



金屬陶瓷系列刀具

Metal Ceramic End Mills



Bewise Inc.

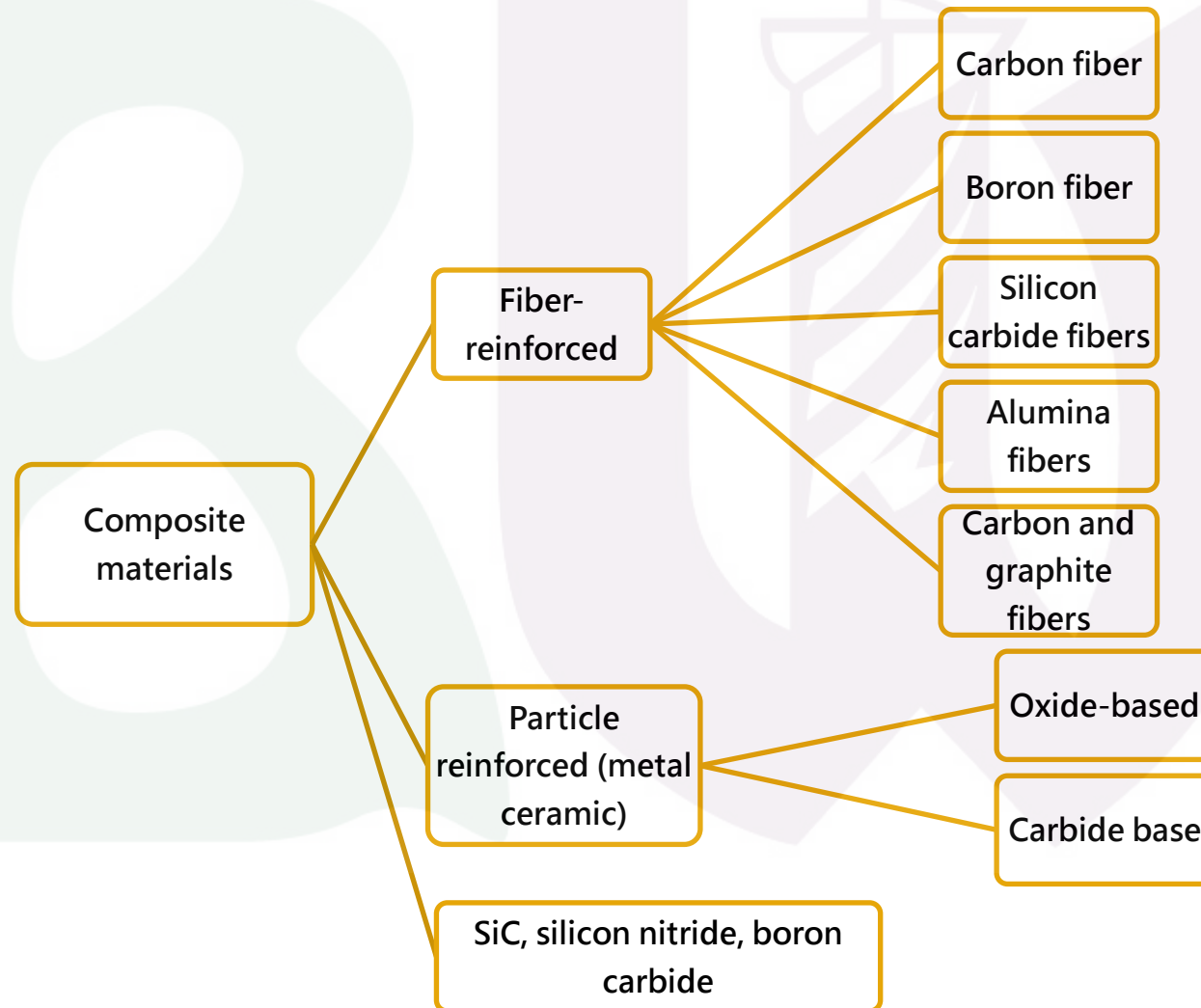
碧威股份有限公司

www.tool-tool.com

Introduction to composite materials



COMPOSITE MATERIALS



COMPOSITE MATERIALS

- Classification by structure:

Layers composite materials - plywood ...

Particle filled composite materials – metal ceramic ...

Fiber reinforced composite materials - glass steel ...

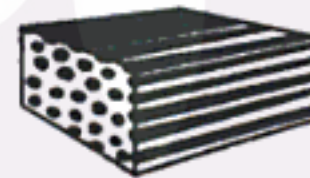
Skeleton composite materials - foam fill plastics ...

Layer composite

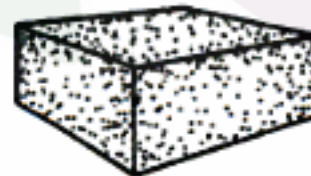


層疊複合

Continuous fiber composite



連續纖維複合



顆粒複合

Particle composite



短切纖維複合

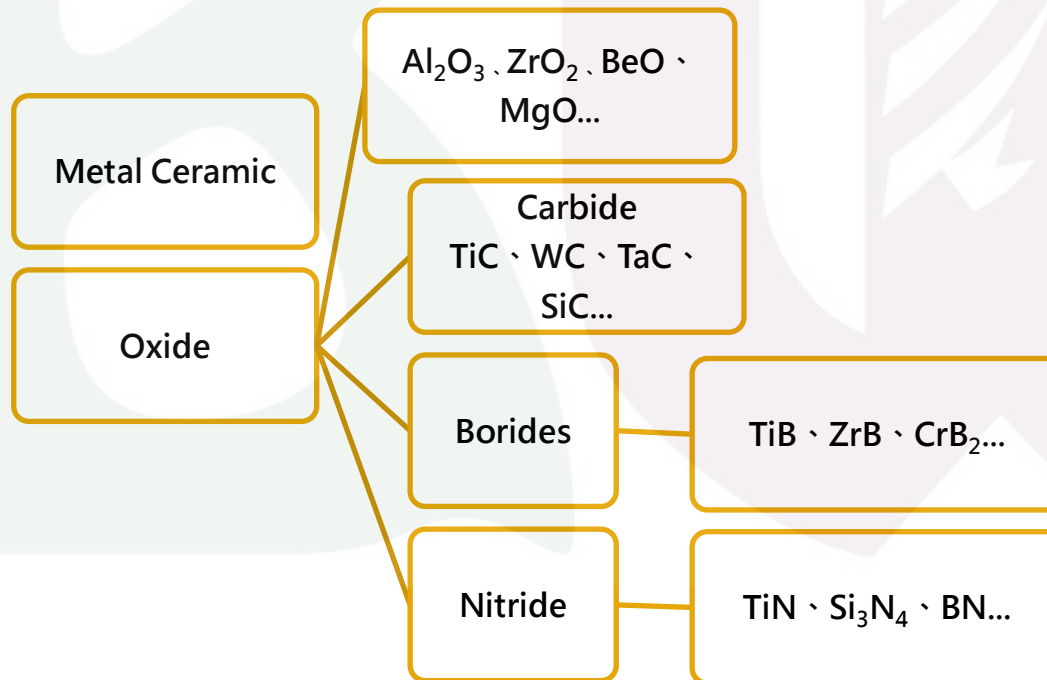
Short fiber composite

Introduction to Metal Ceramic



INTRODUCTION TO METAL CERAMIC

- Metal ceramic mainly includes two series - alumina matrix (Al_2O_3) and nitride silicon (Si_3N_4), adding a variety of oxides, nitrides, carbides, and borides to form different varieties of metal ceramic materials of alumina matrix and nitride silicon matrix.



INTRODUCTION TO METAL CERAMIC

- Metal ceramic due to tiny ceramic particles spread evenly in a continuous metal phase to form a continuous film, will wrap ceramic particles, resulting in metal-ceramic has the characteristics both of the metal and ceramic, not only through the good plasticity of the metal thermal conductivity, and improvement of material that withstand mechanical and thermal stress, but also get a higher strength and hardness while the ceramic phase to strengthen the metal matrix material.
- Metal ceramic is the earliest metal matrix composites. It' s one non-homogeneous materials composed of metal and ceramic (particle reinforced composite material). Metal and ceramic can be composed of different proportions of different properties of materials. Metal matrix is usually as structural materials; Ceramic matrix is always use as tool materials.
- Carbide metal ceramic is the most widely used metal-ceramic, usually use Co, or Ni as adhesives. Carbide metal ceramic commonly referred to as carbide when it apply to tool materials.



INTRODUCTION TO METAL CERAMIC

The metal-ceramic composites is one multiphase composite material consisting of one or more of the ceramic phase and metal or alloy. Ideal metal ceramic is with both advantages of metal and ceramic. If the structure of metal ceramic is fine, it can not only maintain high-strength, high hardness, wear resistance, heat resistance, anti-oxidation and chemical stability of ceramic, but also with better metal toughness and plasticity, which is a very important tool and structural materials. Low density, high hardness, wear resistance, thermal conductivity, and it won't be brittle easily by sudden cold or hot.

In addition, deposit one ceramic coating, good air tightness, high melting point, and poor heat transfer, on the metal surface to prevent oxidation or corrosion under high temperature. Metal-ceramic has benefits of metal toughness, high thermal conductivity and good thermal stability, corrosion and wear-resistant.



Material Composition Characteristics Table

CARBIDE MATERIAL COMPOSITION CHARACTERISTICS TABLE



Common Carbide Material

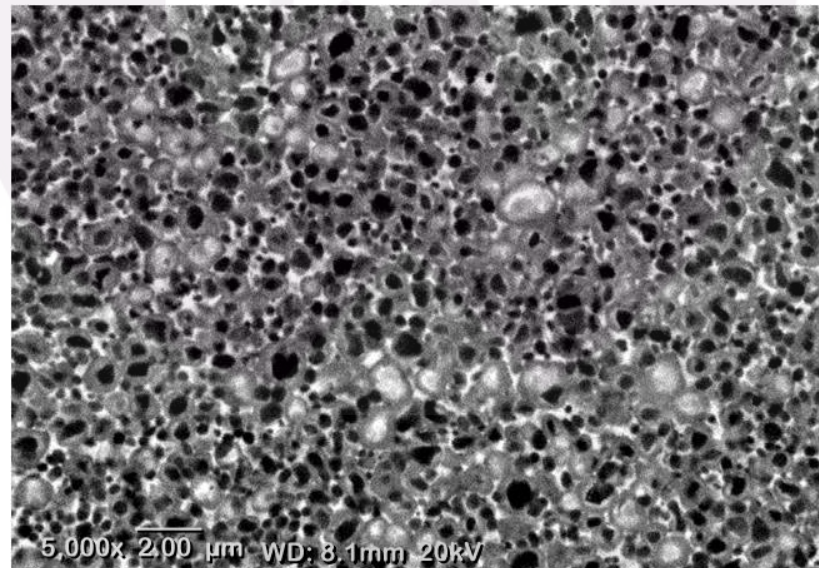
		WC-Co			WC-TiC-Co			WC-TiC-TaC-Co	
Chemical Composition	WC	97	94	92	66	79	78	84	82
	TiC				30	15	14	6	6
	TaC							4	4
	Co	3	6	8	4	6	8	6	8
Mechanical Characteristics	HRA	91	89.5	89	92.5	91	90.5	92	91
	Bending Strength /MPa	1080	1370	1470	880	1130	1180	1230	1470
Density / $10^3 \text{ kg} \cdot \text{m}^{-3}$		14.9~15.3	14.6~15.0	14.4~14.8	9.4~9.8	11.0~11.7	11.2~11.7	12.6~13.0	12.4~12.9
Application		Work on continuous cutting metal of brittleness, like cast iron which means colorful metal and non-ferrous metal			Rough and fine cutting for lathing milling and digging			For difficult cutting, like rough and fine cutting for heat-resistant alloy steel.	

BW METAL CERAMIC COMPOSITION CHARACTERISTICS TABLE

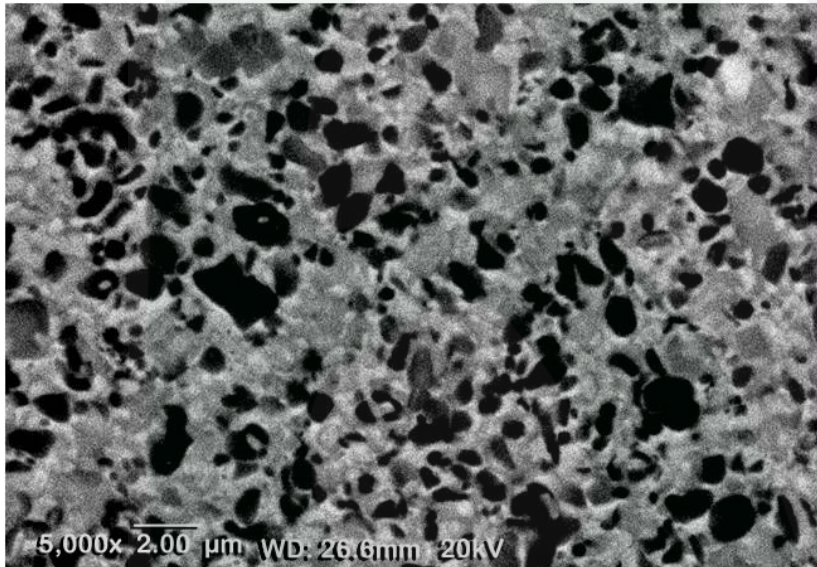


Metal Ceramic Composition Characteristics

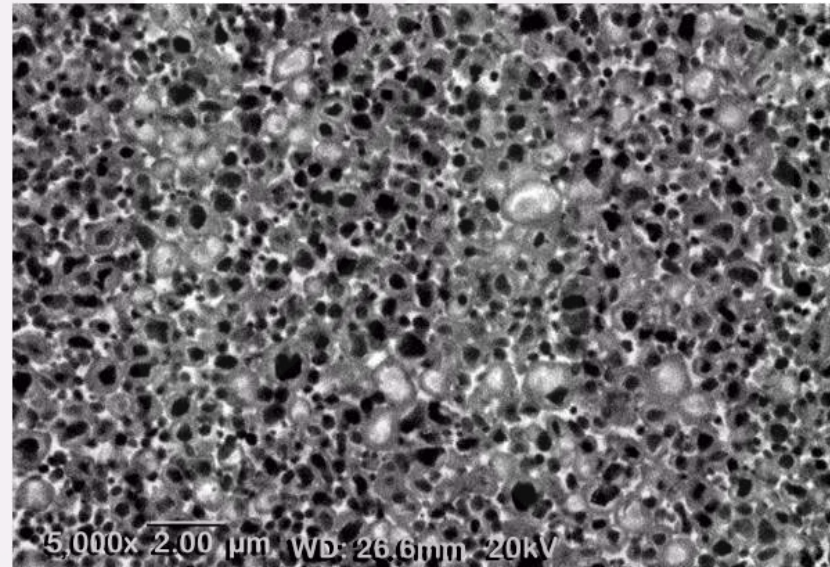
Main content	Color	Specific gravity	Hardness (HV)	Hardness (Gpa)	Tenacity (Mpa.m ^{1/2})	Flexural Strength (Mpa)
TiCN+Nb	blue gray	6.4	1500~1650	14.5~16.2	10.0~10.5	2500~1960



BW METAL CERAMIC SEM PHOTO



Other Material



BW metal ceramic-even particle diameter

BW Metal Ceramic Material



Introduction to BW metal ceramic



BW METAL CERAMIC CUTTERS

- Following the development of machinery industry, a lot of difficult materials (such as chilled cast iron, hardened steel, stainless steel, Titanium alloy, etc.) are more widely applied. Those difficult to machine materials among them, such as stainless steel which with high content of Cr and Ni, Cr, can improve the strength and toughness of stainless steel, but it also increases the bonding tendency of stainless steel and cutter; Ni may apply a stable organization, but large plastic of organizations easily lead to hardening. Use tungsten cobalt carbide cutting tools to process, but the result is unsatisfactory. Metal ceramic, with high strength, high hardness, resistance to abrasion, anti-high temperature, anti-oxidation and chemical stability, has excellent performance and good solution for cutting specific difficult materials.



BW METAL CERAMIC CUTTERS- FOUR FLUTE CORNER RADIUS END MILLS



BW METAL CERAMIC CUTTERS- FOUR FLUTE SQUARE END MILLS



APPLICABLE WORK MATERIAL FOR METAL CERAMIC CUTTERS



■ anti-heat stainless steel

standard	spec number	code	(%) chemical composition								
			C	Si	Mn	P	S	Ni	Cr	Mo	Cu
JIS	-	SUS316 J1L	≤0.08	≤1.0	≤2.0	≤0.045	≤0.03	12.0-16.0	17.0-19.0	1.20-2.75	1.0-2.5
JIS	-	SUS317 J1	≤0.04	≤1.0	≤2.5	≤0.045	≤0.03	15.0-17.0	16.0-19.0	4.0-6.0	
DIN	17480	X12Cr-Ni25-20	≤0.15	≤1.5	1.0-2.5	≤0.025	≤0.02	19.0-22.0	24.0-27.0		
DIN	SEW470	X12NiCr-Si36-16	≤0.15	1.0-2.0	≤0.03	≤0.015	≤0.015	33.0-37.0	15.0-17.0		



APPLICABLE WORK MATERIAL FOR METAL CERAMIC CUTTERS

- High temperature pressure vessel parts stainless steel forgings

HB	Elongation	≥ 43	≥ 40	≥ 40
	Mpa Tensile Strength	≥ 520	500-700	500-700
Tensile	Mpa Yield - strength	≥ 205	≥ 205	≥ 205
	mm thickness	-	≤ 130	-
Chemical composition (%)	Nb	8xC%-1.0	10xC% - 1.0	10xC% - 1.0
	Cr	17.0-20.0	17.0-19.0	17.0-19.0
	Ni	9.0-13.0	9.0-13.0	9.0-12.0
	S	≤ 0.03	≤ 0.03	≤ 0.03
	P	≤ 0.04	≤ 0.045	≤ 0.04
	Mn	≤ 2.0	≤ 2.0	≤ 2.0
	Si	≤ 1.0	≤ 1.0	≤ 0.85
	C	0.04-0.10	≤ 0.08	≤ 0.08
Code	SUSF347 H			
Spec-number	G3214			
standard	JIS JIS ASTM			

APPLICABLE WORK MATERIAL FOR METAL CERAMIC CUTTERS

■AUSTENITE OVAL-SHAPED GRAPHITE CAST IRON

standard	Spec number	code	Chemical composition (%)	HB		
				Yield strength Mpa	Tensile strength Mpa	% Elongation
DIN	1694	GGG-Ni- Cr35-3	C	≥210	≥370	≥7
AST M	A349	Type D-4	Si	-	≥41 4	-
ASTM	1694	GGG-Ni- Mn23-4	Mn	≥210	≥440	≥25
			P	-	-	-
			Ni	28.0- 32.0	34.0-36.0	22.0-24.0
			Cr	4.5- 5.5	2.0-3.0	-
			Cu	-	-	-
			Si	5.0- 6.0	1.5-3.0	-
			C	≤2.4	≤2.6	≤2.6

CUTTING CHARACTERISTICS OF BW METAL CERAMIC



- Cutting characteristics:
 - Have a stable cutting performance (thermal shock resistance enhancement) in wet cutting.
 - Better performance than the past types of nano tungsten carbide in anti-abrasion and anti-exhaustion.Material properties:
- Organization:

Loss resistance is excellence, the internal organization is fine particles and the hardness after sintered of appearance is higher than the hardness of the internal part, which forms the surface of the TiC hardened layer, it can play a superior result of resistance to abrasion.

Features:

With better flexural strength than HSS metal material and sintered tungsten carbide powder for working on the super hard alloy of high Ni content over 18%. Better resistance to damage and stable machining under wet cutting.



CUTTING CHARACTERISTICS OF BW METAL CERAMIC



Advantages:

- the effect of self-sharp and regrinding for cutting edge
- stable chemical properties
- no infiltration effect on the blade
- other parts of cutter material transferred which can be neglected
- Co for metal bonding material, replacing the mixture of Ni and Co, pollution-free
- higher processing security
- broader applications
- greater ability to maintain the surface finish and accuracy.
- strengthen intermittent processing capacity



Cutting test for metal ceramic and tungsten carbide end mills

DRY CUTTING

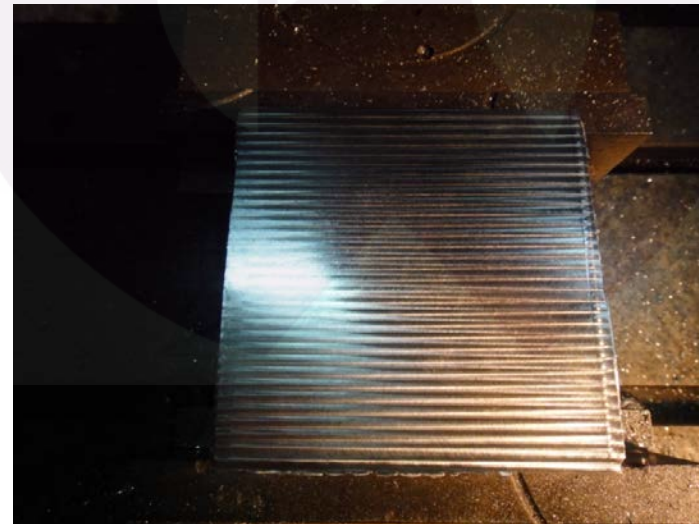


Spec: Dia 8mm x R0.5 x Flute 20mm x Overall 60mmL x Helix 35°

Cutting method: no oil, water, cutting oil added (dry cutting) and under general room temperature

Working Condition :

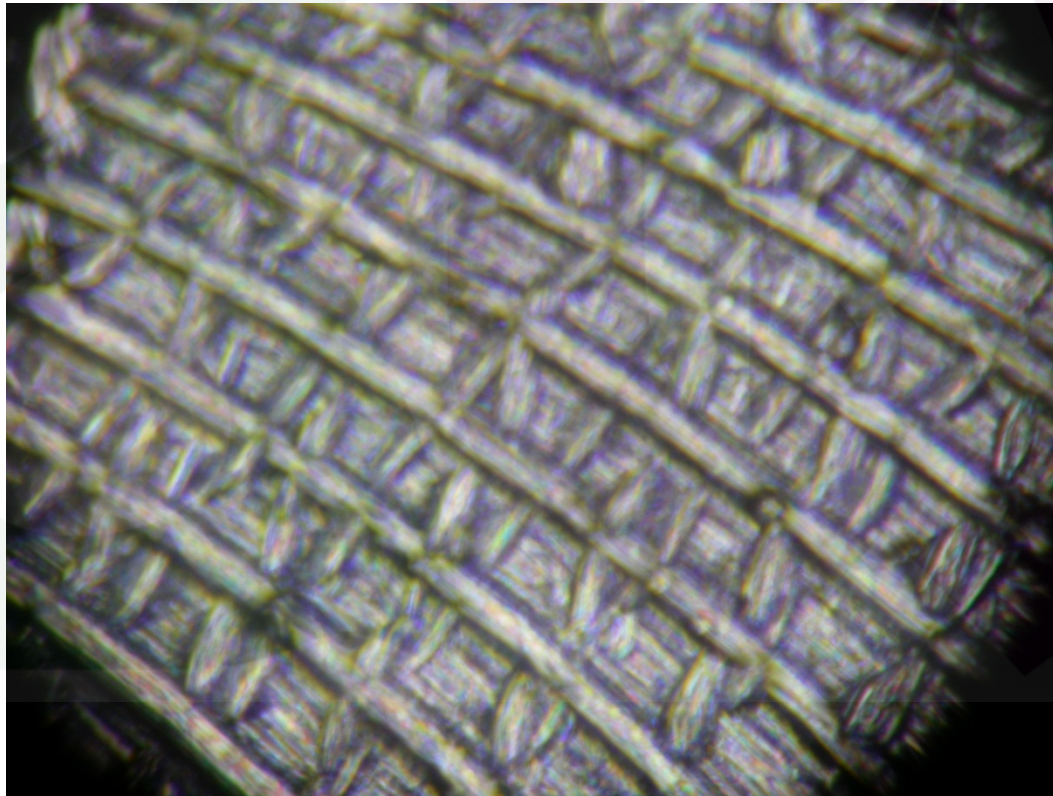
Material Spec	100*100mm
Rotation Speed	5000
Feed Rate	600
Total Cutting Length	850mm



DRY CUTTING TEST OF HSS CUTTER

Tool mark metallographic photo of work piece after high speed steels

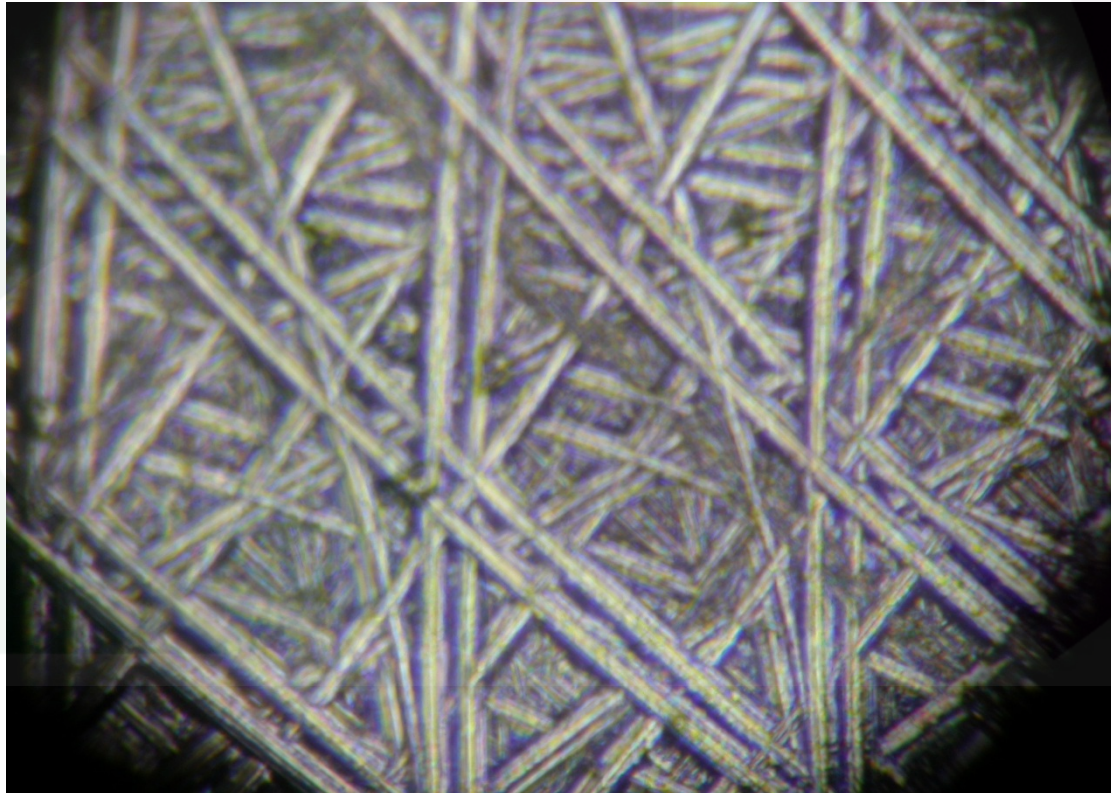
NO.1 Cutter - 2 Flute End Mills/HSS



DRY CUTTING TEST OF TUNGSTEN CARBIDE CUTTER

Metallographic photo of tool mark after carbide cutter

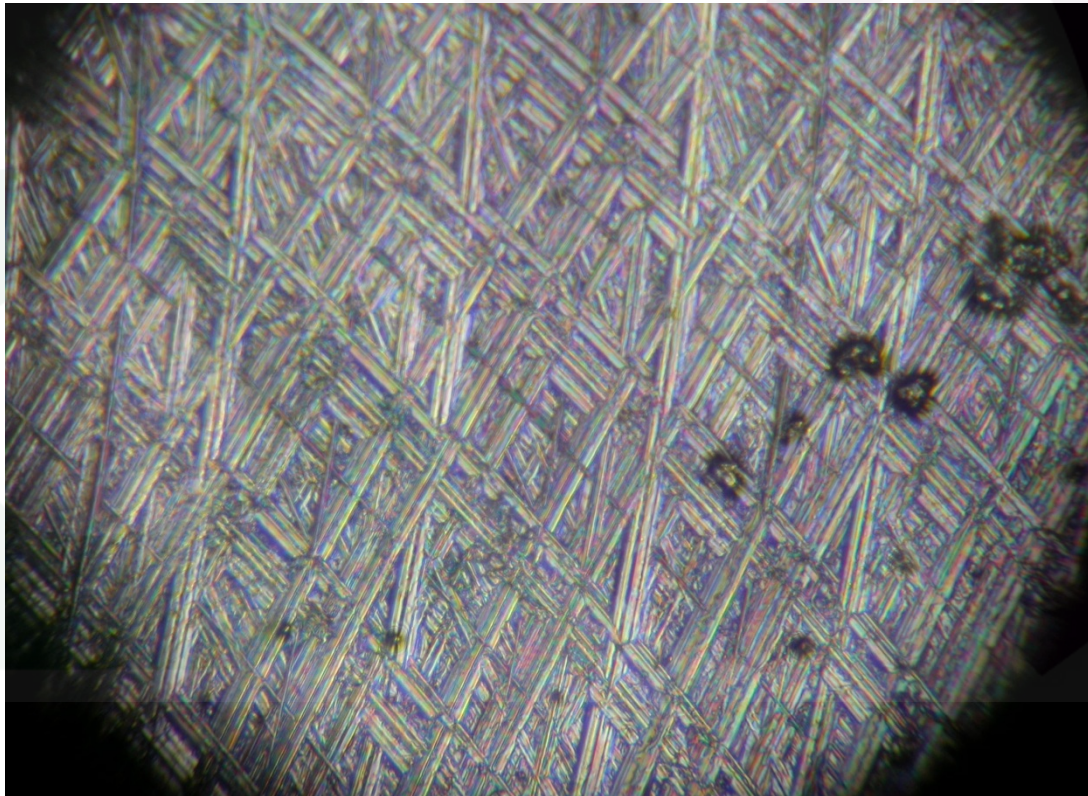
NO.2 cutter - 4 Flute Corner Radius End Mills/ Solid Carbide - Nano Micro Grain



DRY CUTTING TEST OF TUNGSTEN CARBIDE CUTTER

Metallographic photo of tool mark after carbide cutter

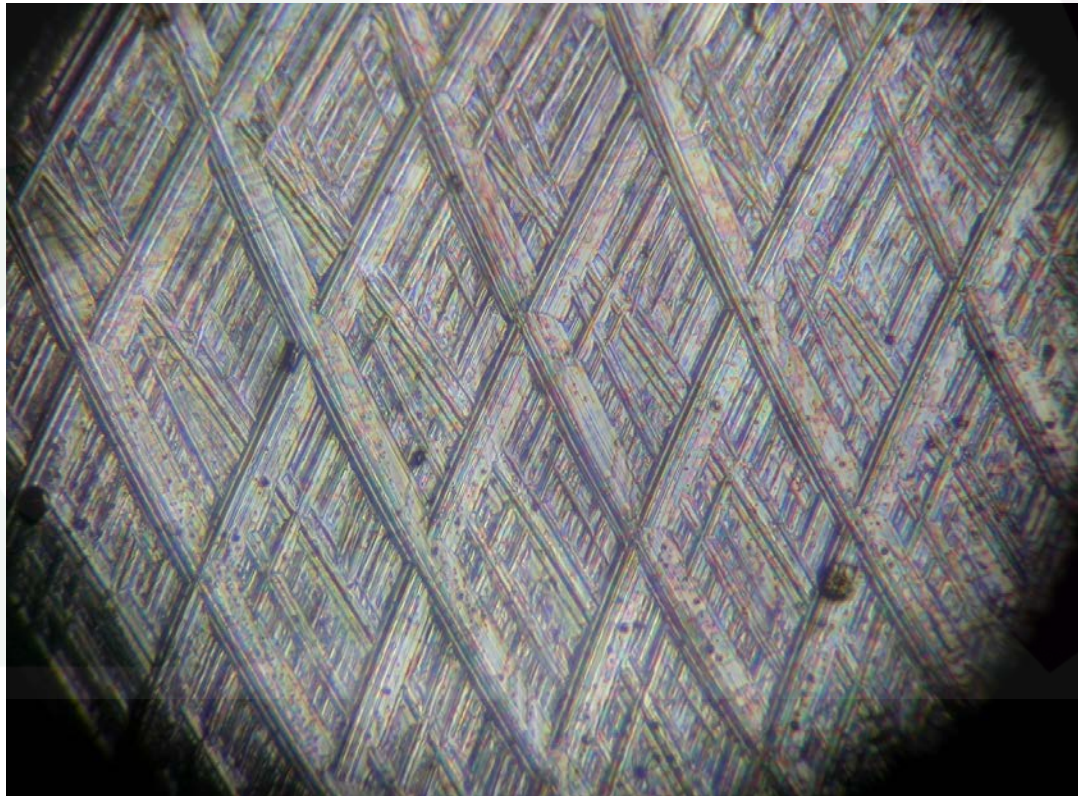
NO. 3 cutter - 4 Flute End Mills/ Solid Carbide - Super Micro Grain



DRY CUTTING TEST OF TUNGSTEN CARBIDE CUTTER

Metallographic photo of tool mark after carbide cutter

NO.4 cutter - 4 Flute Corner Radius End Mills/ Solid Carbide - Micro Grain



DRY CUTTING TEST OF METAL CERAMIC CUTTER



Spec: Dia 8mm x R0.5 x Flute 20mm x Overall 60mmL x Helix 35°
Cutting method: no oil, water, cutting oil added (dry cutting) and under general room temperature

Working Condition :

Material	Stainless Steel
Material Spec	100*100mm
Rotation Speed	5000
Feed Rate	600
Total Cutting Length	3400mm

Before cutting

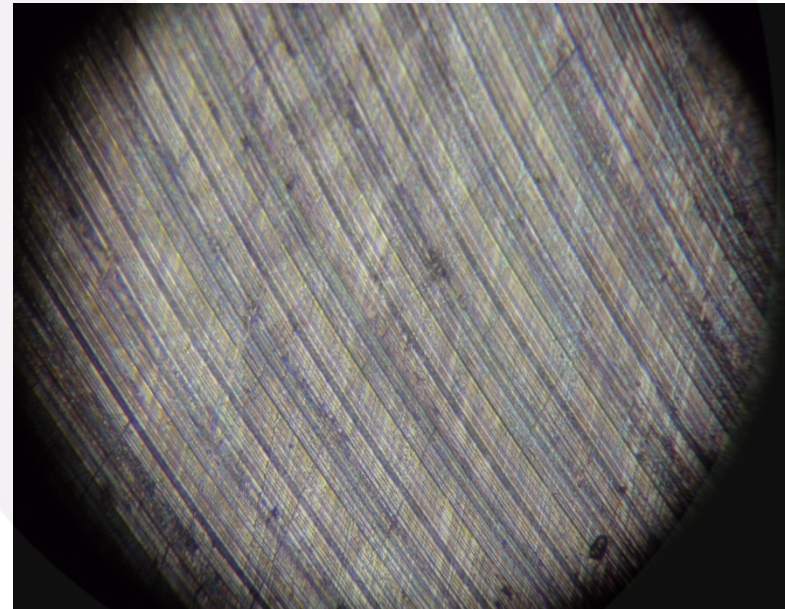
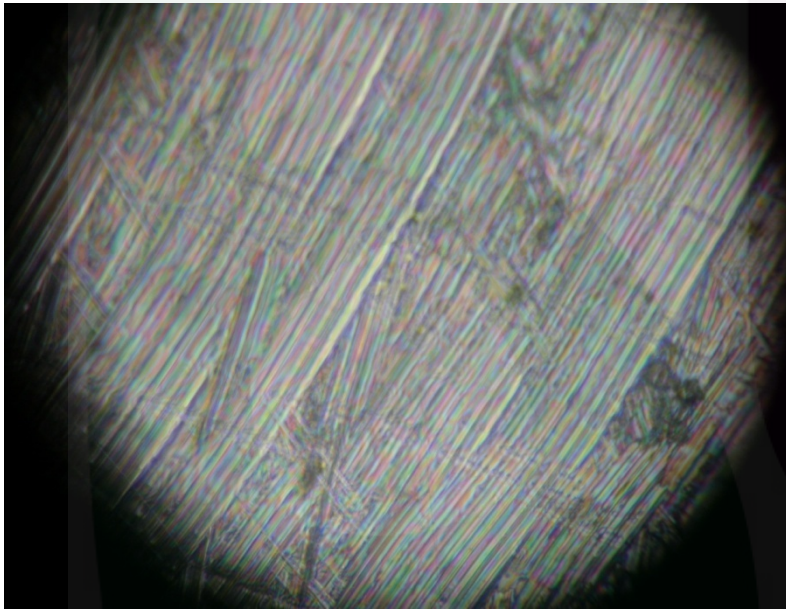


After Cutting



DRY CUTTING TEST OF METAL CERAMIC CUTTER

Metallographic photo of tool mark after metal ceramic cutter cut at beginning

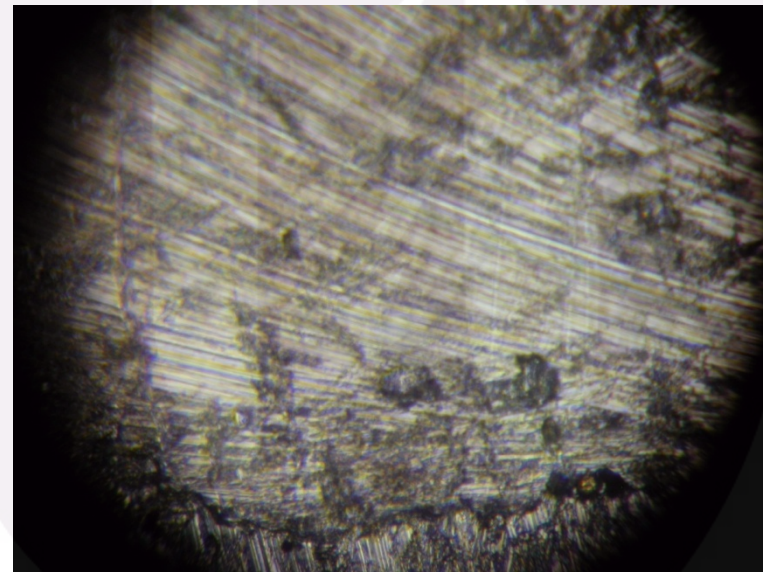
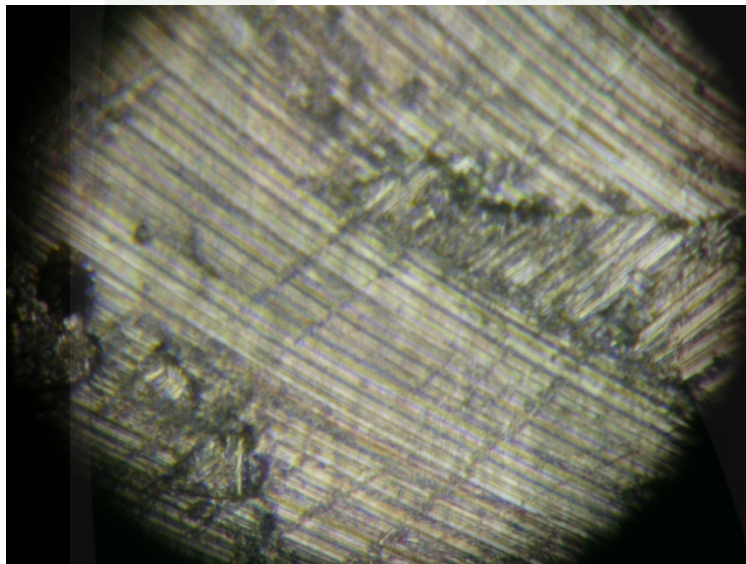


The surface of tool marks is fine and consistent tidy, the metallographic photo shows the obvious difference compared with tungsten carbide cutter.



DRY CUTTING TEST OF METAL CERAMIC CUTTER

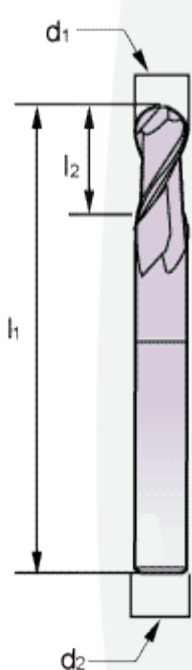
Metallographic photo of tool mark after metal ceramic cutter cut 3400mm



After cutting a long distance, although the tool has worn, the tool mark is tidy and its surface quality is still fine from the metallographic photo. It is still excellent compared with other cutter. From these photos it can be summarized in that **the tool life is 4 to 5 times** than the other tools, and get better quality.

Specification of metal ceramic end mills

METAL CERAMIC TWO FLUTE BALL NOSE END MILLS



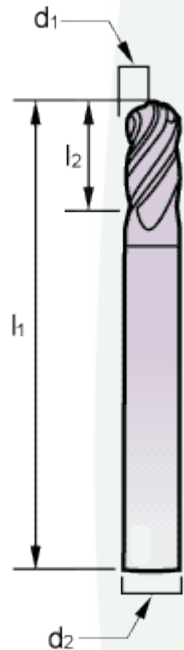
Content of work material : Ni20~50%

unit: mm

Order Code	$\Phi d1(h10)$	l2	l1	$\Phi d2(h6)$
2MC010B	R0.5	2	48	6
2MC020B	R1	4	48	6
2MC030B	R1.5	6	48	6
2MC040B	R2	8	48	6
2MC060B	R3	12	48	6
2MC080B	R4	16	60	8
2MC100B	R5	20	68	10



METAL CERAMIC FOUR FLUTE BALL NOSE END MILLS



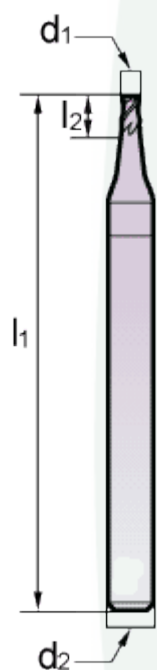
Content of work material : Ni20~50%

unit: mm

Order Code	$\Phi d1(h10)$	$l2$	$l1$	$\Phi d2(h6)$
4MC040B	R2	11	48	6
4MC060B	R3	13	48	6
4MC080B	R4	19	60	8
4MC100B	R5	22	68	10



METAL CERAMIC TWO FLUTE SQUARE END MILLS



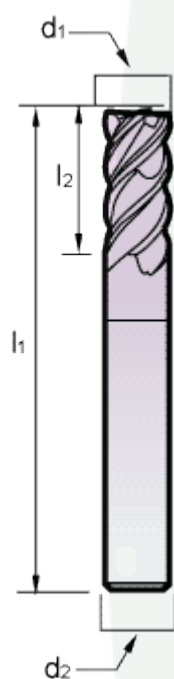
Content of work material : Ni20~50%

unit: mm

Order Code	$\Phi d1(h10)$	l2	l1	$\Phi d2(h6)$
2MC010	1	3	48	6
2MC020	2	6	48	6
2MC030	3	7	48	6
2MC040	4	8	48	6
2MC060	6	13	48	6
2MC080	8	19	60	8
2MC100	10	22	68	10



METAL CERAMIC FOUR FLUTE SQUARE END MILLS



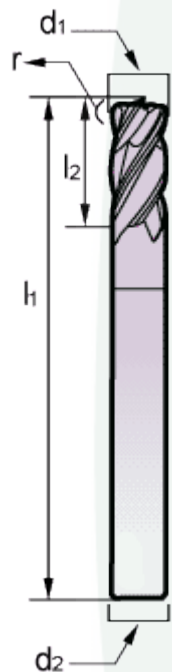
Content of work material : Ni20~50%

unit: mm

Order Code	$\Phi d1(h10)$	$l2$	$l1$	$\Phi d2(h6)$
4MC040	4	11	48	6
4MC060	6	13	48	6
4MC080	8	19	60	8
4MC100	10	22	68	10



FOUR FLUTES METAL CERAMIC CORNER RADIUS END MILLS – (MADE-TO-ORDER)



4 Flutes



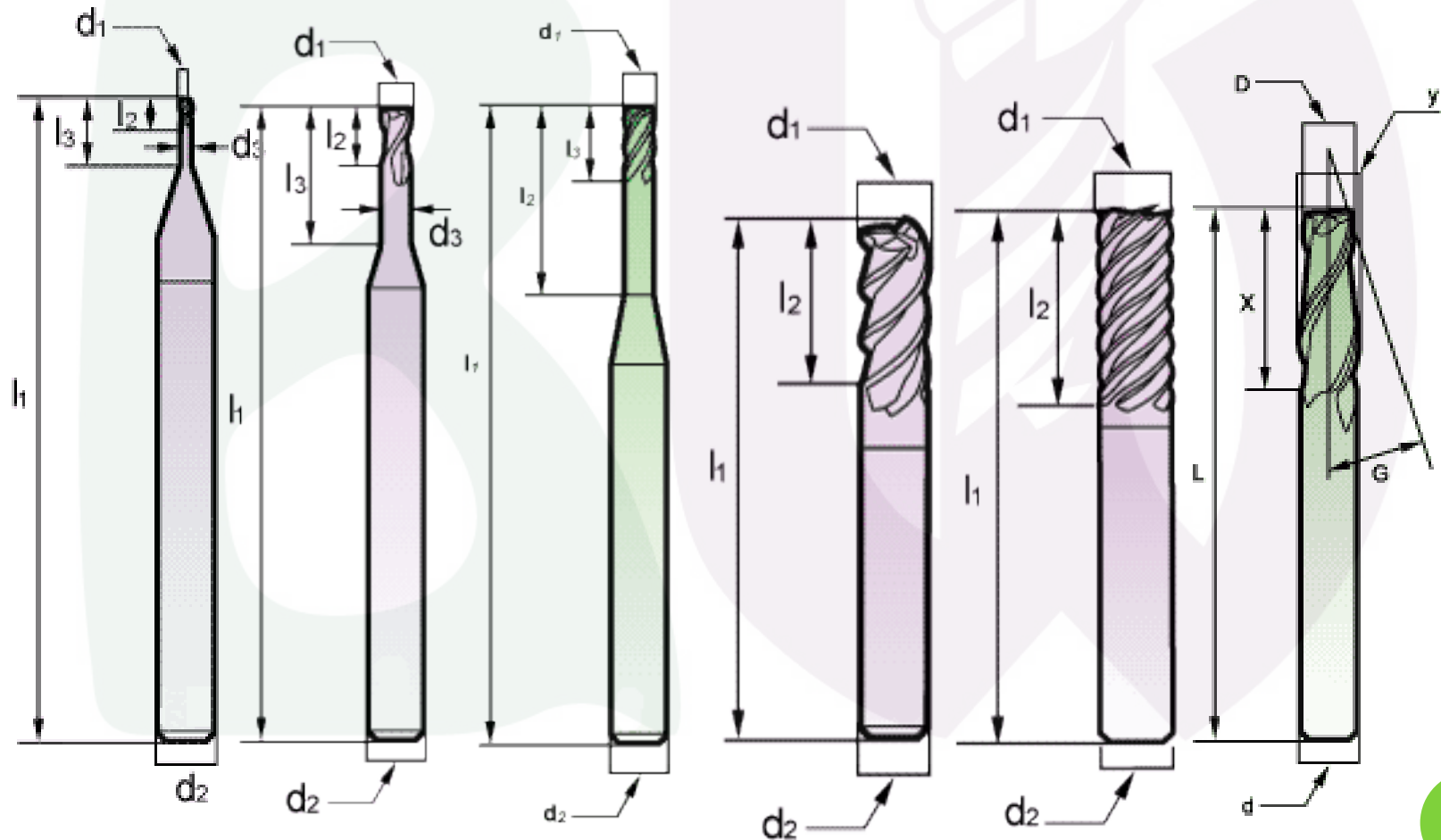
Content of work material : Ni20~50%

unit: mm

Order Code	$\Phi d1(h10)$	r	l2	l1	$\Phi d2(h6)$
4MC0405R	4	0.5	10	48	6
4MC0505R	5	0.5	13	48	6
4MC0605R	6	0.5	16	48	6
4MC0610R	6	1.0	16	48	6
4MC0805R	8	0.5	20	60	8
4MC0810R	8	1.0	20	60	8
4MC1010R	10	1.0	30	68	10
4MC1020R	10	2.0	30	68	10
4MC1030R	10	3.0	30	68	10



CUSTOM MADE-METAL CERAMIC CUTTING TOOL SERIES



CUSTOM ORDER-AEROSPACE METAL CERAMIC CUTTER SERIES



BW
Beeway
Thank You !

