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

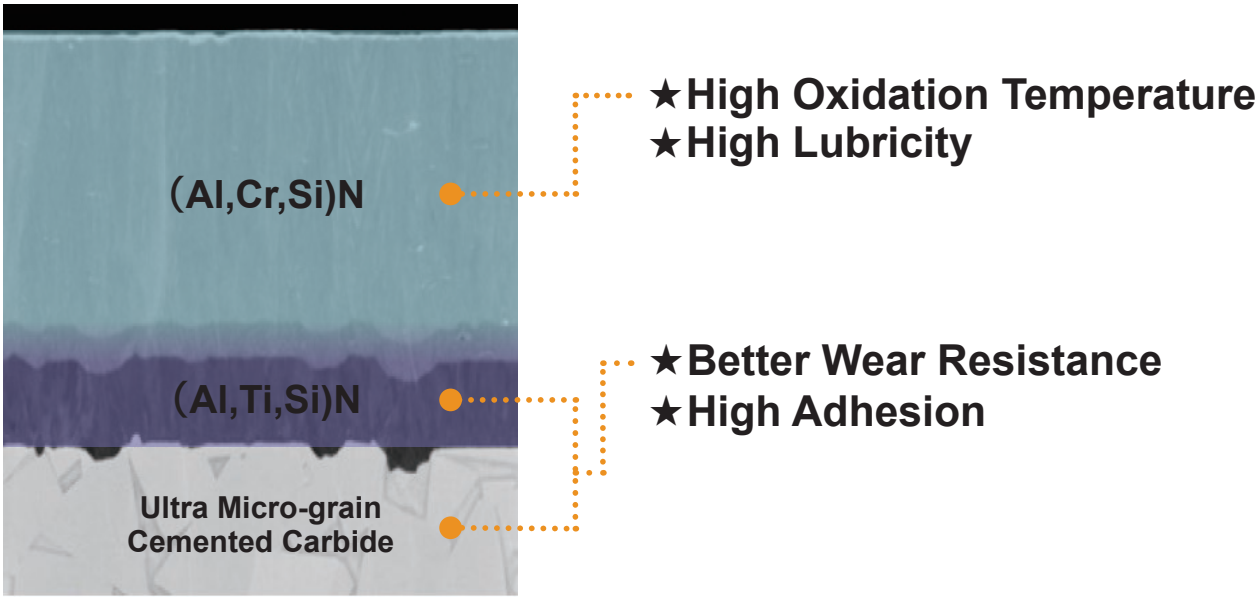
For Machining of Hardened Steel

# iMPACT MIRACLE End Mill Series

# IMPACT MIRACLE REVOLUTION

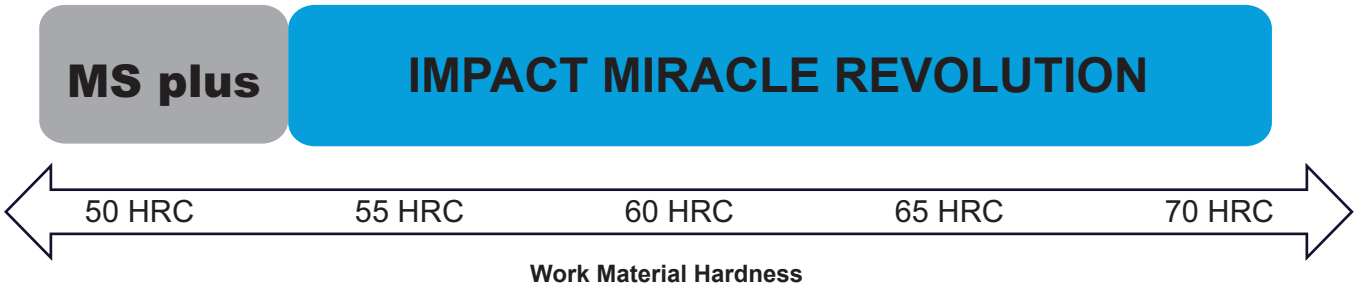
## IMPACT MIRACLE REVOLUTION Coating

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)

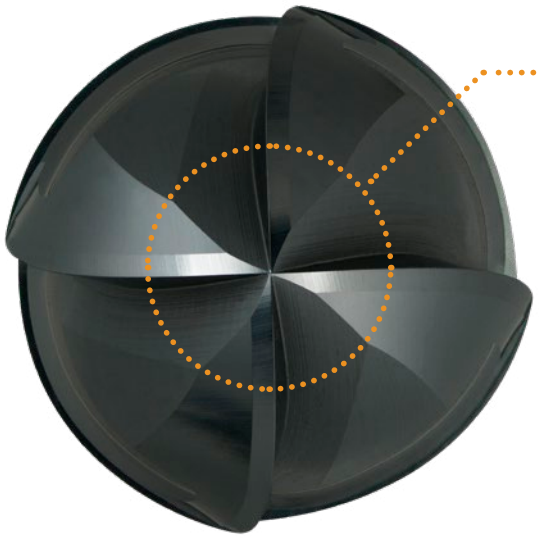
| No. of Flutes | Type | Specifications | Shape | Corner Radius RE | | Dia. DC | | Depth of Cut APMX | Size | Workpiece Material | | | Page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | P | H | | |
| | | | | Min. | Max. | Min. | Max. | Max. DC | | Tool Steel ≤45HRC | Hardened Steel ≤55HRC | Hardened Steel >55HRC | |
| **Ball Nose** | | | | | | | | | | | | | |
| 2 | **VFR2SSB** | Strong S Curve<br>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<br>For Machining of Vertical Walls |  | 0.1 | 3.0 | 0.2 | 6.0 | 6 | 74 | ○ | ◎ | ◎ | P.13 |
| 4 | NEW<br>**VFR4MB** | For High Speed and<br>High Efficiency machining |  | 0.5 | 6.0 | 1.0 | 12.0 | 22 | 9 | ○ | ◎ | ◎ | P.6 |
| **Corner Radius** | | | | | | | | | | | | | |
| 4 | **VFRPSRB** | Completely Seamless Curved R Edge<br>DC≥1.5<br>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

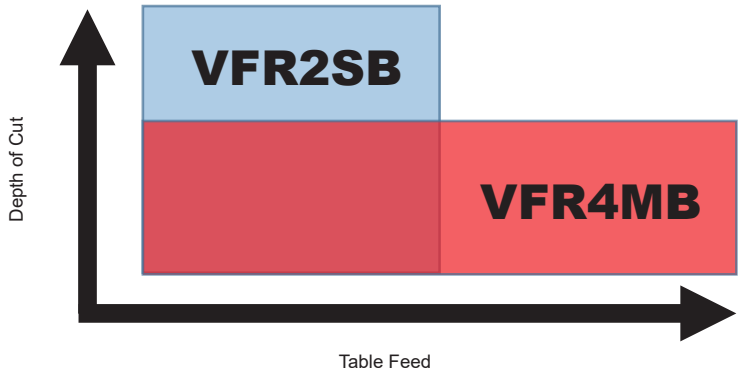
All 4 flutes extend from the centre to the periphery. This enables high feeds at any cutting angle and negates the need to calculate different machining conditions.




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.

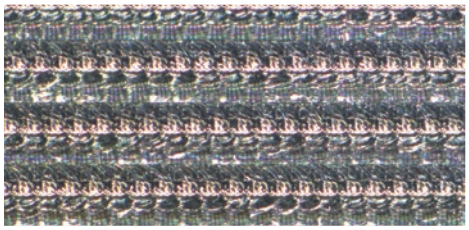


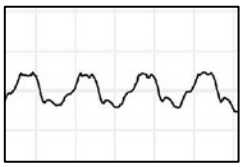
# Cutting Performance

## 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.

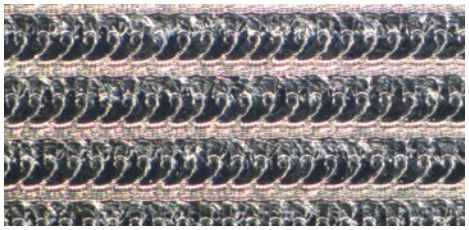
**VFR4MB**

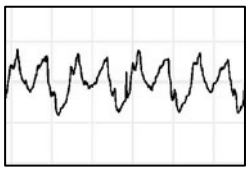




**Ra:0.27**
**Rz:1.01**

2-Flute conventional product



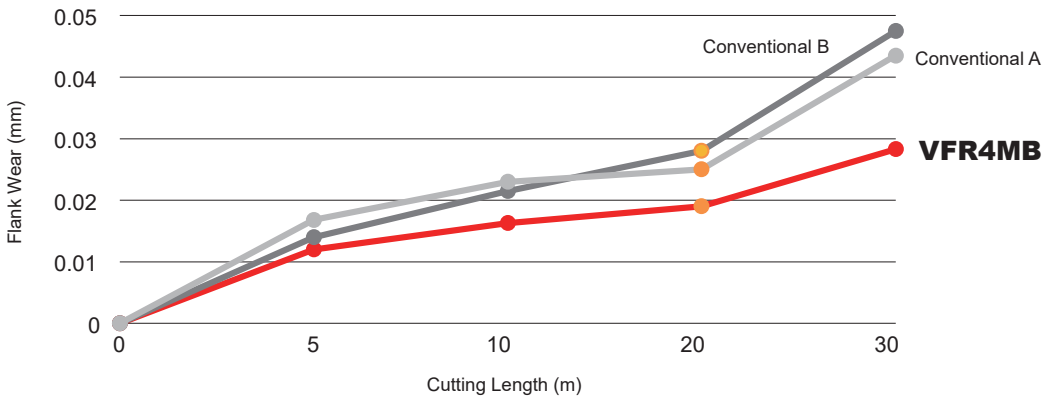


**Ra:0.32**
**Rz:1.62**

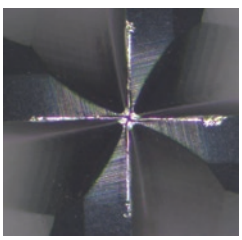
<Cutting Conditions>
Workpiece Material : ASP23(62HRC)
Tool : VFR4MBR0400 DC=8mm
Revolution : n=12000min$^{-1}$
Table Feed : f=3600mm/min
Depth of Cut : ap=0.2mm
ae=0.8mm
Overhang Length : 20mm
Cutting Mode : Air blow
Down(climb) Cut

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

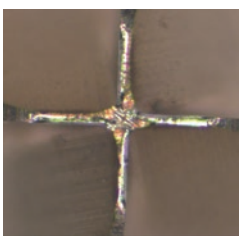
IMPACT MIRACLE REVOLUTION end mills demonstrate excellent wear resistance even when machining high hardness workpiece materials.



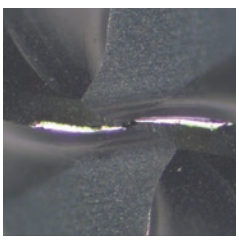

Taken after a cutting length of 20 m



**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

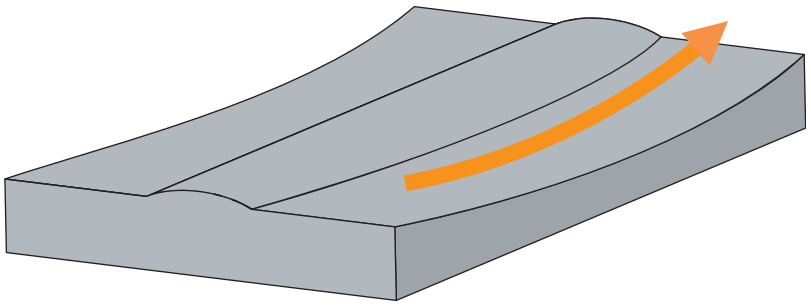
Ball nose, Medium cut length, 4-Flute

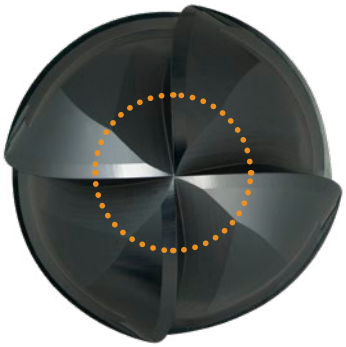
# VFR4MB

## 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.

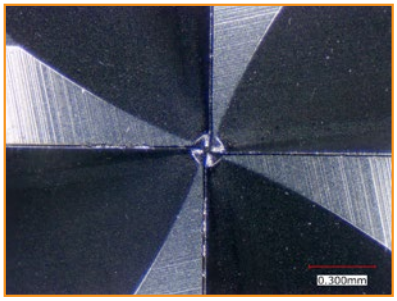




<Cutting Conditions>

| | |
|---|---|
| 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

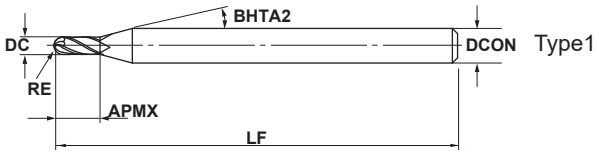
· VFR4MB showed almost no wear and no change in surface roughness even though the tip was overworked on the contours of a press mould.
· By making it possible to machine with a single end mill, the costs were reduced and the time problems which required a tool change every 2 hours of machining or more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

# VFR4MB NEW

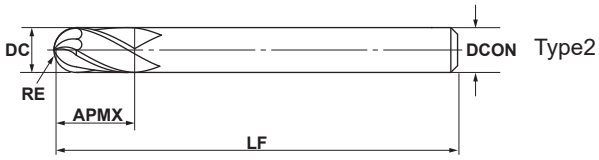
Ball nose, Medium cut length, 4-Flute

| 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<br>- 0.008 | 0<br>- 0.009 | 0<br>- 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.

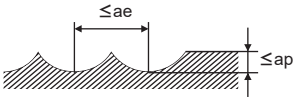
● : **Inventory maintained in Japan.**

# VFR4MB

Ball nose, Medium cut length, 4-Flute

## Recommended Cutting Conditions

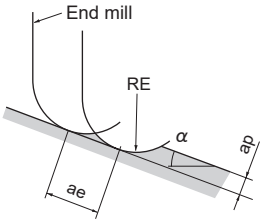
(mm)

| 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) $\alpha$ is the inclination angle of the machined surface.



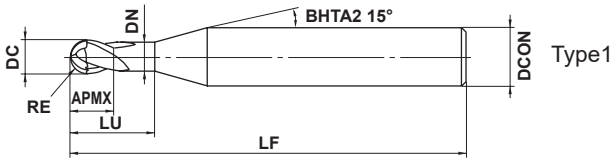

ae:Pick Feed

# VFR2SSB

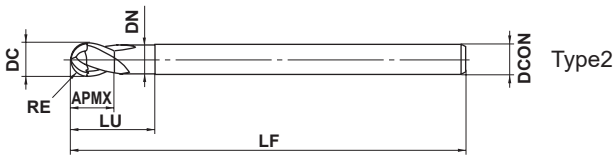
Ball nose, Short cut length, Short shank, 2-Flute

| 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<br>- 0.005 | 0<br>- 0.006 | 0<br>- 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.**

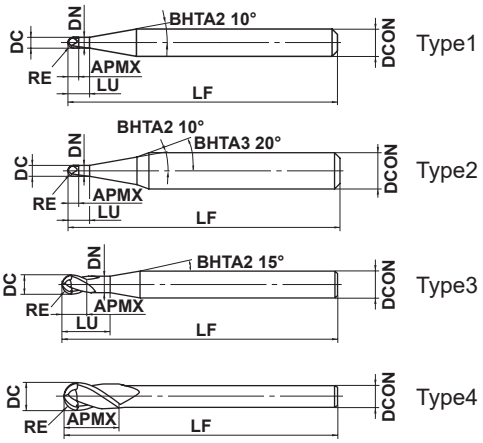
# VFR2SB

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**

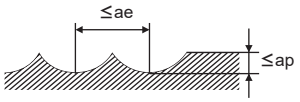
Ball nose, Short cut length, 2-Flute **VFR2SB**

## 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 |

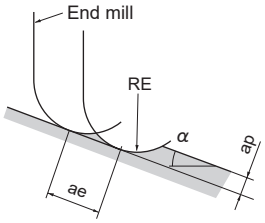
Depth of cut




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) $\alpha$ is the inclination angle of the machined surface.



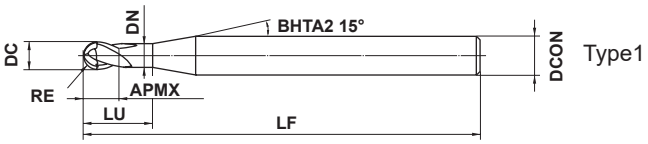

ae:Pick Feed

# VFR2SBF

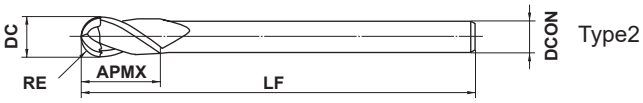
Ball nose, Short cut length, 2-Flute, For mirror finishing

| 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<br>- 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 |

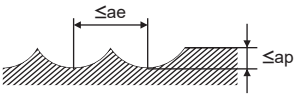
* Number of Flutes

**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.**

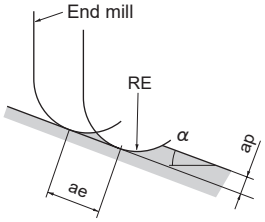
## Recommended Cutting Conditions

(mm)

| Workpiece Material | Carbon Steel, Alloy Steel (180—280HB)<br>Alloy Steel (≤350HB), Pre-hardened Steel (35— 45HRC)<br>Hardened Steel (45— 52HRC), Hardened Steel (55— 62HRC)<br><br>JIS S45C, SCM440, SKD, SKT, NAK, PX5, SKD61, SKT4, SKD11 etc. | | | | | | Hardened Steel (62—70HRC)<br><br>SKS, SKH etc. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R<br>**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) $\alpha$ is the inclination angle of the machined surface.



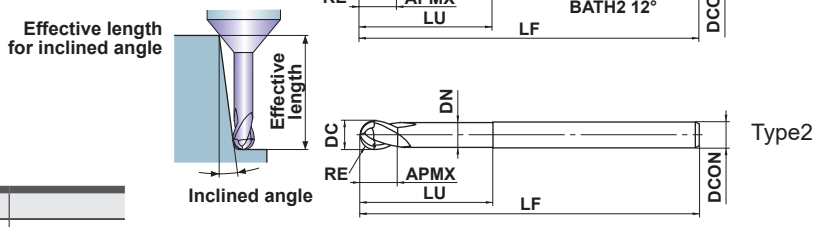

ae:Pick Feed

# 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

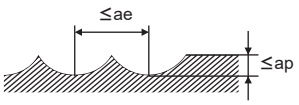
Ball nose, Long neck, 2-Flute

## 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.

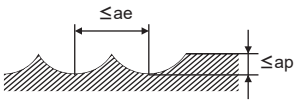
Note 2) If the depth of cut is shallow, the revolution and feed rate can be increased.

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.

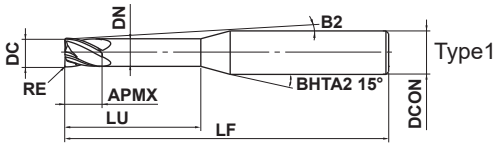
# VFRPSRB

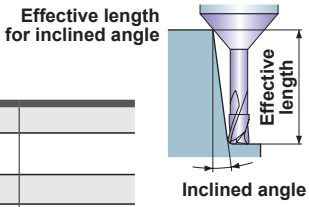
Conner radius, Short cut length, 4-Flute

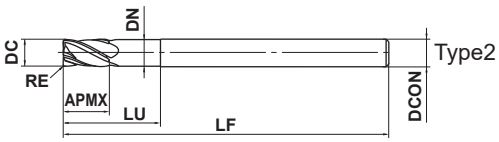



| Carbon Steel, Alloy Steel, Cast Iron (<30HRC) | Tool Steel, Pre-Hardened Steel,Hardened Steel (≤45HRC) | Hardened Steel (≤55HRC) | Hardened Steel (>55HRC) | Austenitic Stainless Steel | Titanium Alloy, Heat Resistant Alloy | Copper Alloy | Aluminium Alloy |
|---|---|---|---|---|---|---|---|
| | ○ |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






| 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

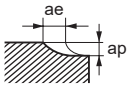
* No interference

**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.

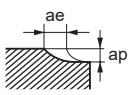
Note 3) For profile machining such as moulds, machining conditions may differ considerably depending on the workpiece geometry, machining methods and depth of cut. Reduce the feed rate especially when machining the corner sections of a workpiece.

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.

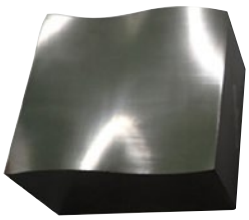
## VFR2SBF

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

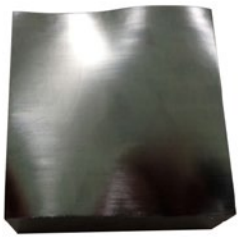


## Cutting Example

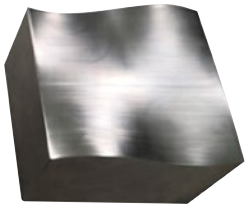
# VFR2SB



**ASP23**
**(62 HRC)**



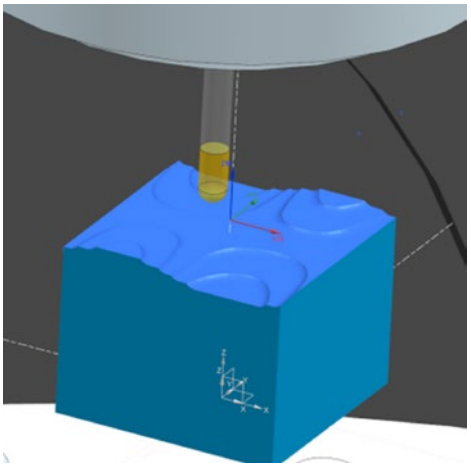
**AISI M2**
**(64 HRC)**



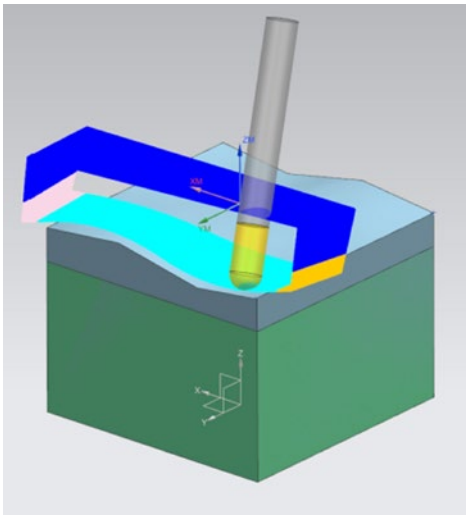
**HAP72**
**(68 HRC)**

<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°)



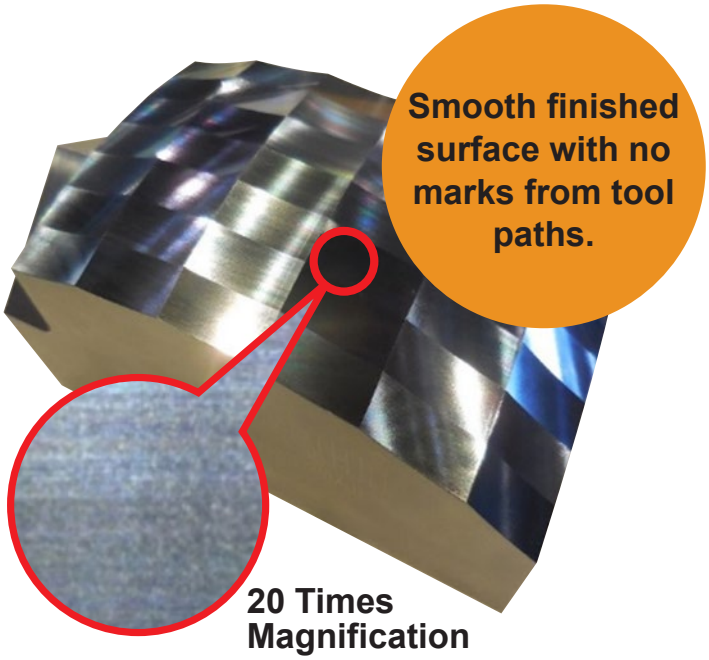
**Cutting Time : 234 min**
**Tools Used : 4**

(mm)

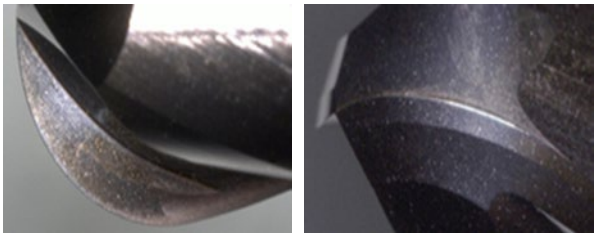
| Process | RE | n ($min^{-1}$) | vf (mm/min) | ap | ae | Finishing Allowance | Cutting Time (h:m:s) | Number of Tools |
|---|---|---|---|---|---|---|---|---|
| Rough Machining | **R 3.0** | 12000 | 1600 | 0.35 | 1.0 | 0.2 | 1:01:45 | 2 |
| Medium Finish Machining | **R 3.0** | 8000 | 500 | 0.3 | 0.1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

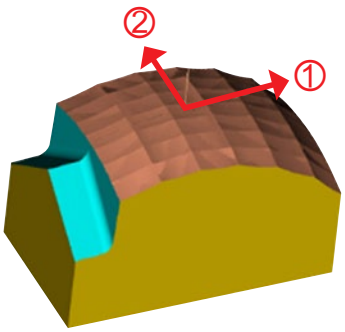


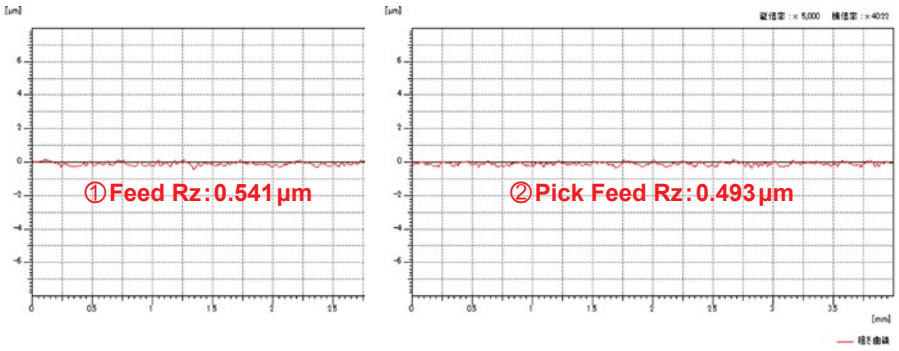

**By using 5-axis machining, cutting at the tip of the ball nose can be avoided**



**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

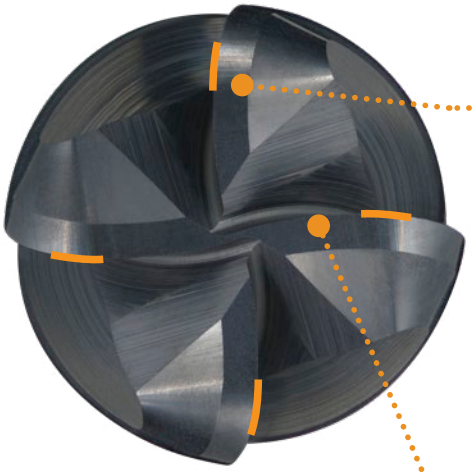
(mm)

| 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<br>Side Finish Machining | VQMHVRBD1600R500 | Air Blow | 3000<br>2000 | 150<br>100 | 1800<br>240 | 0.15<br>0.03 | 32<br>— | 1<br>— | 0.2<br>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

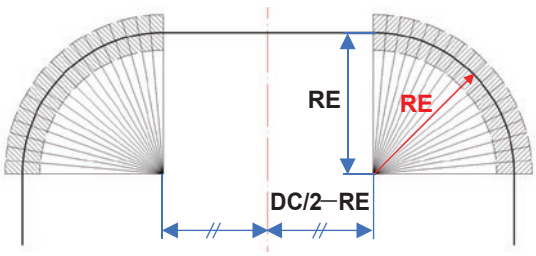
Suppresses chipping.

## 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.



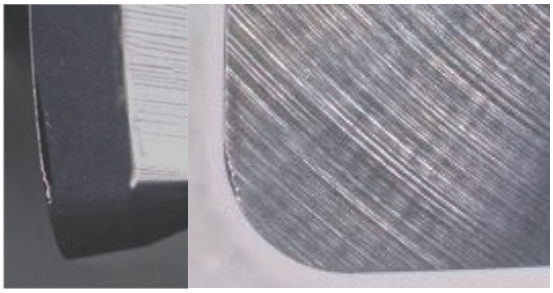

**DC :** Cutting Dia.
**RE :** Corner Radius

| | | | |
|---|---|---|---|
| **VFRPSRB** | 0.5≤DC≤6 mm : ±0.005<br>8≤DC≤12 mm : ±0.007 | Conventional Precision Radius | ±0.01 |

## Completely Seamless Curved R Edge, DC≥1.5mm

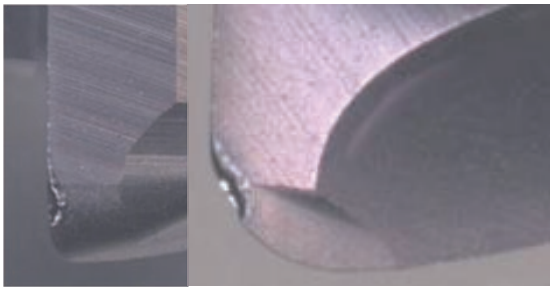
A stable machining surface is achieved by a seamless blend between the radius and flank geometry.

**VFRPSRB**



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

Conventional

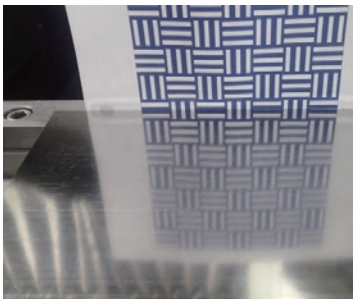


Chipping occurs because the stress is concentrated on the joint between the flank and corner edge geometry.

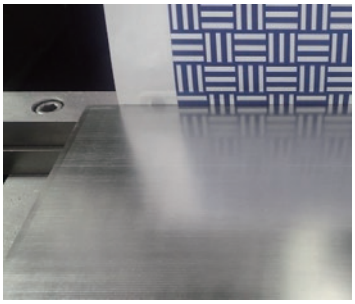
## Equipped with a Wiper Edge, DC≥1.5mm

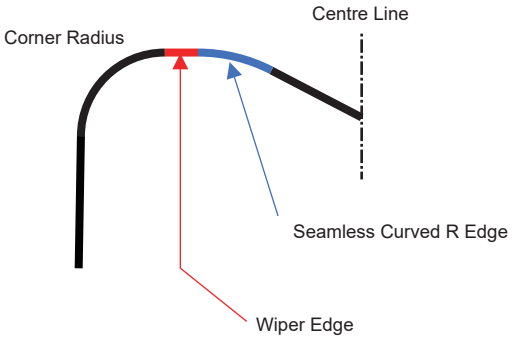
A smooth surface finish is possible by utilising a wiper edge.

**VFRPSRB**



Conventional

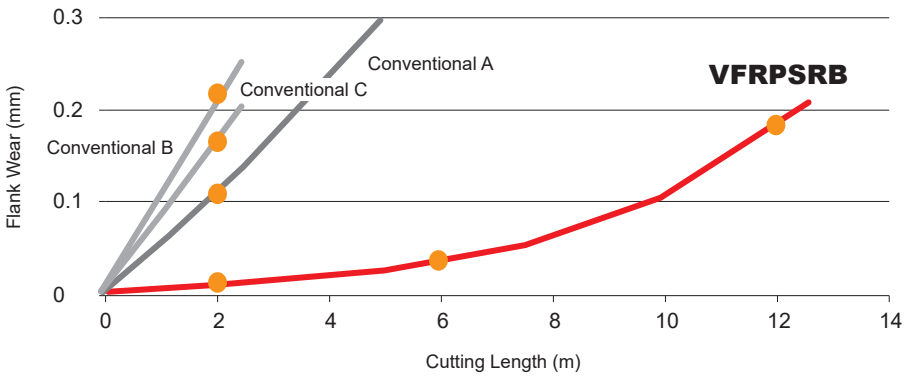




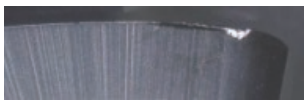
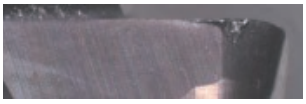
# Cutting Performance

## 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 |  | | |

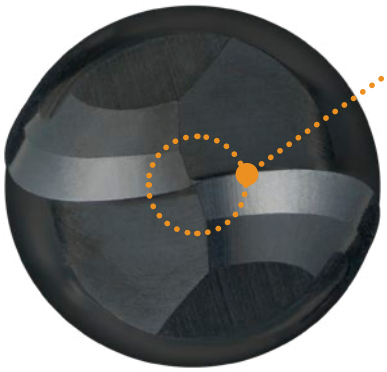
<Cutting Conditions>

| | |
|---|---|
| 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.

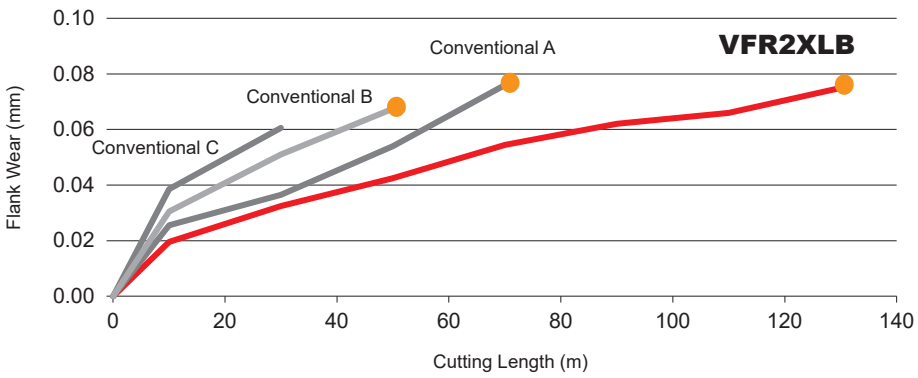
## Strong Back Taper

Reduces chatter and vibration when machining vertical walls.

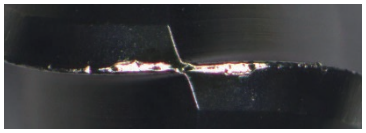
# Cutting Performance

## Wear Resistance Comparison - Machining ASP23 (62HRC)

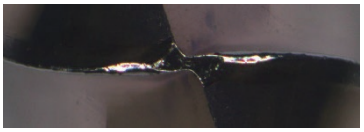
Greatly improved wear resistance for high precision machining.




<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



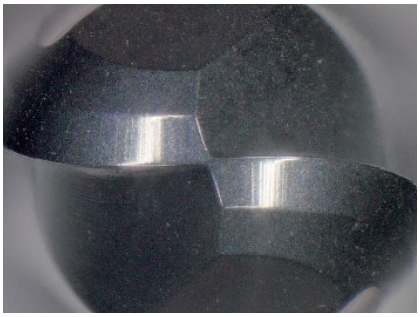
Conventional B

# Cutting Performance

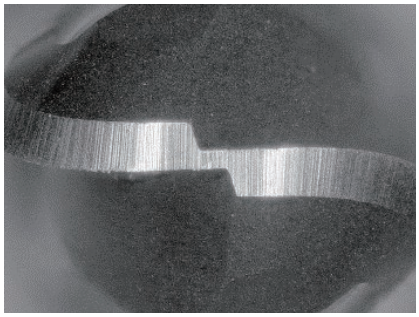
## Cutting Edge Geometry for Finishing

Sharp but strong cutting edge enables good surface finishes.

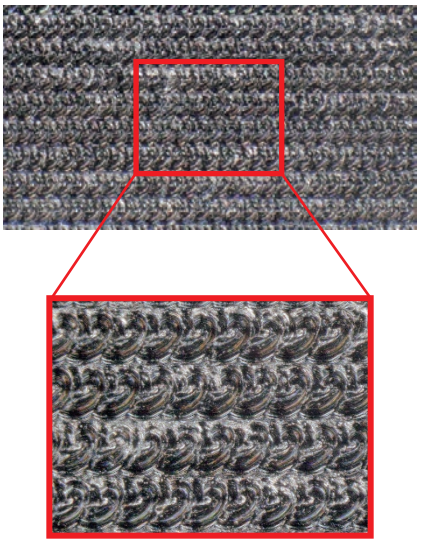
**VFR2XLB**



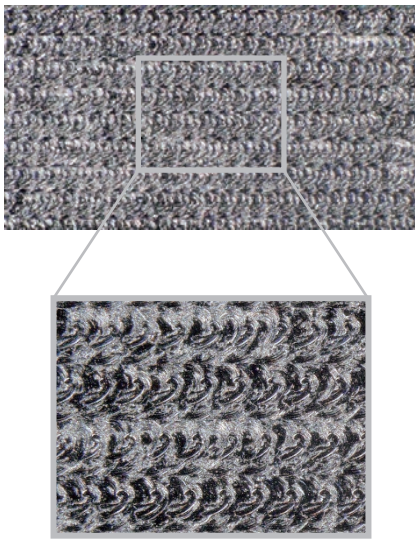
Conventional



### Comparison of Surface Finishes

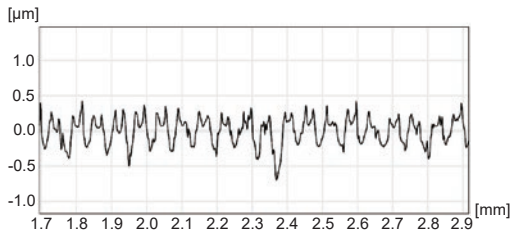


Sharp edges leave a uniform finish.

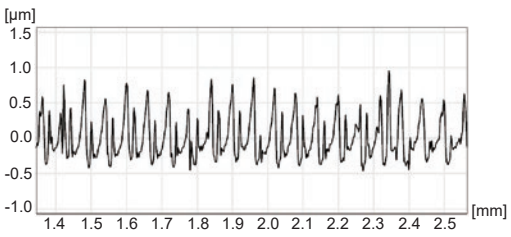


A dull edge leaves an undefined finish.

### Comparison of Surface Roughness (Feed Side)




Ra=0.174μm, Rz=1.12μm



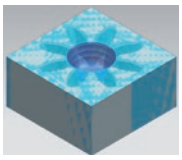
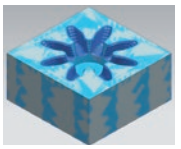
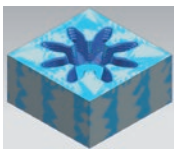
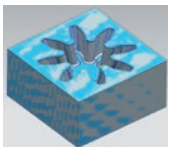
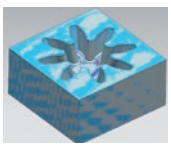
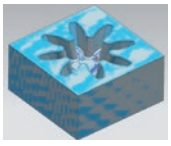
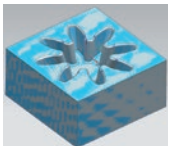

Ra=0.240μm, Rz=2.01μm

# 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

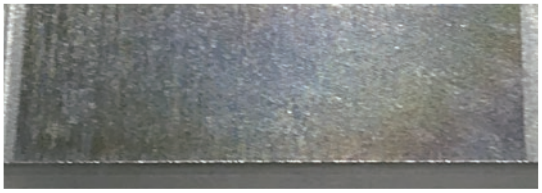
## Comparison of Surface Finishes - Machining of Dies Used for Plastic Moulding

Ideal surface finishes of dies can be achieved.

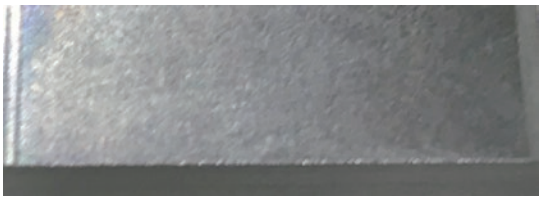
Workpiece Material : Steel die used for plastic moulding ( M340 58HRC )

(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 | |



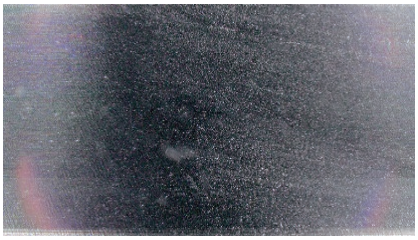
**VFR2XLB** Has a smooth surface



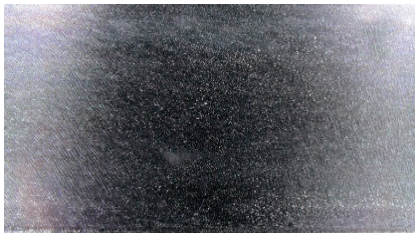
Conventional

## Comparison of Surface Finishes - Machining SKD11

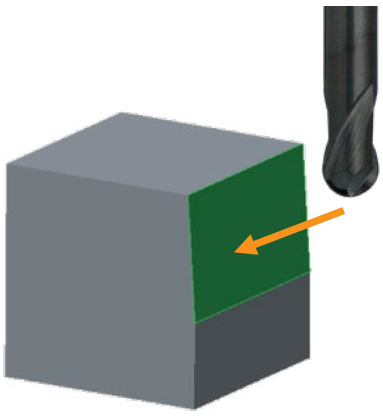
Excellent surface finish compared to those machined by conventional tools.



**VFR2XLB**



Conventional A cloudy surface finish

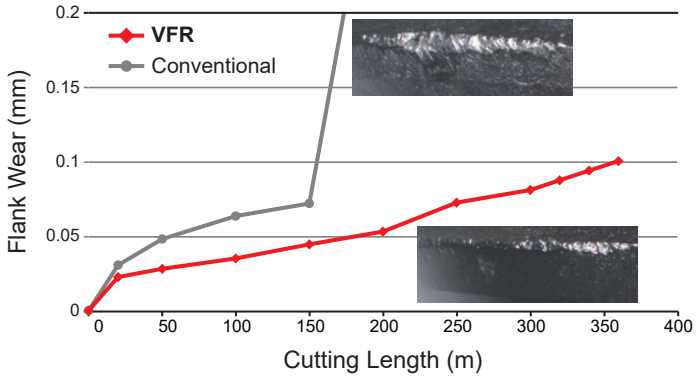


Cutting Form : 1° Taper Cutting

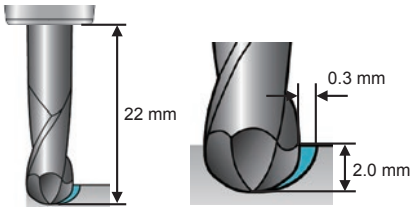
<Cutting Conditions>
Workpiece Material : JIS SKD11 (60HRC)
Tool : VFR2XLBR0100N100
Revolution : n=19000 $min^{-1}$
Table Feed : f=680 mm/min
Depth of Cut : ap=0.02 mm
ae=0.02 mm
Overhang Length : 16 mm
Cutting Mode : Air blow
Machine : Vertical MC (HSK-E32)

# Cutting Performance

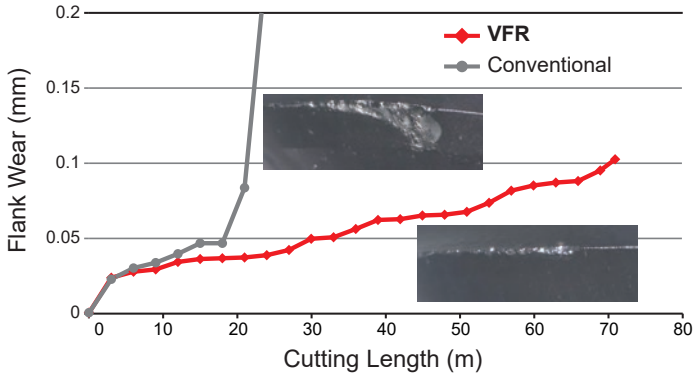
## JIS SKD61 (52HRC)



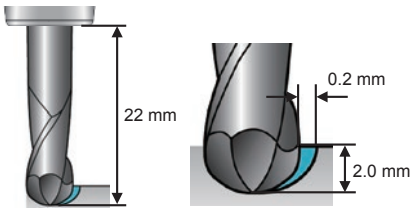

<Cutting Conditions>
Workpiece Material : JIS SKD61 (52HRC)
Tool : VFR2SBR0300
Revolution : n=17000 min$^{-1}$
Table Feed : vf=1700 mm/min
Feed per Tooth : fz=0.05 mm/t.
Depth of Cut : ap=2 mm, ae=0.3 mm
Overhang Length : 22 mm
Cutting Mode : Air blow
Machine : Vertical MC (HSK-A63)



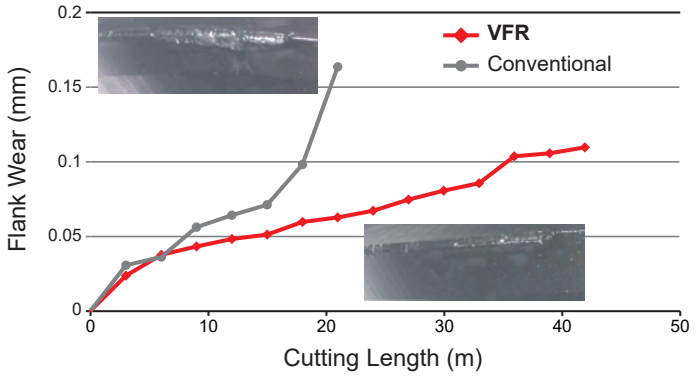

## JIS SKD11 (60HRC)



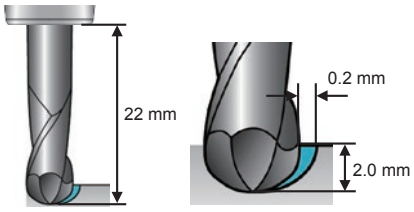

<Cutting Conditions>
Workpiece Material : JIS SKD11 (60HRC)
Tool : VFR2SBR0300
Revolution : n=5400 min$^{-1}$
Table Feed : vf=540 mm/min
Feed per Tooth : fz=0.05 mm/t.
Depth of Cut : ap=2 mm, ae=0.2 mm
Overhang Length : 22 mm
Cutting Mode : Air Blow
Machine : Vertical MC (HSK-A63)



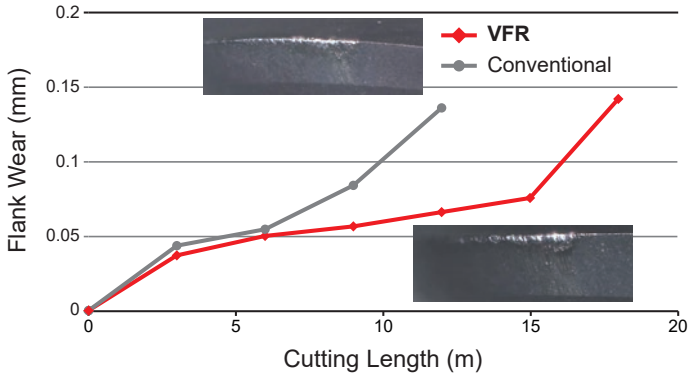

## ASP23 (62HRC)



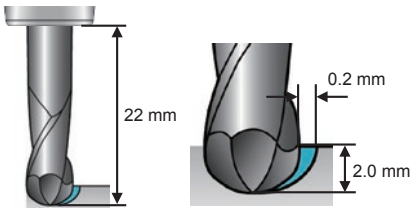

<Cutting Conditions>
Workpiece Material : ASP23 (62HRC)
Tool : VFR2SBR0300
Revolution : n=5400 min$^{-1}$
Table Feed : vf=540 mm/min
Feed per Tooth : fz=0.05 mm/t.
Depth of Cut : ap=2 mm, ae=0.2 mm
Overhang Length : 22 mm
Cutting Mode : Air Blow
Machine : Vertical MC (HSK-A63)




## JIS SKH51 (64HRC)

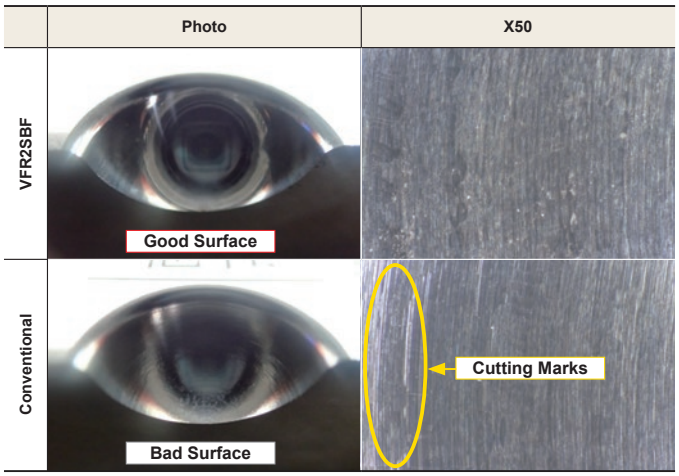



<Cutting Conditions>
Workpiece Material : JIS SKH51 (64HRC)
Tool : VFR2SBR0300
Revolution : n=5400 min$^{-1}$
Table Feed : vf=540 mm/min
Feed per Tooth : fz=0.05 mm/t.
Depth of Cut : ap=2 mm, ae=0.2 mm
Overhang Length : 22 mm
Cutting Mode : Air Blow
Machine : Vertical MC (HSK-A63)

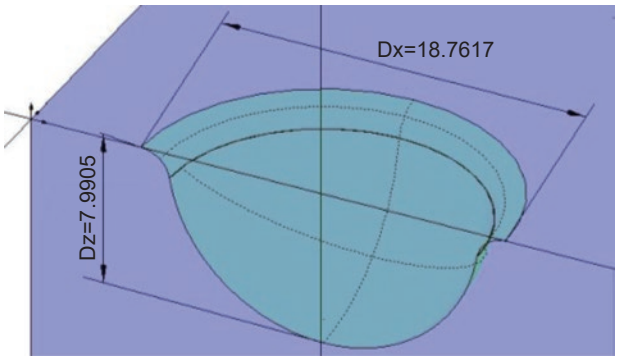


# Cutting Performance

## 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.


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(Tools specifications subject to change without notice.)


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