MITSUBISHI MATERIALS

VQ4MVM

HIGH-PERFORMANCE SMART MIRACLE END MILL





TOOL NEWS **B197A-H**

High-Performance End Mill

SMART MIRACLE End Mill Series

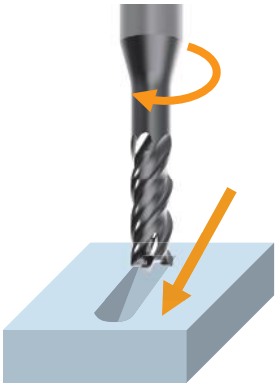
VQ4MVM

Multi-functional end mill capable of steep ramping when machining a wide range of materials.

Ramping is a method of sinking gradually as the tool traverses.

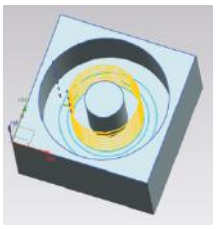
This eliminates the need for a pilot hole when machining pockets, thereby reducing costs through tool consolidation. Compared to direct plunge cutting, ramping enables simultaneous multi-axis feed at high speeds to lower machining times. This method is ideal for machining wide and shallow pockets.

VQ4MVM provides high-performance and multi-functionality. It can perform shoulder milling, grooving, and helical machining, as well as ramping angles of up to 30º in carbon and alloy steels.



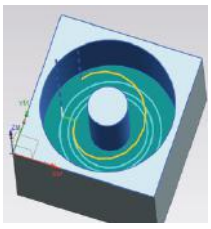
Steep Ramping Capability

27 sec

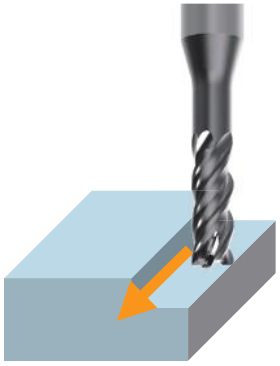


Conventional
Helical Milling
7 passes needed

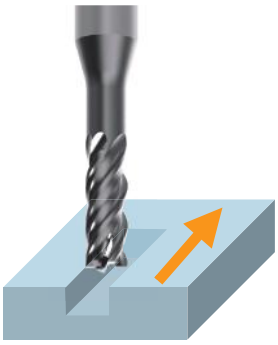
14 sec



VQ4MVM
Helical and Ramping
Only 1 pass needed



Shoulder Milling



Slot Milling



Pocket Milling



Helical Milling

SMART MIRACLE End Mill Series

Newly-developed coating with improved wear resistance.
The smoothening treatment of the coating layer reduces cutting resistance and significantly improves chip discharge.

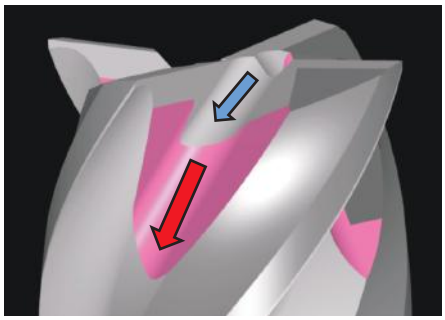
SMART MIRACLE Coating (Al,Cr)N coating is the most suitable coating for higher efficiency machining.

ZERO-μ Surface The original surface treatment technology provides a smooth coating layer.



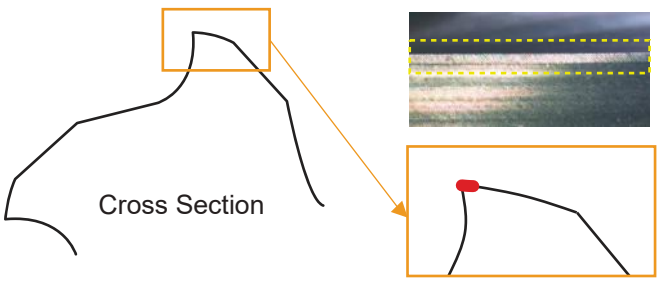
Secondary Gash

A first and secondary gash provides high capacity chip evacuation that far exceeds conventional designs when ramping.



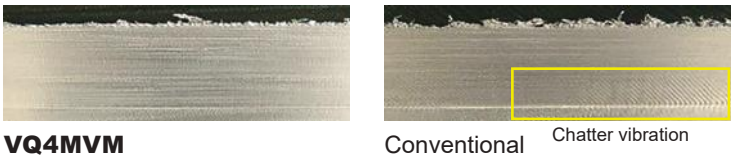
Micro Relief Angle

This exerts a margin effect that provides a guide during machining.
Combined with irregular helix flutes, vibration damping and suppression of burrs are improved.



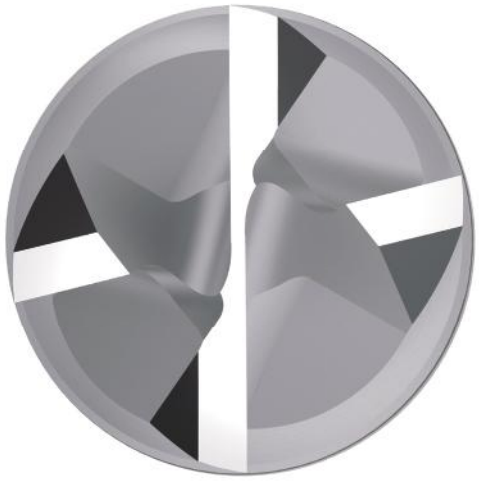
Irregular helix flutes and the micro relief angle improve vibration damping and provide excellent surface finishes.

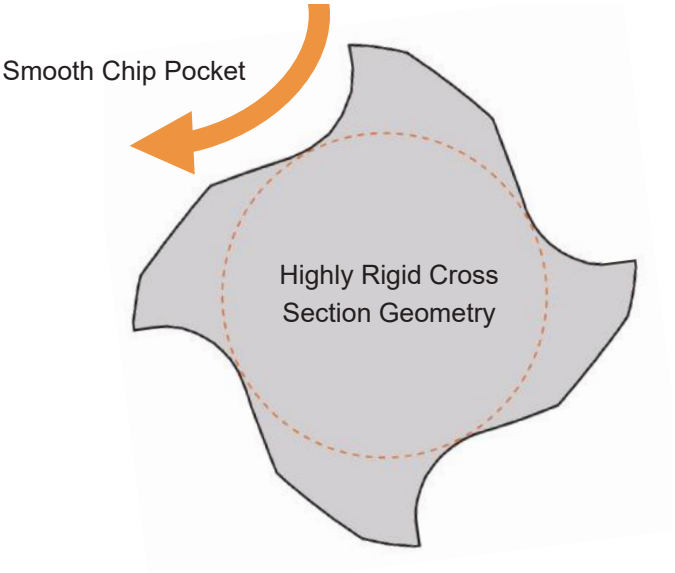
ANSI 304 vc=330 SFM, fz=.002 IPT, ap=.197 inch, ae=.118 inch



Chip Pocket and Highly Rigid Geometry

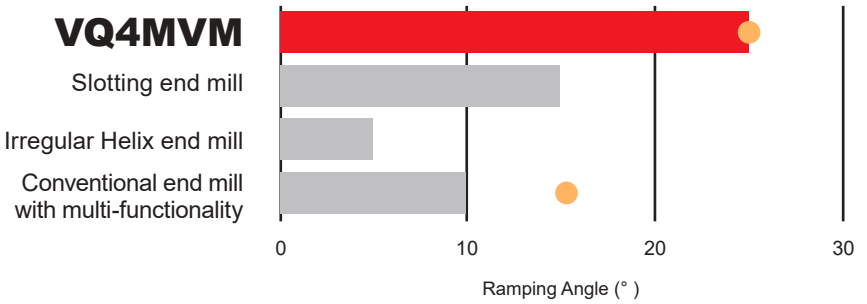
VQ4MVM is suitable for steep ramping and chip evacuation performance due to the highly rigid geometry.





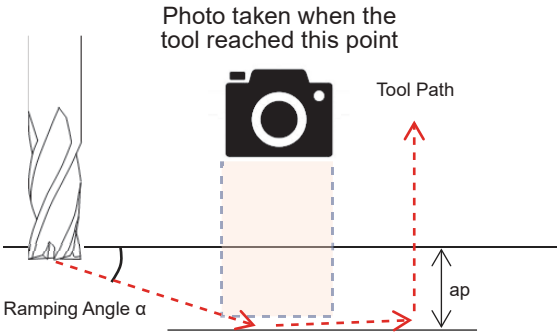
Comparison of Ramping Angles when Machining 304

Provided a good machined surface when machining with a ramping angle of 25°. The cutting conditions used in this comparison test differ from the recommended conditions. Please check the recommended conditions before commercial use.



<Cutting Conditions>

Workpiece Material	: AISI 304
Tool	: Ø.394 inch
Cutting Speed	: vc=165 SFM
Feed per Tooth	: fz=.001 IPT
Depth of Cut	: ap=.394 inch ae=.394 inch
Over Length	: 1.378 inch
Cutting Mode	: External Coolant (Emulsion)
Machine	: Vertical M/C (BT50)



● : Machining Surface



VQ4MVM 25°



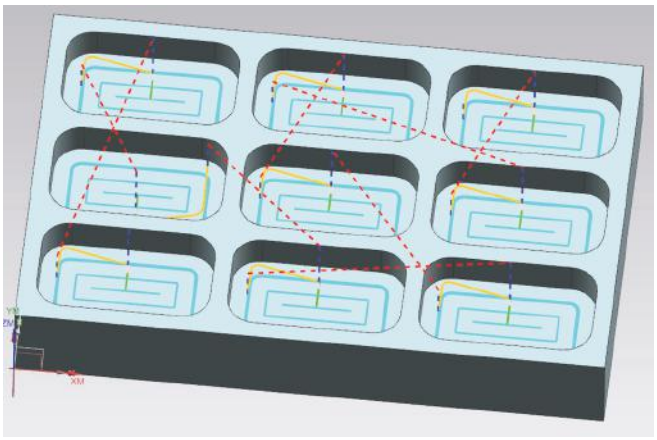
Conventional end mill 15°

Comparison of Continuous Pocketing when Machining 1055

During continuous machining of small pockets, steep ramping reliably shortens machining time.

Workpiece Material : AISI 1055 Pocket Size 1.969” x 1.181” x .394” R=8
Tool : Ø.394 inch

Simulated by **VQ4MVM**



Total Cycle Time 4:35

Ramping Angle 17° At the start of machining

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.002 IPT
Depth of Cut : ap=.394 inch

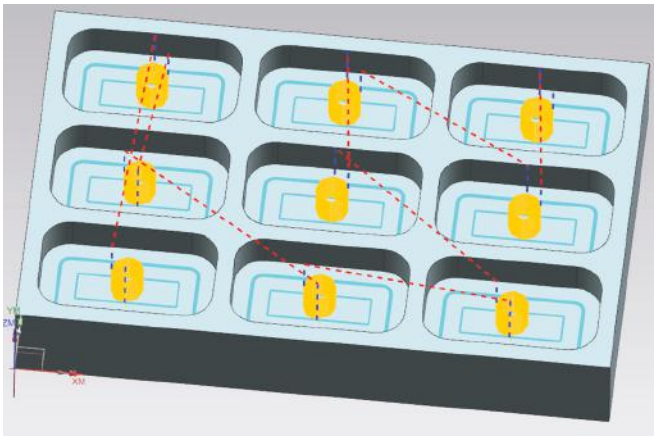
Rough Cutting

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch
ae≤.197 inch

Finish Cutting

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch
ae≤.197 inch

Simulated Conventional Machining



Total Cycle Time 6:42

Helical Angle 2° At the start of machining

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch

Same cutting conditions for roughing and finishing

Rough Cutting

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch
ae≤.197 inch

Finish Cutting

<Cutting Conditions>
Cutting Speed : vc=330 SFM
Feed per Tooth : fz=.003 IPT
Depth of Cut : ap=.394 inch
ae≤.197 inch

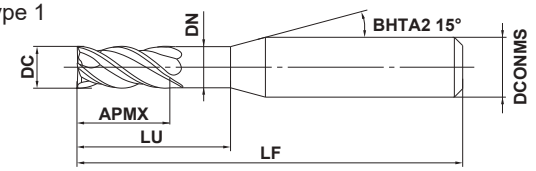
VQ4MVM

End mill, Medium cut length, 4 flute, For multi-functional machining

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	Aluminum Alloy
◎	○			◎	○		

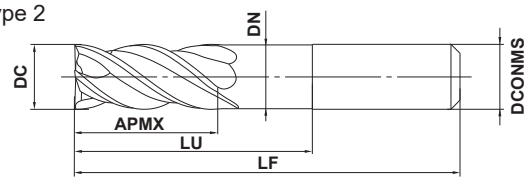


Type 1



DC≤12				
0 - 0.020				
DCONMS=6				
0 - 0.008				
DCONMS8, 10	DCONMS=12			
0 - 0.009	0 - 0.011			

Type 2



- Multi-functional end mill that enables steep ramping angles.
- Chip evacuation is improved by widening the radial cutting edge pocket.

Order Number	Dimensions (mm)						No. of Flutes	Stock	Type
	DC	APMX	LU	DN	LF	DCONMS			
VQ4MVMD0400N180	4	11	18	3.85	50	6	4	●	1
VQ4MVMD0500N180	5	13	18	4.85	50	6	4	●	1
VQ4MVMD0600N200	6	13	20	5.85	60	6	4	●	2
VQ4MVMD0800N240	8	19	24	7.85	60	8	4	●	2
VQ4MVMD1000N300	10	22	30	9.70	70	10	4	●	2
VQ4MVMD1200N360	12	26	36	11.70	75	12	4	●	2

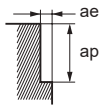
Note 1) SMART MIRACLE Coating has very low electrical conductivity. Therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

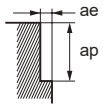
DC = Cutting dia. **DN** = Neck dia.
APMX = Depth of cut max. **LF** = Functional length
LU = Usable length **DCONMS** = Connection dia.

● : USA Stock

Recommended Cutting Conditions

Side Milling

Workpiece Material		Mild Steel, Carbon Steel Alloy Steel (180–280HB) AISI 1045, AISI 4140				Pre-Hardened Steel (≤45HRC) Alloy Tool Steel NAK, PX5, SKD,SKT				Austenitic Stainless Steel Ferritic and Martensitic Stainless Steel, Titanium Alloys AISI 304, AISI 316, AISI 410, AISI 430, Ti-5Al-5V-Mo-3Cr			
Dia. DC		Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
(mm)	(inch)												
4	**.157**	9500	55.1	.236	.047	5600	19.3	.157	.016	6400	18.5	.157	.024
5	**.197**	7600	55.1	.295	.059	4500	19.7	.197	.020	5100	18.5	.197	.035
6	**.236**	6400	55.1	.354	.071	3700	19.7	.236	.024	4200	22.8	.236	.047
8	**.315**	4800	51.2	.472	.094	2800	20.5	.315	.031	3200	24.8	.315	.059
10	**.394**	3800	47.2	.591	.118	2200	18.1	.394	.039	2500	26.0	.394	.071
12	**.472**	3200	39.4	.709	.142	1900	17.7	.472	.039	2100	24.0	.472	.094
Depth of Cut													

Workpiece Material		Precipitation Hardening Stainless Steel Cobalt Chromium Alloys AISI 630, AISI 631				Heat Resistant Alloys Inconel718			
Dia. DC		Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
(mm)	(inch)								
4	**.157**	5600	19.3	.157	.031	2400	4.7	.157	.016
5	**.197**	4500	19.7	.197	.039	1900	4.7	.197	.020
6	**.236**	3700	19.7	.236	.047	1600	5.1	.236	.024
8	**.315**	2800	20.5	.315	.063	1200	5.1	.315	.031
10	**.394**	2200	18.1	.394	.079	950	5.5	.394	.039
12	**.472**	1900	17.7	.472	.094	800	5.5	.472	.047
Depth of Cut									

Note 1) SMART MIRACLE coating has very low electrical conductivity. Therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

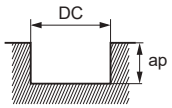
Note 2) When cutting austenitic stainless steels and titanium alloys, the use of water-soluble cutting fluid is effective.

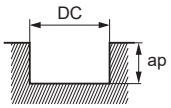
Note 3) If the depth of cut is shallow, the revolution and feed rate can be increased.

Note 4) 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.

Recommended Cutting Conditions

Slot Milling and Ramping

Workpiece Material		Mild Steel, Carbon Steel Alloy Steel (180–280HB) AISI 1045, AISI 4140				Pre-Hardened Steel (≤45HRC) Alloy Tool Steel NAK, PX5, SKD,SKT				Austenitic Stainless Steel Ferritic and Martensitic Stainless Steel, Titanium Alloys AISI 304, AISI 316, AISI 410, AISI 430, Ti-5Al-5V-Mo-3Cr			
Dia. DC		Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
(mm)	(inch)												
4	**.157**	8000	33.1	.157	.157	4800	8.3	.079	.157	4800	11.0	.157	.157
5	**.197**	6400	33.1	.197	.197	3800	8.3	.098	.197	3800	11.0	.197	.197
6	**.236**	5300	33.1	.236	.236	3200	9.1	.118	.236	3200	11.8	.236	.236
8	**.315**	4000	29.1	.315	.315	2400	9.4	.157	.315	2400	12.6	.315	.315
10	**.394**	3200	26.8	.394	.394	1900	10.6	.197	.394	1900	13.8	.394	.394
12	**.472**	2700	22.4	.472	.472	1600	10.2	.236	.472	1600	13.4	.472	.472
Depth of Cut													

Workpiece Material		Precipitation Hardening Stainless Steel Cobalt Chromium Alloys AISI 630, AISI 631				Heat Resistant Alloys Inconel718			
Dia. DC		Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)	Revolution (min-1)	Feed rate (IPM)	Depth of cut ap (inch)	Depth of cut ae (inch)
(mm)	(inch)								
4	**.157**	4000	9.8	.079	.157	2000	3.7	.047	.157
5	**.197**	3200	9.8	.098	.197	1600	3.7	.059	.197
6	**.236**	2700	11.4	.118	.236	1300	3.8	.071	.236
8	**.315**	2000	10.2	.157	.315	990	3.9	.094	.315
10	**.394**	1600	9.1	.197	.394	800	4.7	.118	.394
12	**.472**	1300	8.3	.236	.472	660	4.3	.142	.472
Depth of Cut									

Note 1) SMART MIRACLE coating has very low electrical conductivity. Therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

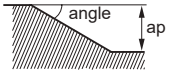
Note 2) When cutting austenitic stainless steels and titanium alloys, the use of water-soluble cutting fluid is effective.

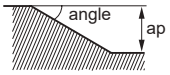
Note 3) When performing machining with a strong ramping angle, a high gripping force holder is recommended.

Note 4) When performing ramping deeper than the recommended depth of cut, please divide the process into multiple steps within the recommended depth of cut.

Note 5) 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.

Feed Rate Factor for Ramping

Workpiece Material		Mild Steel, Carbon Steel Alloy Steel (180–280HB)							Pre-Hardened Steel (≤45HRC) Alloy Tool Steel			Austenitic Stainless Steel Ferritic and Martensitic Stainless Steel Titanium Alloys			
Dia. DC		Slot Milling Feed %							Slot Milling Feed %			Slot Milling Feed %			
(mm)	(inch)	1°	5°	10°	15°	20°	25°	30°	1°	5°	10°	1°	5°	10°	15°
4	**.157**	100	90	80	80	60	60	60	80	70	60	90	80	70	50
5	**.197**	100	90	80	80	60	60	60	80	70	60	90	80	70	50
6	**.236**	100	90	80	80	60	60	60	80	70	60	90	80	70	60
8	**.315**	100	95	90	90	90	75	75	70	60	50	90	80	70	60
10	**.394**	100	95	95	95	90	80	80	70	60	50	80	70	60	50
12	**.472**	100	95	95	95	90	80	80	70	60	50	80	70	60	50
Depth of Cut															

Workpiece Material		Precipitation Hardening Stainless Steel Cobalt Chromium Alloys					Heat Resistant Alloys	
Dia. DC		Slot Milling Feed %					Slot Milling Feed %	
(mm)	(inch)	1°	5°	10°	15°	20°	1°	5°
4	**.157**	90	80	70	60	60	90	80
5	**.197**	90	80	70	60	60	90	80
6	**.236**	90	80	70	60	60	90	80
8	**.315**	90	80	70	60	60	90	80
10	**.394**	80	80	70	60	60	80	70
12	**.472**	80	80	70	60	60	80	70
Depth of Cut								

Note 1) SMART MIRACLE coating has very low electrical conductivity. Therefore, an external contact type of tool setter (electric transmitted) may not work. When measuring the tool length, please use an internal contact type (non-electrical type) or a laser tool setter.

Note 2) When performing ramping, please use the feed rate shown on the previous page multiplied by the coefficient.

Note 3) When cutting austenitic stainless steels and titanium alloys, the use of water-soluble cutting fluid is effective.

Note 4) When performing machining with large ramping angles, a high-grip holder is recommended. Also, if the machine or workpiece material lacks rigidity, or if chipping occurs on the cutting edge, adjust the ramping angle and feed rate.

Note 5) When performing ramping deeper than the recommended depth of cut, please divide the process into multiple steps within the recommended depth of cut.

MTEC

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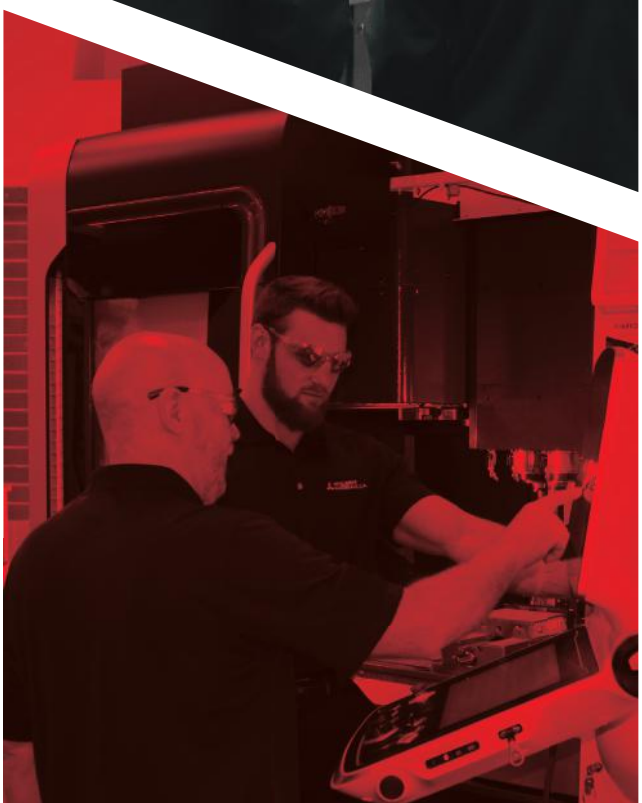
We are excited to offer several levels of training with goals to reach our highest level--Craftsman Machining Technology. At MTEC NC, we will train using a combination of classroom and hands-on machine time to develop skills and real-world understanding of materials, tools and applications. In addition to multi-day courses, we will have Machining Technology skills seminars, as well as seminars from our partners to complement our apprentice level courses, our journeyman courses, and up to our craftsman level courses.

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- Basic Milling
- Basic Turning
- Advanced Drilling
- Advanced End Milling
- Advanced Turning
- Basic Threading
- Advanced Face Milling
- Basic Workpiece Materials
- Tool Grades
- Advanced Workpiece Materials

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Information on course schedule,
course description, and accommodations

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MITSUBISHI MATERIALS U.S.A. CORPORATION

California Office
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(Moldino CS)

41700 Gardenbrook Road, Suite 120
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Fax: 248.308.2627

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.

www.mmc-carbide.com/us

Tools specifications subject to change without notice.

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