Overhang Length	: 15 mm
Cutting Speed	: vc=603 m/min	Cutting Mode	: Air Blow
Table Feed	: vf=1280 mm/min	Machine	: Vertical MC (HSK-E25)

For Your Safety
●Don't handle inserts and chips without gloves. ●Please machine within the recommended application range and exchange expired tools with new ones in advance of breakage. ●Please use safety covers and wear safety glasses. ●When using compounded cutting oils, please take fire precautions. ●When attaching inserts or spare parts, please use only the correct wrench or driver. ●When using rotating tools, please make a trial run to check run-out, vibration and abnormal sounds etc.

MITSUBISHI MATERIALS CORPORATION

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Overseas Sales Dept, Asian Region
Marunouchi Nijubashi Building 22F, 3-2-3, Marunouchi, Chiyoda-ku, Tokyo 100-8117, Japan

Overseas Sales Dept, European & American Region
Marunouchi Nijubashi Building 22F, 3-2-3, Marunouchi, Chiyoda-ku, Tokyo 100-8117, Japan

http://www.mmc-carbide.com/
(Tools specifications subject to change without notice.)

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