

SMART MIRACLE End Mill Series for Difficult-to-cut Materials

VQN2MB/4MB/4MBF

New
Product

Cutting Edge Geometry Enables Stability, Versatility & High Efficiency Machining of Heat Resistant Alloys



SMART MIRACLE End Mill Series for Difficult-to-cut Materials

VQN2MB/4MB/4MBF

(Al, Ti, Si) N-based coating with outstanding wear resistance, combined with optimized cutting edges, provide high machining efficiency and a stable cutting performance.

Features

(Al, Ti, Si) N-based Coating

The (Al, Ti, Si)N-based coatings maintain their film hardness and heat resistant properties under the harshest of conditions making it a highly suitable coating for end mills machining heat resistant super alloys.

New Cutting Edge Geometry

The corner radius cutting edge rake angles have been optimized for consistent contact. Additionally the structure of both the 2 and 4 flute end mills have been strengthened.



VQN2MB

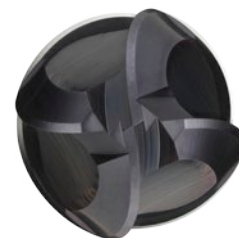
Versatile 4 Flute Type

When compared to 2-flute types, end mills with 4 flutes have a longer tool life and provide higher efficiency machining. In addition the new types have a much improved chip disposal rate to prevent clogging.

Now available is the new VQN4MBF with a full 4-flute end geometry, ideal for 5 axis machining. The new VQN4MB, with 4 side flutes displays a special end geometry with only 2 flutes, designed with extra space for excellent chip evacuation during rough machining.



VQN4MBF























VQN4MB

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

Ball End Mill

Medium (ap=3xDC)

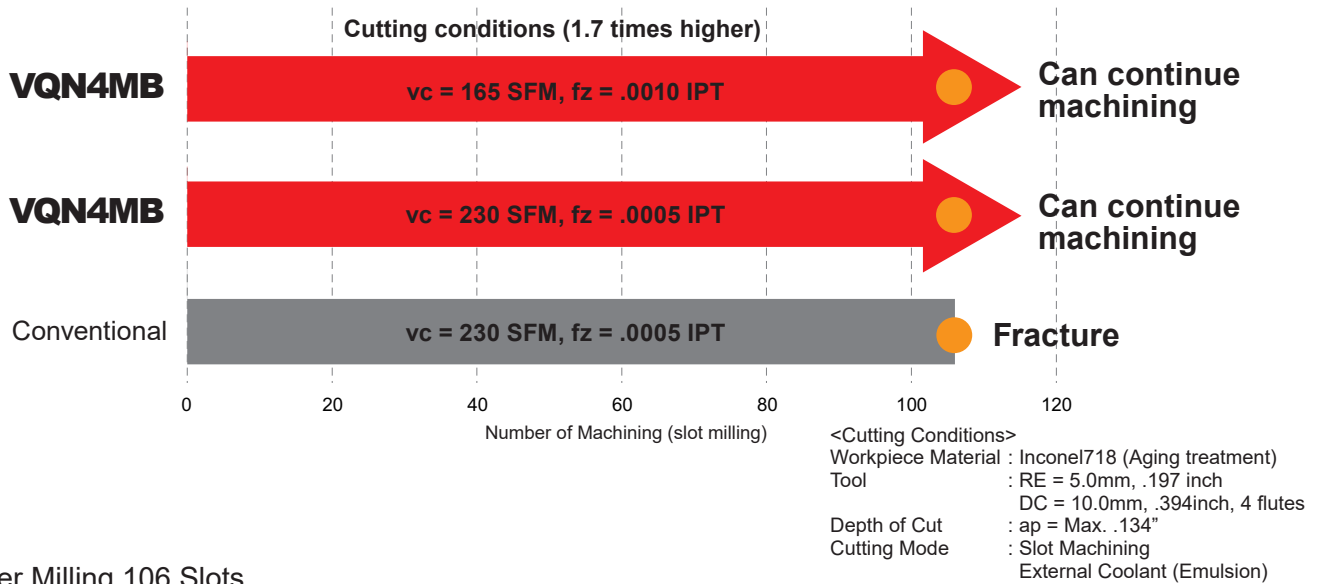
VQN2MB				METRIC RE 0.5-1.5	DC	-	2	F  R 	S	○
				METRIC RE 2.0-6.0	2-2.4 xDC	-	2	F  R 	S	○
VQN4MB				METRIC RE 1.0-6.0	1-2.4 xDC	-	4	F  R 	S	○
VQN4MBF				METRIC RE 1.0-6.0	1-2.4 xDC	-	4	F  R 	S	-

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

Cutting Performance

Machining Inconel 718 - Comparison of Fracture Resistance

Cutting time has been reduced due to an increased feed rate and an excellent resistance to fracturing during slotting. Ideal for machining heat resistant alloys typically used in the aerospace industry.

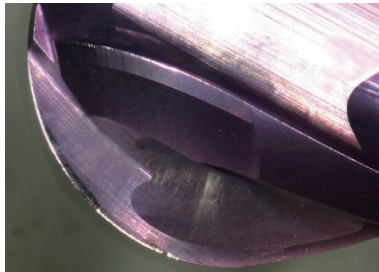


After Milling 106 Slots



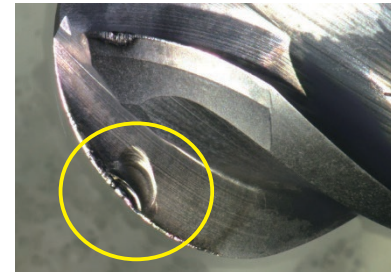
VQN4MB

vc = 165 SFM, fz = .0010 IPT



VQN4MB

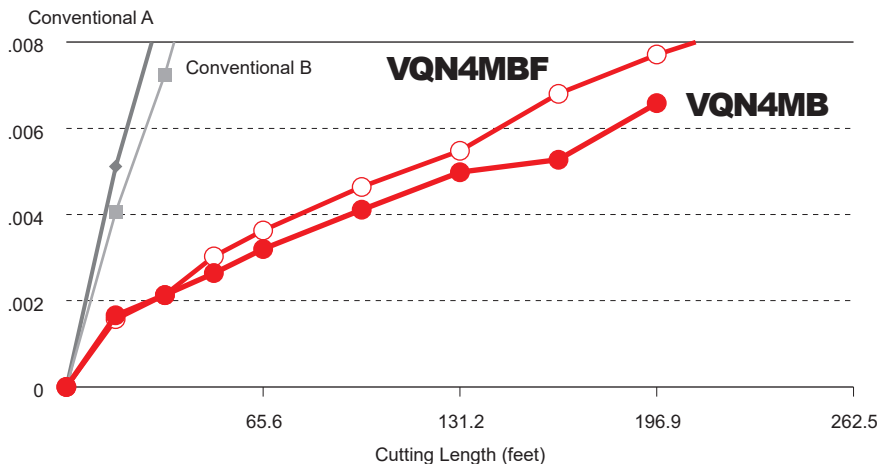
vc = 230 SFM, fz = .0005 IPT



Conventional Fracture
vc = 230 SFM, fz = .0005 IPT

Machining Inconel 718 - Comparison of Wear Resistance

Both VQN4MBF and VQN4MB have more than four times the wear resistance of conventional products.



**4 Times
Tool Life**

<Cutting Conditions>
 Workpiece Material : Inconel718
 Tool : RE = 3.0mm, .118 inch, 4 flutes
 Cutting Speed : vc = 130 SFM
 Feed : fz = .0020 IPT
 Depth of Cut : ap = .094 inch
 ae = .012 inch
 Cutting Mode : Down Cut
 External Coolant (Oil)

VQN2MB NEW

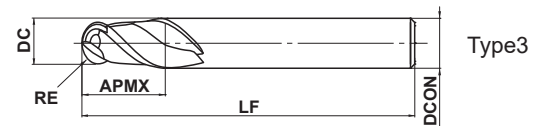
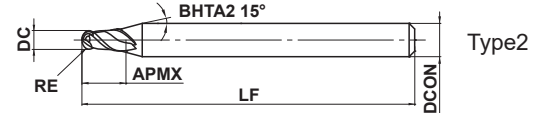
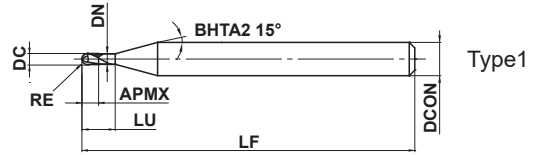
Ball nose, Medium cut length, 2 flute



RE≤1.5

RE>1.5

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



RE ≤ 6		
±0.010		
DCON=6	8 ≤ DCON ≤ 10	DCON=12
0 - 0.005	0 - 0.006	0 - 0.008



- (Al, Ti, Si) N-based coating exhibits excellent wear and chipping resistance when machining heat resistant super alloys.
- The R cutting edge rake angle and ball nose geometry have been optimised to improve strength.

(mm)

Order Number	RE	DC	APMX	LU	DN	LF	DCON	No.F [*]	Stock	Type
VQN2MBR0050	0.5	1	1	4	0.94	60	6	2	●	1
VQN2MBR0100	1.0	2	2	6	1.9	60	6	2	●	1
VQN2MBR0150	1.5	3	3	8	2.9	60	6	2	●	1
VQN2MBR0200	2.0	4	8	—	—	60	6	2	●	2
VQN2MBR0250	2.5	5	12	—	—	60	6	2	●	2
VQN2MBR0300	3.0	6	12	—	—	60	6	2	●	3
VQN2MBR0400	4.0	8	14	—	—	70	8	2	●	3
VQN2MBR0500	5.0	10	18	—	—	80	10	2	●	3
VQN2MBR0600	6.0	12	22	—	—	80	12	2	●	3

* Number of Flutes

DC = Cutting Dia. **DN** = Neck Dia.
RE = Radius of Ball Nose **LF** = Overall Length
APMX = Length of Cut **DCON** = Shank Dia.
LU = Neck Length

● : USA Stock

End Mills for Machining Difficult-to-cut Materials

VQN2MB

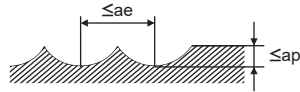
Medium cut length, 2 flute

Recommended Cutting Conditions

(inch)

RE		$\alpha \leq 15^\circ$		$\alpha > 15^\circ$		Depth of Cut a_p	Depth of Cut a_e
(mm)	(inch)	Revolution (SFM)	Feed Rate (IPT)	Revolution (SFM)	Feed Rate (IPT)		
Workpiece Material: Nickel-based Heat Resistant Super Alloy Inconel718, Inconel713C, WASPALLOY etc.							
0.5	.020	65	25.2	65	29.9	.004	.010
1.0	.039	65	12.6	65	15.0	.008	.020
1.5	.059	65	9.8	65	9.8	.012	.030
2.0	.079	65	7.5	65	8.7	.016	.039
2.5	.098	65	7.1	65	7.9	.020	.049
3.0	.118	65	6.7	65	8.3	.024	.059
4.0	.157	60	5.1	60	6.3	.031	.079
5.0	.197	60	5.1	60	5.5	.039	.098
6.0	.236	60	4.3	60	4.7	.047	.118

Depth of cut

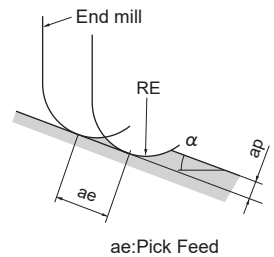


Note 1) For heat resistant super alloy, the use of water-soluble coolant is effective.

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

Note 3) Vibration may occur if the rigidity of machine or workpiece is low. In this case, please reduce the revolution and feed rate proportionately.

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

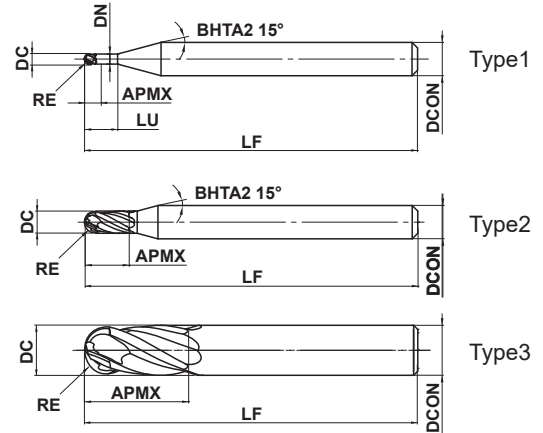


VQN4MB NEW

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	Heat Resistant Alloy	Copper Alloy	Aluminum Alloy
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RE ≤ 6		
±0.010		
DCON=6	8 ≤ DCON ≤ 10	DCON=12
⁰ / _{-0.005}	⁰ / _{-0.006}	⁰ / _{-0.008}



- (Al, Ti, Si) N-based coating exhibits excellent wear and chipping resistance when machining heat resistant super alloys.
- The 2-flute end cutting edge provides excellent chip evacuation and is ideal for rough machining.

(mm)

Order Number	RE	DC	APMX	LU	DN	LF	DCON	No.F [*]	Stock	Type
VQN4MBR0100	1.0	2	2	6	1.9	60	6	4	●	1
VQN4MBR0150	1.5	3	3	8	2.9	60	6	4	●	1
VQN4MBR0200	2.0	4	8	—	—	60	6	4	●	2
VQN4MBR0250	2.5	5	12	—	—	60	6	4	●	2
VQN4MBR0300	3.0	6	12	—	—	60	6	4	●	3
VQN4MBR0400	4.0	8	14	—	—	70	8	4	●	3
VQN4MBR0500	5.0	10	18	—	—	80	10	4	●	3
VQN4MBR0600	6.0	12	22	—	—	80	12	4	●	3

* Number of Flutes

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APMX = Length of Cut **DCON** = Shank Dia.
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End Mills for Machining Difficult-to-cut Materials

VQN4MB

Medium cut length, 4 flute

Recommended Cutting Conditions

(inch)

RE		$\alpha \leq 15^\circ$		$\alpha > 15^\circ$		Depth of Cut a_p	Depth of Cut a_e
(mm)	(inch)	Revolution (SFM)	Feed Rate (IPT)	Revolution (SFM)	Feed Rate (IPT)		
1.0	.039	65	15.0	65	20.1	.008	.020
1.5	.059	65	13.4	65	16.5	.012	.030
2.0	.079	65	12.6	65	15.0	.016	.039
2.5	.098	65	9.8	65	12.2	.020	.049
3.0	.118	65	8.3	65	9.8	.024	.059
4.0	.157	60	6.3	60	7.5	.031	.079
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6.0	.236	60	5.9	60	6.7	.047	.118

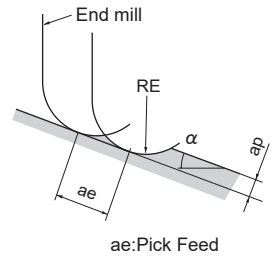
Depth of cut	
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Note 1) For heat resistant super alloy, the use of water-soluble coolant is effective.

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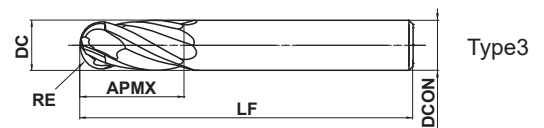
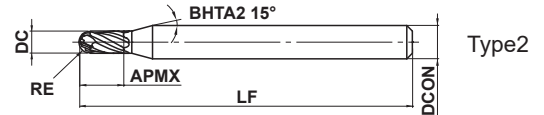
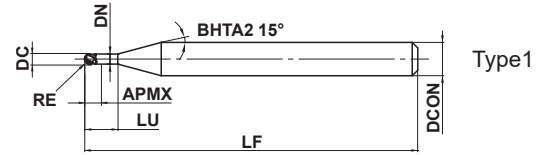


VQN4MBF NEW

Ball nose, Medium cut length, 4 flute



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RE ≤ 6		
±0.010		
DCON=6	8 ≤ DCON ≤ 10	DCON=12
$\begin{matrix} 0 \\ -0.005 \end{matrix}$	$\begin{matrix} 0 \\ -0.006 \end{matrix}$	$\begin{matrix} 0 \\ -0.008 \end{matrix}$



- (Al, Ti, Si) N-based coating exhibits excellent wear and chipping resistance when machining heat resistant super alloys.
- The 4-flute end cutting edge is also ideal for 5-axis machining.

(mm)

Order Number	RE	DC	APMX	LU	DN	LF	DCON	No.F [*]	Stock	Type
VQN4MBFR0100	1.0	2	2	6	1.9	60	6	4	●	1
VQN4MBFR0150	1.5	3	3	8	2.9	60	6	4	●	1
VQN4MBFR0200	2.0	4	8	—	—	60	6	4	●	2
VQN4MBFR0250	2.5	5	12	—	—	60	6	4	●	2
VQN4MBFR0300	3.0	6	12	—	—	60	6	4	●	3
VQN4MBFR0400	4.0	8	14	—	—	70	8	4	●	3
VQN4MBFR0500	5.0	10	18	—	—	80	10	4	●	3
VQN4MBFR0600	6.0	12	22	—	—	80	12	4	●	3

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End Mills for Machining Difficult-to-cut Materials

VQN4MBF

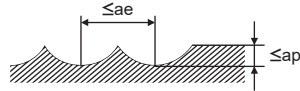
Medium cut length, 4 flute

Recommended Cutting Conditions

(inch)

Workpiece Material		Nickel-based Heat Resistant Super Alloy Inconel718, Inconel713C, Waspaloy etc.						
RE		$\alpha \leq 15^\circ$			$\alpha > 15^\circ$			Depth of Cut a_p
(mm)	(inch)	Revolution (SFM)	Feed Rate (IPT)	Depth of Cut a_e	Revolution (SFM)	Feed Rate (IPT)	Depth of Cut a_e	
1.0	.039	65	7.1	.016	65	12.2	.020	.008
1.5	.059	65	6.7	.024	65	13.4	.030	.012
2.0	.079	65	7.5	.031	65	12.6	.039	.016
2.5	.098	65	5.9	.039	65	9.8	.049	.020
3.0	.118	65	6.7	.047	65	9.8	.059	.024
4.0	.157	60	5.1	.063	60	7.5	.079	.031
5.0	.197	60	3.9	.079	60	7.9	.098	.039
6.0	.236	60	5.1	.094	60	6.7	.118	.047

Depth of cut

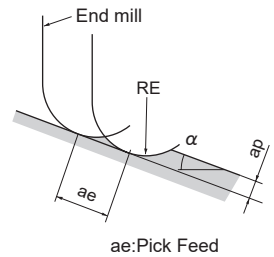


Note 1) For heat resistant super alloy, the use of water-soluble coolant is effective.

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

Note 3) Vibration may occur if the rigidity of machine or workpiece is low. In this case, please reduce the revolution and feed rate proportionately.

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



Memo

A series of horizontal dashed lines for writing, spanning the width of the page.



SMART MIRACLE End Mill Series for Difficult-to-cut Materials

VQN2MB/4MB/4MBF

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 using rotating tools, please make a trial run to check run-out, vibration and abnormal sounds etc.

 **MITSUBISHI MATERIALS U.S.A. CORPORATION**

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