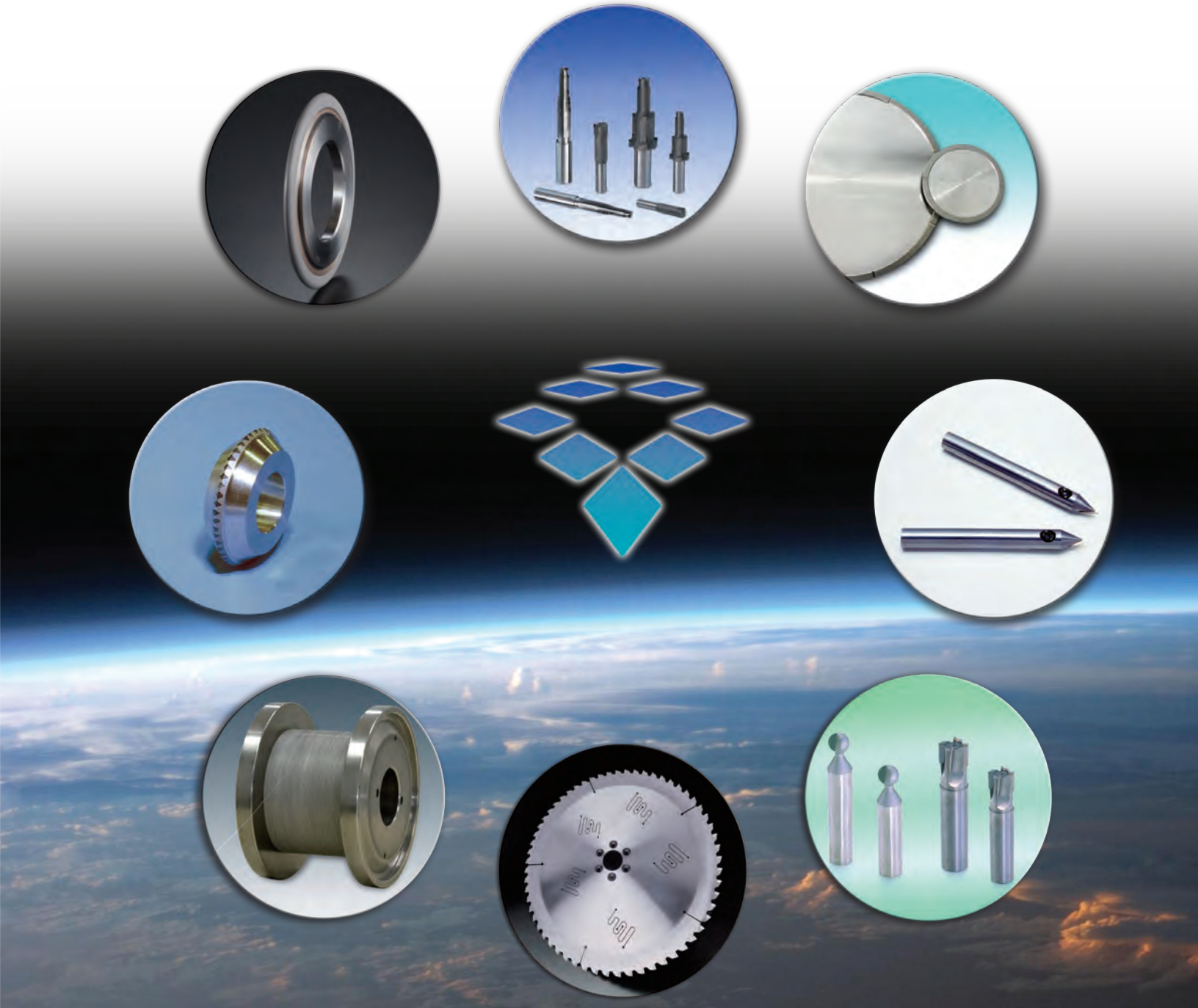
A.L.M.T.

Diamond Tools

Precision Diamond Tooling Catalog



A Sumitomo Company

Introducing...basic and advanc

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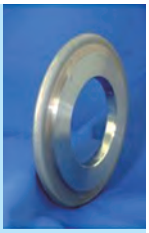

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ed diamond & cBN tooling from A.L.M.T.

A.L.M.T. Corp. offers a wide range of products to meet all of your cutting, grinding, and polishing needs.

Thank you for using A.L.M.T.


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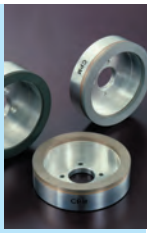
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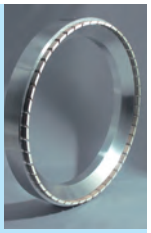
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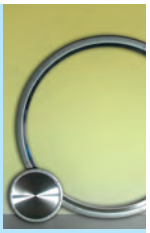
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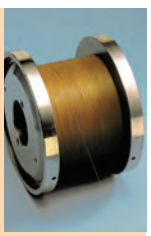
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Precise Diamond & cBN Grinding Tools

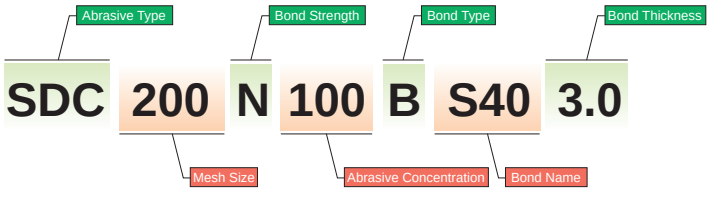
Type of Bond

Resin	B
Metal	M
Vitrified	V
Electro-plated	E

Abrasive

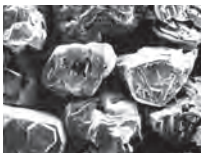
Type	JIS Display
Natural Diamond	D
Synthetic Diamond	SD
Coated Synthetic Diamond	SDC
Cubic Boron Nitride	cBN*
Coated Cubic Boron Nitride	cBNC*

Identification System of Diamond & cBN Wheel



Diamond Abrasive


Natural Diamond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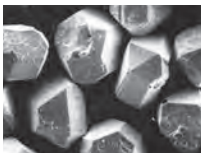
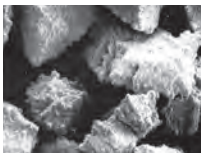

Metal Bond


Coated Resin Bond

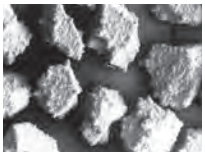
Mesh Size

Display Size	JIS	Average (μm)
16	16/20	1190
20	20/30	840
30	30/40	590
40	40/50	420
50	50/60	300
60	60/80	250
80	80/100	177
100	100/120	149
120	120/140	125
140	140/170	105
170	170/200	88
200	200/230	74
230	230/270	63
270	270/325	50
325	325/400	44
400		37
600		30
800		20
1000		15
1500		10
2000		8
3000		5

cBN Abrasive


Monocrystal


Polycrystal


Coated Monocrystal

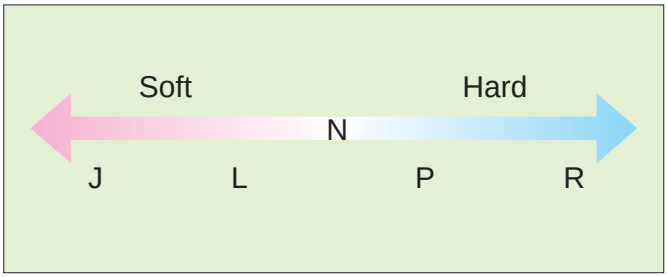
Concentration

Degree of Concentration	Grain Content ct/cm³ (mg/cm³)
150	6.6 (1320)
125	5.5 (1100)
100	4.4 (880)
75	3.3 (660)
50	2.2 (440)

Notes: 1ct=200mg

Bond Strength

"N" is standard and indicates the bonding of the abrasive and bond.



Material Processed by Diamond or cBN Wheel

Diamond

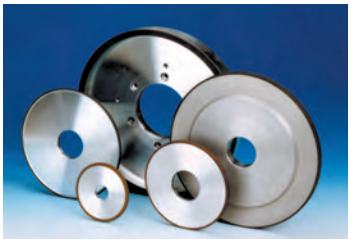
• Cutting Tool	• Electric Parts	• Magnetic Material	• Crystalline Material	• Ceramic Products	• Wear Resistant Metal	• Plastic	• Graphite • General Wheel • Jewelry
• Tungsten carbide • Cermet • Ceramics (Alumina, etc.)	• Ceramic (Aluminum nitride, etc.) • Silicon • Compound semiconductor	• Ferrite • Rare earth	• Glass • Crystal • Quartz • Sapphire	• Stone • Refractory Material • Tile • Asphalt • Concrete	• Sprayed Metal • Stellite	• F.R.P.	

cBN

• Cutting Tool	• Wear Resistant Tool	• Structural Component	• Corrosion Resistant Metal	• Heat Resistant Metal	• Magnetic Material	• Cast Iron
• SKH • SKS • SK	• SKD • Sprayed Metal • Stellite	• SCM • SNCM • SCr • SUJ	• SUS	• SUH • Inconel • Ti Alloy • Nimonic	• Sendust • Alnico	

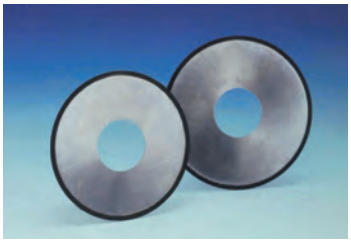
Resin Bond Wheel

These consist of bonding-added resin in main proportions to various fillers. Phenol resin is mainly used but polyimide resin, which has better heat resistance, is becoming more common. FluteMAX can provide great grinding results for creep feed grinding in any kind of material.



Grinding wheel

FluteMAX



Cutting wheel

Resinbond wheel

Characteristics

1. Small new modules and good surface roughness
2. Maintains good grinding ability during the cutting of resistant material

Usage

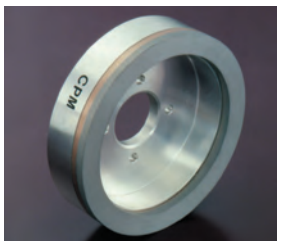
Metal material such as tungsten carbide, cermet, and high speed steel

From rough to finish grinding for certain materials such as fine ceramics, ferrite, and glass

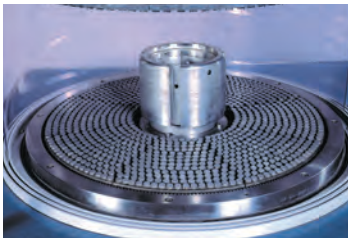
Metal Bond Wheel

Metal Bond Wheel consists of various types of alloys: copper, tin, silver, steel, cobalt, and tungsten. MT Bond Wheel has excellent grinding ability as well as long tool life and is highly recommended for ceramics, carbide, and cermet.

MT Bond Wheel



CP Wheel



DPG Wheel

Core Drill

Metalbond wheel

Characteristics

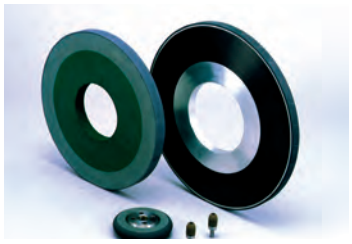
1. High wear resistance and strong gripping of abrasive
2. Good grinding ability on glass and ferrite

Usage

Rough grinding for certain materials such as glass, ceramics, ferrite, semiconductor material, and stone

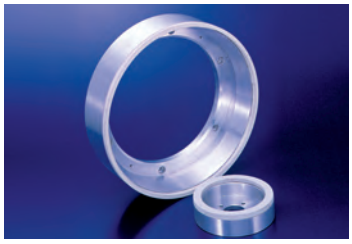
Vitrified Bond Wheel

Ceramic bond-added glass is the main component to the Vitrified Bond Wheel. VITMATE has a specially developed bond for cBN and Easy Wheel. Main material applications are carbide and ceramics, but is capable of grinding other materials as well.



VITMATE

HIG-V



CPV

Easy Wheel

Vitrifiedbond wheel

Characteristics

1. High trueing and dressing ability due to high hardness as well as accuracy of air hole
2. Trueing and dressing can be acheived easily using VITMATE with a Rotary Dresser on the machine
3. HIG-V uses a special bonding technique for high speed usage

Usage

Steel, tungsten carbide, and ceramics, etc.

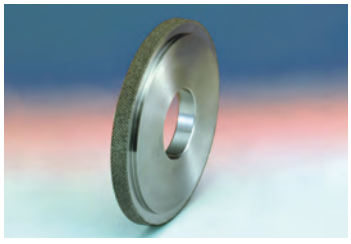
Suitable for high efficiency processes of high speed grinding

Electroplated Wheel

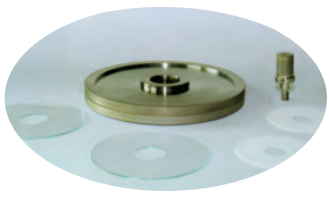
Bonding plated occurs on just a single layer of metal core with Ni plating. Pyramid wheel was designed to improve evacuation of grinding chip, especially in soft material, and leads to increased grinding ability.

Gear Grinding

Super Sizing



Pyramid Wheel



Chamfering Wheel

Electroplated wheel

Characteristics

1. Maintains exceptional grinding ability due to high protrusion
2. Stable processing accuracy due to high density and high wear resistance
3. Easy to form and reusable body
4. Excellent chip evacuation

Usage

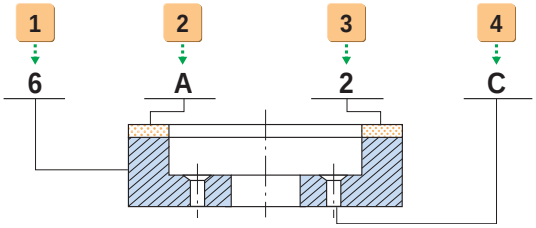
Diamond

Rough grinding or forming of carbide and ceramics, etc.
Soft material such as rubber or FRP

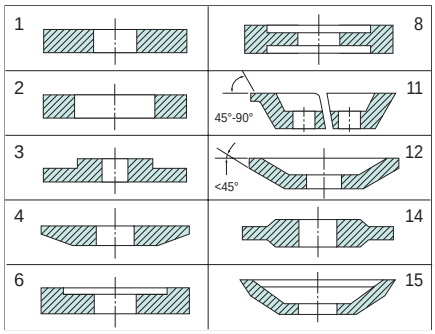
cBN

Forming of steel, inner grinding and gear grinding, etc.

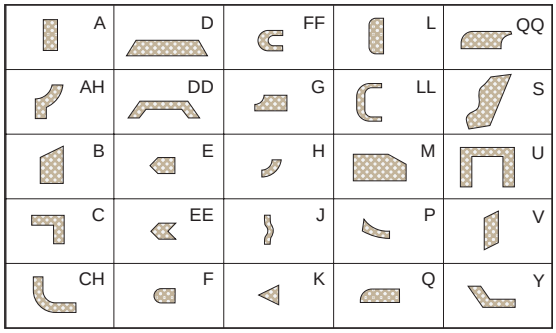
Identification Method of Wheel Shape



1 Standard Body Shape



2 Cross Sectional Shape of Abrasive Layer



3 Abrasive Layer Position & Symbol Reference to B

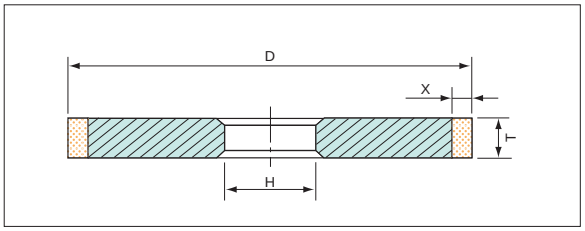
Symbol	Position	Diagram
1	Outer Boundary	
2	Side	
3	Both Sides	
4	Incline or Roundness, Inside	
5	Incline or Roundness, Outside	
6	Part of Outer Boundary	
7	Part of Side	
8	Whole	
9	Edge	
10	Inner Circumference	

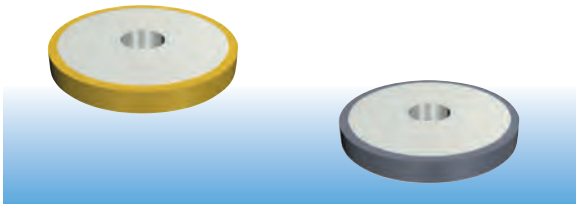
4 Modification & Symbol

Symbol	Modification	Diagram
B	Spot Facing Hole	
C	Countersinking Hole	
H	Straight Hole	
M	Straight & Threading Hole	
P	Relief at One Side	
Q	Insert of Abrasive Layer	
R	Relief at Both Sides	
S	Segmented Abrasive Layer	
SS	Slot Segmented Abrasive Layer	
T	Threading Hole	
V	Reverse Attachment of Abrasive Layer	
W	With Shaft	
Y	Reverse Insert of Abrasive Layer	

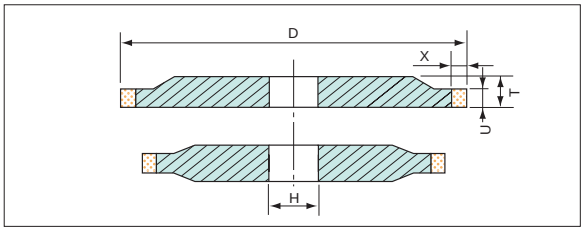
Standard Wheel Shape1

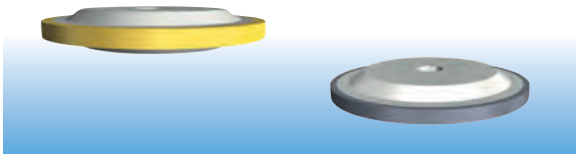
1A1 Straight



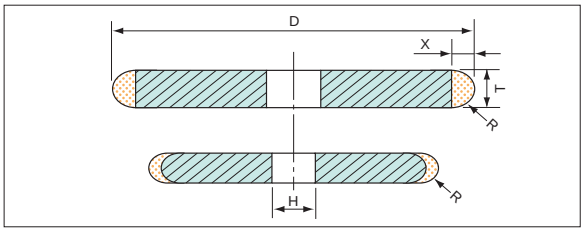


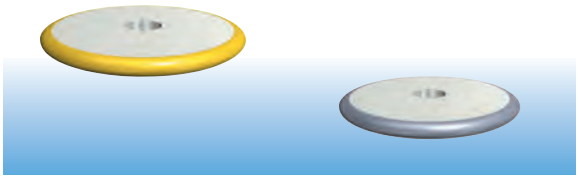
3A1/14A1 Straight with Boss



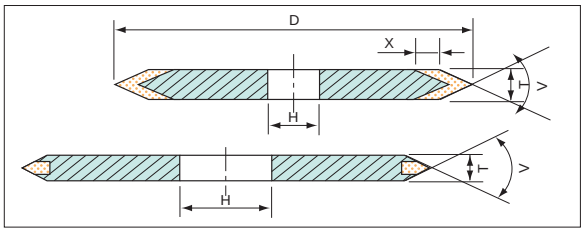


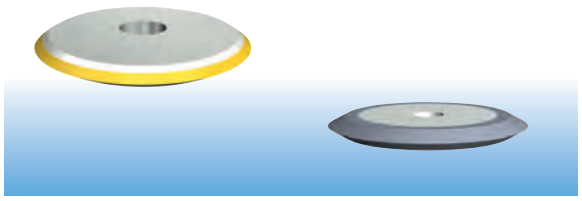
1F1/1FF1 Straight with R



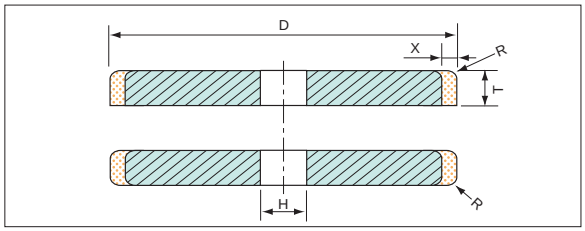


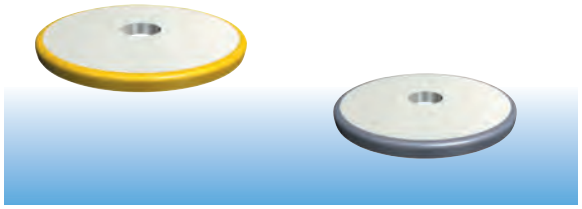
1EE1/1E6Q V Face



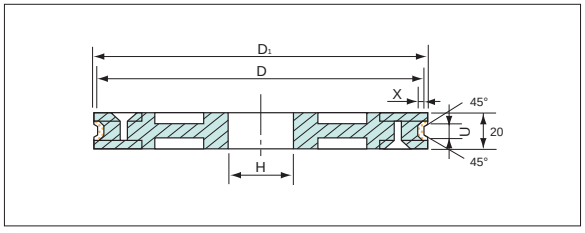


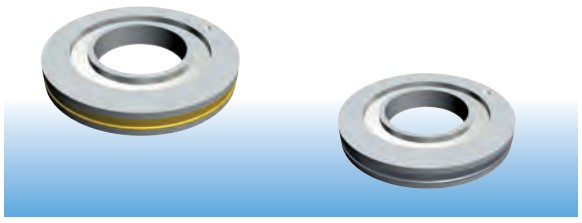
1Q1/1L1 Chipbreaker





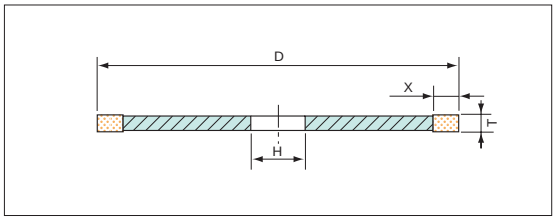
1DD6Y Centering

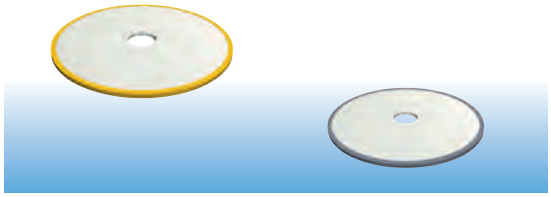




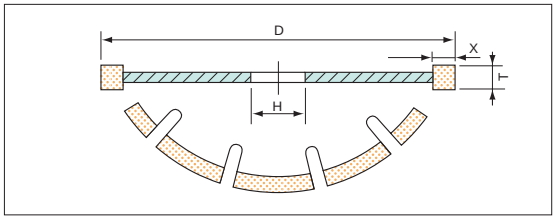
Standard Wheel Shape 2

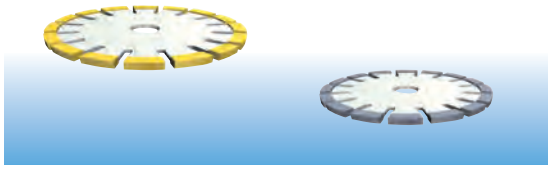
1A1R Cutting



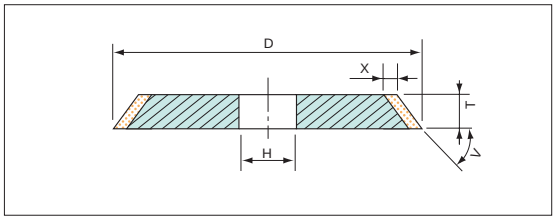


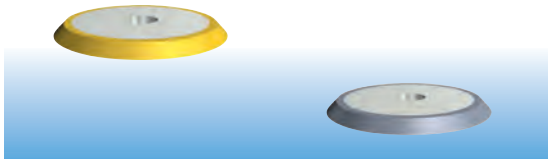
1A1RSS Cutting Saw



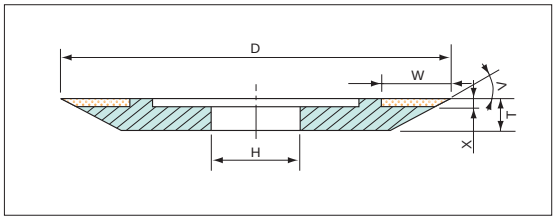


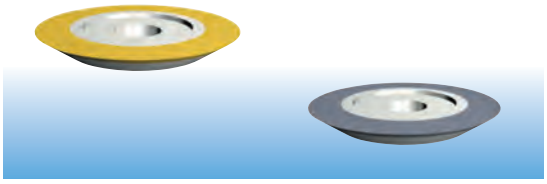
1V1 Straight with Angle



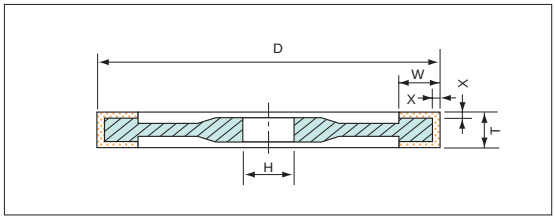


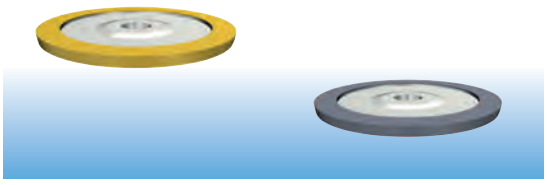
4B2 One Side V Face



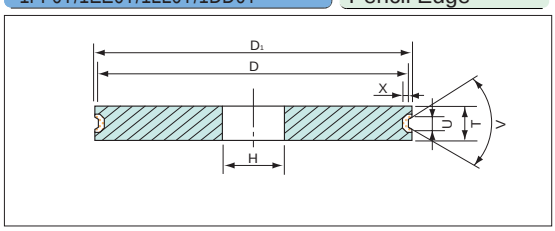


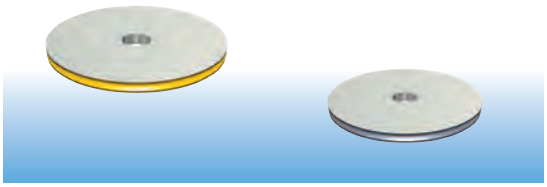
9U1 U-shaped Straight





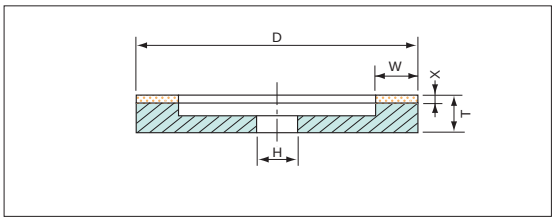
1FF6Y/1EE6Y/1LL6Y/1DD6Y Pencil Edge

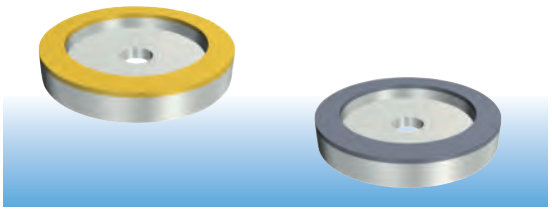




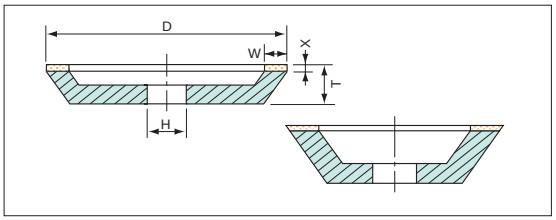
Standard Wheel Shape 3

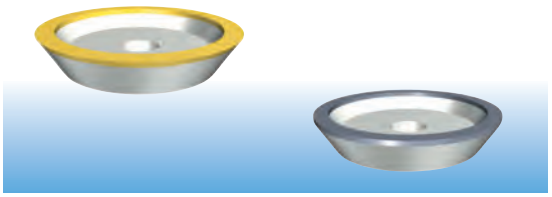
6A2 Plain Cup



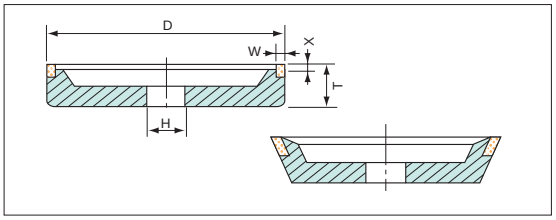


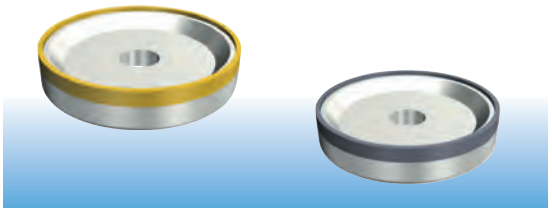
11A2/11B2 Flair Cup



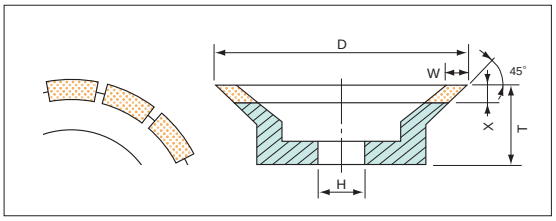


6A9/11V9 Corner Cup

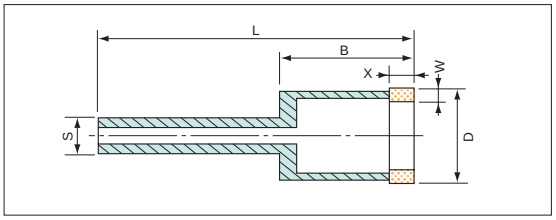


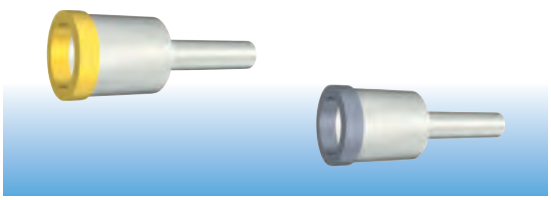


11V2S Wedge-shaped Segment Cup

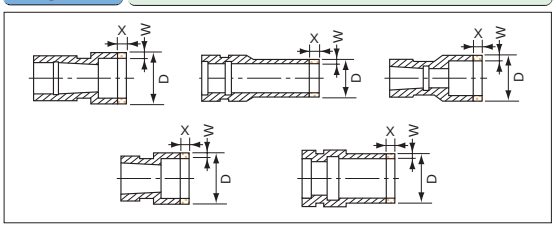


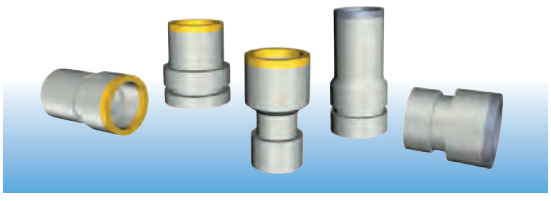
3A2 Core Drill





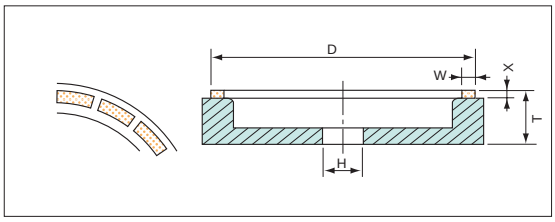
3F2 Curve Generator

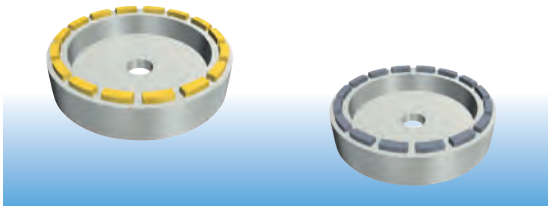




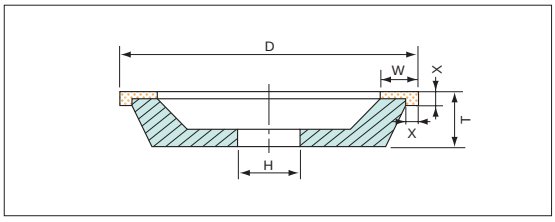
Standard Wheel Shape 4

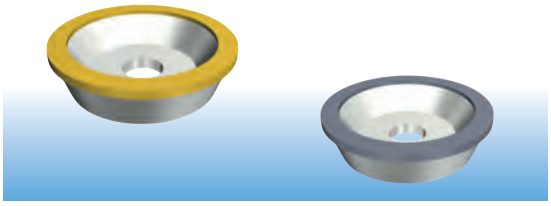
6A2S Segment Cup



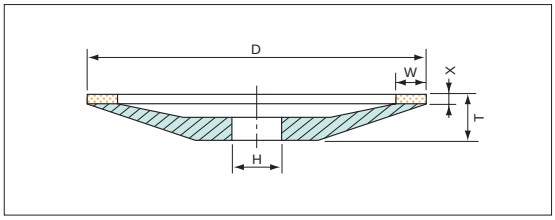


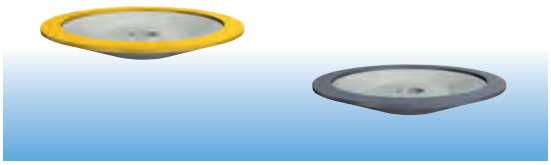
11C9/11Y9 L-shaped Flair Cup



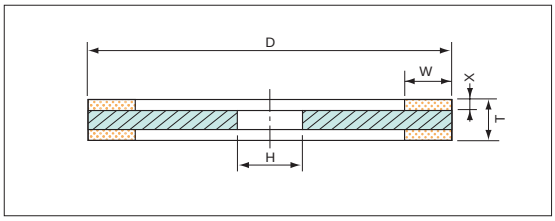


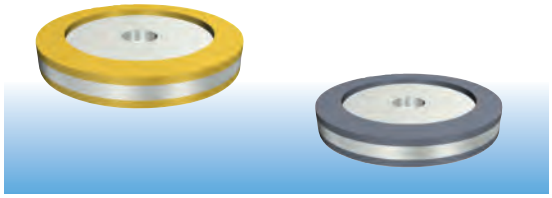
12A2 Dish



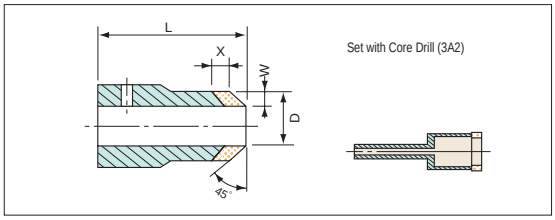


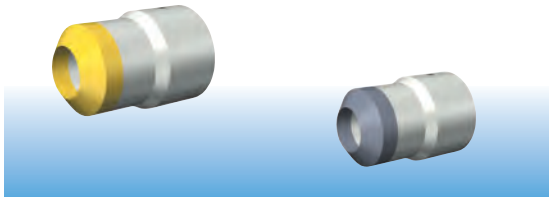
9A3 Both Side Cup



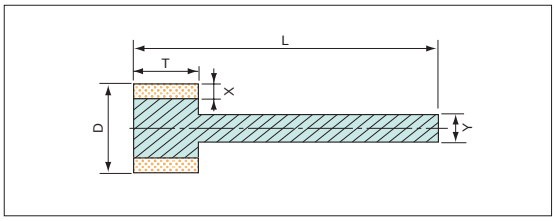


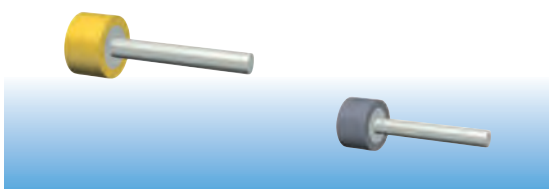
3V2T Chamfering





W Internal with Shank





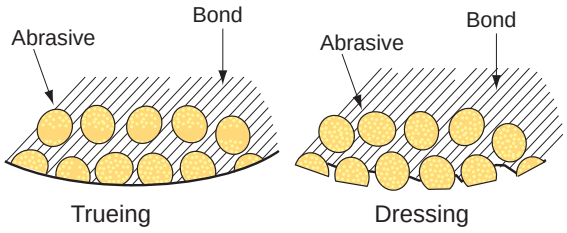
About Trueing and Dressing

Dia. 1. Method of Trueing for Each Type of Diamond and cBN Wheel

Trueing Method and Tool			Applicable Abrasive	Applicable Bond (*1 *2)	Forming	Remarks
Diamond Tool Method	Rotating Type	Rotary Dresser	Dia	Easy Wheel	Possible	Used mostly with cBN wheel; cannot be applied to diamond except in some cases
			cBN	V.B	Possible	
		Metal Wheel	Dia	Easy Wheel	Possible	
			cBN	V.B.M.(E)	Possible	
		Electrodeposition Arbor	cBN	V.B	Not Possible	
	Static Type	Single Point, Multi-point Dresser	cBN	V.B	Not Possible	
		Impregnated Dresser	cBN	V.B.(E)	Not Possible	
		Block Dresser	cBN	V.B	Possible	
		Electrodeposition Block Dresser	cBN	V.B.(M)	Not Possible	
Conventional Wheel Method	Rotating Type	Grinding Wheel	Dia	B.V.M	Possible	Rotating Type can be used for most diamond and cBN but Static Type is very limited
			cBN	B.V.M	Possible	
	Static Type	Stick	Dia	B.V.(M)	Not Possible	
			cBN	B.V.(M)	Not Possible	
Soft Steel Method	Rotating Type	Soft Steel Roll	Dia	B	Not Possible	Simple way applied from long ago; forming is not possible
			cBN	B	Not Possible	
	Static Type	Soft Steel Block	Dia	B	Not Possible	
			cBN	B	Not Possible	
Free Abrasive Method	Lapping		Dia	B.V.M	Not Possible	Specialized equipment is required
			cBN	B.V.M	Not Possible	
Crash Method	Steel Roll		Dia	V	Possible	
			cBN	V	Possible	
Electro-discharge Machining	Electrode		Dia	M	Possible	
			cBN	M	Possible	

*1: B: Resin Bond M: Metal Bond V: Vitrified Bond E: Electro-plated Wheel
*2: Order of easiness for trueing; () is not general

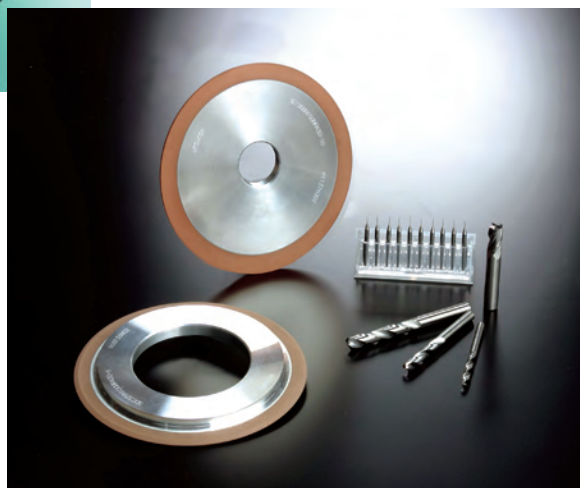
Fig. 1. Illustration of Trueing and Dressing



Dia. 2. Method of Dressing for Each Type of Diamond and cBN Wheel

Dressing Method and Tool			Applicable Abrasive	Applicable Bond
Diamond Tool Method	Rotating Type	Rotary Dresser	Dia	Easy Wheel
			cBN	V
		Metal Wheel	Dia	Easy Wheel
			cBN	V
	Static Type	Single Point, Multi-point Dresser	cBN	V
		Impregnated Dresser	cBN	V
		Block Dresser	cBN	V
Conventional Wheel Method	Rotating Type	Grinding	Dia	B.V.M.E
			cBN	B.V.M.E
	Static Type	Stick	Dia	B.V.M.E
			cBN	B.V.M.E
Soft Steel Method	Rotating Type	Soft Steel Roll	Dia	B
			cBN	B
	Static Type	Soft Steel Block	Dia	B
			cBN	B
Free Abrasive Method	Lapping		Dia, cBN	B.V.M.E
	Blasting		Dia, cBN	B.V.M
Crash Method	Steel Roll		Dia, cBN	V
Electro-discharge Machining			Dia, cBN	M
Electro-chemical Machining			Dia, cBN	M

*1: B: Resin Bond M: Metal Bond V: Vitrified Bond E: Electro-plated Wheel
Order of easiness for dressing



Diamond/cBN Lapping Plate

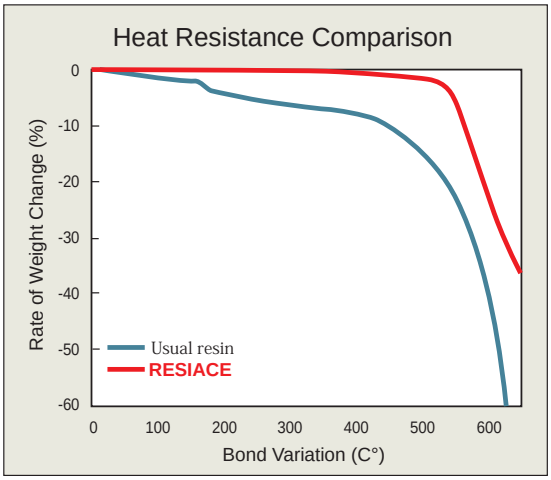
RESIACE

MB Spark was developed to meet the needs of surface quality improvement of elements used in automotive and household appliance in the progress of energy saving and miniaturization. MB Spark changes the world of double disc grinding by improving the trueing interval over a conventional resin bond grinding wheel, in combination with electro-discharge trueing.

Heavy Duty Grinding

Ultimate superheat resin bond

RESIACE exhibits high performance in heavy duty grinding, particularly in cemented carbide or cermet applications. It performs especially well in heat resistant grinding processes without experiencing deformation.



Special Features

- High Heat Resistance
  Bond does not experience heat deteriorization even under severe grinding conditions
- Superior Grinding
  Highly efficient grinding due to superior ability and exceptional durability
- High Shape Retension
  No need for shape correction

Usage

- Flute grinding for carbide drill, endmill, and PCD drill
- Chipbreaker grinding for insert
- Other tool grinding (cylindrical grinding, surface grinding, etc.)

Bond Variation

Three types are available, depending on usage and conditions

Bond Strength	Special Features
BRA10	Focus on sharpness
BRA20	Standard
BRA30	Focus on tool life

Data /Water-soluble Coolant

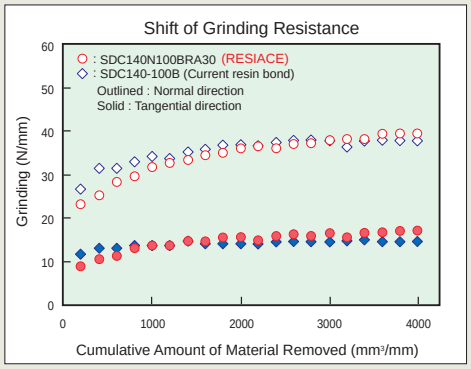
■ Grinding Test Conditions

Work Material: Tungsten carbide
Specification: SDC140-100B
Peripheral Speed: 1600m/min
Depth of Cut: 2mm
Feed Rate: 50mm/min
Coolant: Water soluble

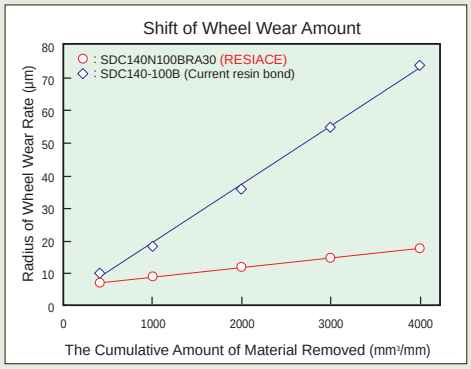
■ Results

Equivalent grinding ability (grinding resistance) and 6 times tool life (grinding ratio) compared to current resin bond. Significant improvement of interval for shape correction is possible for flute grinding of carbide drill or endmill.

Grinding Ability



Wear Amount



Data /Oil Based Coolant

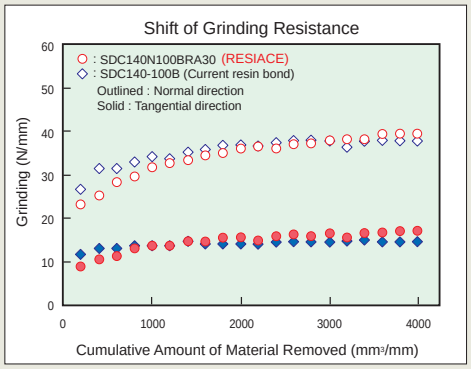
■ Conditions of Grinding Test

Specification: SDC140-100B
Peripheral Speed: 1600m/min
Depth of Cutting: 1mm
Feed Rate: 30mm/min
Coolant: Oil based

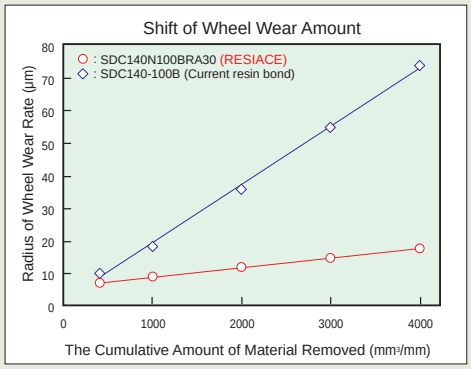
■ Results

RESIACE achieved significant grinding ratio (about six times) by maintaining superior grinding ability, even in the range where current resin bond shows signs of excessive wear due to heat deterioration. The combination of grinding ability and shape maintenence makes flute grinding of carbide drill or endmill possible.

Grinding Ability



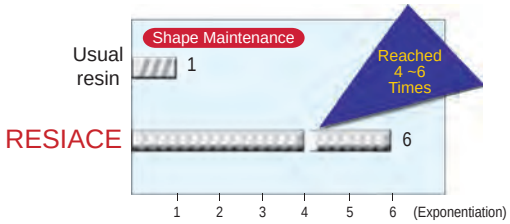
Wear Amount

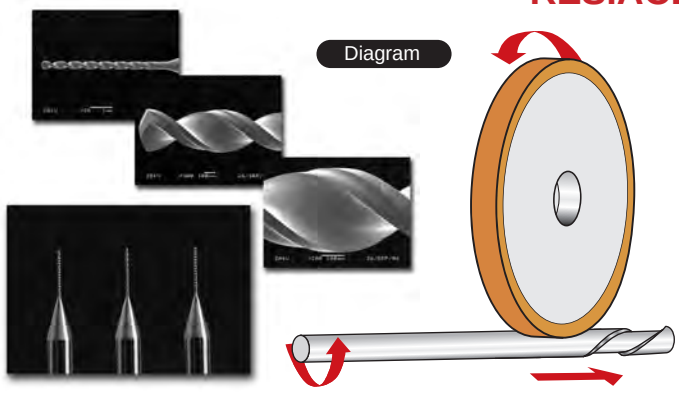


Process Results

RESIACE

- Process: PCB flute grinding
- Evaluation: Interval of shape correction
- Results:



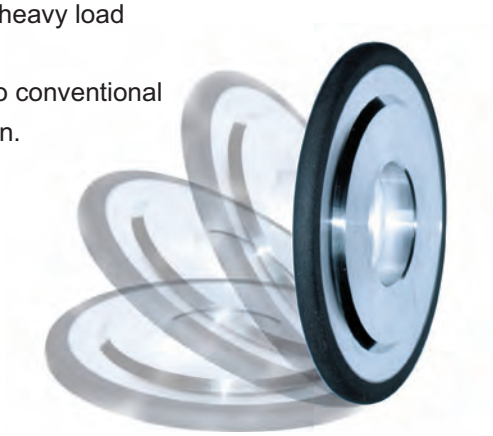


FluteMAX

FluteMAX applies super heat resistant resin with a special filler to achieve both superior cutting ability and long tool life. Suitable for grooving applications such as endmills, drills, reamers, and creep feed grinding for various other tools.

Special Features

- Super heat resistant resin helps to reduce deterioration under very high temperatures.
- Excellent cutting ability and shape retention even for heavy load grinding such as creep feed grinding.
- High feed rate and long dressing interval compared to conventional items which leads to high efficiency and cost reduction.

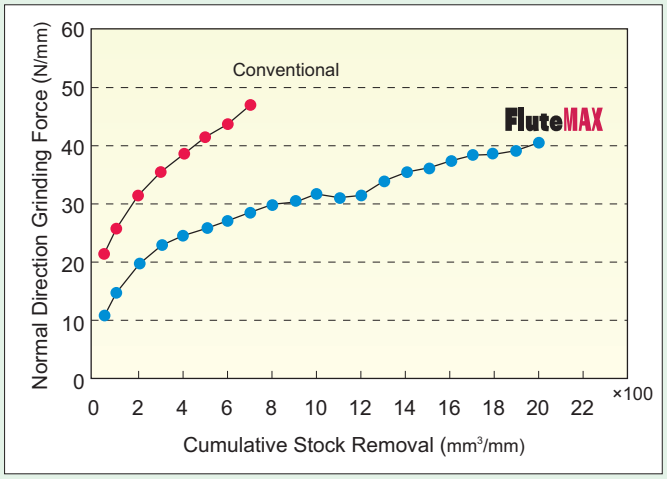


• Comparison to Conventional Bond for Creep Feed Grinding of Carbide

■ Working Conditions

Work Material	cemented carbide
Wheel Specification	SDC140-100B

Wheel Speed	V=1,600m/min
Speed for Work Material	F=80mm/min
D.O.C.	a=0.5mm/pass

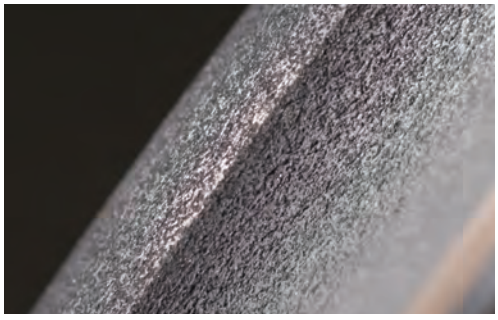


• Results

Grinding force of conventional bond suddenly increased and was interrupted due to burn, while the FluteMAX kept low grinding force and maintained cutting ability.

CBM Bond Wheel

While resin bond combined with diamond or cBN wheel is ideal for low horsepower and low rigidity machines, it is unsuitable for high efficiency or long tool life grinding because of its low heat resistance. CBM Bond Wheel was created to exhibit excellent heat resistance of metal bond and surpasses the grinding ability of the resin bond wheel.

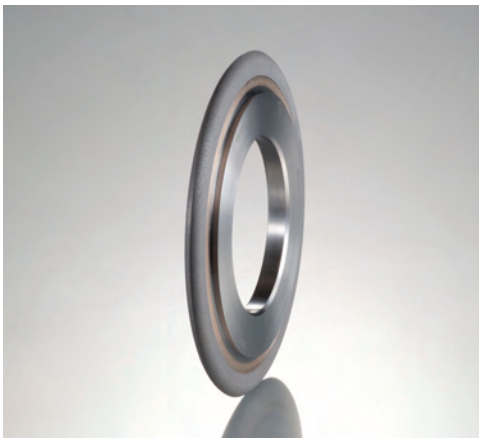


Characteristics

Newly developed metal bond has both excellent grinding ability and provides long tool life. It also increases grinding efficiency, especially when used with oil-based coolant.

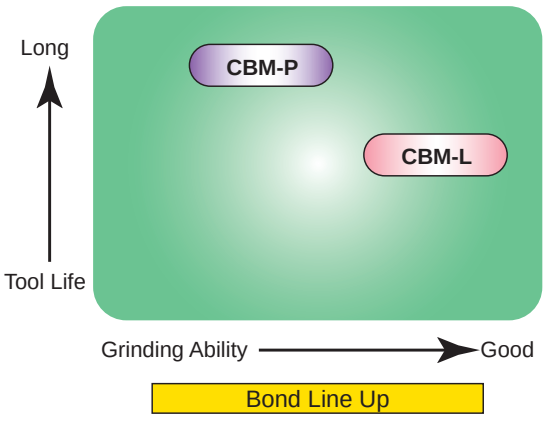
Usage

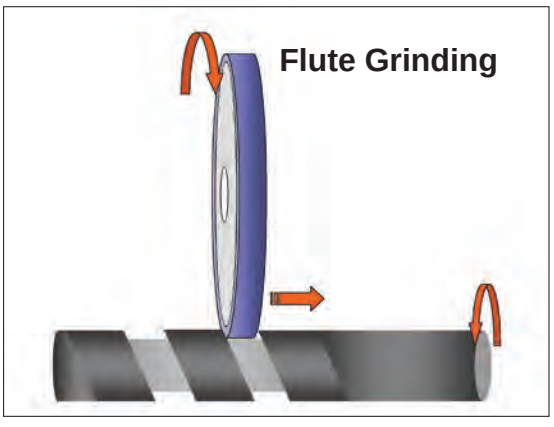
- Flute grinding for endmills, drills, and reamers
- Chipbreaker grinding for inserts
- Heavy duty grinding of various tools, including special steel tools



Recommended Usage

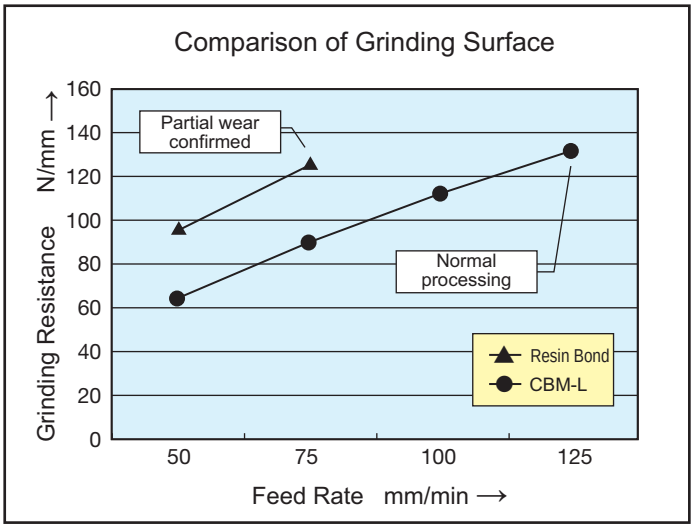
Line Up	Recommendation
CBM-L	To increase ***feed rate*** when flute grinding high speed steel or carbide drill
CBM-P	To increase ***tool life*** when flute grinding high speed steel or carbide drill





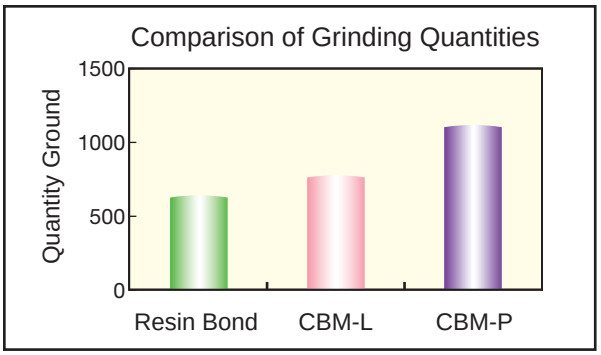
Grinding Resistance Comparison

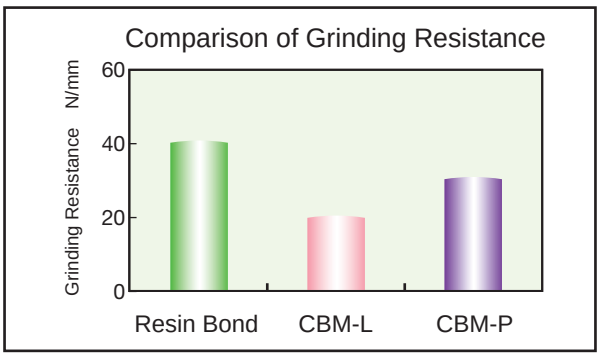
1) Wheel Specification
① Resin: SDC325N100B
② CBM-L: SD325L100CBM
2) Work Material
Cemented Carbide
3) Conditions
- Wheel Peripheral Speed: 1500 mm/min
- D.O.C. : 3mm
- Coolant : Oil-based
- Machine: Horizontal spindle surface grinder

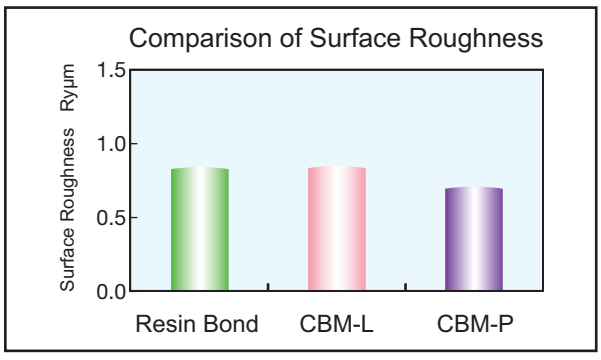


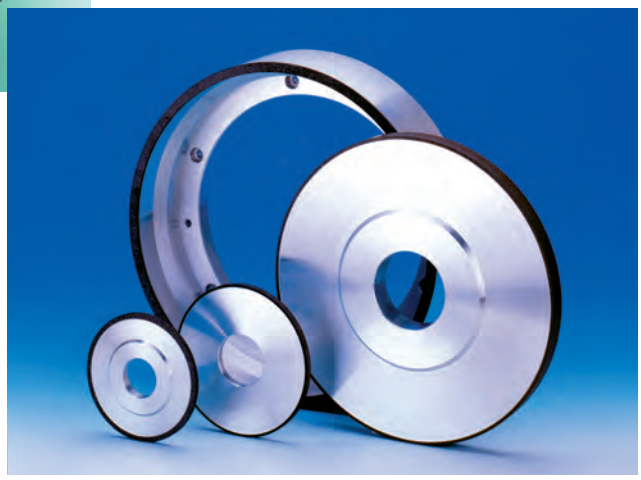
Resin Bond Comparison

1) Wheel Specification
① Resin: SDC325N100B
② CBM-L: SD325L100CBM
2) Work Material
Cemented Carbide
3) Conditions
- Wheel Peripheral Speed: 1500 mm/min
- D.O.C. : 3mm
- Coolant : Oil-based
- Machine: Horizontal spindle surface grinder









Hybrid Wheel

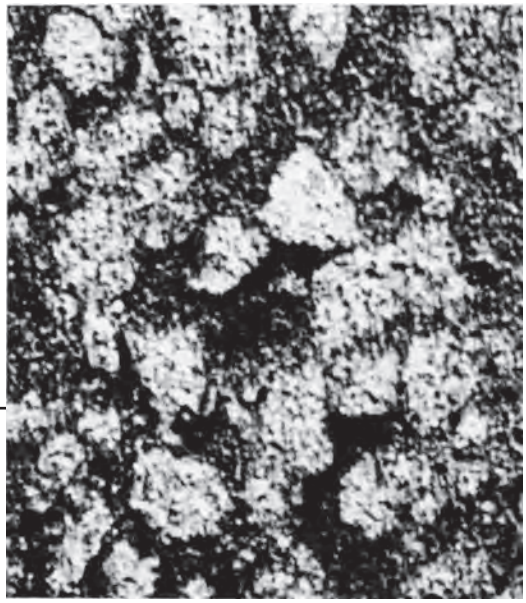
The Hybrid Wheel was developed for high-efficiency processing of cermet, a material that is difficult to grind. Hybrid consists of metal bond and resin bond which offer excellent grinding ability. The incorporation of these two materials offer:

- excellent grinding ability and long tool life due to an effective micro-segment of special metal bond
- good surface roughness and minimal chipping due to resin bond matrix

The Hybrid Wheel is a diamond wheel created to make cermet grinding easier.

Characteristics

- Machining efficiency: more than double
- Dressing interval: more than double
- Tool life: more than 1.5 times
- Surface roughness: good



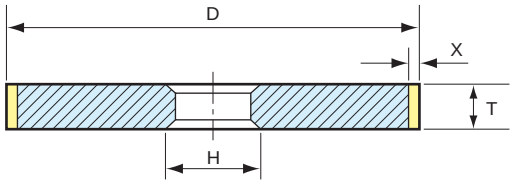
Micro-segment structure

Main Usage

- Outer grinding of cermet, surface grinding, surface honing, grooving and chipbreaker grinding, etc.
- Various grinding including cemented carbide and ceramics

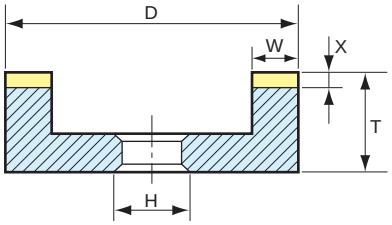
Type and standard size

Straight Type



Item Number	D	T	X	H
HS050	50	3,5,8,10, 15,20	3,5	As requested
HS075	75			
HS100	100			
HS125	125			
HS150	150			
HS175	175			
HS180	180			
HS200	200			
HS250	250	10,15,20, 25,30		
HS300	300			
HS350	350			
HS400	400			
HS500	500			
HS600	600			

Cup Type



Item Number	D	T	X	H
HC050	50	3,5,8,10	3,5	As requested
HC075	75			
HC100	100			
HC125	125			
HC150	150	5,8,10,15		
HC175	175			
HC200	200			
HC250	250			
HC300	300			
HC350	350			
HC400	400			
HC500	500			

All cup wheel types are available.

Performance of Hybrid Wheel

		Hybrid	Current resin bond
Wheel	Size	350×12W×6×, 6A2	
	Specification	#325−75−HB	SDC325R75B
Work Material	Size	12.7 × 3.175	
	Specification	TIC−TIN Cermet	
Grinding Condition	Machine	TA outer grinder	
	Peripheral Speed	1,600m/min	
	Speed of Cutting (side)	3mm/min	
	Speed of Cutting (R part)	40mm/min	
	Coolant	Water soluble	
Result	Current Value	9A	10A
	Dress Interval	300~400%	100%
	Processing Quantity	150~200%	100%
	Surface Roughness	Good	Good
	Chipping	Good	Good

When Ordering

Please indicate the item number and hole size (H) when ordering.

Special requests are also welcome.

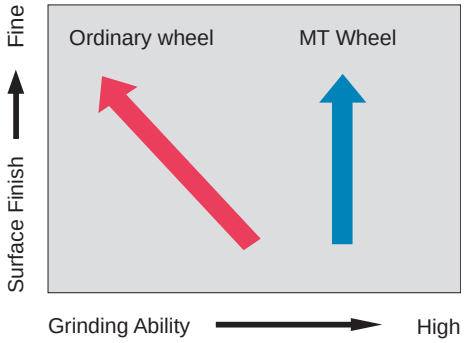
MT Bond Diamond & cBN Wheels

MT Bond is a new metal bond which is manufactured to reach optimum grinding ability, fusing the advantages of both resin bond and metal bond. The Diamond Wheel efficiently grinds ceramic, carbide, cermet, and quartz as well as other materials. MT Bond Wheel is recommended for the surface grinding with 6A2 cup wheel and the creep feed grinding by profiled wheel, which sustains its grinding ability.

MT Bond Wheel--pursuing the ideal grinding wheel

Efficiency & Accuracy

MT10 and 20 are recommended for the grinding operation of various tools such as tungsten carbide, cermet, and high speed steel. MT30, 40, and 50 are recommended for the surface grinding of glass, various ceramics, and steels.



Grinding Operations

Ceramic
- Aluminum Oxide, Silicon Nitride, Silicon Carbide, Zirconium
- Surface grinding (horizontal spindle)
- Surface grinding (VSRT)
- Double disc grinding
- Flat face honing

Magnet
- Ferrite, Neodium
- Surface grinding (VSRT)
- Double disc grinding
- Flat face honing

Tooling
- High Speed Steel: Flute grinding, Nick grinding, Profile grinding
- Tungsten Carbide, Cermet: Flute grinding, Chipbreaker grinding, Thread grinding, Profile grinding, Flat face honing, Double disc grinding

Automotive & Machinery
- Steel Casted Alloy, Sintered Alloy
- Surface grinding (VSRT)
- Double disc grinding
- Flat face honing

Semiconductor
- Silicon Compound
- Surface grinding (VSRT)

Optical & Electronics
- Glass, Crystal, Quartz, Sapphire
- Surface grinding (horizontal spindle)
- Surface grinding (VSRT)
- Double disc grinding
- Flat face honing
- Curve generation
- Cylindrical grinding

Medicare & Others
- Plastics, PVA Grinding Stone
- Finish on eye-glass lens edge
- Dressing

MT10 • MT20 • MT30 • MT40 • MT50

Straight Style

Type	D	T	X	H	Grit Size	Concentration
1A1	50	2~30	3,5,7	As specified	60 ~ 3,000	25 ~ 125
	75					
	100					
3A1	150					
	200	3~30				
14A1	250					
	300					
	400					

Cup Style

Type	D	W	X	H	Grit Size	Concentration
6A2	50	As specified	3,5,10	As specified	60 ~ 3,000	25 ~ 125
	75					
	100					
11A2	125					
	150					
12A2	175					
	200					
11B2	250					
	300					
6A9	350					
	400					
6A2S	500					
	600					

Specials can be designed and produced based on consultation.

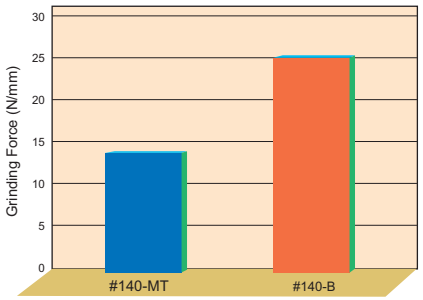
■ MT Bond grinding force is lower than resin bond

Data.1

- Comparison of grinding force of surface grinding of silicon nitride

Workpiece: Silicon Nitride

Grinding Conditions
Wheel Speed: V=1,760m/min
Work Speed: F =10m/min
D.O.C.: a =20μm



Result — The grinding force (normal force) is 40% lower than the resin bond wheel.

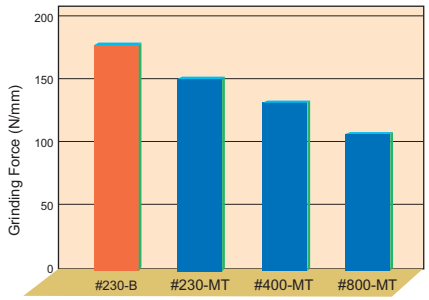
■ Finer grit reduces grinding force

Data.2

- Grinding force on creep feed grinding

Workpiece: Silicon Nitride

Grinding Conditions
Wheel Speed: V=1,600m/min
Work Speed: F =60m/min
D.O.C.: a =1mm



Result — MT Bond Wheel shows 20% lower grinding force than resin bond wheel with the same grit size. The finer grit produces a lower grinding force (comparison is between grit sizes #230, #400, and #800 US mesh).

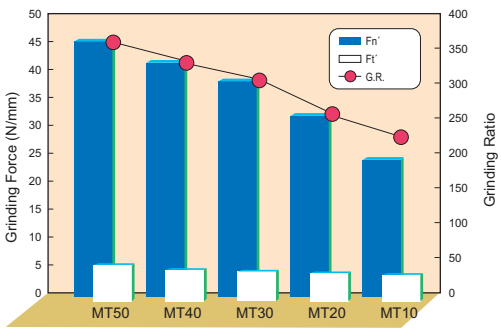
■ Grinding ability of MT Bonds

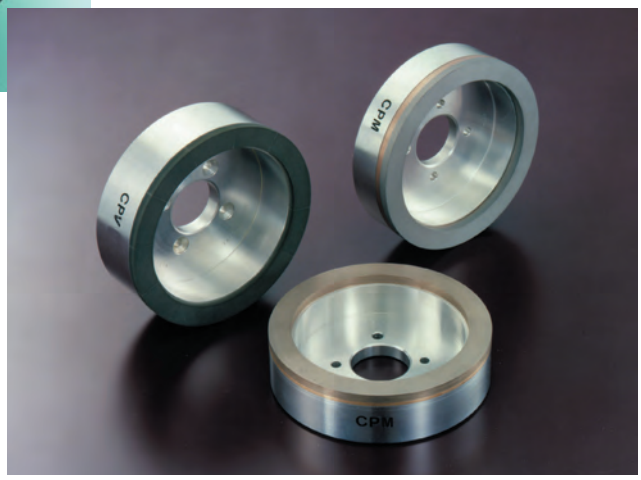
Data.3

- The perfomance of MT Bonds on silcon nitride grinding

Workpiece: Silicon Nitride

Grinding Conditions
Wheel Speed: V=1,650m/min
Work Speed: F =10m/min
D.O.C.: a =20μm

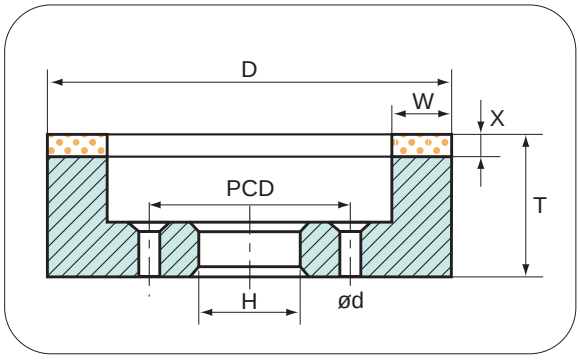




CP Wheels

The grinding of PCD-PCBN, both extremely difficult-to-grind-materials, results in high wear on the grinding wheel and longer grinding time because they grind against each other between the super abrasives. A.L.M.T.'s solution is CPV, which increases efficiency by shortening grinding time, and CPM, which reduces tool costs by extending tool life. A suitable wheel can be selected based on the specifics of an operation.

Wheel Shape

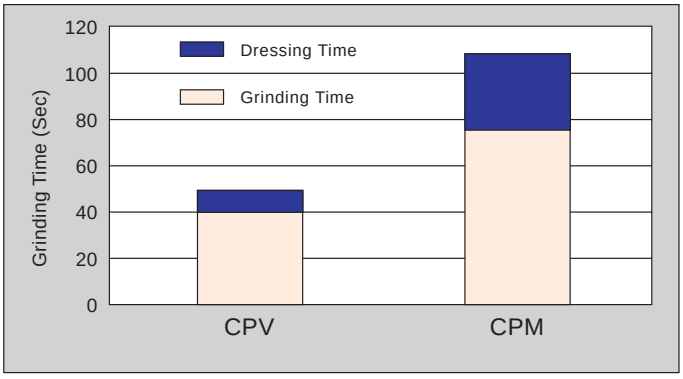


For Efficient Grinding

CPV

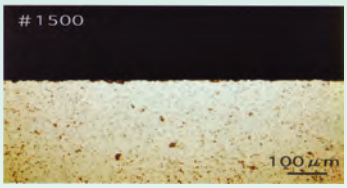
CPV Advantage

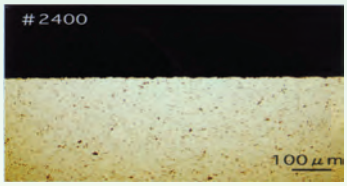
The combination of efficient dressing and higher grinding ability results in overall shorter grinding time.



Chipping Size on Cutting Edge

CPV and CPM can be applied to rough and finish grinding by selecting grit size in accordance to required limit of chipping.



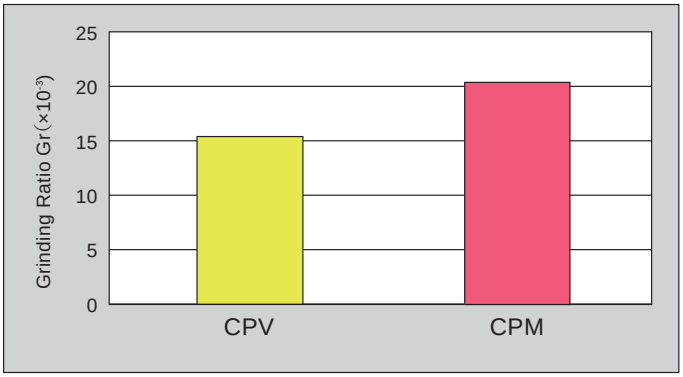


For Longer Lasting Grinding Operation

CPM

CPM Advantage

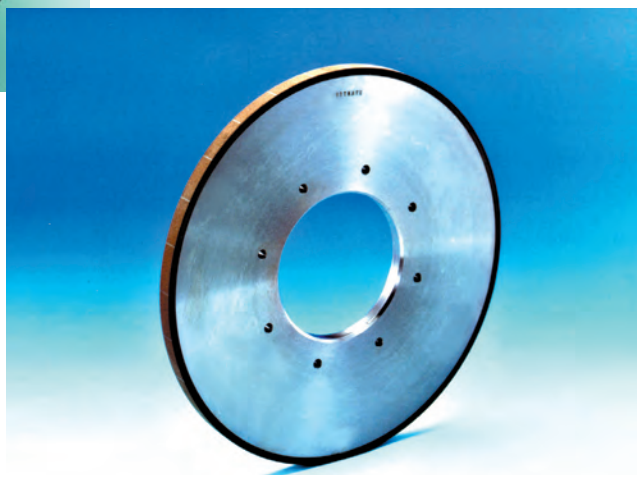
Under the same conditions, CPM increases the grinding ratio, as well as extends tool life and reduces tool costs.



■ Standard Dimensions for CPV & CPM Wheel

Machine Type	Outer Dia.（D）	Width（W）	Depth of diamond layer（X）	Bore dia.（H）	Setting hole（PCD）
CPG	150	5	10以下	40	4-?6.8キリ
		10			
Ewag		15			
		20			
Makino	125	5	10以下	31.75	なし
		10			
		15			
		20			
	150	5	10以下	38.1	なし
		10			
		15			
		20			
Waida	200	5	10以下	60	4-ø8.5キリ
		10			
		15			
		20			

Please inquire about special dimensions



VITMATE

Features

- High accuracy and efficiency grinding with VX bond for longer wheel life and exceptional grindability
- High holding power with cBN grain
- Controllable dressing ability for required surface roughness and grinding speed
- Multiple combinations of porosity and bond grades for a wide range of applications

Running Conditions	
O.D.	ø3～750mm
Thickness	3～300mm
Width	2～15mm
Spec.	cBN（＃60～＃2000）

Applications

Industries: Automotive, bearing, household appliances, tools, machinery, gears, mold & die
Work piece: Cam, crank shaft, injection needle, rocker arm, compressor, bearing, ball screw, motor

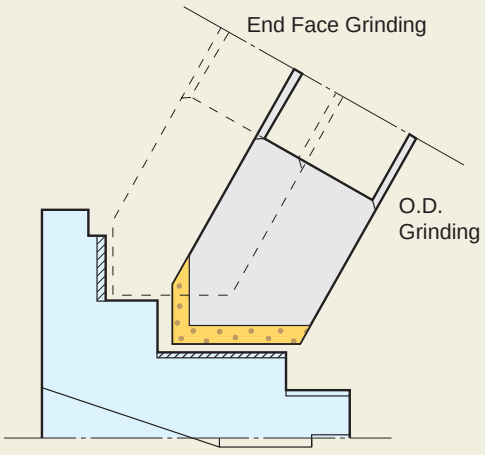
2 times dressing interval for compressor component

Data1.

Piece & Material: Compressor component, SCM415(HRC62)
Stock Removal: O.D. = 0.28 End Face = 0.15mm

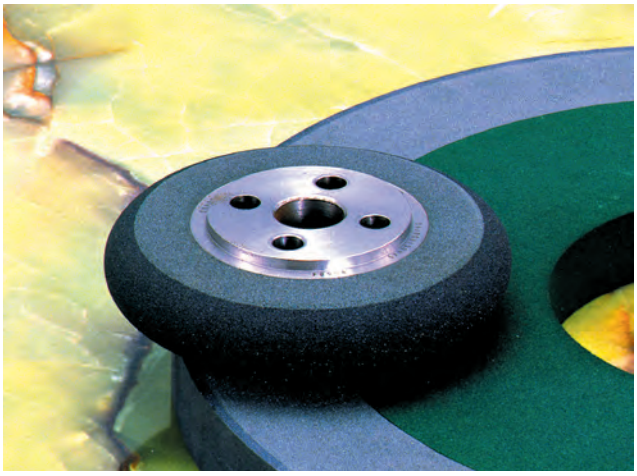
■ Application Example

1. Machine : Angular grinder
2. Wheel :350D-22U
   BN120N175VX5
3. Dresser :Diamond rotary dresser
   SD40M
4. Conditions :
   Peripheral speed = 80m/s
   Work rotation = 320 rpm
   Stock allowance = O.D. 0.28mm
   End Face 0.15mm
   Coolant emulsion = 5%



■ Results

	Conventional	VITMATE	Efficiency
Roughness	5.0μmRmax	3.2μmRmax	56% improved
Grinding time	40sec	30sec	25% improved
Dressing interval	400 pcs.	800 pcs.	Operating rate increased
Wheel life	70,000 pcs.	140,000 pcs.	Wheel life extended



UNIMATE

Features

- Uniform performance over the entire perimeter of wheel by ring integral molding and sintering of cBN layer
- Improved trueing accuracy, especially with formed diamond rotary dresser
- Dramatically improved coolant holding and less grinding burn

Running Conditions	
O.D.	ø3～750mm
Thickness	3～300mm
Width	2～15mm
Spec.	cBN（＃60～＃2000）

Applications

Industries: Automotive, bearing, household appliances, tools, machinery, gears, mold & die
Work piece: Cam, crank shaft, injection needle, rocker arm, compressor, bearing, ball screw, motor

High accuracy grinding by integral molding core

Data1.

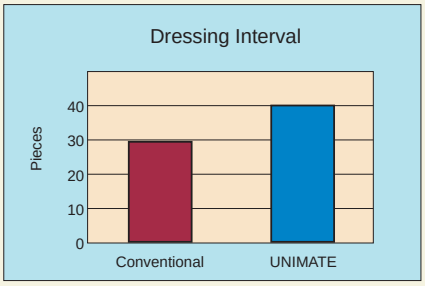
Workpiece: Inner race of CV joint

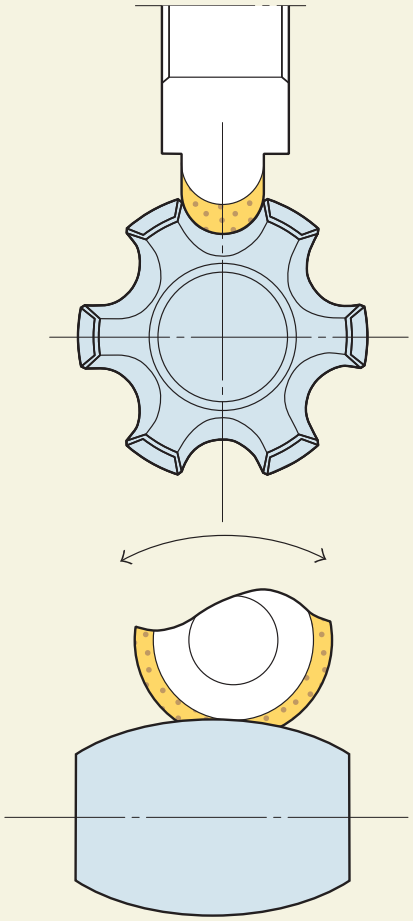
■ Application Example

1. Machine : Surface grinder
2. Wheel :126D-23U
   BN100N150VX4A
3. Peripheral speed :46m/s
4. Table feed : 600mm/min

■ Results

1. UNIMATE : 0.8-2.0Ra
   Requirement : 2.5Ra
2. Dressing interval : 25% extension





HiG-V

Features

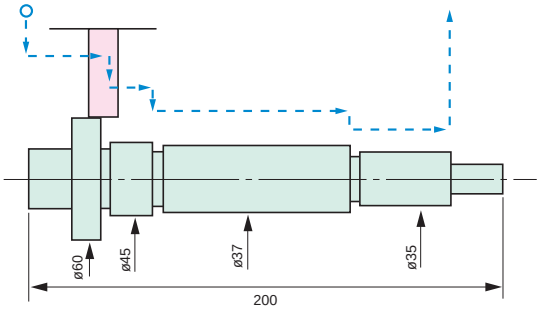
- High speed grinding wheel for over 60m/s
- High grindability and safety with selected core
- Amazing productivity
- Long lasting quality and satisfactory surface

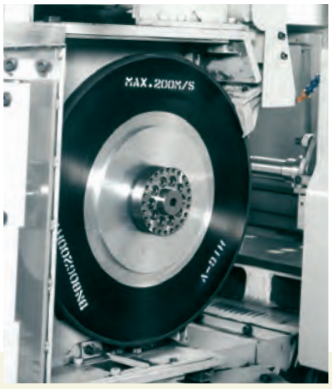
Running Conditions	
O.D.	ø100~500mm
Thickness	5~50mm
Width	3~6mm
Spec.	cBN(#60~#325)

Applications

Industries: Automotive, bearing, machine tool
Application: High speed grinding
Work piece: Cam, crank shaft, turbine blade

For high speed contour grinding





Data1.

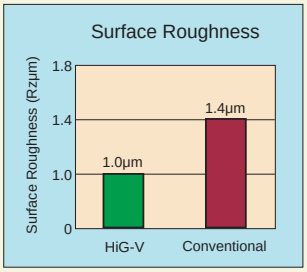
Material: Hardened bearing steel (HRC=60)

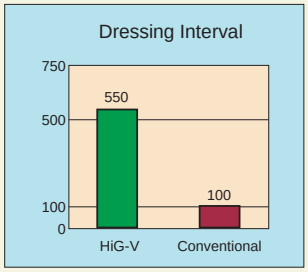
■ Application Example

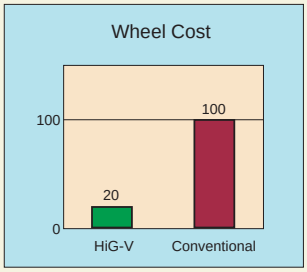
1. Machine : High speed grinder
2. Wheel :400D-10U
   BN60M200VX2
3. Peripheral speed = 160m/s
4. D.O.C. = 0.2mm/diameter
5. Wheel Feed = 300 mm/min
6. MRR: Z' = 180mm³/mm/s

■ Results

1. Surface roughness: 40% improved
2. Dressing interval: 5.5 times lengthened
3. Dresser life: lengthened by less dressing
4. Wheel cost: 80% reduced







EG Wheel

Features

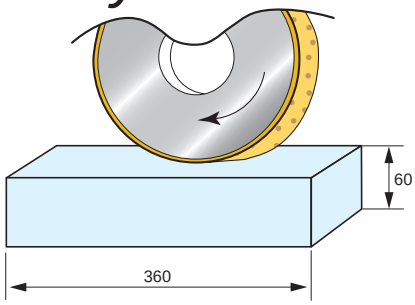
- Easy dressing and trueing on a grinder with special diamond rotary dresser
- Excellent run-out and form accuracy in short time on a grinder
- No special unit, technology, or skill required
- Accurate arrangement of cutting edges for surface roughness, productivity and wheel life

Applications

Industries: Machine tool, household appliances, automotive, bearing
Work piece: Ceramics and carbide

Running Conditions	
O.D.	ø3~750mm
Thickness	3~300mm
Width	2~15mm
Spec.	cBN(#80~#3000)

Good surface roughness, high productivity, and long lasting quality



Data1.

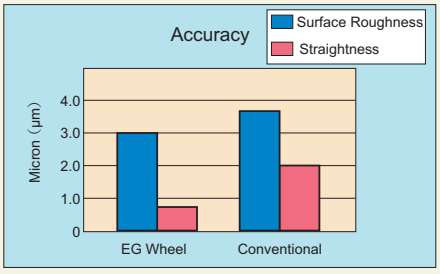
Material: Ceramics post
Alumina 60×360L

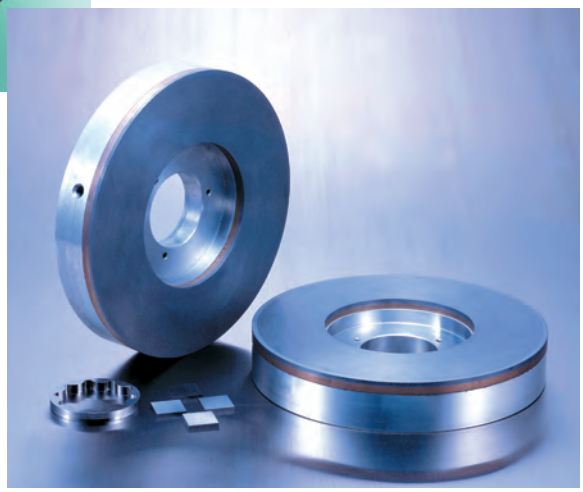
■ Application Example

1. Machine : Okamoto surface grinder PSG-63DXNC
2. Wheel : 300D-15U
   1) #270 resin bond wheel
   2) SD230G100C3
3. Rotary Dresser : 150D-10U SD40-M
4. Dresser Drive Unit : SGS-50 (ALMT)

■ Results

1. 6 times productivity than conventional diamond resin bond wheel
2. Dressing from trueing from 60 min. to 5 min.





Double disc metal bond wheel for electro-discharge trueing

MB SPARK

MB Spark was developed to meet the needs of surface quality improvement of elements used in automotive and household appliance in the progress of energy saving and miniaturization. MB Spark changes the world of double disc grinding by improving the trueing interval over a conventional resin bond grinding wheel, in combination with electro-discharge trueing.

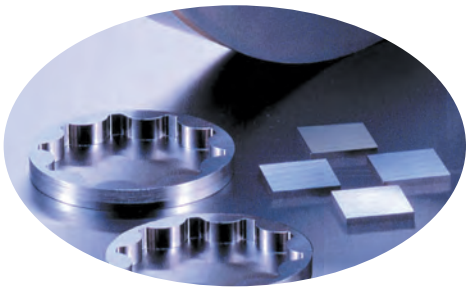
Features

1. Metal bond wheel with excellent electro-discharge trueing capability. Easy high-accuracy trueing on a grinder.
2. Long lasting cutting performance and high-wear resistance.
3. Less industrial waste--stops sludge produced from grinding wheel during trueing.

The next generation of double disc grinding systems

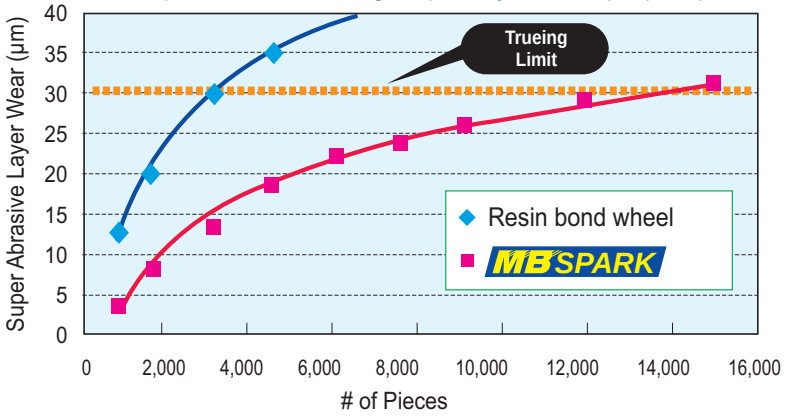
Long Lasting Quality

MB Spark has higher wear resistance than conventional resin bond wheel and keeps flatness of super abrasive layer longer. No frequent trueing interval is suitable for automated production line.



■ Comparison of Grinding Capability

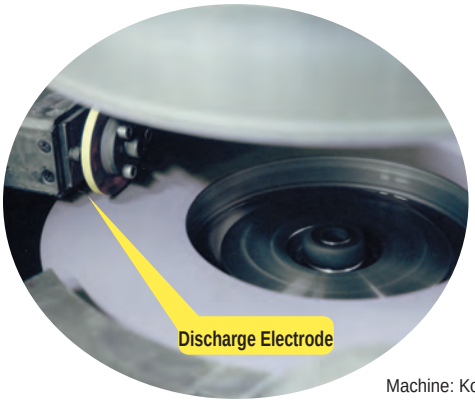
Workpiece:
Oil pump component



■ Application

● Air conditioner component ● Oil pump component ● Engine component

3 times the wheel life of conventional resin bond wheel.



Machine: Koyo Machinery

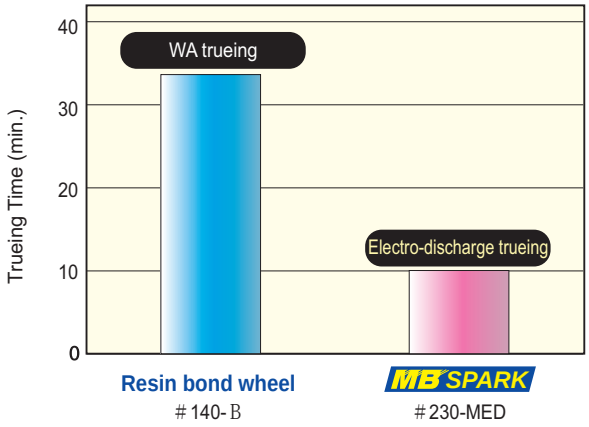
Electro-discharge trueing

High Trueing Performance

- Shorter work time on grinder; quick trueing with high accuracy using special low-melting metal bond suitable for electrodischarge trueing.

- Further benefits are attained with the fine super-abrasive for excellent flatness acquired in a short time frame.

■ Comparison of Trueing Performance



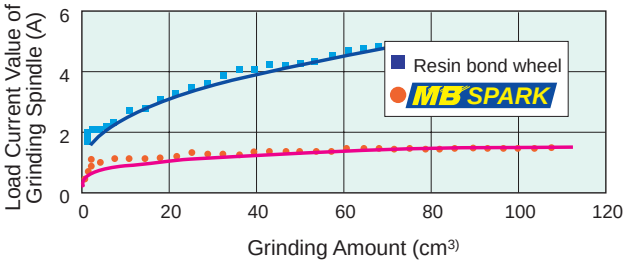
■ Grinding Example

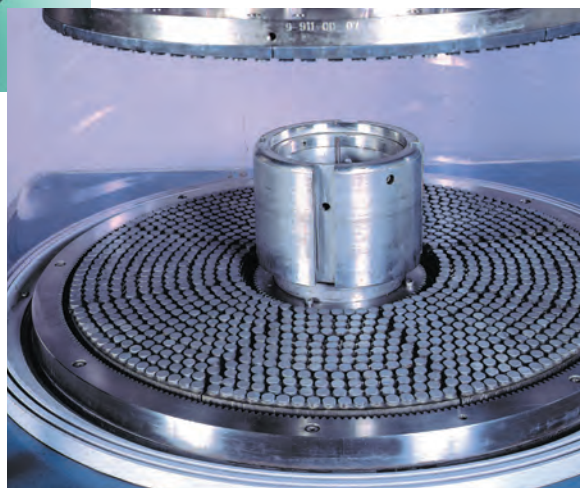
Grinder	Koyo KVD-300
Grinding Wheel	ø305D-75W-3X-ø80H MB Spark #230-MED Resin bond wheel #140-B
Workpiece	Oil pump component Powermetal SMF4040
Condition	
Wheel Rotation	Upper:1500min-1(C.C.W)
	Lower:1500min-1(C.C.W)
Total Stock Amount	0.2mm (both sides)
Rough Stock	0.19mm (both sides)
Rough Grinding Speed	0.035mm/sec
Finish Stock	0.01mm (both sides)
Finish Grinding Speed	0.015mm/sec
Spark out	2sec

High Grindability

Excellent cutting performance with a rigid metal bond suitable for double disc grinding, which has high retention of super abrasiveness due to electro-discharge trueing.

Displays ability to work in the same tough conditions as a conventional bond wheel.





Divisible Cassette Diamond/cBN Lapping Plate

DPG Wheel

1 Environment

Replace lapping with environmentally friendly, fixed abrasive diamond pellet grinding.
1) Reduce industrial waste dramatically
2) No clean-up with chloric organic solvent
3) Clean operating environment

2 High Efficiency

Grinding speed 5 to 100 times as fast as loose abrasive lapping.

3 Low Production Cost

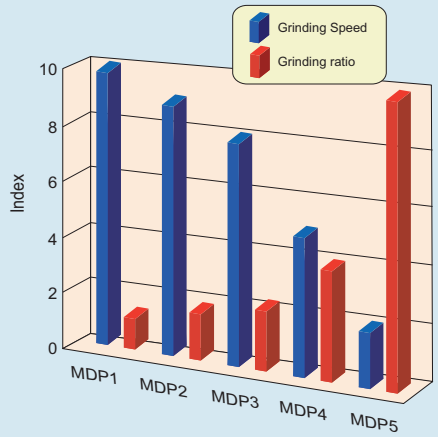
Reduce maintenance costs with long lasting plate and gear.

4 Process Reduction

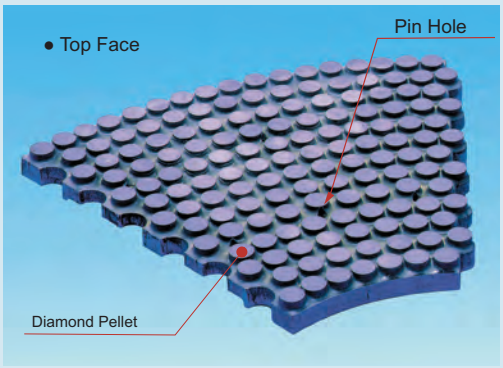
Integrate pre-grinding and lapping in one process

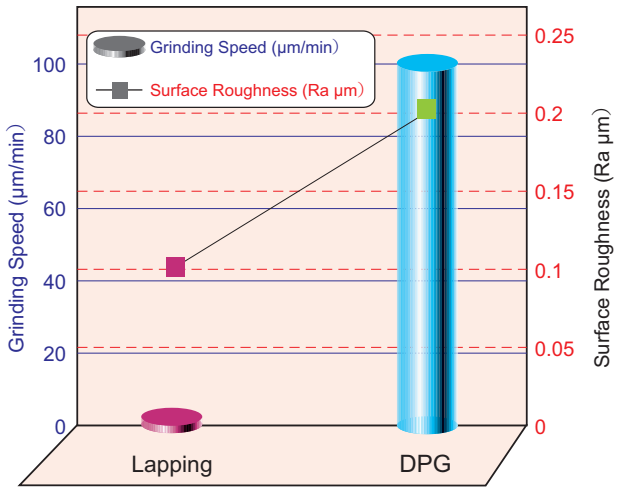
DPG WHEEL DATA

■ Grindability of MDP Bond



■ Cassette Plate





Example application

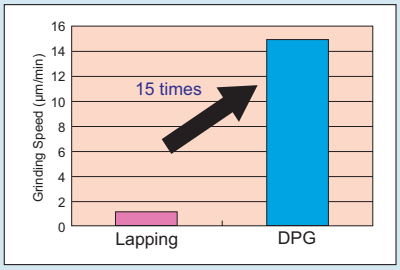
Metal bond wheel
MDP Series (rough grinding)

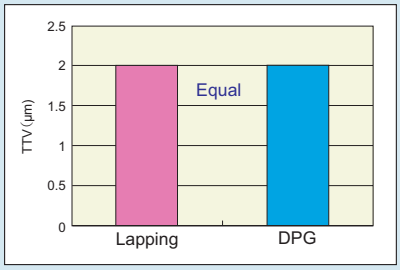
Workpiece: Alumina ø80-5T-ø70H

Wheel Specs: 9B SD400-MDP4

- Conditions

1)Top Plate: 7min^{-1}
2) Bottom Plate: 20min^{-1}
3) Sun Gear: 9min^{-1}
4) Internal Gear: 7min^{-1}
5) Grinding Pressure: 15KPa
6) Coolant: ODIAP (2%)





Superior Fine Grain

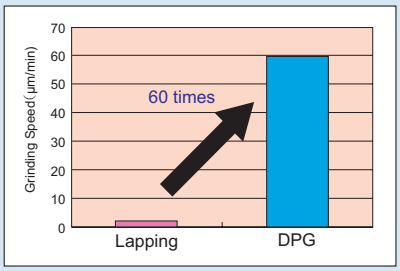
Vitrified Bond Wheel
VDP Series (finish grinding)

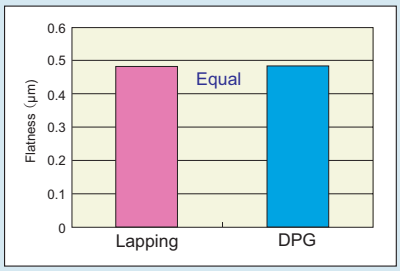
Workpiece: Tool Steel ø20-3T

Wheel Specs: 9B SD2000-VDP3

- Conditions

1)Top Plate: 50min^{-1}
2) Bottom Plate: 50min^{-1}
3) Sun Gear: 10min^{-1}
4) Interal Gear: 0min^{-1}
5) Grinding Pressure: 200KPa
6) Coolant: ODIAP (2%)





❶ Easy change of plate

- No detaching base plate
- Divisible cassette fixed on base plate
- Short dressing time
  (9B = 20 minutes, less than 2 hours for 16B)

❷ Pellet pattern keeps high grinding accuracy

- Divisible cassette designed for pellet layout
- Seams never interfere with the density of pellet distribution

❸ Free layout of coolant hole for top plate

- Coolant pool on clamp face

Size	Max. Dia.	Min. Dia.
4B	299	117
5B	389	213
6B	380	148
6B/9B	650	384
9B	637	218
12B	1058	360
13B	950	274
15B	1022	346
16B	1127	270
18B	1260	294
20B	1355	458
24B	1592	554
28B	1864	660

*Special sizes also available

Usage

- Grooving of endmills, drills and reamers
- Breaker grinding of inserts
- Heavy grinding of various tools including special steel tools

Type

3 different bond types

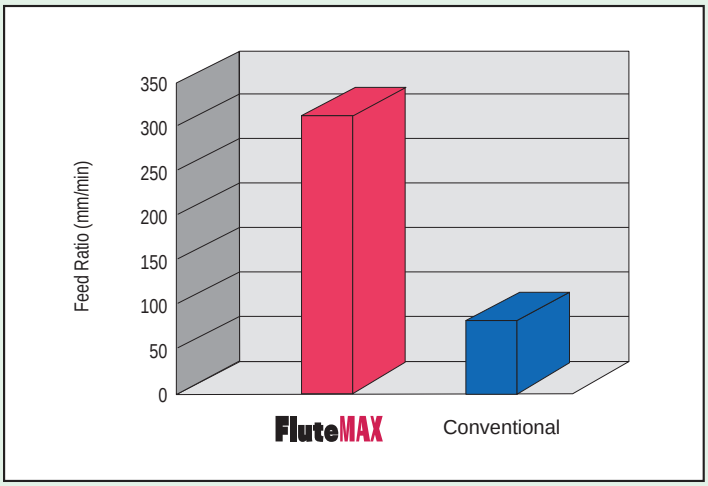
Bond Strength	Special Feature
L	Superior cutting ability
N	Standard
P	Superior shape retention

• Flute Grinding of Cemented Carbide Endmill

■ Working Conditions

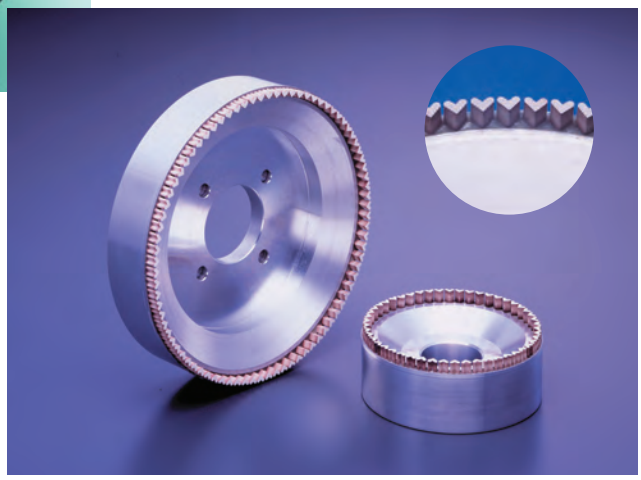
Work Material	8D 2-flute endmill
Wheel Specification	SDC270-100B

Wheel Speed	V=1,600m/min
D.O.C.	a=1.5mm (1st time) 0.5mm (2nd time)



• Results

Compared to conventional items in the market FluteMAX can increase feed ratio by 4 times and has same dress interval life.



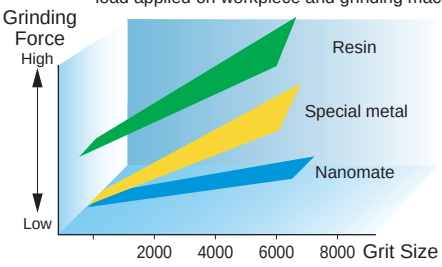
Nanomate V-Heart

Nanomate V-Heart which consists of strong holding diamond grit and high porosity vitrified bond, combined with a specially-shaped diamond layer, offers lower grinding force, creating a new field for grinding operations. Nanomate has a flatness of less than 1µm on ø300 wafer and makes difficult-to-grind weak and brittle materials, including semi-conductor, electronics, and other materials.

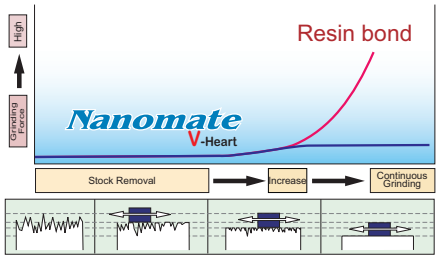
Lower grinding force, shallower affected layer

Grinding Force

Low grinding forces result in reduction of each load applied on workpiece and grinding machine.

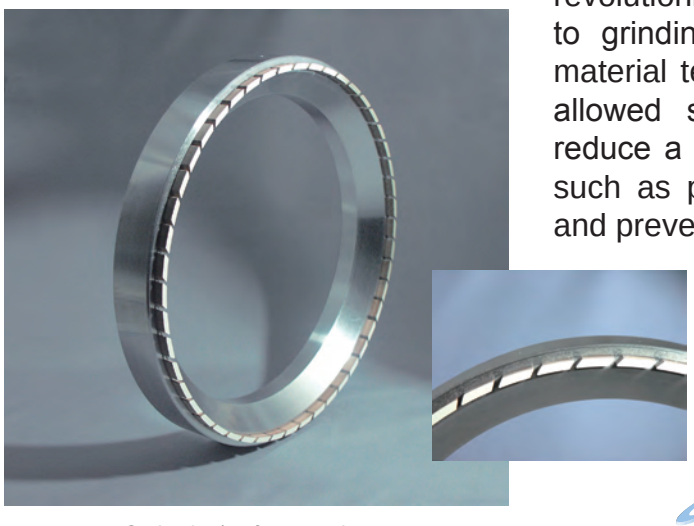


● Grinding force is 1/10 of resin bonding wheel

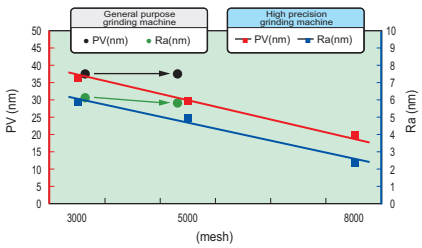


Nanomate F-Star

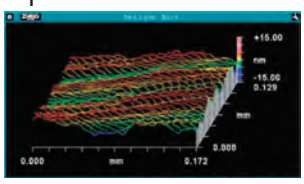
Super-fine diamond grit and super-fine ceramics revolutionized the conventional wisdom with regard to grinding wheels. Application of both acquired material technology and production technology has allowed super-fine grinding. Its effectiveness to reduce a grinding damaged layer of brittle material such as polish-reduction of ø300mm silicon wafer and prevent cracks on a thin layer device wafer.

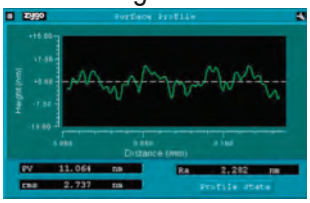


■ Grain size/surface roughness

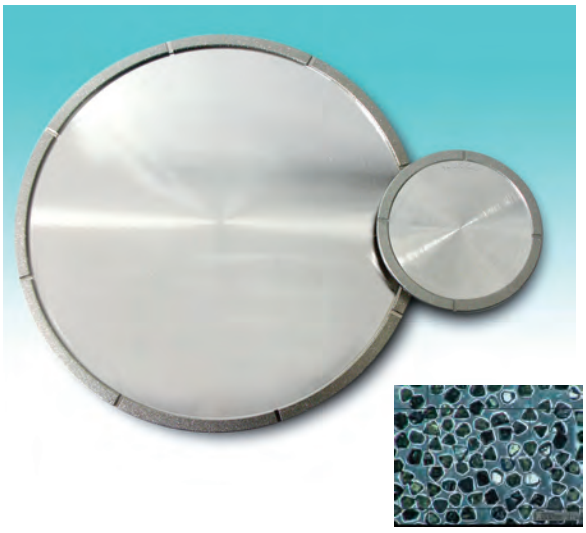


Super-fine diamond grain and super-fine ceramics open the door to advanced technologies.





Grinding result by SD8000 Nanomate



Diversifying the CMP process

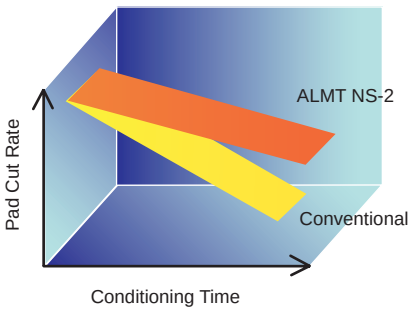
CMP Conditioner

1 High quality diamond
- Scratches caused by diamond crash can be minimized
- More uniformity of the diamond grit shape and stable performance

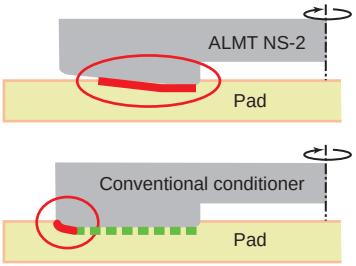
2 High precision core material
- Uniform contact with the conditioner

3 High precision electro-plating
- Perfect single diamond layer
- Uniform distribution of the diamond grit creates the best surface condition of the pad and stable lapping performance

4 Dedicated production line
- CMP Conditioner is produced on a line isolated from other tools



Long life due to optimizing the shape of the abrasive grain layer



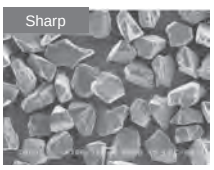
CMP Condtioner

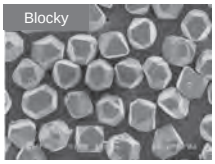
CMP Conditioner corresponds to ø300mm wafer

Correspond to CMP Pad Conditioner for ø300mm
High grinding ability for the dressing operation of CMP Pad ø300mm wafer.

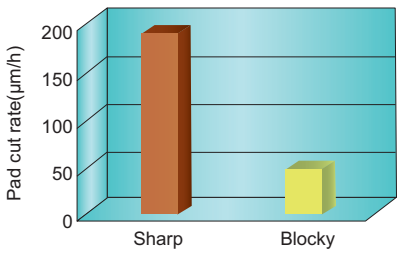
Features

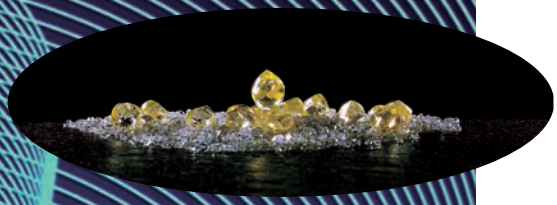
1. Excellent precision of the tool core processing and electroplating results in high grinding performance
2. Long lasting grinding performance
3. Adjustable when required due to the unique shape of the diamond layer





Adjustment cutting rate is possible with various selections of diamond abrasive

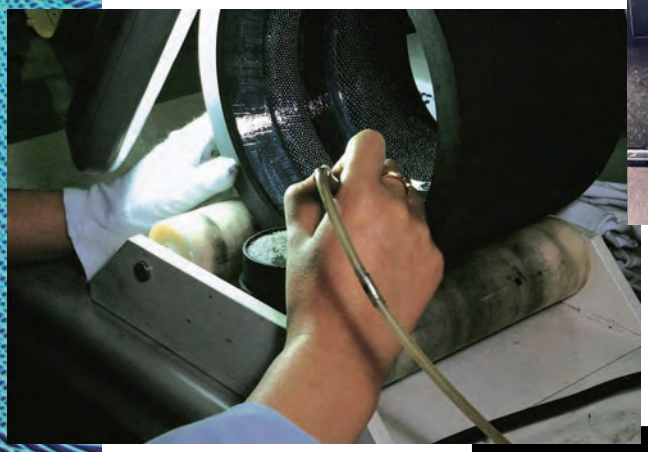


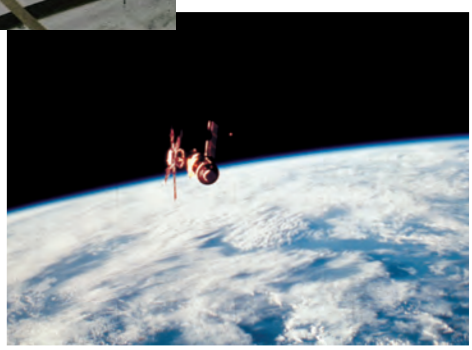


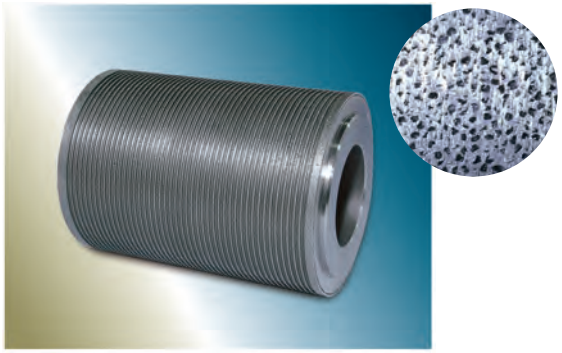
Rotary Dressers

Super-fine diamond grit and super-fine ceramics revolutionized the conventional wisdom with regard to grinding wheels. Application of both acquired material technology and production technology has allowed super-fine grinding. Its effectiveness to reduce a grinding damaged layer of brittle material such as polish-reduction of ø300mm silicon wafer and prevent cracks on a thin layer device wafer.

Great satisfaction brought by A.L.M.T.Corp.'s Rotary Dresser.

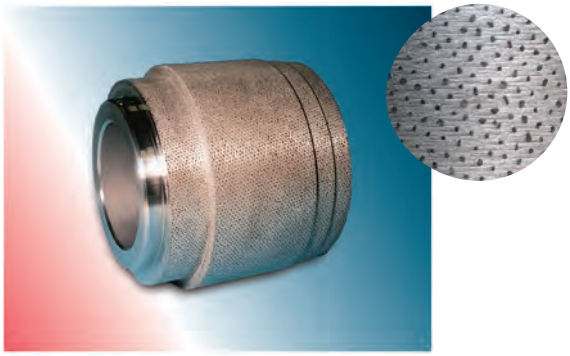






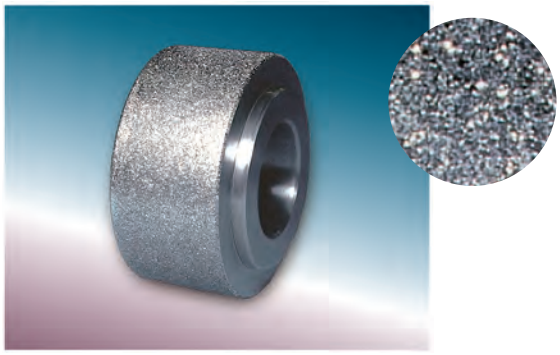
RZ Type

Advanced technology in high precision electro-deposition allows any type of profile can be produced. The high concentration of diamond grit is arranged randomly and made by the reverse plating method, so it is also suitable for longer life applications. Various optional specifications are also available.



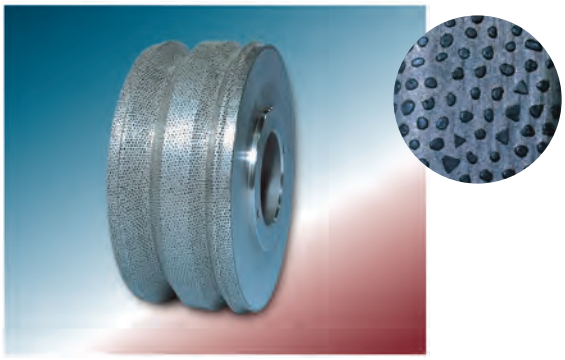
SZ Type

A rotary dresser with diamond grit arranged regularly made by the reverse plating method. Concentration of the diamond can be controlled according to requirements. The SZ Type provides efficient plunge dressing of large size rotary dressers.



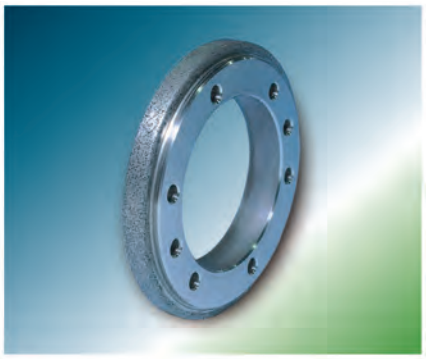
Z Type

The Z Type rotary dresser has diamond fixed directly to the surface of the body through plating. This type can be made relatively easily and is suitable for small lot production and trial production.



SX Type

A rotary dresser with diamond grit arranged regularly made by the reverse powder metallurgy method. This type works very efficiently in grinding applications that require sharp cut of grinding wheels. It can also be effective in traverse dressing and contour dressing.



X Type

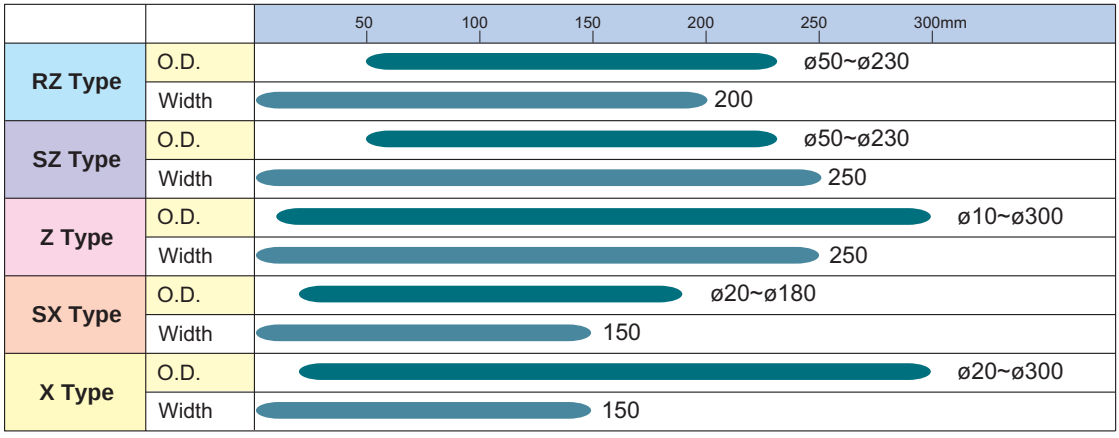
X Type rotary dresser is a metal bond type interfused with diamond particles. High performance is made possible by free selection of concentration and uniform distribution of diamond grit. This type is suitable for transverse dressing of our VITMATE and EG Wheel.

Manufacturing Details & Ranges for Rotary Dressers

■ Details

	RZ	SZ	Z	SX	X
Manufacturing Method	Electro-deposition		Electro-plating	Sintering	Sintering
Diamond Grit Distribution	Random	Regular	Random	Regular	Random
Applicable Grit Size	#20~#140	#16~#20	#30~#140	#16~20	#30~80
Profile	Complex Fine	Form	Form	Form	Cup Straight
Dress Method	Plunge	Plunge	Plunge Traverse	Plunge Traverse	Traverse
Major Applications	• Bearings • Injection Needles	• Shafts	• Gear Grinding	• Turbine Blades • Camshafts	• Internal Grinding • Centerless Grinding
Geometrical Accuracy	◎	○	○	○	-
Surface Roughness	◎	○	○	○	▲
Dressing Force	○	◎	○	◎	◎
Major Features	• Highest precision • Fine profile • Complex profile	• Large diameter	• Gear grinding	• Any concentration settable • High dressing ability	• Consistant dressing ability

■ Ranges



*Specials available upon request

Outline of Production Processes for Rotary Dressers

Electro-deposition Method

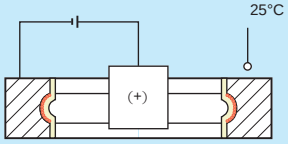
RZ・SZ Type

Reverse Plating Method

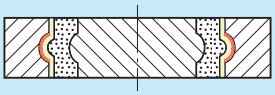
As the product is processed under room temperature, the accuracy is not changed by thermal expansion.

Diamond Setting

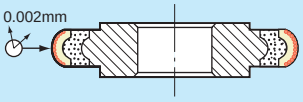
Plating



Setting Body



Machining Body

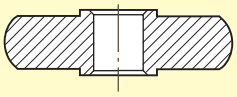


Electro-plating Method

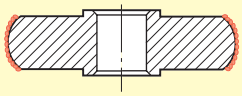
Z Type

Diamond is fixed directly on the body and finished by lapping on the surface.

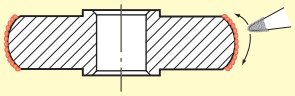
Machining Body



Diamond Body



Control Grinding



Sintered Method

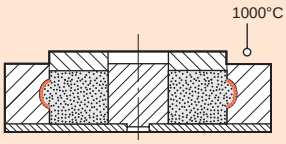
SX Type

Powdered Metallurgy Method

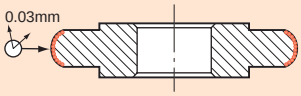
Surface of the diamond layer is lapped in the final process to achieve specified accuracy.

Diamond Setting

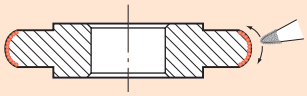
Sintering



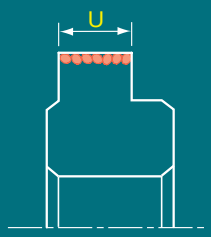
Machining Body



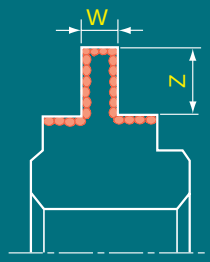
Control Grinding



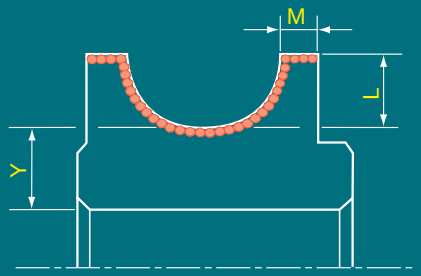
Tolerances on Rotary Dresser Designs



U	Value (mm)
RZ Type	≥10
SZ Type	≥10
SX Type	≥3
Z Type	≥3
X Type	≥3

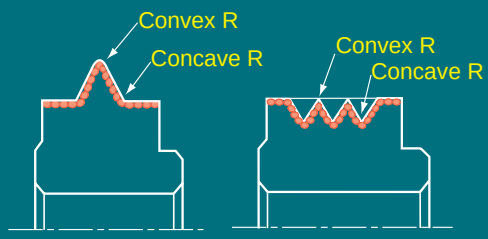


W	Value (mm)
RZ Type	≥0.5Z
SZ Type	≥0.5Z
SX Type	≥4Z
Z Type	≥4Z
X Type	≥2Z



Y	Value (mm)
RZ Type	≥10
SZ Type	≥10
SX Type	≥ 4
Z Type	≥ 4
X Type	≥ 4

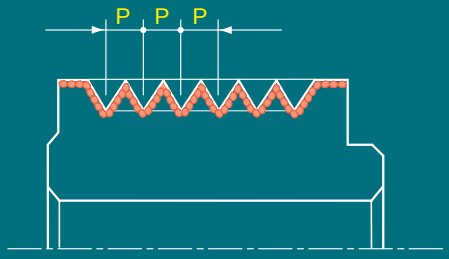
M	Value (mm)
RZ Type	≥ L
SZ Type	≥ L
SX Type	≥0.5L
Z Type	≥0.5L
X Type	≥0.5L



*Convex R	Value (mm)
RZ Type	≥0.1
SZ Type	≥0.2
SX Type	≥0.2
Z Type	≥0.3

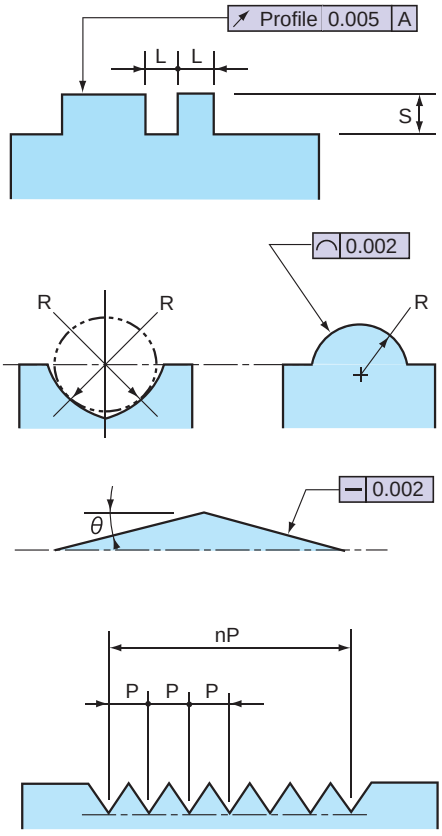
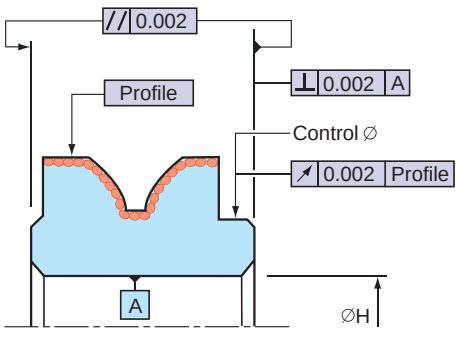
*Concave R	Value (mm)
RZ Type	≥0.03
SZ Type	≥0.15
SX Type	≥0.15
Z Type	≥0.3

*Value depending on diamond grain sizes.



P	Value (mm)
RZ Type	≥0.3

Accuracy of Rotary Dressers

Item	Factor	Symbol	Accuracy (mm)	Illustration
Profile	Runout	↗	0.002	
	Width	L	±0.005	
	Radius	R	±0.002	
	Step	S	±0.001	
	Outline	⌒	0.002	
	Angle	θ	± 2′	
	Straightness	—	0.002	
	Pitch	P	±0.002	
	Accumulative Pitch	nP	±0.004	
Body	Bore	∅H	+0.005 −0	
	Parallelism	//	0.002	
	Squareness	⊥	0.002	
	Runout	↗	0.002	

Other tolerances available upon request

Optional Specifications of Rotary Dressers

Optional Specifications for RZ Type (reverse plating)

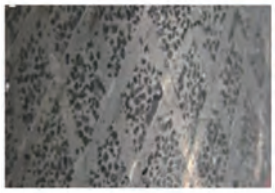
1. Improved Dressing Ability (for fast dressing)

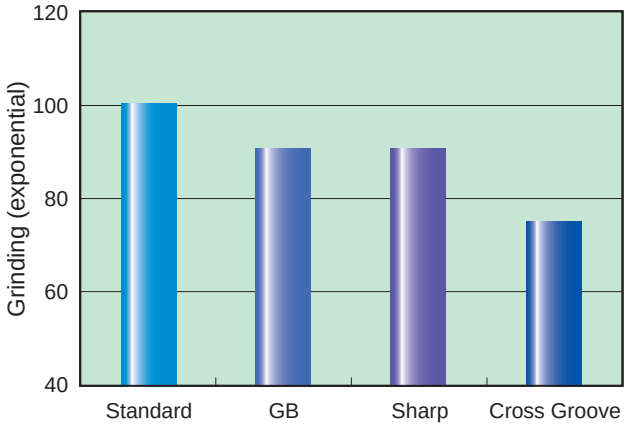
- **GB Type (controlled diamond concentration)**
  Even for electro-deposition type which the diamond concentration is difficult to contol, lower concentration is easily attainable for faster dressing by setting glass balls in the diamond layer.

- **Sharp Type (controlled diamond projection)**
  By a unique process that does not etch into the bond layer, diamond projection is controlled freely without pull-out of the diamond grit.

- **Cross Ditch (controlled diamond concentration)**
  Improves the evacuation of chips and coolant.

■ Cross-ditch Surface and Shape





2. Improved Wear Resistance (for longer life)

- **Strong Type**
  Peak of convex shape, which is easily worn out, is reinforced by setting pre-shaped diamond to hold accuracy and wear resistance.

Optional Specifications for SX Type

3. For Improving Wear Resistance

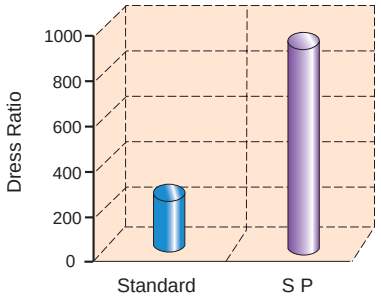
- **High Concentration Type**
  By the unique pattern of diamond setting, the number of diamond cutting edge increased to a maximum of 100pcs/cm^2, and provides longer tool life.

- **Strong Type**
  The peak of convex shape, which is easily worn out, is reinforced by setting pre-shaped diamond in order to hold accuracy and wear resistance.

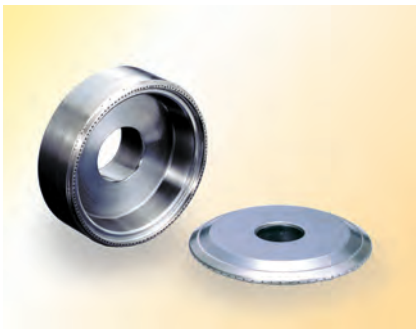
Optional Specifications for Vitrified cBN Wheels (SP Type)

4. For stable performance and longer lasting sharpness

- **SP**
  RZ-SP and SX-SP are available and are suitable for the dressing of vitrified cBN wheels and other high hardness abrasive wheels, where high wear resistance on the profile of the rotary dressers is required.



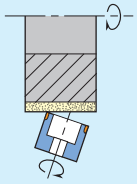
- **Polycrystalline Prism Diamond**
  The Crown Dresser, made by arranging isotropic polycryst prism diamond, provides stable tool life and performance, solving the problem of short tool life and instability caused by un-isotropy and cleavage, which are characteristic of mono-crystal diamond.



■ Dressing Example

Target Dresser

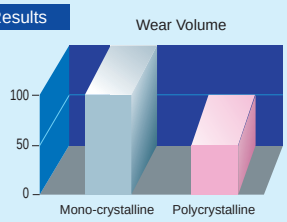
Mono-crystalline	Polycrystalline



Dressing Conditions

Wheel specs: CBN230G125V3 ø30×20×5 1200min^{-1}
RD specs: 0.4ª 2L 25pcs ø25×18 250min^{-1}
Testing Instrument: TOOLMEX
Feed Rate: 240mm/min
Dressing Amount: 0.002mm/pass (Total 1.0 mm in 500 dressing cycles)

Results

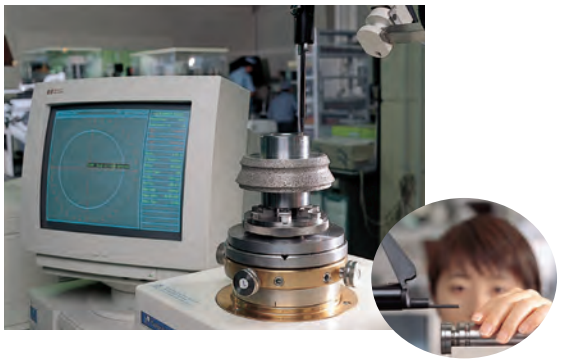


Inspection of Rotary Dressers

For higher accuracy...

Required accuracy of rotary dressers is becoming more strict, ranging from microns to submicrons. To ensure required accuracy, we have established an excellent inspection system with the most up-to-date equipment.

Description of Inspection



■ Inspection with transfer test pieces

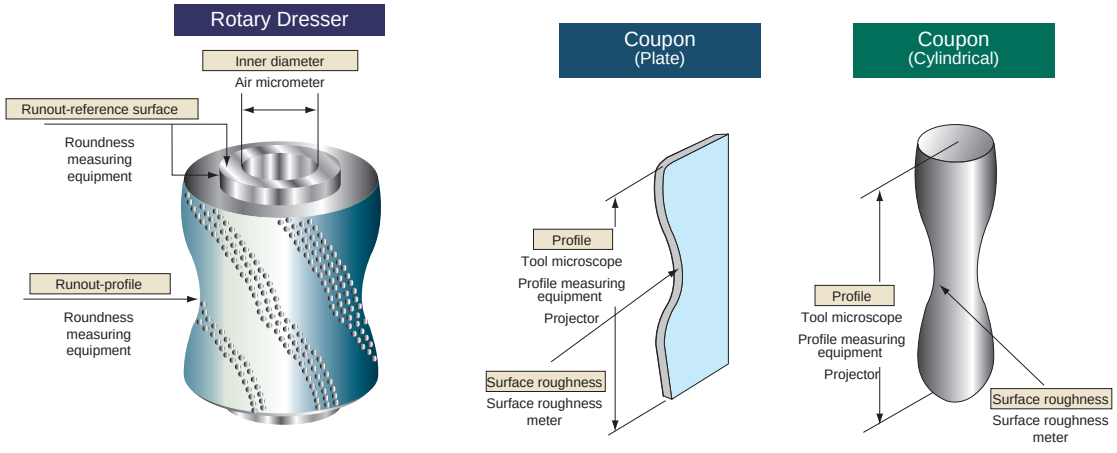
1. Measuring dimensional accuracy and profile
   ……tool microscope, profile measuring equipment, projector
2. Surface roughness……surface roughness meter

■ Body accuracy

1. Bore…….....…air micrometer
2. Parallelism, squareness
   .....roundness measuring equipment
3. Reference surface (controlø) runout
   .....roundness measuring equipment
4. Profile runout.....roundness measuring equipment

■ Slip Test Results

An inspection sheet showing measurements taken by the transfer test is attached.



Recommended Dressing Conditions

■ Plunge Dress

	Conventional Grinding Wheel	Hard Conventional Grinding Wheel	cBN Wheel
Dress Direction	Down	Down	Down
Peripheral Speed Ratio	0.25~0.5	0.3~0.9	0.3~0.9
Dress Amount	0.02~0.03mm	0.02~0.03mm	0.01~0.015mm
Infeed Rate	0.5~1μm/rev. of wheel	0.1~0.5μm/rev. of wheel	0.01~0.5μm/rev. of wheel
Dress Out	0~3 sec.	0~3 sec.	0~3 sec.

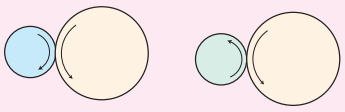
■ Traverse Dress

	Conventional Grinding Wheel	Hard Conventional Grinding Wheel	cBN Wheel
Dress Direction	Down	Down	Down
Peripheral Speed ratio	0.25~0.5	0.3~0.9	0.3~0.9
Dress Amount	0.02mm	0.02mm	0.01mm
Depth of Cut	0.005~0.03mm/pass	0.003~0.005mm/pass	0.002~0.003mm/pass
Dress Out (Traverse cycles)	0~4 times	0~4 times	0~4 times
Feed Rate	80~140mm/min	See below	See below

*RD= Rotary Dresser

Feed Rate

Down Dress | Up Dress



Feed rate = C×RD width × grinding wheel revolution

Vr (RD peripheral speed) = RD revolution (min-1) × RD O.D. × π

Vs (grinding wheel peripheral speed) = grinding wheel revolution (min-1) × O.D. × π

$$\text{peripheral speed ratio} = \frac{Vr}{Vs}$$

Operation	C
Standard	0.025~0.1
Efficient grinding	0.125~0.2
Centerless	0.005~0.01

Technical Data

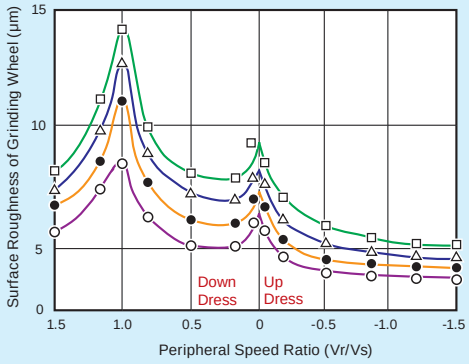
In dressing, the surface roughness of grinding wheels is influenced by elements such as:

1 Peripheral speed ratio (Vr/Vs), 2 infeed per revolution of wheel (Ar), and 3 dress out (Na).

1 Peripheral Speed Ratio

1 Influence of Peripheral Speed Ratio on Grinding Wheel Surface Roughness

- Control of the grinding surface accuracy by up-dress is easier than by down-dress
- Higher feed rate creates more open grinding surface (grinding ability increases).

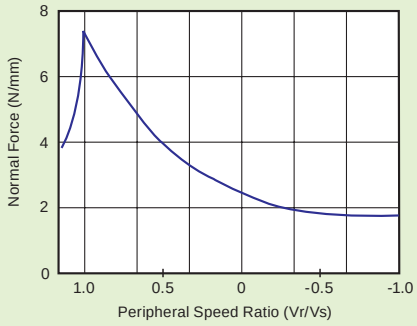


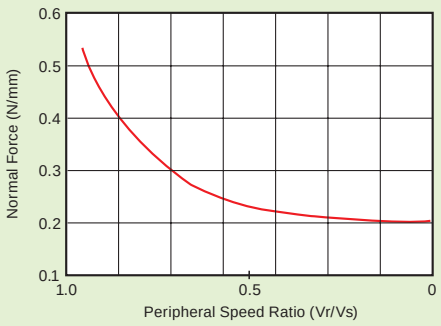
Test Conditions	
Grinding Wheel	WA60K
Rotary Dresser	#20/30
Grinding Wheel Peripheral Speed	Vs=29m/s
Dress Out	Na=0

Infeed per rev. of grinding wheel
Ar=0.18μm/rev
=0.36μm/rev
=0.54μm/rev
=0.72μm/rev

2 Influence of Peripheral Speed Ratio on Dressing Force

- Larger peripheral speed ratio allows higher normal force (increase in grinding ability).
- Tangential force shows the same tendency as normal force, but the value is much smaller.



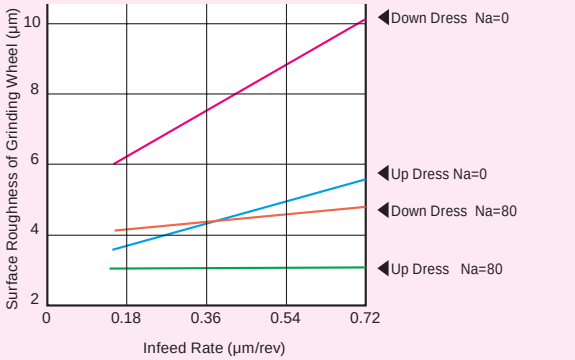


2 Infeed Rate

1 Influence of Infeed Rate of Grinding Wheel Surface Roughness

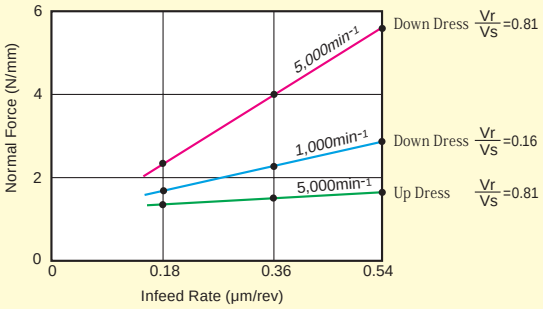
(Na= Dress out wheel rotation frequency)

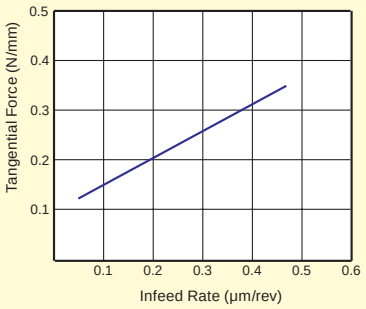
- Higher feed rates create a more open grinding surface (grinding ability increases).
- Longer dress-out time diminishes sharpness of the grinding surface



2 Influence of Infeed Rate on Dressing Force

- Larger feed rate increases normal force (grinding ability increases).
- Tangential force shows the same tendency as normal force, but the value is much smaller

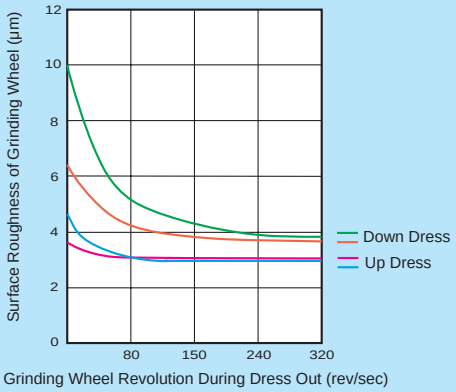




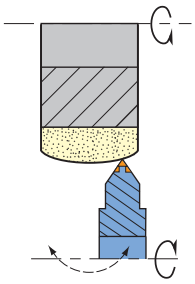
3 Dress Out

Influences of Dress out on Grinding Wheel Surface Roughness

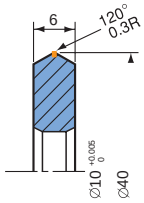
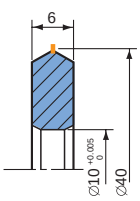
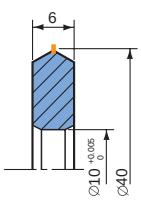
- Longer dress out time increases roundness of the grinding surface, but reduces sharpness.

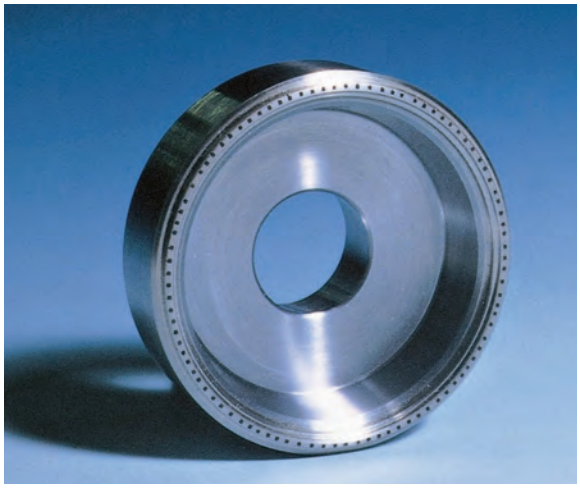


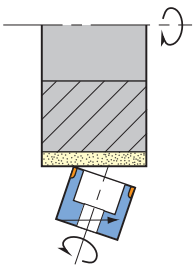
Small Size/High Performance



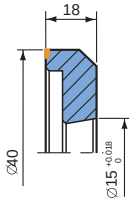
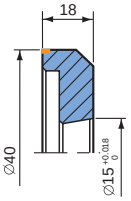
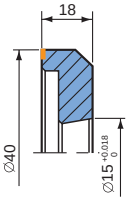
Straight Type

	Straight Type		
Model Number	S40-N	S40-C	S40-Ⅰ
Profile			
Diamond	Natural Diamond	CVD Prism (Crown)	Synthetic Diamond
Grit Size	40SPC	0.4×0.4	SD#40
Concentration	60 pcs/circumference	90 pcs/circumference	3.3ct/cm³





Cup Type

	Cup Type		
Model Number	C40-N	C40-C	C40-Ⅰ
Profile			
Diamond	Natural Diamond	CVD Prism (Crown)	Synthetic Diamond
Grit Size	40SPC	0.4×0.4	SD/40
Concentration	40 pcs/circumference	90 pcs/circumference	3.3ct/cm³

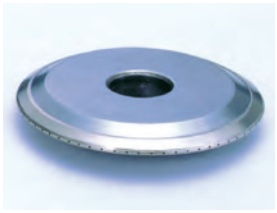
Other sizes and specifications available upon request.

Crown Dresser

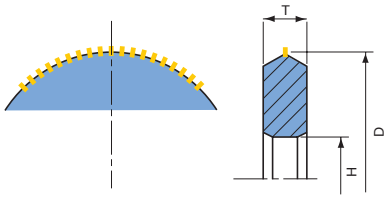
■ Features

1. Binderless CVD coated diamond is capable of high resistance, like monocrystal diamond.
2. Constant and stable active area with diamond column.
3. Cost effective with no reworking.
4. Optimized dressing performance is a result of diamond column size and distribution.

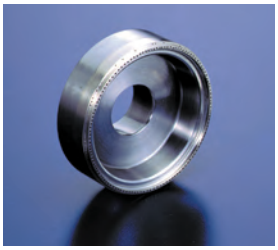
Straight Type



Size		CVD Size	Pitch
D	ø35~180	0.2□,0.4□, 0.6□,0.8□	0.8~2mm
H	ø8~30		
T	6~20		

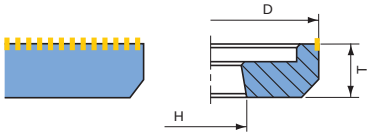


Cup Type

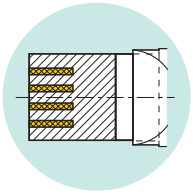


Size		CVD Size	Pitch
D	ø40~80	0.2□,0.4□, 0.6□,0.8□	0.8~2mm
H	ø10~20		
T	15~20		

Please contact us for special sizes.



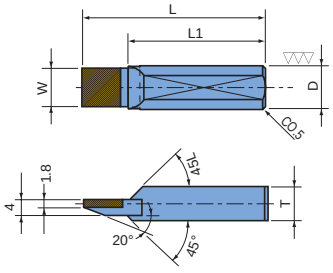
CVD Ace Dresser



(mm)

L	L1	D	W	T
50	38	11	10	9

Please contact us for special sizes.



Diamond Disc Dresser

Worm wheel gear grinding with high accuracy

Monocrystal

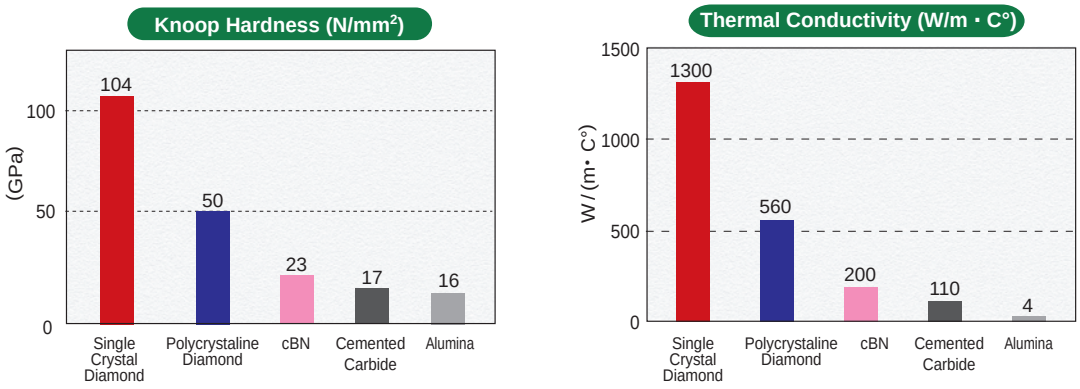
Precision Cutting Tools

A.L.M.T. Corp. has succeeded in making increasingly dominant precision diamond-cutting tools using our unique tool designs and ultra-precision machining technology without impairing the material's excellent practical characteristics.

We will guide you through a new stage of cutting technology that includes our vision of High Output, High Productivity, Environment and Nano-Definition, Ultra Precision, and High Accuracy.

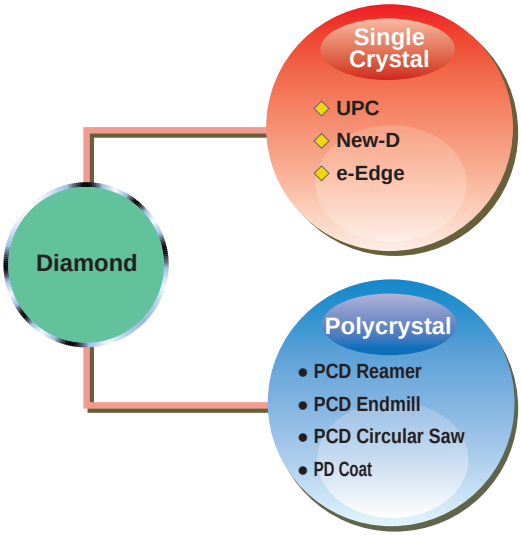
We hope that you will be pleased with the revolutionary change brought about by the Ultra Precision Cutting Tools of A.L.M.T.

● Material Characteristics of Diamond

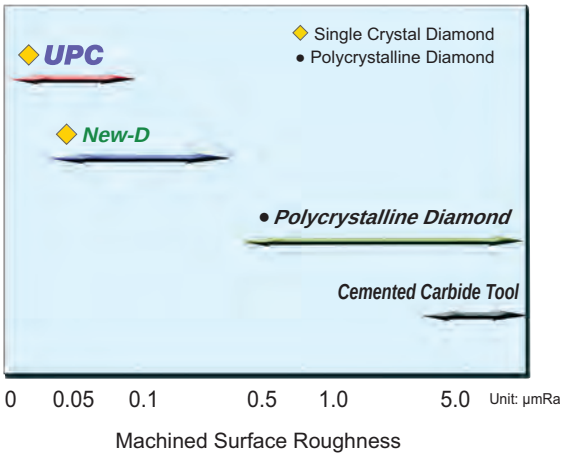


*The charactersitics of diamond are ideally suited for the requirements of cutting tools due to its exceptional hardness and low thermal conductivity

● Diamond Type and its Manufactured Products

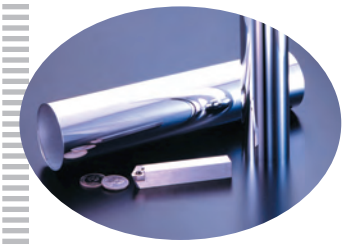


Graph demonstrates smoothness of machined workpiece by conventional tools and our newly developed tools.



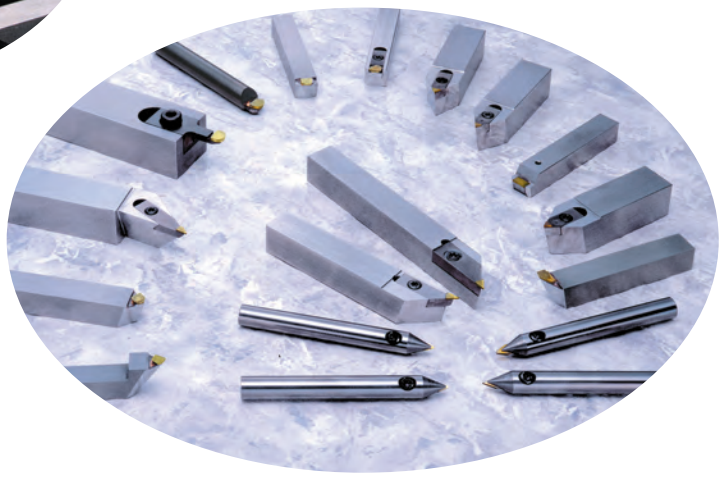
Ultra Precision Cutting Tools

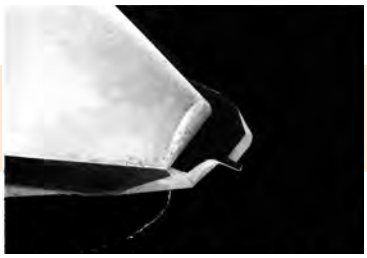
Nano/Microforming Tools UPC



A.L.M.T. Corp., as a leading manufacturer of ultra-precision diamond cutting tools offers a broad range of nano- and micro-forming cutting tools to satisfy market needs.

Our many years of experience and know-how have provided us with a comprehensive understanding of the optimal physical properties of mono-crystal diamond. Our state-of-the-art development process yields the highest precision in tool edge measurement. As a result, our diamond cutting tools achieve high-precision microscopic cutting in workpieces with nanometer requirements.



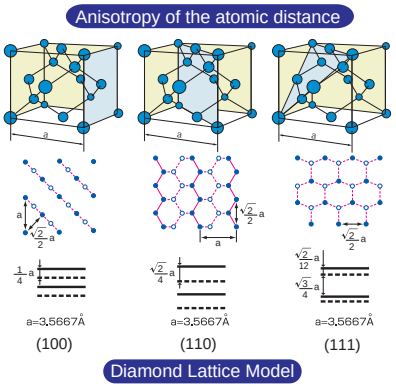


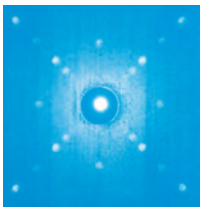
Extremely sharp cutting edge with advance

Measuring Technology Used for Diamond Selection

Checking the variation in the distance between carbon atoms in single crystal diamond assists in determining the optimal crystal orientation.

The pursuit of producing nanometer-accurate diamond cutting tools begins with the selection of optimal mono-crystal diamond. Although it is known that the lattice constant of diamond is 3.5667Å the distance between the crystal planes in single crystal diamond varies, causing contamination or divisibility. Therefore it is very important to select the best diamond ore and determine the optimal crystal orientation based on the application.



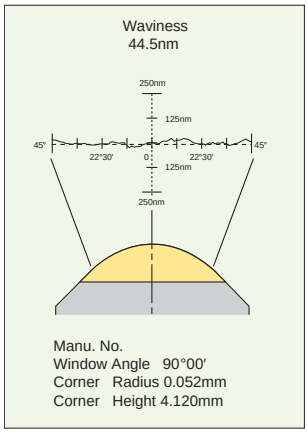


X-ray photography of single crystal diamond

Polishing and Measuring Technology

Tool edge polishing technologies used for profiling under nanometer tolerances

In order to accurately produce nanometer-controlled movement on a workpiece, a cutting tool requires a sharp cutting tool edge capable of producing nanometer-sized chips, in addition to high contour precision. We have achieved this using our unique polishing and measurement technologies.



Contour inspection sheet

Cutting edge shape

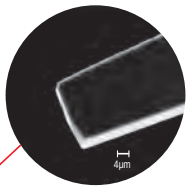
Sharply polished monocrystal diamond

Extremely fine chips measured down to nanometer dimensions

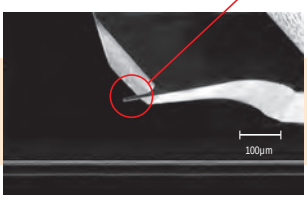
Nano-cutting and Micro-cutting Technology

Straightness and surface roughness unobtainable with photolithography or ion-beam method

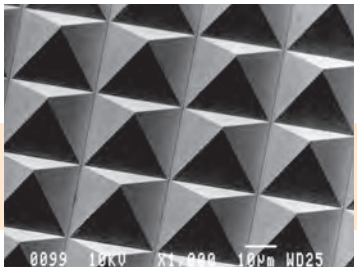
With its extremely sharp cutting edge, the UPC-Nano Series developed by A.L.M.T. Corp. achieves excellent surface roughness and straightness, which cannot be obtained using photolithography or ion-beam methods. They are also effective tools in high aspect-ratio applications where micrometer precision is required.



Width of 15μm tip of Nano endmill

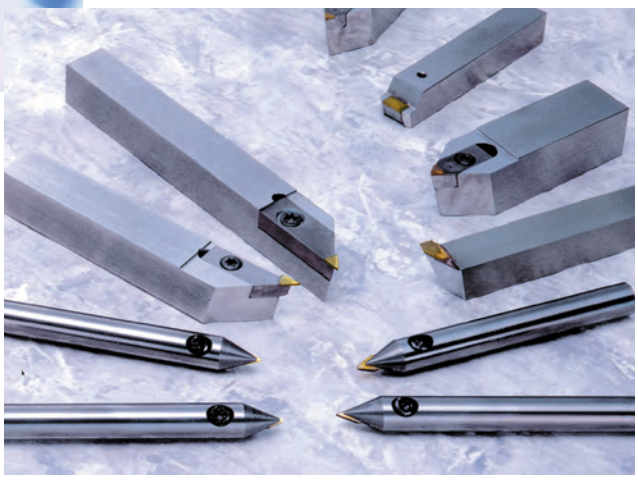


Polished surface shown in the same magnfication



Molds surface by microforming

ed UPC cutting tools



Ultra Precision Cutting Tools

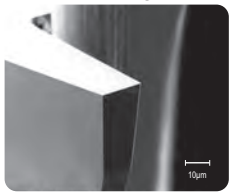
Nano/Microforming Tools UPC

With their extremely sharp cutting edge, the UPC-Nano Series developed by A.L.M.T. Corp. achieves excellent surface roughness and straightness, which cannot be obtained using photolithography or ion-beam methods. They are also effective tools in high aspect-ratio applications where micrometer precision is required.

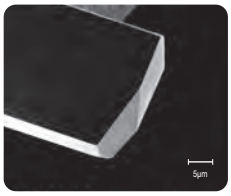
Straightness and surface roughness unobtainable with photolithography or ion-beam method

UPC-nano edge

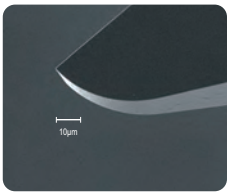
UPC - Nano groove



UPC - Nano endmill

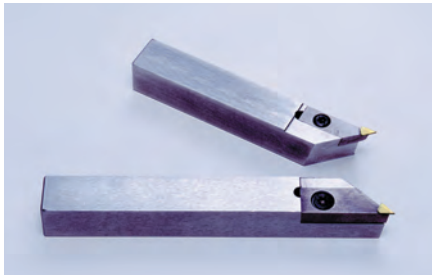


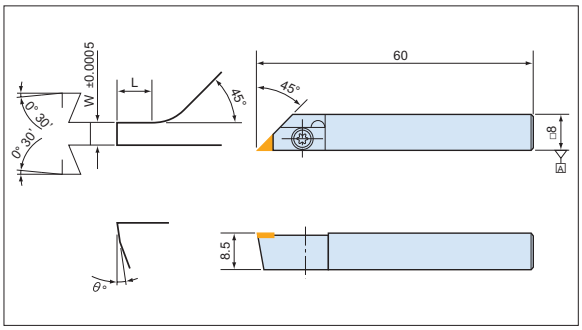
UPC - Nano ballendmill



UPC -Nano groove

for ultra fine grooving



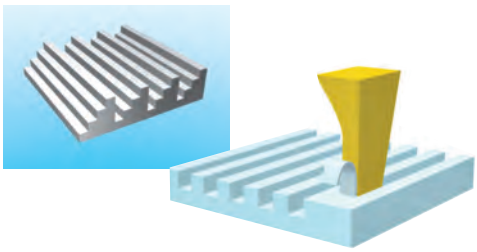


Application

1. Hologram diffraction grating
2. Straight fine grooving
3. LCD display optical waveguide

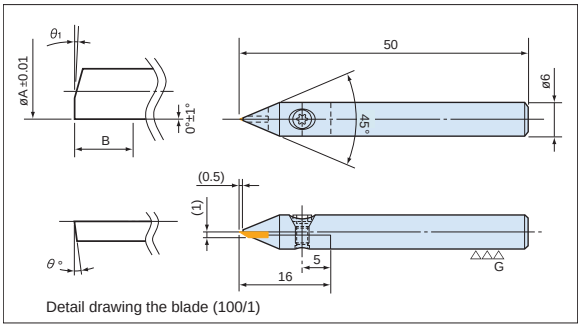
Features

1. Grooving of the world's smallest byte width (0.9μm)
2. World's highest accuracy (±0.5μm)
3. Durable cutting tool edge achieved by high precision polishing
4. Extremely fine grooving, unobtainable with photolithography or ion-beam cutting



UPC -Nano endmill

Square type



Detail drawing the blade (100/1)

Applications

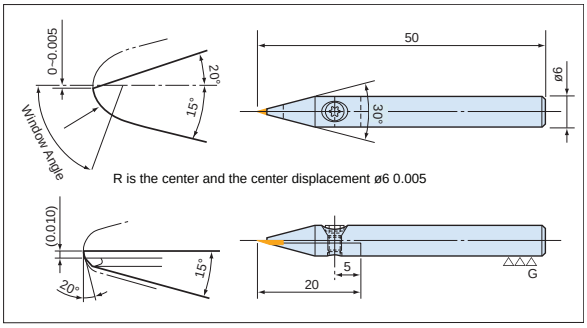
1. Hologram diffraction grating
2. Fine grooving of free curves
3. LCD display optical waveguide
4. Microscopic machine part cutting

Features

1. World's smallest class groove width (30µm) achieves flexible grooving such as curving
2. World's highest dimensional tolerance (2.5)
3. Durable cutting tool edge achieved by high-precision polishing
4. Extremely fine grooving, unobtainable with photolithography, etching, or ion-beam cutting

UPC -Nano ballendmill

Ball-end type



Applications

1. Micro-lens array
2. Submillimeter lens with curve free surface
3. Molding for LCD display optical waveguide
4. Microscopic machine part cutting

Features

1. World's smallest ball endmill (R30µm)
2. World's highest contour accuracy (50nm)
3. Three dimensional precision can be attained due to superior cutting edge

UPC -Nano Profile

Flat type

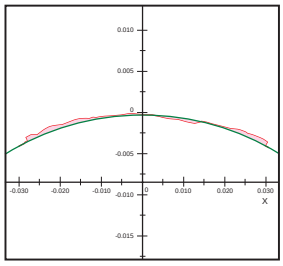

Cutting edge

Applications

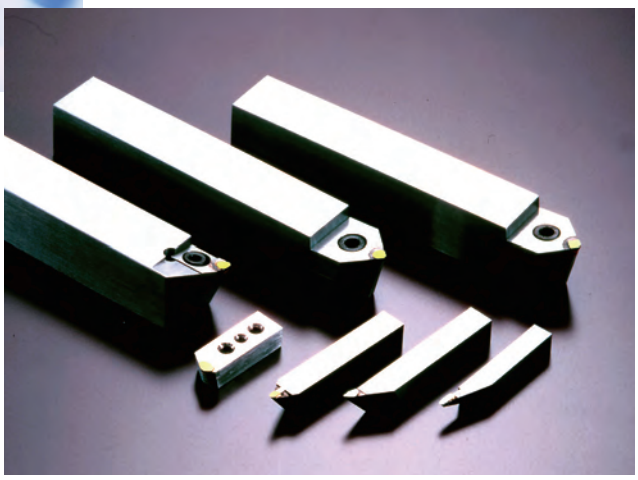
1. Screen sheet molding
2. Micro lens molding
3. Optical element molding

Features

1. Can machine both parabolic and elliptic surfaces of 1µm max. using same tool
2. Shape integrity of parabolic and curved surfaces guaranteed



Inspection sheet



Ultra Precision Cutting Tools

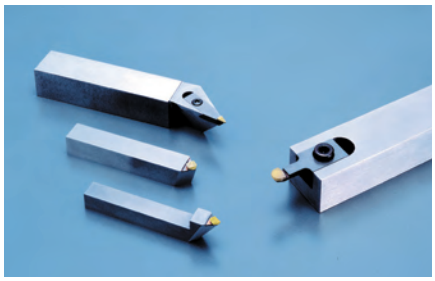
Nano/Microforming Tools UPC

"UPC," the series of ultra precision cutting tools developed by A.L.M.T. Corp. features an extremely sharp tool edge with a controlled waviness of 50 nm or less in high-precision aspheric and free-curve cutting. The edge preparation of the tool is nanometer accurate relative to the material characteristics that enable high-precision mirror surface finishing.

Precision machined V groove from the free surface aspherical plane. Can also control the cutting edge radius.

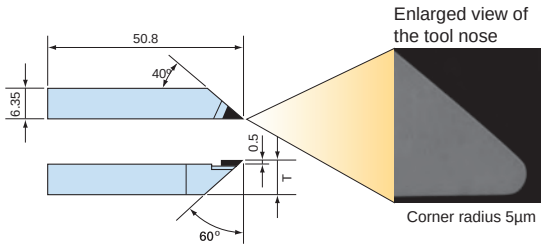
UPC-R

UPC-R shows extraordinary success in ultra precision spherical and aspherical cutting applications.



Applications

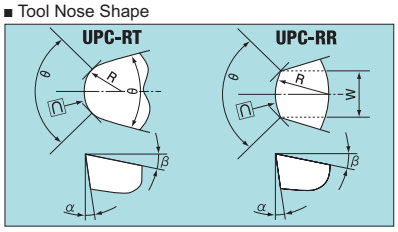
1. CD • DVD pickup lenses molding
2. Molding for camera optical lenses
3. Spherical and aspherical reflecing mirrors for laser and x-ray equipment
4. Spherical and aspherical lenses
5. Other precision parts machined with CNC 2-axis lathe



Features

1. A tool edge contour of 0.05μm (50nm) is achieved over a wide working angle of 90º.
2. The cutting edge is precisely finished with minimal waviness. The use of SEM at 2000x magnification for inspection eliminates chipping on the finished tool edge surface.
3. A record of the tool edge contour obtained by our newly developed measuring system (resolution of 5nm) is attached to each tool to guarantee the quality.

■ Tool Nose Shape



■ Dimensions & Limit Precision

Type		Contour ⌓ θ≤90°	Contour ⌓ θ≤120°	Contour ⌓ θ≤15°	Corner Radius R	Tool Edge Angle θ	Tool Width W	Clearance Angle α	Face Angle β
UPC-RT	Ultraprecision SS	0.05μm	0.15μm	0.20μm	0.005~3mm	15°	—	0°~20°	-30°~10°
	Precision S	0.5μm	1.0μm	2.0μm					
UPC-RR	Ultraprecision SS	0.05μm	0.15μm	0.20μm	0.10~200mm	—	0.5~5.0	0°~20°	-30°~10°
	Precision S	0.5μm	1.0μm	2.0μm					

UPC-F

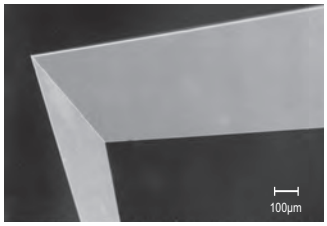
UPC-F excels in high-efficiency and ultra-precision surface and cylindrical cutting applications.

Applications

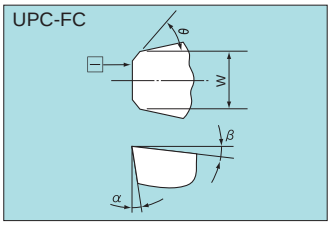
1. Laser reflecting mirrors
2. Polygon mirrors
3. Copier sensitive drums
4. Ultra-fine flat or cylindrical surfaces

Features

1. The time required for break-in operation for initial usage is eliminated or greatly reduced.
2. The edge preparation of the cutting tool is based on the material and the cutting conditions to provide a uniform and high quality surface finish.



■ Tool Nose Shape

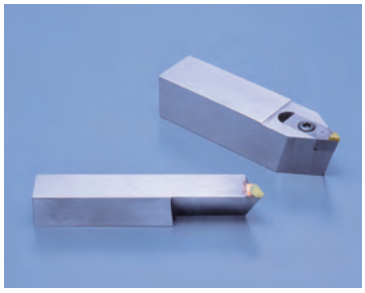


■ Shape Dimensions

Type	Tool Edge Angle θ	Tool Width W	Clearance Angle α	Face Angle β	Horizontal Face Angle Y	Corner Radius R
UPC-FC	45°~80°	1.0~4.0	0°~5°	-5°~0°	0°~15°	—

UPC-T

UPC-T is the optimal tool for fine grooving applications such as Fresnel lens.

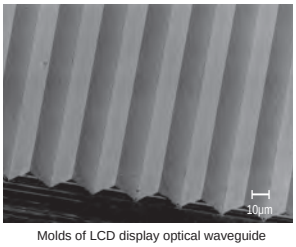


Applications

1. Molds of LCD display optical waveguide
2. Fresnel lens molding
3. Other fine grooving applications

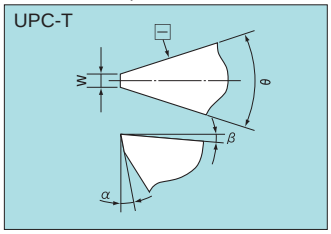
Features

1. The cutting edge is uniform and extremely sharp, without c chipping or undulation
2. The shape of the cutting edge is guaranteed to submicron tolerances



Molds of LCD display optical waveguide

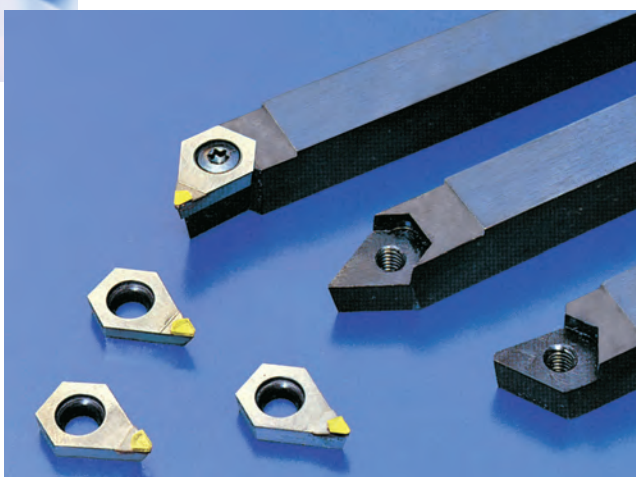
■ Tool Nose Shape



■ Shape Dimensions

Type		Tool Edge Angle θ	Leading Edge Width W	Straightness ⏤	Clearance Angle α	Face Angle β
UPC-T	Ultraprecision SS	min20°	min0.2μm	0.05μm	0°~15°	-5°~10°
	Precision S		min2μm	0.1μm		

New Monocrystal Diamond Cutting Tools



New D

New D mono-crystal diamond cutting tools feature precision designed crystal orientation acquired through x-ray analysis and are strongly bonded on a carbide shank using a newly developed method.

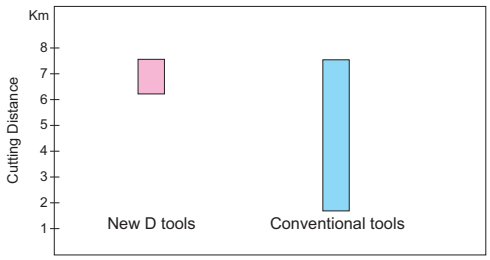
Proprietary precision processing technology used in their manufacture gives New D cutting tools a higher quality edge.

1) Average tool life is 1.5~2 times that of conventional mono-crystal diamond cutting tools with much less variation in individual tool life.
2) The combination of a proprietary insert and holder design (design patent JAPAN) makes the tool setting as simple and precise as disposable inserts.
3) Standard designs for the inserts are for straight cutting and for profile cutting. The tolerance of the inserts for profile cutting is with 5μm.
4) High quality surface finishing is possible even with continuous use because there is no fusion or accumulation of chips on the rake face.
5) The diamond is brazed strongly in place.
6) Outstanding durability even for interrupted cutting.
7) Unlike conventional mechanical clamp types, chips flow smoothly off the rake face for higher precision.

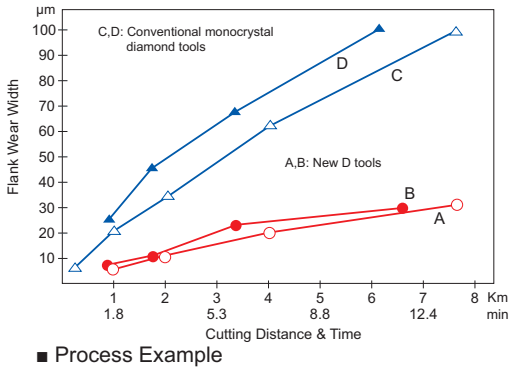
■ Features

(Data1.2)
Cutting Speed: 565m/min Feed Rate: 0.2mm/rev
D.O.C. : 0.12mm Cutting Fluid: alcohol-oil mist
Workpiece Material: High Si-Al alloy (Si:18%)

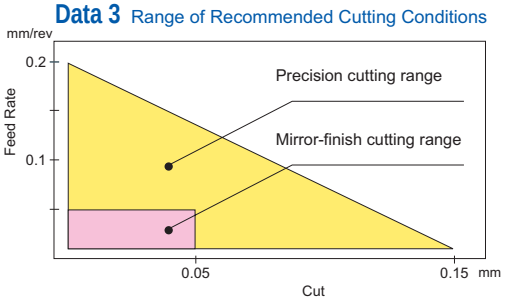
Data 1 Comparison of Tool Life and Stability for Interrupted Cutting
(Distance cut to flank wear width = 30μm)



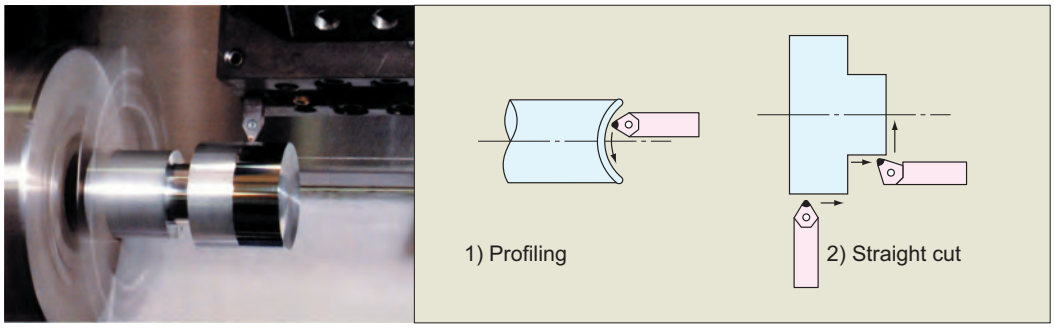
Data 2 Comparison of Tool Life in Interrupted Cutting



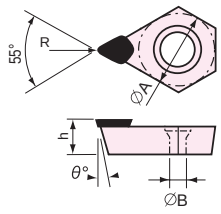
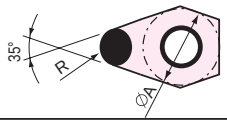
Data 3 Range of Recommended Cutting Conditions



■ Process Example

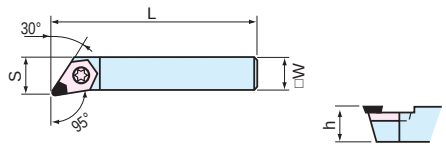
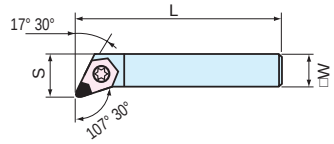
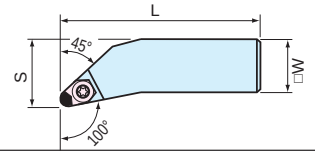
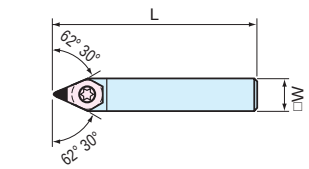


■ Insert Types

Insert Specifications	Types		R	I.C. θ	Relief øA (mm)	I.H. øB (mm)	Thickness h (mm)	Holder
	Long Life Type	Precision Type						
	NWD-CL302	NWD-CP302	R0.2	7°	∅ 9.525	∅ 4.4	+0.2 4-0	NDH-R1□ -L1□ -N1□ NDH-QR1□ -QL1□
	NWD-CL305	NWD-CP305	R0.5					
	NWD-CL308	NWD-CP308	R0.8					
	NWD-CL310	-	R1.0					
	NWD-CL316	-	R1.6					
	NWD-CL320	-	R2.0					
	NWD-PL302	NWD-PP302	R0.2	11°				
	NWD-PL305	NWD-PP305	R0.5					
	NWD-PL308	NWD-PP308	R0.8					
	NWD-PL202	NWD-PP202	R0.2		∅ 6.35	∅ 2.8	+0.2 3-0	NDH-RO□ -LO□ -NO□
	NWD-PL205	NWD-PP205	R0.5					
	NWD-PL208	NWD-PP208	R0.8					
		for aluminum wheels		7°	∅ 9.525	∅ 4.4	+0.2 5.5-0	NDH-R20V -L20V -R25V -L25V
	NWD-CL416	NWD-CL416-AW	R1.6					
	NWD-CL420	NWD-CL420-AW	R2.0					
	NWD-CL425	NWD-CL425-AW	R2.5					

Precision type/cutting edge contour precision 5μm

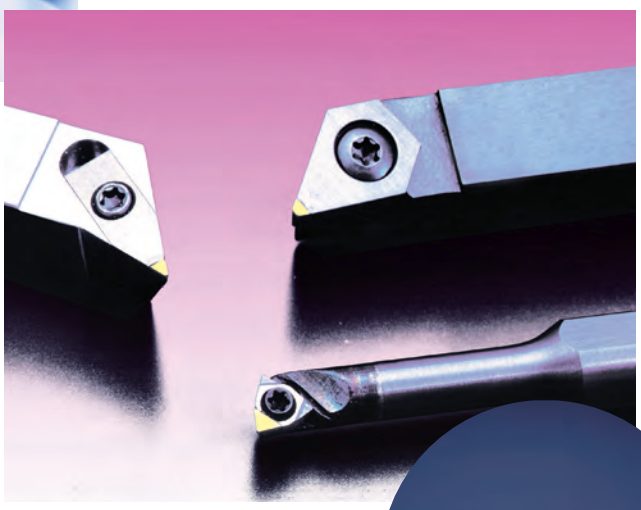
■ Holder Types

Holder Specifications	Types		Size (mm)				Insert
	Right Hand	Left Hand	W	L	S	h	
	NDH-R06	NDH-L06	6	50	6.5	6	NWD-PP2□□ -PL2□□
	NDH-R08	NDH-L08	8	60	8.5	8	
	NDH-R10	NDH-L10	10	80	10	10	NWD-CL3□□ -PL3□□ -CP3□□ -PP3□□
	NDH-R12	NDH-L12	12	100	12	12	
	NDH-R16	NDH-L16	16	125	16	16	
	NDH-QR10	NDH-QL10	10	80	13	10	
	NDH-QR12	NDH-QL12	12	100	15	12	
	NDH-QR16	NDH-QL16	16	125	19	16	
	NDH-R20V	NDH-L20V	20	150	25	20	NWD-CL416 -CL420 -CL425
	NDH-R25V	NDH-L25V	25	150	32	25	
	Free						
	NDH-N06		6	50	-	6	NWD-PP2□□ -PL2□□
	NDH-N08		8	60	-	8	
	NDH-N10		10	80	-	10	NWD-CL3□□ -PL3□□ -CP3□□ -PP3□□
	NDH-N12		12	100	-	12	
	NDH-N16		16	125	-	16	

Please inquire for specifications except the above in the case of an order

■ Use

- Automotive parts
  (pistons, aluminum wheels, compressors, commutators, etc.)
- Plastic lens, resin molded parts
- HDD parts
- Aluminum die castings, other non-ferrous material



New D e-EDGE

To meet customers' demands for low cost and green operation, we introduce the New D *e-EDGE* for multi-purpose mono-crystal cutting tool for aluminum.

Features

1) Low cost/high performance
2) Special holder for HDD aluminum die cast part and in stock
3) Special inserts for existing holders
4) Sharp cutting and very good cutting heat diffusibility

Mono-crystal diamond cutting tool provides high performance at a low cost

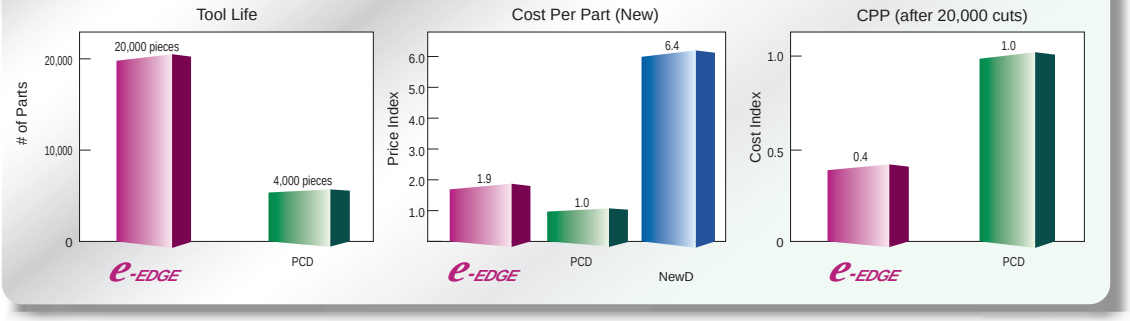
Application

- Electro equipment
  HDD parts (hub, bracket) copy parts (drum, sleeve, plastic)
- Automobile component
  Motor parts, transmission parts, air compressor, and other high Si content aluminum parts
- Non-ferrous material
  Any PCD application

* Please use the new Di-Byte mirror finish

■ Cost Comparison

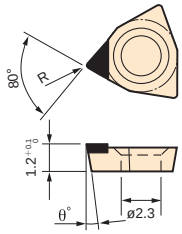
Material: HDD part (A383)
Machine: CNC lathe
Tool: *e-EDGE* / PCD cutting tool
Rake: 0° Clearance: 7°
Condition: Vt: 480m/min
F: 0.04mm/rev
Stock Removal: 0.05mm
Criteria: Burr Roughness: 0.8Ra



High perfomance for dry cutting of aluminum die-cast alloy

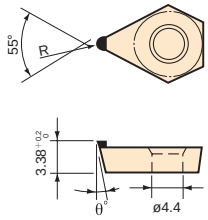
Insert & Holder (Standard)

● Boring （Min. ø5.5mm)



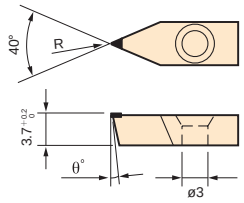
Type	Size(mm)	
	R	θ°
NWD-CE 101	0.1	7
NWD-CE 102	0.2	7
NWD-PE 101	0.1	11
NWD-PE 102	0.2	11

● OD Turning/Copying to use with New D holder



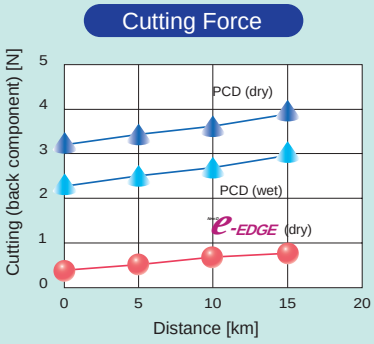
Type	Size(mm)	
	R	θ°
NWD-CE302	0.2	7
NWD-CE304	0.4	7
NWD-CE308	0.8	7
NWD-CE312	1.2	7
NWD-PE302	0.2	11
NWD-PE304	0.4	11
NWD-PE308	0.8	11
NWD-PE312	1.2	11

● HDD/Aluminum Die-cast Part



Type	Size(mm)	
	R	θ
NWD-CEHD 01	0.1	7
NWD-CEHD 02	0.2	7
NWD-PEHD 01	0.1	11
NWD-PEHD 02	0.2	11

■Example

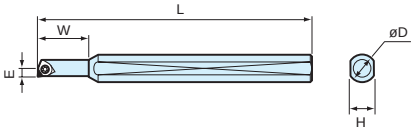


Material: A383
ø105mm×280mm; interrupted
Machine: CNC lathe
Tool: e-EDGE /PCD cutting tool
Rake: 0° Clearance: 7°
Conditions: Vt: 565m/min
F: 0.1mm/rev
Stock removal: 0.2mm/dia.
Coolant: e-EDGE : Dry
PCD: water emulsion

Results

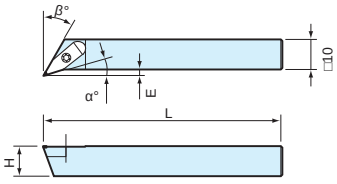
e-EDGE E-Edge has lower cutting force than PCD and maintains good cutting condition.

● Boring Holder (Min. ø5.5mm dia.)



Type	Size (mm)					
	D	H	W	L	E	
BR/L08	8	7	15	80	2.8	Left
BR/R08						Right
BR/L10	10	9	25	100	2.8	Left
BR/R10						Right

● HDD/Aluminum Die-cast Holder



Type	Size(mm)					
	H	L	E	α°	β°	
HDL10	10 +0.2 −0	80	2.5	15	35	Left
HDR10	10 +0.2 −0	80	2.5	15	35	Right

PCD Reamer & Endmill

High machining accuracy combined with mass-production at low cost is required for the processing of aluminum alloys for auto parts. Our PCD (Poly Crystalline Diamond) cutting tools achieve long tool life and high machining accuracy by constructing sharp

High machining accuracy combined with mass-production at low cost is required for the processing of aluminum alloys for auto parts. Our PCD (Poly Crystalline Diamond) cutting tools achieve long tool life and high machining accuracy by constructing sharp cutting edges which use grinding technology applied to PCD. The resulting special feature is that tool hardness is effectively more than 10 times that of carbide tools. Longer life of PCD cutting tools improves productivity, reduces the frequency of tool replacement and machining cost. In addition, machining accuracy and discharge of cutting chips have been improved by cutting edge grinding technology and strengthening the breaker function. A.L.M.T. will respond to all requests from diversified automobile parts manufacturers as a pioneer manufacturer of diamond tools.

Our PCD reamers make efficient and high-speed cutting possible

Advantages gained by upgrading from a carbide reamer to a PCD reamer

High Efficiency/Reduction of Tool Cost

- Improvement in tool life
- Improvement in machining accuracy
- Reduction in machine time
- Reduction in frequency of tool replacement

«Reduction of Tooling Cost and Improvements in Productivity»

• Tool Life

Work Material	Carbide	PCD
ADC12 (Contains 12% Si)	1	10~20
A390 (Contains 18% Si)	1	20~

• Cutting Machine Time

(Test) Item	Carbide	PCD
# of Rotations N(min^{-1})	2000	6000
Cutting Speed V(m/min)	125	380
Feed Rate f(mm/min)	400	1800
Machining Time	3 :	1
Tool Size	ø20×4NT(Machining Depth 20mm)	

• Number of Tool Replacement

(Test) Item	Carbide	PCD
# of Tool Replacements	10 times	once

Purposes Non-ferrous Metal (Aluminum Alloy)

Machined Components

- Cylinder head
- Cylinder block
- Transmission/steering components
- Compressor components

Features

1. Multi-stage machining can be done on one pass by using an integrated profiled step tool.
2. Long tool life with sharp cutting edge made by adopted grinding technology that provides excellent sharpness and wear resistance compared to cemented carbide tools.
3. Excellent machining surfaces can be obtained by rapid feed even with cutting speeds at 500 m/min.
4. Stable cutting and sufficient performance when using emulsion type water-soluble coolant.
5. New mechanism that prevents various common machining problems.

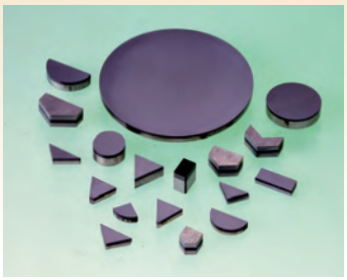
Ex. of problems

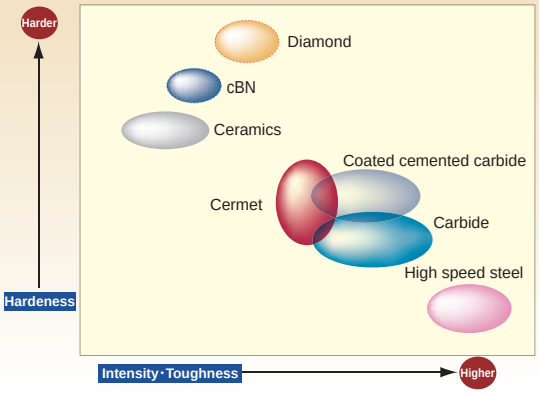
- Vibration, chattering → Assurance of dynamic balance
- Built-up edge → Surface finishing to prevent built-up edge
- Clogging of tools with cutting chips → Chipbreaker process

Comparison of carbide reamer to PCD reamer

The position of diamonds

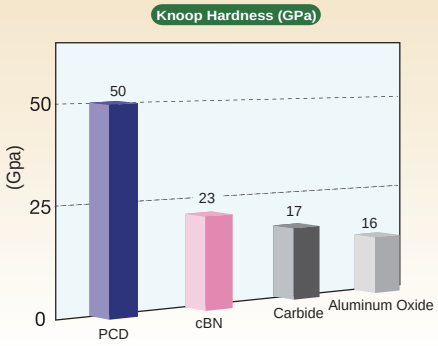
In the field of cutting tools, diamonds with excellent material features are in the limelight as the material that is expected to be applied for fine shape machining as well as various requests and issues in high grade and high efficient machining.

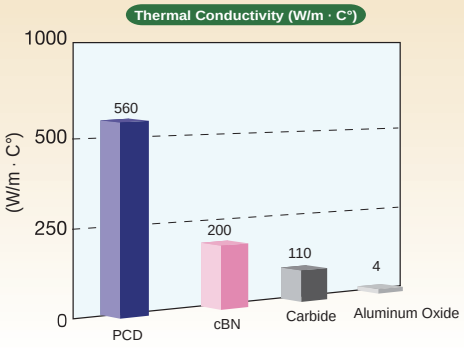




Material Features of PCD

The features of PCD (Poly Crystalline Diamond) in poly crystalline cutting tool materials are as follows:
1) Hardness is high 2) Thermal conductivity is high 3) Coefficient of thermal expansion is small.
It has excellent thermal conductivity and hardness, which is required for cutting tools, compared to other tool materials.





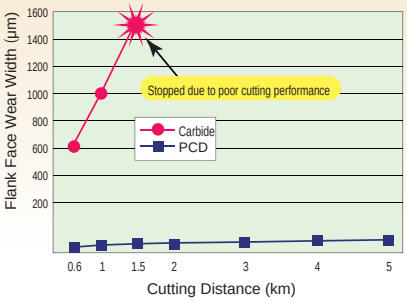
Comparison of Cutting Performance Between PCD (Poly Crystalline Diamond) and Carbide Tools

Longer life than carbide by a ratio of 10 to 20 times

A390-T36 and ADC-12 that are widely used as a main material for automotive components had many problems such as grade of processing surface and running cost of machining with carbide cutting tools. Using PCD has solved various problems, especially machining ADC-12 which is difficult to cut due to its longer tool life and stable machining accuracy compared to carbide.

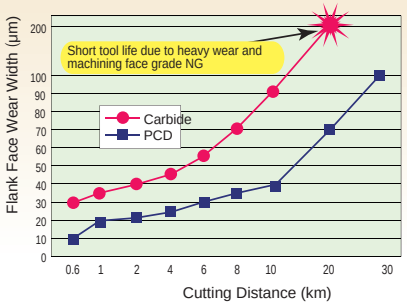
A390-T6 Cutting distance and flank face wear width

Cutting distance (Km)	0.6	1.0	1.5	2.0	3.0	4.0	5.0
PCD flank face wear width (μm)		35	50	55	60	70	80
Carbide flank face wear width (μm)	600	1000	1500	Immeasurable			



ADC12 Cutting distance and flank face wear width

Cutting distance (Km)	0.6	1.0	2.0	6.0	10.0	20.0	30.0
PCD flank face wear width (μm)	10	20	22	30	40	70	100
Carbide flank face wear width (μm)	30	35	40	55	90	200	—



Data.1

Amazing accuracy
Generated from segmented cutting chips

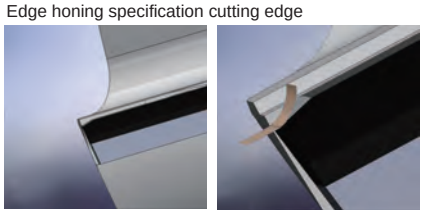
Solving problems

A. Length of cutting chips

1) Edge honing specifications
Bend the flow of cutting chips moderately to shorten the cutting chip length.

2) Chipreaker specifications
Curl the cutting chips by the wall surface of the chipbreaker to forcibly shorten the length of cutting chips.

Edge honing specification cutting edge

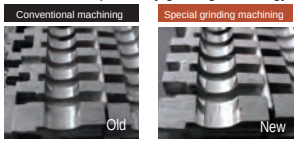


As a means to eliminate loss of productivity, the chipbreaker has been enhanced.

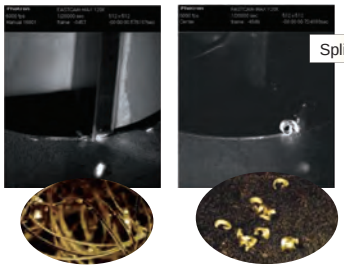
B. Width of cutting chips

3) Nick Specifications
Shorten the width of cutting chips by a dent prepared on the cutting edge.

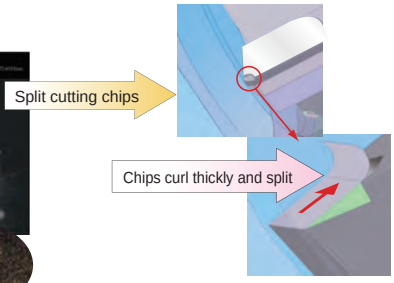
- Cutting resistance and contour accuracy have been improved by grinding technology



High machining accuracy due to non-opaque granular chips



Without chipbreaker With chipbreaker



Data.2

Superior design and quality
Capable of both high efficiency cutting and high machining accuracy

The concentricity and cylindricality of cutting edges have greatly improved due to high shank rigidity (carbide) and grinding technology on the cutting edge.
The machining efficiency per cutting edge has improved by cutting down the machine time.

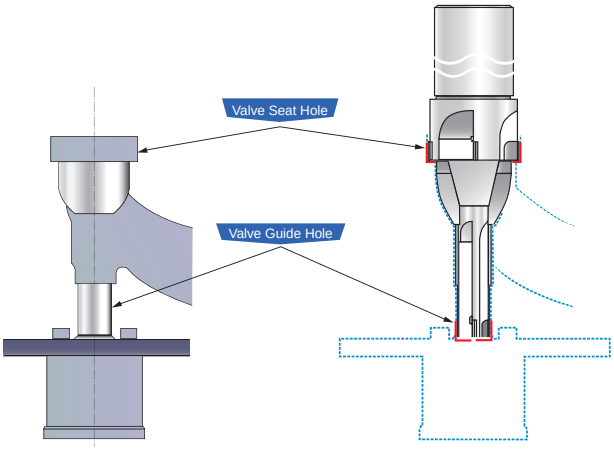


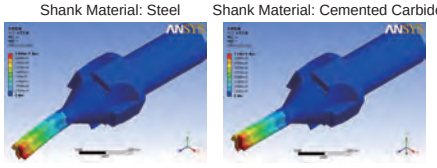
Diagram of work material Cross section of machining tool

Machining Conditions

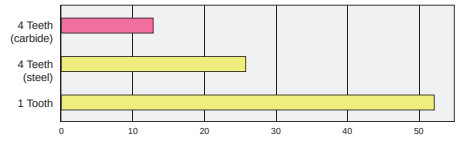
Workpiece	Cylinder head, valve seat, guide hole
Material	Aluminum alloy casting AC4B
Machines	Horizontal machining center
Tool Size	ø11-ø36-L150
# of Rotations (min^{-1})	3500
Cutting Speed (m/min)	395
Feed Rate (mm/rev)	0.3
D.O.C.(mm/dia.)	0.5
Coolant	Emulsion type water-soluble

Deformation volume by CAE analysis

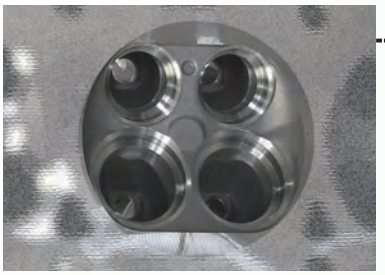
Shank Material: Steel Shank Material: Cemented Carbide



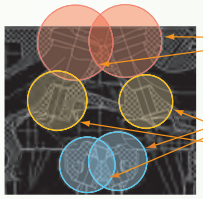
Differences of Performance Between Shank Materials			
Machining Results	1 Tooth	4 Teeth (steel)	4 Teeth (carbide)
Machining time (s)	52	26	13
Circularity (mm)	0.01	0.05	0.03
Coaxiality (mm)	0.01	0.07	0.05



Machining Time (s)



Machining Application



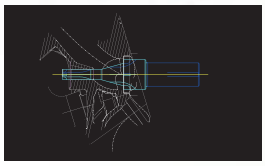
Stage 1 Valve seat and guide hole

Stage 2 HLA (Hydraulic Lash) adjuster hole finishing

Stage 3 Intake & exhaust valve guide hole finishing

Stage 1 Valve seat and guide hole finishing

The issues such as concentricity and cylindricality are solved by high shank rigidity and high cutting edge accuracy.

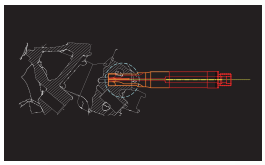


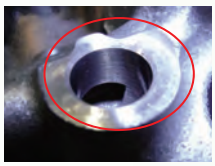
■ **Valve seat and guide hole finishing specifications**

	Machine: Horizontal machining center	
Machining Conditions	# of Rotations (min-1)	6,000
	Feed Rate (mm/rev)	0.48
	Feed Speed (mm/min)	2,880
	D.O.C. (mm/dia)	0.6
	Coolant	Emulsion type water-soluble

Stage 2 Hydraulic lash adjuster hole finishing

The issues such as chip removal and cylindricality are solved by the design that responded to thin-walled & blind hole machining portions.



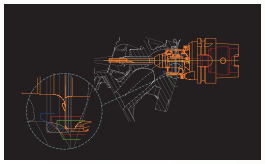


■ **Hydraulic lash adjuster hole finishing specifications**

	Machine: Horizontal machining center	
Machining Conditions	# of Rotations (min-1)	5,000
	Feed Rate (mm/rev)	0.34
	Feed Speed (mm/min)	1,540
	D.O.C. (mm/dia)	0.5
	Coolant	Emulsion type water-soluble

Stage 3 Intake & exhaust valve guide hole finishing

Concentricity and cylindricality of the cutting edge are controlled by its high accuracy and the self-guide effect is enhanced in order to respond to long overhang and bending. Moreover, the discharge amount of chips by the guide hole shape and coolant design. As a result, it can machine 10 times the number of holes compared to cemented carbide to improve productivity.



■ Intake & exhaust valve guide hole finishing specifications

	Machine: Horizontal machining center	
Machining Conditions	# of Rotations (min-1)	3,250
	Feed Rate (mm/rev)	0.1
	Feed Speed (mm/min)	325
	D.O.C. (mm/dia)	0.1
	Coolant	Emulsion type water-soluble

■ Machining Results

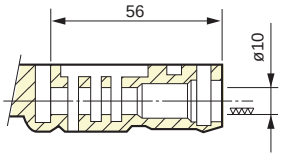
Cutting Tool	Tool Life (# machined holes)	Ratio of prices	Ratio of costs	Coaxiality	Inner diameter change volume
Carbide	1,200	1	1	—	—
Our PCD tool	12,000	3	0.8	10μm	3μm/10,000 hole

PCD REAMER

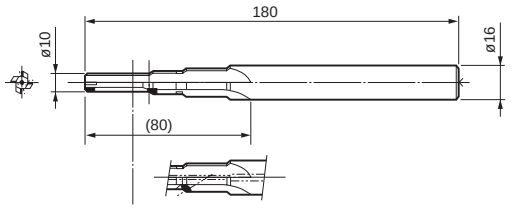
Application of PCD reamer machining

Reamer machining of automobile hydraulic regular valves

Item	Carbide Reamer	PCD Reamer
Cutting Speed (m/min)	120	120
Feed Speed (mm/rev)	0.2	0.2
D.O.C. (mm/dia)	0.4	0.4
Coolant	oil-based	water-soluble
Surface Roughness (μmRz)	8	3
Circularity	10	5
Running Cost	1	0.5



Workpiece



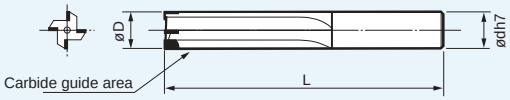
■ Shape

Cutting Edge Dia. øD	Cutting Edge Dia. øD	Other Specifications
ø3~ø4	1 tooth	**Blade dia. tolerance - Standard specifications:** øD±0.0025mm **High-accurate specifications:** øD±0.0015mm (ø5>; ø25>) **Along the length - Max. length:** 450mm (Standard L/D=3~5)
ø4~ø6<	3 teeth	
ø6~ø8<	4 teeth	
ø8>	6 teeth	

Our Products

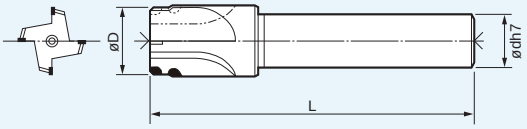
PCD reamer *(single-step reamer)*

Body Materials 1) Solid carbide 2) Comb. of carbide & steel 3) Hardened steel
Applications HDD, CD-ROM, rocker arms, etc.



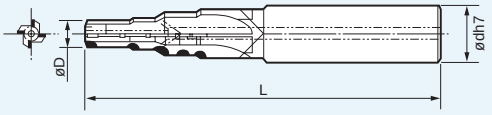
PCD reamer *(with chamfering tip)*

Body Materials 1) Solid carbide 2) Comb. of carbide & steel 3) Hardened steel
Applications Compressor body, ABS actuator, power steering body, etc.



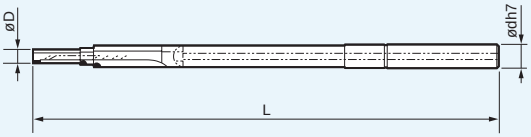
PCD reamer *(PCD profiled step reamer)*

Body Materials 1) Solid carbide 2) Comb. of carbide & steel 3) Hardened steel
Applications Oil pumps, steering, AT hydraulic control body, etc.



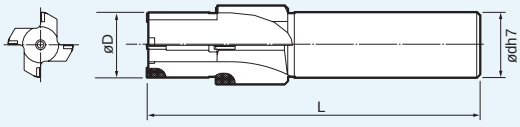
PCD gun reamer *(multiple step reamer)*

Body Materials 1) Comb. of carbide & steel
Applications AT hydraulic control body, etc.



PCD reamer *(with breakers)*

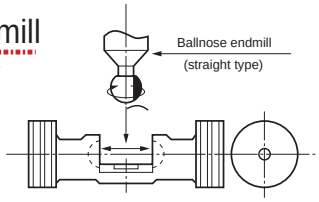
Body Materials 1) Comb. of carbide & steel
Applications ABS body, oil pumps, AT hydraulic control body, etc.



PCD ENDMILL

Application of PCD ballnose endmill

Machining of spherical surface on compressor parts for automobile air conditioner



■ Application of Machining

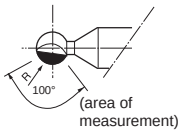
Results	Roughness 1.6μmRz or less Circularity 5.0μm
Workpiece	ADC12 [contains Si 11.5%]
Conditions	# of rotations N=1200 [rpm] Feed f=0.005 [mm/rev] final
Tool	Ø15.9×100L Spherical tolerance ±0.01mm Radius tolerance ±0.01mm

■ Possible Manufacturing Range

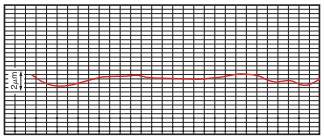
Length of cutting edge(ℓ)	8mm or less (at rake angle 0°: can machine up to 25mm)
Rake Angle θ (Axial rake)	5° or less (at 10°: cutting edge length 4mm or less)

■ Shape

Cutting Edge Dia. øD	Cutting Edge Dia. øD	Other Specifications
ø3~ø4	1 tooth	**Blade dia. tolerance - Standard specifications:** øD±0.1mm **High-accurate specifications:** øD±0.01mm (ø5 or more ø25 or less) **Along the length - Max. length:** 450mm (Standard L/D=3~5)
ø4~ø6 or less	3 teeth	
ø6~ø8 or less	4 teeth	
ø8 or more	6 teeth	



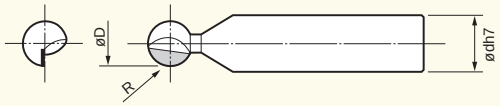
■ Contour Level Data 2μm



Our Products

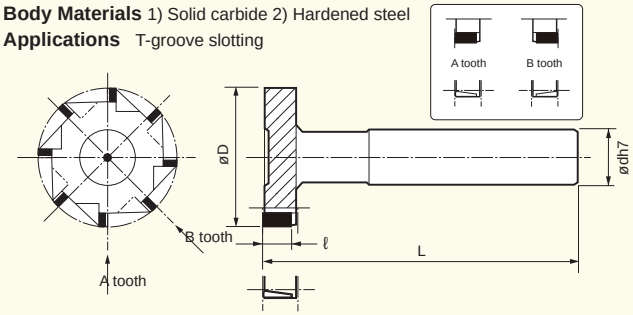
PCD endmill *(ballnose endmill)*

Body Materials 1) Solid carbide 2) Hardened steel
Applications Compressor parts, etc.



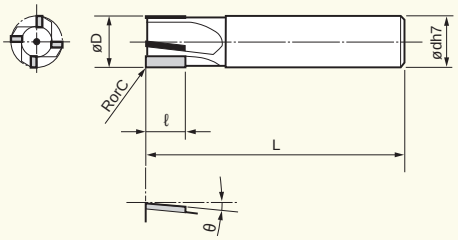
PCD endmill *(T-slot)*

Body Materials 1) Solid carbide 2) Hardened steel
Applications T-groove slotting



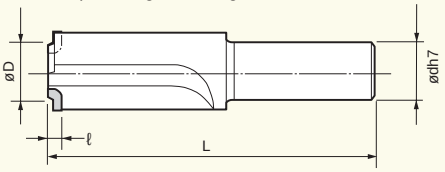
PCD endmill *(for deburring casting parts)*

Body Materials 1) Solid carbide 2) Hardened steel
Applications HDD, cylinder block



PCD spot facing cutter

Body Materials 1) Solid carbide 2) Hardened steel
Applications Various spot facing machining



PCD Circular Saw

Our PCD Circular Saw is capable of high accuracy machining while providing noise reduction with long lasting quality as a result of analyzing individual factors such as superior tool performance and improving an operating environment and terra-ecology.

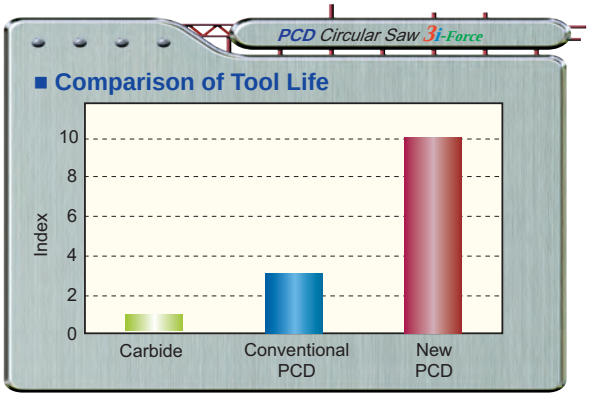
Features
- Newly developed VC mark reduces 15% of vibration
- Cost competitive with new PCD and blade shape

Application
- Aluminum casting gate cutting
- Grooving for circuit board electric parts

3 i-Force
Intelligent Force

Accuracy | Noise Reduction | Cost Effective

3 i-Force provides high performance and cost reduction due to matching the blade shape and the newly developed VC mark --our own innovative design.



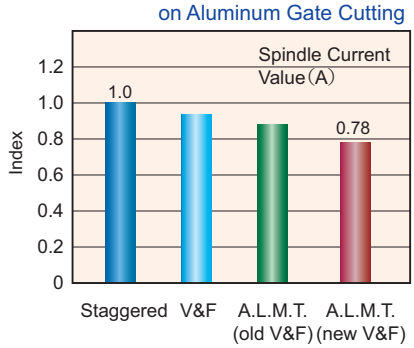
1. Best combination of cutting edge shape

Sharply-ground new V & flat blade is exceptional with low-power cutting and cost performance

- Specifications: ø250 - 6T - 8NT

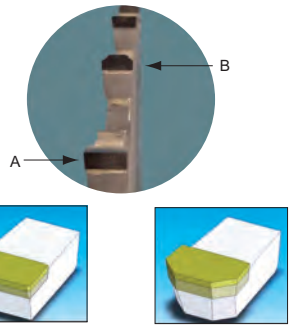
Speed	2,365rpm
D.O.C.	30mm/pass
Feed/tooth	19μm
Tested with 0.2mm pre-wear	

■ Comparison by Blade Shape on Aluminum Gate Cutting



- New V&F Flat Blade

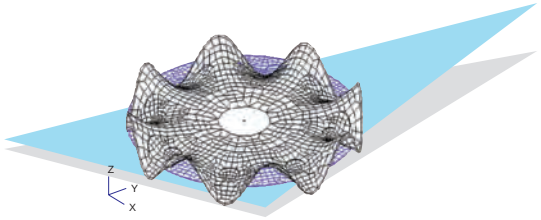
Chip segmentation and cutting force reduction



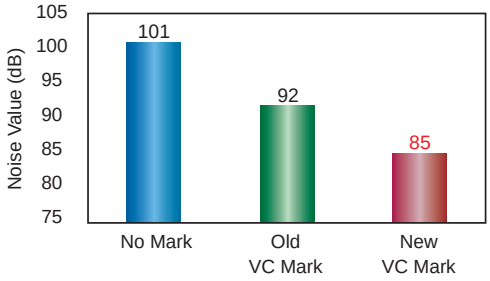
A. Flat blade B. V blade

2. Damping effect by newly developed VC mark

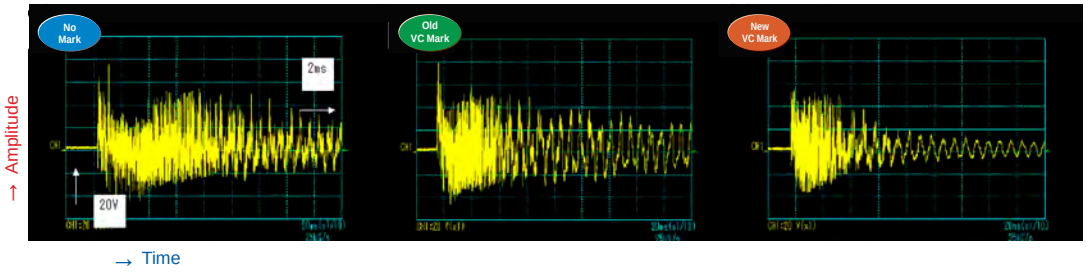
New VC mark was developed by using 3-dimensional CAE analysis and a test model trial.
New VC mark suppresses cutting vibration max. 15% and provides a comfortable operationg environment.



Waved form chart shows damping effect by type. Newly developed VC mark provides high accracy cutting while reducing chipping of cutting edge.



■ Comparison of Dampened Wave

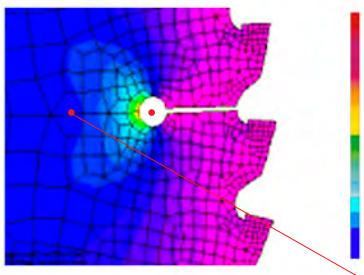


3. 2 effects by unique slit shape

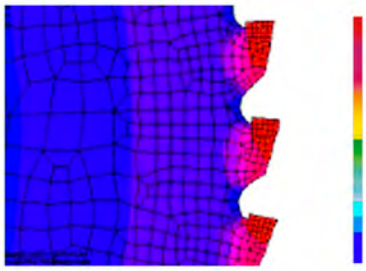
Prevent deformation and tip elimination by cutting heat

Thinner cutters are required for chips and power reduction according to Green Procurement on ISO14000s.
Special attention to detail has resulted in the succesful development of the slit, which reduces stress and cuts heat.

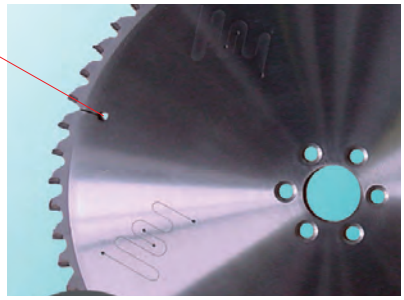
1) Release internal stains and reduce side run-out
2) Dissipate cutting heat and protect tip brazing

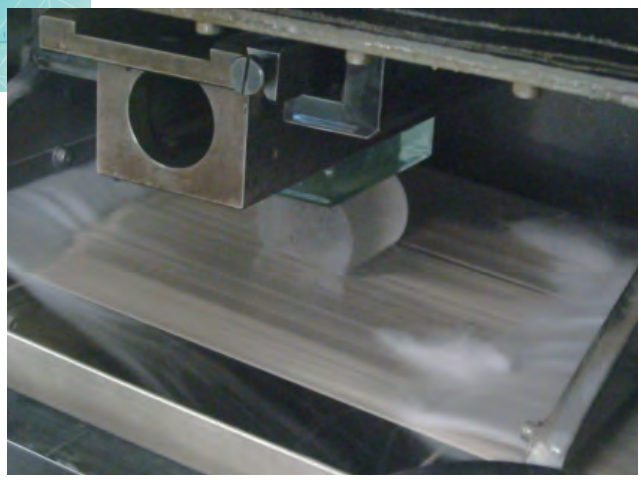


Max. principle stress (with slit)



Max. principle stress (without slit)





Diamond Wire Saw

PWS

Pat. #3078020

Precision Wire Saw

■ Features of PWS (PWS-R · E)

- High-precision, high efficiency (cutting speed: 2 to 10 times the loose grain)
- Improve the work environment (a water-soluble machining fluid can be used)
- Significantly improved recycling (separation of the chips can be recovered)
- Application can be selected according to the needs specification

Environmentally friendly slicing
Fixed Abrasive Diamond Wire Saw technology continues to evolve...

■ Applications

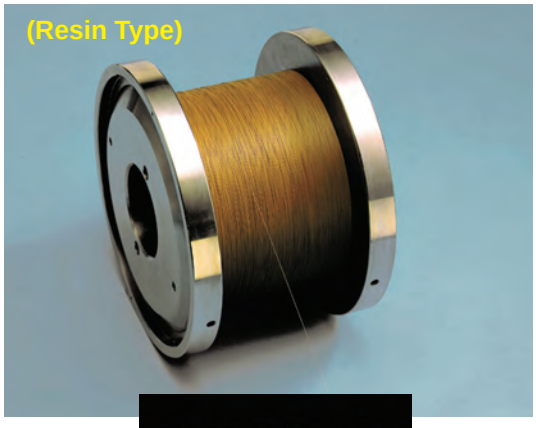
- Glass, ceramics, quartz and brittle materials such as sapphire
- Magnetic material such as neodymium and ferrite magnets
- Semiconductors and silicon for solar cells
- More difficult to cut materials SiC, various substrates

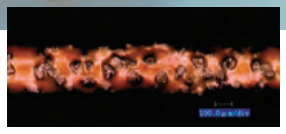
■ Standard Specification For Fixed Abrasive Diamond Wire Saw Formula

Type	Diameter	Average Particle Dia.	Production Length
PWS-R	ø0.245±0.01	40~60μm	~100km
PWS-E	ø0.255±0.01	30~40μm	~50km

*For long products, and other specifications, please contact us.

PWS-RType



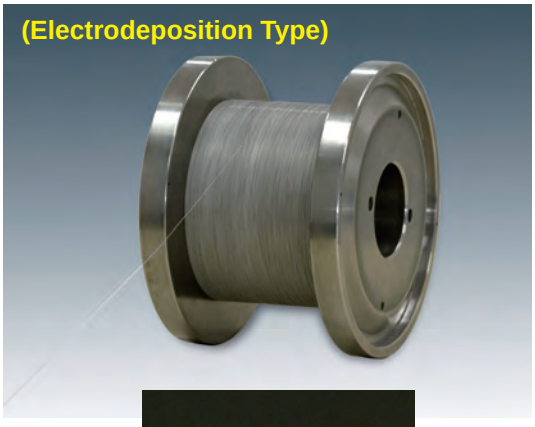


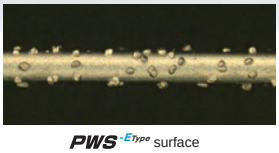
PWS-RType surface

■ PWS-R Features

- Ideal for maching a variety of materials
- Capable of high quality finishing

PWS-EType

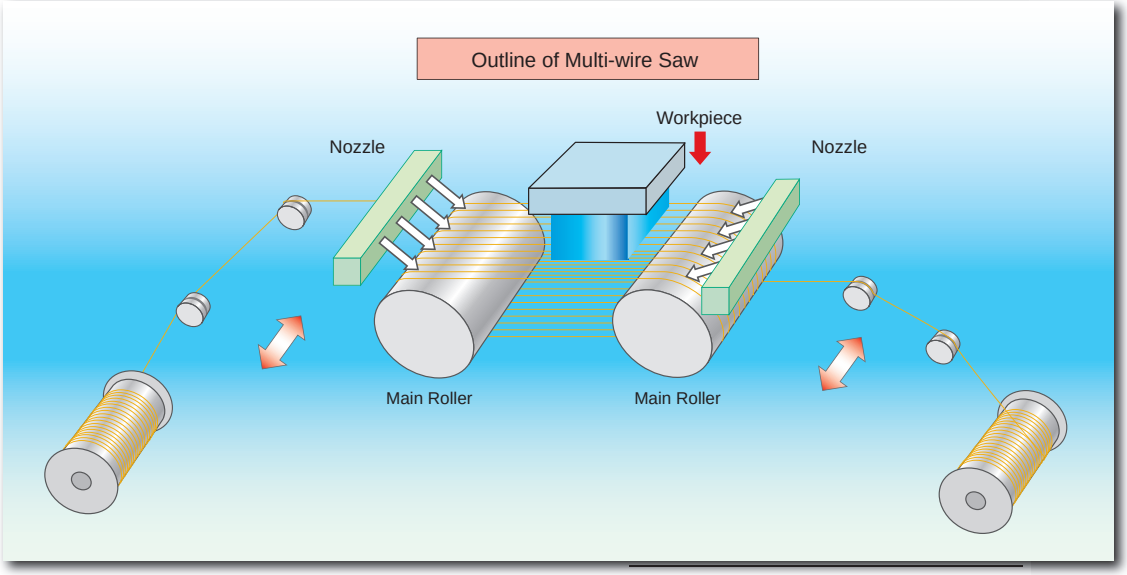




PWS-EType surface

■ PWS-E Features

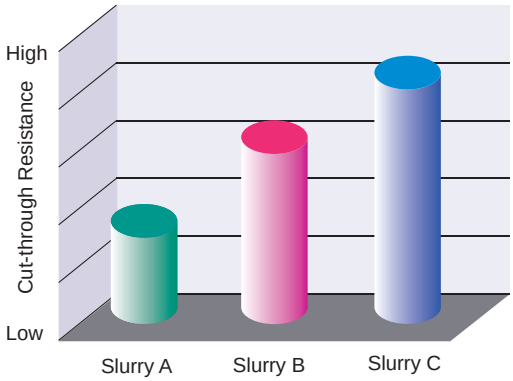
- To achieve high efficiency machining with abrasive high retention

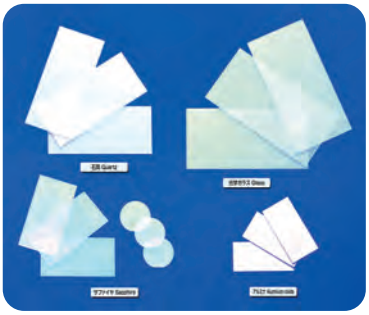


■ Case Processing

Specifications: PWS		PWS-R	PWS-R	PWS-E
Evaluation System		Multi-wire saw	Multi-wire saw	Multi-wire saw
Work Materials	Material	Neodymium magnets	Plate Glass	Sapphire
	Dimension	W(50×4columns)×H(25×4high)×L(50×2columns)mm	ø50mm×L200mm	ø50mm×L200mm
Cutting Condition	Wire Speed	max800m/min	max400m/min	max400m/min
	Work Feed Speed	0.6mm/min	Ave0.1mm/min	Ave0.3mm/min
	Wire Running Direction	Round-trip running	Round-trip running	Round-trip running
	Wire Tension	30N	35N	35N
	Slurry	Water-insoluble slurry	Water-soluble slurry	Water-soluble slurry
Cutting Results	Surface Roughness (Ra)	on and less than 1.5μm	on and less than 0.4μm	on and less than 0.5μm
	Waviness (WCM)	on and less than 20μm	on and less than 30μm	on and less than 30μm
	Total Thickness Variation(TTV)	on and less than 10μm	on and less than 10μm	on and less than 10μm
	Average Thickness	0.74mm	0.6mm	0.6mm
	Kerf-loss	0.26mm	0.26mm	0.26mm
PWS Specification	Dia. of Core Wire	40–60μm		30–40μm
	Outer Diameter	Ave. 0.25mm		Ave. 0.255mm

* Total length of cutting direction was measured.





Workpiece: glass, alumina, sapphire

Cutting resistance varies depending on the working fluid. Please contact us for assistance in selecting the optimal working flu

For Carbide Tool Grinding

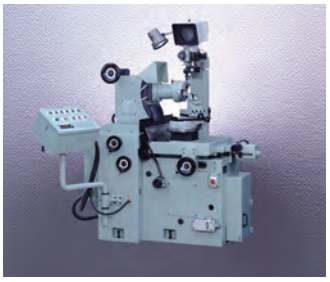
CPG Series Compact Tool Grinders

CPG-310 • CPG-200

CPG-310

High Operativity and High Output

- Constant feed and handwheel operated oscillating width control.
- X20 projector for centering and profiling.



Specifications

- ø150mm projector
- Constant feed unit
- Coolant unit
- Holder (QC-21)

CPG-200

- Basic grinder for low volume production
- X20 projector for centering and profiling

Features

1) Incomparable rigidity

Precise angler bearing for grinding spindle and pivot

2) Excellent grind accuracy

Super rigid grinding spindle for sharp cutting edge grinding

3) Highly efficient operation

Quick cutting edge angle and relief angle with oscillating location adjustment of wheel with workpiece sight. Leaning mechanics with centering grinding point and highly precise projector for high efficiency operating environment.

Options

Special power-up units for CPG Series

Depth Feed Digital Meter

- CPG-310
  Linear scale (min. 1μm)
- CPG-200
  Ball screw and length measuring encoder

Angle Digital Meter

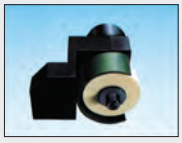
Angle measuring encoder (min. 1 min.)

Coolant Tank

Paper filler type

Accessories

Special jigs for CPG series



• Brake trueing unit BT-2

• 3-D vise

• On machine dressing CT-1 (CPG-310)

• Holders

• Jig for cylindrical grinding

• Jig for radius grinding

• Jig for negative land

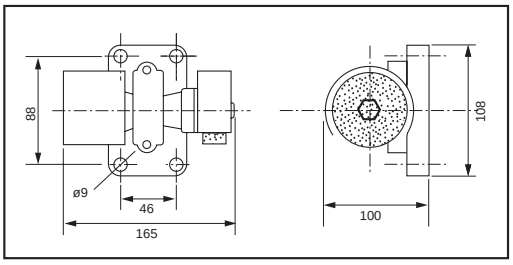
Trueing Unit

Brake Dresser

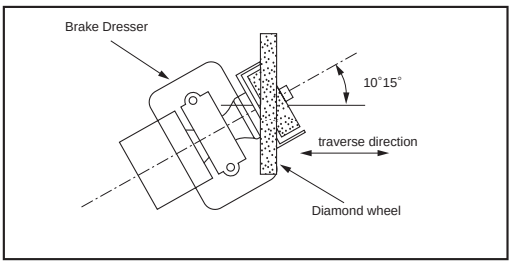
Features & Instructions

The brake dresser consists of a grinding wheel, bearing, and brake controller. The grinding wheel drags with a rotating diamond grinding wheel. At high speeds, the brake shoe causes friction by centrifugal force, and peripheral speed difference between grinding wheels reduction of drag speed. This press force and peripheral speed difference removes run-out on the diamond layer. To remove the hard wear layer or make the layer straight, traverse table feed and intermittant wheel feed are required.

Dimensions



Example



ODIAP

Grinding Fluid

Feature

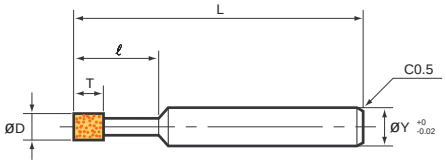
- Water soluble grinding fluid specialized for fixed abrasive operation

■ Application

- PWS
- DPG

Diamond/cBN Standard Grinding Pins

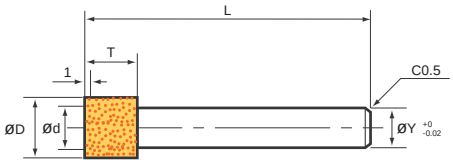
W11 Grinding Pin



CD		D	T	ℓ	L	Grit #
W11003	SD	0.3	2	5	35	#800
W11004	SD	0.4	2	5	35	#400
W11005	SD	0.5	2	8	35	#400
W11006	SD	0.6	3	8	40	#200
W11007	SD	0.7	3	8	40	#200
W11008	SD	0.8	3	10	40	#200
W11009	SD	0.9	3	10	40	#200
W11010	SD	1.0	3	10	40	#200
	LD	1.0	3	15	40	#200
W11012	SD	1.2	5	10	45	#200
	LD	1.2	5	15	45	#200
W11013	SD	1.3	5	10	45	#200
	LD	1.3	5	15	45	#200
W11015	SD	1.5	5	10	45	#200
	LD	1.5	5	17	45	#200
W11017	SD	1.7	5	13	45	#200
	LD	1.7	5	20	45	#200
W11020	SD	2.0	5	13	45	#200
	LD	2.0	5	20	45	#200
W11023	SD	2.3	5	13	45	#200
	LD	2.3	5	20	45	#200
W11025	SD	2.5	5	13	45	#120
	LD	2.5	5	20	45	#120
W11030	SD	3.0	5	15	50	#120
	LD	3.0	5	22	50	#120
* W11060	SD	6.0	5	20	65	#120
	LD	6.0	5	27	65	#120

(Y=ø3 but *Y=ø6)

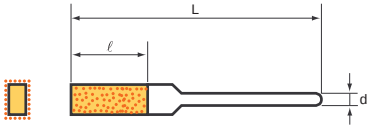
W12 Grinding Pin



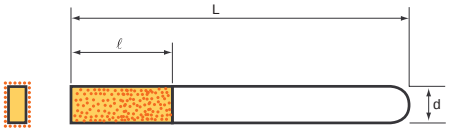
CD		D	T	d	L	Y	Grit #
W12035	SD	3.5	5	-	60	3	#120
W12040	SD	4.0	5	-	60	3	#120
W12045	SD	4.5	5	-	60	3	#120
W12050	SD	5.0	5	2	70	3	#120
W12060	SD	6.0	8	3	70	3	#120
W12070	SD	7.0	8	4	70	6	#120
W12080	SD	8.0	8	5	70	6	#120
W12090	SD	9.0	8	6	70	6	#120
W12100	SD	10.0	10	7	100	6	#120
W12120	SD	12.0	10	9	100	10	#120
W12150	SD	15.0	10	12	100	10	#120

Handy Diamond File - Standard

N Handy File for Precision



F Handy File for Iron

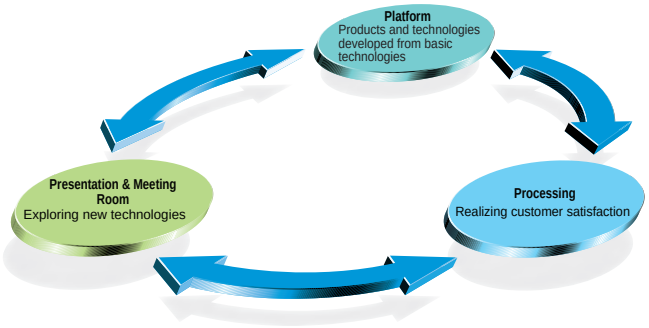


Application	Type	CD	Grit # G	L	ℓ	d	1 Flat	2 Half Round	3 Round	4 Square	5 Three Square	6 Taper	7 Oval	8 Swaged	9 Balance Edge	X Knife	Y Crossing	Z Clam
(N)	10 Piece value set	7310	#140	140	50	ø3	●	●	●	●	●							
	5 pcs set	7320	#200	200	70	ø4	●	●	●	●	●							
	8 pcs set	7330	#200	180	70	ø3.4	●	●	●	●	●	●	●	●				
	10 pcs set	7340	#140	140	50	ø3	●	●	●	●	●	●	●	●	●	●		
	12 pcs set	7350	#120	140	40	□2.2	●	●	●	●	●	●	●	●	●	●	●	●
(F)	5 pcs set	7360	#120	215	80	Square	●	●	●	●	●							
	8 pcs set	7370	#120	200	70	Square	●	●	●	●	●	●	●	●				
	10 pcs set	7380	#120	185	50	Square	●	●	●	●	●	●	●	●	●	●		
	12 pcs set	7390	#120	170	40	Square	●	●	●	●	●	●	●	●	●	●	●	●

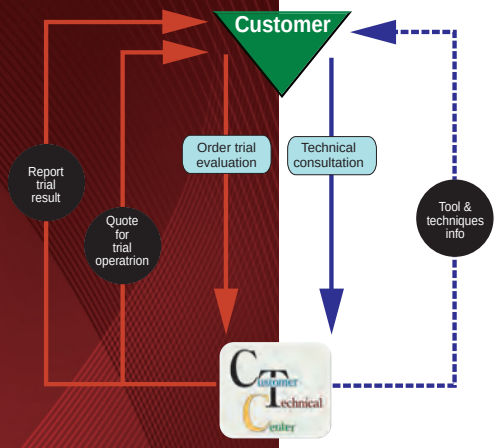
* Please contact us about stock.
* Service Set 10 pcs, 10 pcs for precision (No.7340) is a set of five triangular flat half-circle round the corner.

Visit CTC for Assignment & Solution

The application field of diamond and cBN tools is very wide and diversified, and the demand on the tools is also severe and wide-ranged in accuracy, efficiency, tool life, and environmental concerns. In order to meet demands, A.L.M.T. Corp. established the Customer Technical Center as a solution center to assist and support customers. The CTC is composed of three sections: 1) platform, 2) process evaluation, including measurement and inspection, and 3) presentation and meeting room.



CTC supports our customers' engineering development



Shape a theme through verification and discovery

From Inquiry to Report

The issues at hand are: environment, increase in productivity, cost reduction, number of requests that require quality improvement, and discussion and technical issues; problem solving is a measure of success.

Lay out technologies in four themes

Platform

The products and technologies developed by A.L.M.T. Corp. are illustrated (left). There are 4 sectors: Cutting, Grinding, Polishing, and Forming. New and flexible solutions to diversified requests, plus information to make conclusions regarding future related issues.

Technical database though production and measurement

Operation and Evaluation

Leading-edge processing can only be achieved with up-to-date machines. In this sector, the leading machines installed are classified into three groups: 1) high efficiency processing, 2) wire slicing with bonded wire saw, and 3) precision processing. In each grouping, tools and work to be processed are tried and evaluated on the spot with installed measurement equipment.

Processing Evaluation Division

Corresponds to the processing facility at the request of various evaluations

Grinding Center

■ **Equipment Overview**

Based on the machining center manufactured by Hitachi Seiki VK55; was developed by adding search capabilities to machining is the best machine for grinding center.

■ **Typical Applications Evaluation**

Ceramics, carbide, hardened steel grinding, complex action processing

Vertical High Speed Machining Center

■ **Equipment Overview**

With axial core cooling, its unique lubrication under race lubrication hollow ball screw cooling system and high-speed spindle, high rigidity 50m/min. in the body structure, high capacity due to high feed rate of 0.6G has achieved a processing rate.

■ **Typical Application Evaluation**

CVD tool life evaluation tests in aluminum alloy machining

New composite materials processing characterization using test tools PSL

*CVD: Chemical Vapor Deposition

(Diamond coated by chemical vapor synthesis)

Double-axis Surface Grinder - Opposite (Vertical Type)

■ **Equipment Overview**

To pass through the axis of the workpiece between the two wheels facing up and down by immediate vertical surface grinding. Has a highly rigid spindle held by the prismatic slide.

■ **Typical Applications Evaluation**

Ferrous sintered

Processing of mechanical parts such as two-sided machining castings efficiency, dimensional surface accuracy evaluation test

NC High Speed Cylindrical Grinding Machine

■ **Equipment Overview**

Ultrafast NC's largest cylindrical wheel with peripheral speed up to 160m/sec. as a grinder. Plunge of ferrous material at high peripheral speed, Kontari switching conduct the search, can be evaluated.

■ **Typical Application Evaluation**

High peripheral speed and cylindrical grinding to improve efficiency on iron-based materials processing work test

For the purpose of reducing the high peripheral speed and the grinding wheel wear.

Precision Rotary Surface Grinder

■ **Equipment Overview**

Built-in motor type air spindle is precisie with water-cooled heat to enable smooth rotation with little vibration displacement. Applied to the evaluation process, such as a silicon wafer with fine wheel.

■ **Typical Application Evaluation**

・Silicon wafer processing such as fine wheel test.

Precision Slicer

■ **Equipment Overview**

Ultra-precision air bearings with static pressure on the spindle, small and accurate feeding makes this a high precision slicer.

■ **Typical Application Evaluation**

Ceramics by slicing blade, stacked evaluation tests, such as slicing condenser

High Speed Slicer

■ **Equipment Overview**

Equipped with a discharge trueing system, ideally on a machine Tsuru can swing. Evaluated by automatic alignment to speed. S wheel adopts an air spindle and low-vibration spindle thermal displacement.

■ **Typical Application Evaluation**

Adapted to the evaluation process such as wafer thin blade.

DPG (Diamond Pellets and Grinding)

■ **Equipment Overview**

Based on technology developed by lapping, diamond pellets rigidity that is required for fixed abrasive grinding. The process by wrapping loose grain, fixed abrasive greener can be evaluated when it is changed to processing.

■ **Typical Application Evaluation**

Ceramics, quartz, glass, in the conventional planar processing of metallic materials to move to high-efficiency grinding process by DPG from lap when processing efficiency, reach the surface roughness evaluation test

PWS Multi-wire Sawing Machine

■ **Equipment Overview**

Fixed abrasive diamond wire saw (PWS) using a multi-wire. A machine for cutting only.

Does not require a loose grain as well as DPG.

■ **Typical Application Evaluation**

Sapphire, multi-processing efficiency in cutting, such as silicon, flat trial evaluation.

Measure & Analysis Division

Profile, accuracy, and analysis using the latest equipment

Flatness Measuring Equipment
Flat Master 200XR

Scanning Electron Microscope
EDX-SEM

3-D Surface Structure Analysis Equipment
ZYGO

Spin Tester

Technical & Reliable Network for A.L.M.T. Cor

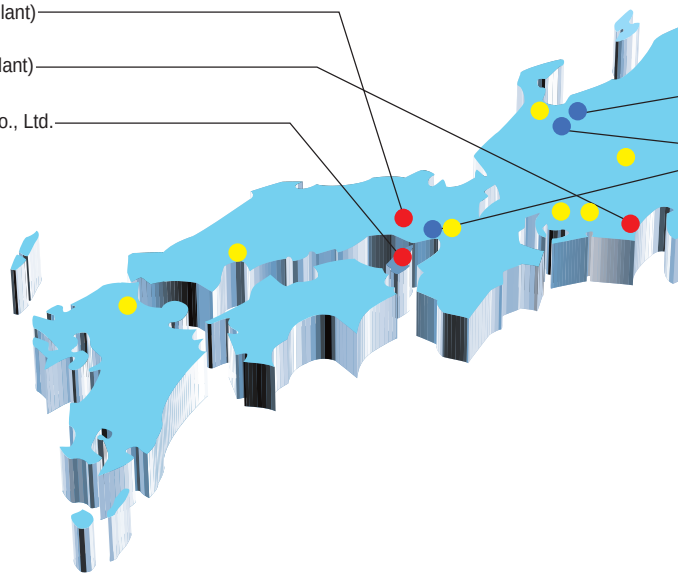
Based on the domestic production subsidiaries with high technologies, the sales network close to the local and overseas markets and the manufacturing affiliates overseas, A.L.M.T. Corp. serve society both at home and abroad with reliable products

Domestic Affiliates (Diamond Tool)

A.L.M.T. DIAMOND Corp. (Harima Plant)

A.L.M.T. DIAMOND Corp. (Shizuoka Plant)

Ajawi Diamond Industrial Co., Ltd.



Global Network (Diamond Tool)

□ Sales ○ Production, Sales

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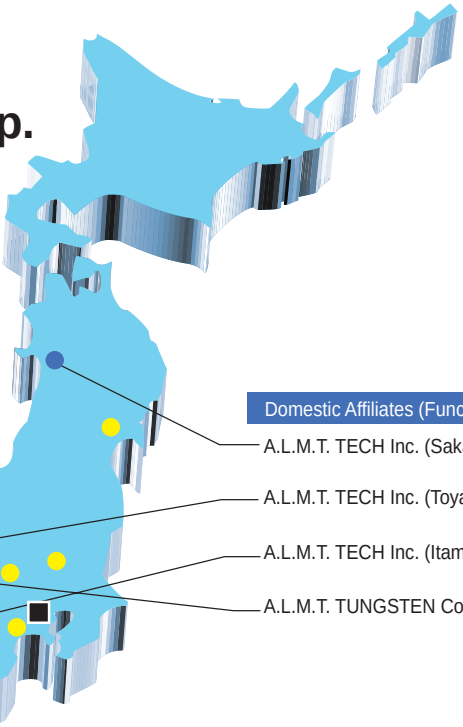

Domestic Affiliates (Functional Material)

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- A.L.M.T. TECH Inc. (Toyama Plant)
- A.L.M.T. TECH Inc. (Itami Plant)
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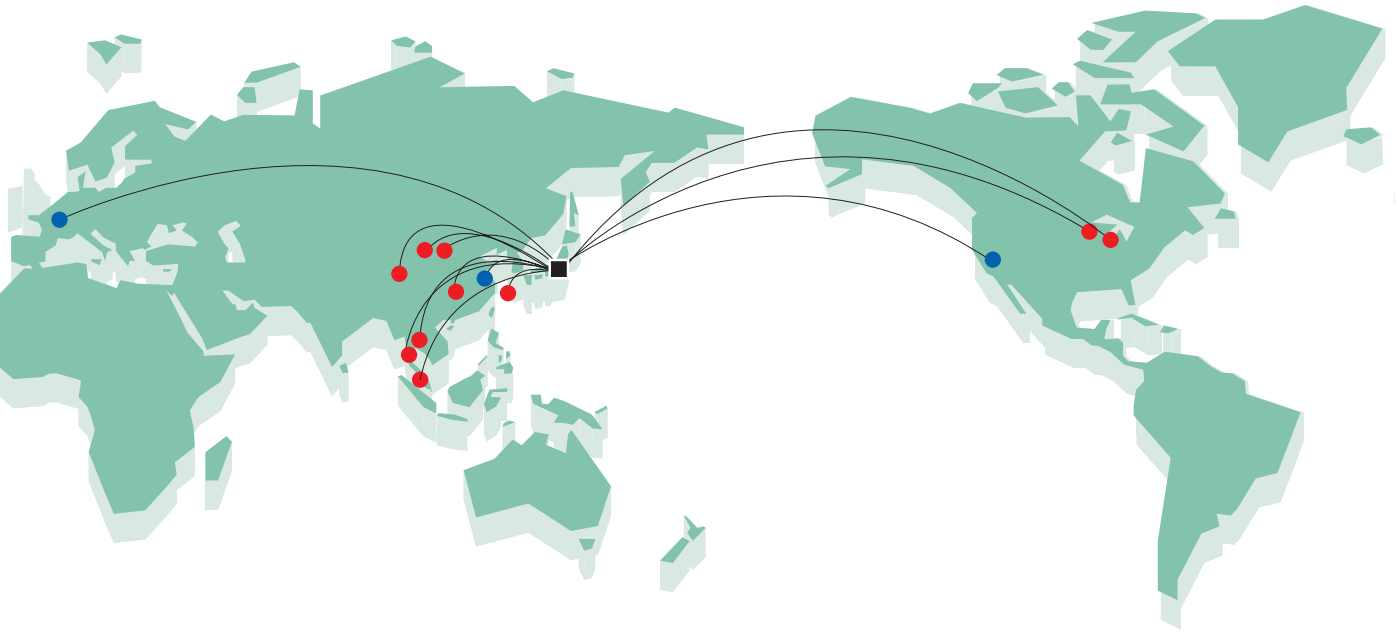

Global Network (Functional Material)

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