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Diamond·CBN Tools



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Automotive

Most suitable tools created with affluent expertise and knowledge for processes and parts.

Engine

For Cylinder Heads / PCD rotating tool

As the engine performance continues improving, the cylinder head shapes of gasoline engines and diesel engines have become more complicated and thinner. Because of many places to machine, tool design that enables composite machining and high-speed machining is needed to reduce machining cost. A.L.M.T. provides optimum tools created with extensive experience and performance.



Features

- Multi-step combination bores can be finished using a single reamer, making it possible to reduce the number of processes.
- Not only can tool management be simplified, but the number of machines can also be reduced.
- Low cutting force and simplification of machine makes space-saving possible.
- Provides well finished surfaces impossible to achieve using cemented carbide tools.
- As one would expect from diamond tools, dimensions remain precise and stable, and shape accuracy can be maintained over long periods of use.
- Increased rotational speed enables shorter machining times.
- Excellent performance can be achieved using environmentally friendly water-soluble cutting oil.

Data 1 Improvement of Productivity by Breaking Chips

Negative Land Specification Cutting Edge



The breaker function is enhanced to prevent a reduction in productivity due to problems caused by chips. Solutions are proposed according to the type of chip problem.

Without chipbreaker



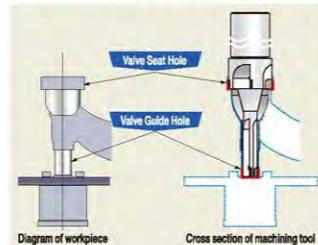
Chips do not curl but become stringy and long.
• Tangled around the cutting tool.
• Remained on the workpiece.

With chipbreaker



Chips forced to curl and broken to pieces.

Data 2 Capable of both high-efficiency and high-precision machining



Precision diamond machining technology ensures cutting edge accuracy and concentricity degree to achieve high efficiency machining.

Parent bore finishing

Difference of Performance Between Shank Materials

Results	1tooth	4teeth (steel)	4teeth (carbide)
Machining time (s)	52	26	13
Roundness (mm)	0.01	0.05	0.03
Coaxiality (mm)	0.01	0.07	0.05

Machining conditions

Machine	Horizontal machining center
Tool Size (mm)	φ11-φ36-L150
Workpiece	Aluminum alloy casting AC4B
Coolant	Water-soluble oil emulsion
Rotational speed (min⁻¹)	3,500
Feed rate (m/min)	395
Feed rate (mm/rev)	0.3
Stock removal (mm/dia.)	0.5

Tool lineup for machining cylinder heads (upper surface)



■ PCD reamer for solenoid holes
Multi-flute, multi-step precision reamer ensures high coaxial accuracy.



■ PCD reamer for spark plug holes
Sleeve insert diameter can be finished with high precision thanks to making the first-contact second step a four-flute geometry.



■ PCD cutter for cam-groove milling
Staggered flutes reduce cutting resistance and prevent chatter.



■ 1-flute PCD reamer for valve lifter holes
Improved roundness by giving full consideration to rotational balance of the tool body.



■ PCD end mill for spring seats
Chip breaker improves evacuation of chips and prevents them from entering the water jacket.



■ PCD reamer for HLA boring
Unique two-flute design for large transverse holes prevents the cutting edge from dropping.



■ Ball nose PCD mill for cam half-round milling
PCD tip improves milling accuracy and reduces processing load in subsequent machining processes.

Finishing of hydraulic lash adjuster (HLA) holes

The high rigidity of the shank and accuracy of the cutting edge achieves coaxiality and cylindricity.

Machining conditions

Machine	Horizontal machining center
Coolant	Water-soluble oil emulsion
Rotational speed (min⁻¹)	5,000
Feed rate (mm/min)	1,540
Feed rate (mm/rev)	0.34
Stock removal (mm/dia.)	0.5

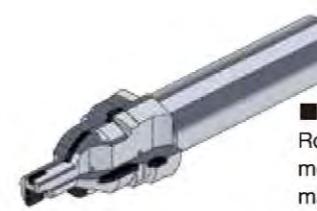
Tool lineup for machining cylinder heads (deck surface)



■ PCD reamer for cam sensor holes
Reduced cutting resistance improves machining speed and accuracy.



■ 4-flute PCD reamer for boring parent metal
A highly rigid body enables finishing of guide holes and seat holes with a high degree of coaxiality prior to press fitting.



■ PCD end mill for valve throats
Rough machining of the parent metal insert areas and machining of the throat can be done simultaneously.



■ 3-flute PCD reamer for boring parent metal
Three flutes reduce chatter.



■ PCD end mill for valve throats
Delivers long service life in throat machining.

Machine	Horizontal machining center
Coolant	Water-soluble oil emulsion
Rotational speed (min⁻¹)	6,000
Feed rate (mm/min)	2,880
Feed rate (mm/rev)	0.48
Stock removal (mm/dia.)	0.6

Machine	Horizontal machining center
Coolant	Water-soluble oil emulsion
Rotational speed (min⁻¹)	6,000
Feed rate (mm/min)	2,880
Feed rate (mm/rev)	0.48
Stock removal (mm/dia.)	0.6

For valve guide hole / PCD rotating tool

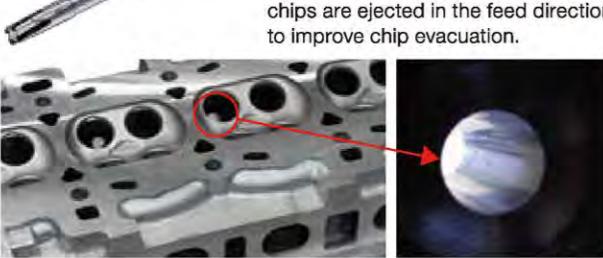
Since sintered alloys or cast iron is used for valve guides, if reamers with cemented carbide cutting edges are used, they wear rapidly resulting in increased frequency of tool change and decreased machining efficiency. Because the hole diameter is about 5 mm and the cutting speed is slow, PCD works better in machining valve guide holes. We offer designs that meet customers' needs and machining conditions using 1-flute and multi-flute PCD reamers.

**Features**

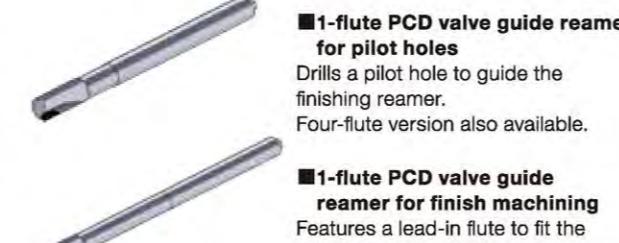
- Tool life is about 10 times longer than cemented carbide tools.
- High precision and high efficiency are realized.

**■4-flute PCD valve guide reamer for finish machining**

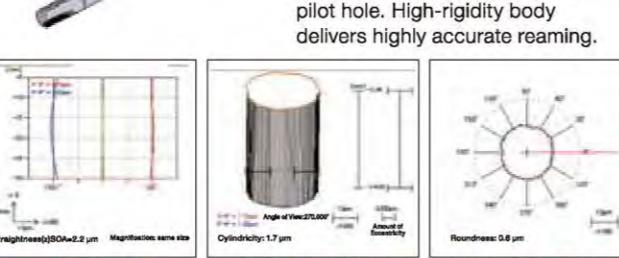
Multi-flute design to achieve high-feed reaming.

**■4-flute PCD valve guide reamer with helix for finish machining**

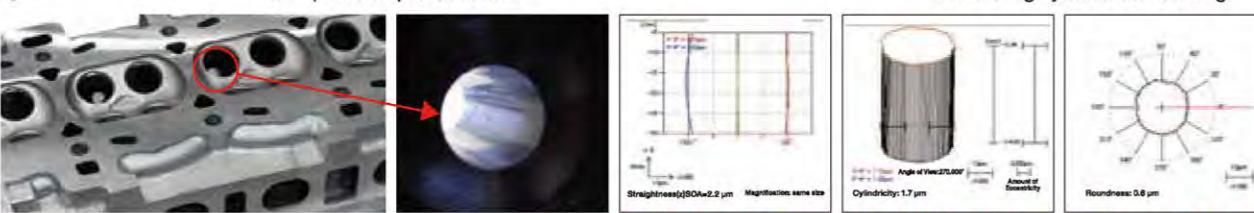
Provided with a negative helix angle; chips are ejected in the feed direction to improve chip evacuation.

**■1-flute PCD valve guide reamer for pilot holes**

Drills a pilot hole to guide the finishing reamer. Four-flute version also available.

**■1-flute PCD valve guide reamer for finish machining**

Features a lead-in flute to fit the pilot hole. High-rigidity body delivers highly accurate reaming.



Straightness: 2.2 μm

Cylindricity: 1.7 μm

Roundness: 0.6 μm

Cam grinding wheel / VITMATE HIG wheel

► **Highly efficient wheel for processing with high dressing performance and wear resistance**
The employment of the bond that has high grain holding force enables the properties of CBN grains to be utilized fully to achieve highly efficient grinding and significant tooling cost reduction.

**Features**

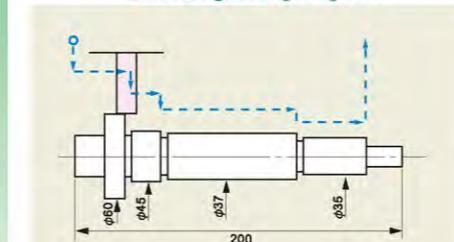
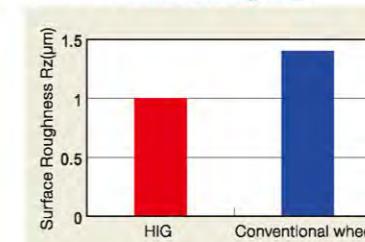
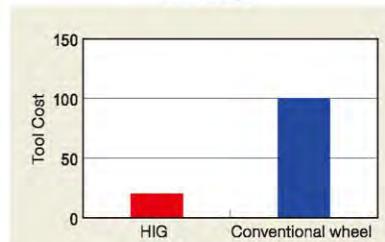
- This wheel has excellent cutting ability and dressing performance as well as high wear resistance to work best in grinding operations that require high accuracy.
- This bond has higher wear resistance to make this wheel ideal for grinding that requires high grinding accuracy.

Applications

- Grinding of cams, crankshafts, injection needles, rocker arms, turbo components, etc.

Machining examples

□Sintered Alloy Machining Example	1)Machine	High-speed cylindrical grinder	5)Conditions	Peripheral speed : 160m/s
	2)Wheel specification	BN120M200VE2	D.O.C. : ϕ 0.2mm	
	3)Wheel : Size	ϕ 400x10U	Feed rate : 300mm/min	
	4)Workpiece	SCM435(HRC60)	6)Coolant	Water-soluble

Contour grinding diagram**【Results】 Surface Roughness****Tool Cost**

*Conventional tool being 100

For machining cast iron and sintered alloy parts / CBN reamers**► Both high efficiency and long life ensured in machining sintered alloy and cast iron.**

CBN that has hardness next to diamond hardly reacts with iron and therefore is capable of producing excellent surface finish. A combination of high hardness and excellent heat resistance realizes high-speed cutting and long life in machining of hardened steel and cast iron. In machining sintered alloy, this tool can minimize the generation of burrs and edge chipping to provide good surface roughness and high machining accuracy.

**Features**

- Most suitable for high-speed finishing of cast iron and sintered alloys.
- Longer tool life than carbide and high speed steel tools.

Applications

- Finishing of holes in sintered alloys and cast iron (FC/FCD). (Engine & transmission parts, etc.)

Machining examples**□Sintered Alloy Machining Example**

- | | |
|-------------------------|--|
| 1) Machine | Machining center (spindle BT30) |
| 2) Tool Size | ϕ 8xL100 |
| 3) Workpiece | Sintered alloys |
| 4) Machining conditions | Feed rate : 250m/min
Feed rate : 0.15mm/rev
Stock removal : ϕ 0.2 |

**■Finishing of Intake and Exhaust Valve Guide Holes**

Finished surface		Carbide coated tool	CBN reamer	
Efficiency	V(m/mm)	60	250	Efficiency 8 times
	F(mm/min)	150	1,200	
Life	Number of hole drilled	150 holes	1000 holes	Life 7 times
Accuracy	Finished surface(μ m)	Rz 7	Rz 1	Accuracy 7 times

Variable valve grinding wheel / MB SPARK**► Both high efficiency and long life ensured in machining sintered alloy and cast iron.**

The machining system that enables the next-generation double-ended surface grinding that defies conventional wisdom. The MB SPARK when used in combination with electro-discharge truing offers significant improvement of truing intervals over resin bond wheels, defying conventional wisdom double-ended surface grinding.

**Features**

- Electro-discharge truing realizes life about 3 times longer than general resin bond wheels.
- Long lasting cutting performance and high-wear resistance.
- Less industrial waste-sludge produced from wheel during truing.

Applications

- Automotive engine components and automotive oil pump components

For processing injector components / Diamond rotary dresser (Tool for forming conventional grinding wheel)**► Highly precise and highly efficient dressing possible.**

This is a rotary dresser that is capable of producing fine and highly precise shapes required for various types of centerless grinding, a dominant operation in production of automotive injector components such as injector nozzles and injection needles.

**Features**

- The rotary dresser RZ type for which the precision electroforming technology is employed and which is capable of coping with complicated shapes is widely used.
- *RZ type: Diamonds electroplated densely to provide high precision and long life.

Applications

- Grinding of injector-related components

For machining valve bodies / PCD rotating tool

Machining spool bores of valve bodies is one of the most difficult operations. This is a bore finishing process that involves intermittent cutting and multi-step machining, for which tools capable of producing good surface roughness, roundness, cylindricity and coaxiality precisely are required. A.L.M.T. proposes optimum design based on our extensive machining quality improving techniques.

**Features**

- Multi-step combination bores can be finished using a single reamer, making it possible to reduce the number of processes.
- Not only can tool management be simplified, but the number of machines can also be reduced.
- Low cutting force and simplification of machine makes space-saving possible.
- Well finished surfaces Provides well finished surfaces impossible to achieve using cemented carbide tools.
- As one would expect from diamond tools, dimensions remain precise and stable, and shape accuracy can be maintained over long periods of use.
- Increased rotational speed enables shorter machining times.
- Excellent performance can be achieved using environmentally friendly water-soluble cutting oil.

Tool lineup for machining valve bodies**Improved machined surface finish****■PCD reamer with function to prevent work material cracking**

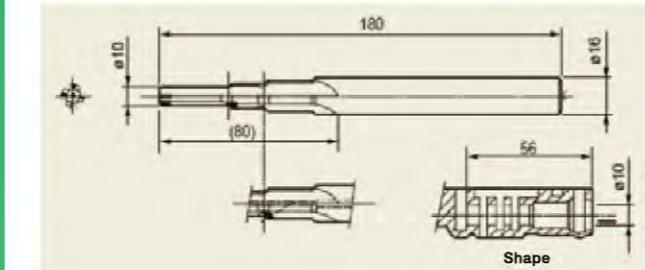
Cracking of the workpiece may cause formation of donut-shaped chips at the finishing hole exit, which may remain on the workpiece. The two-step cutting edge reduces cracking of the workpiece.

■PCD reamer with radial rake angle

An axial or radial rake angle provided on the cutting edge lowers cutting resistance and results in improved cylindricity.

■PCD reamer with chip scraper

Prevents chips from getting caught in the tool at high feed rates using a single flute. Prevents degradation in surface roughness.

For machining valve bodies / PCD rotating tool**An example of valve body machining**

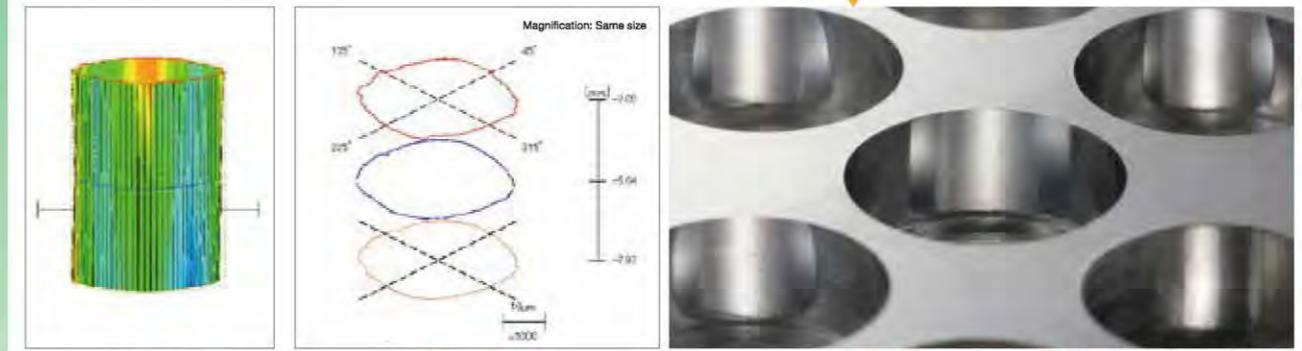
Item	PCD reamer	Carbide reamer
Feed rate (m/min)	120	120
Feed rate (mm/Rev)	0.2	0.2
Stock removal (mm/dia.)	0.4	0.4
Coolant	water-soluble	Water insoluble
Surface Roughness (μmRz)	3	8
Roundness (index)	5	10
Running Cost Ratio	0.5	1

Reamer with unequally spaced flutes reduces chatter and enables high-speed feed

- Greatly reduces chatter and improves cylindricity, roundness, and other parameters.
- Capable of high-speed feed on workpieces that was possible only with a single flute.
- Cycle time can be reduced by about 30% compared to four-flute reamers.
- Design takes rotational balance into consideration.

■Machining examples

Geometry	1-flute balanced	4-flute	4-flute unequal spacing	5-flute unequal spacing
Stock removal (mm/diameter)	0.5~0.7			
Rotational speed (min ⁻¹)		1,000		
Feed rate (mm/min)	400		960	
Feed per revolution (mm/rev)	0.1		0.24	
Feed per cutting edge (mm/z)	0.1		0.06	0.05
Coolant			Water-soluble oil emulsion	
Chatter	None	Yes	None	None
Cylindricity (μm)	6	6	4	3

**■5-flute unequal spacing PCD reamer****Cylindricity 3 μm** **Coaxiality 1 μm** **Surface roughness Ra0.1 μm**

*Note: Image is for illustration purposes.

Transmission

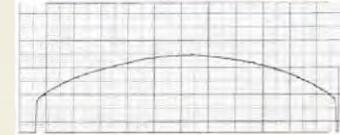
For grinding gears / Disc dresser (Tool for forming conventional grinding wheels)

► Contributing to cost reduction in gear grinding process

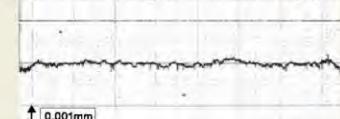
Worm-shaped gear grinding wheels require high tooth form accuracy, a capable and accurate dresser is needed. Our high precision electroplating technology and abrasive surface truing technology can realize "higher accuracy" and "longer life" in gear grinding.



Crowning shape of the disc dresser



Profile accuracy of the crowning part

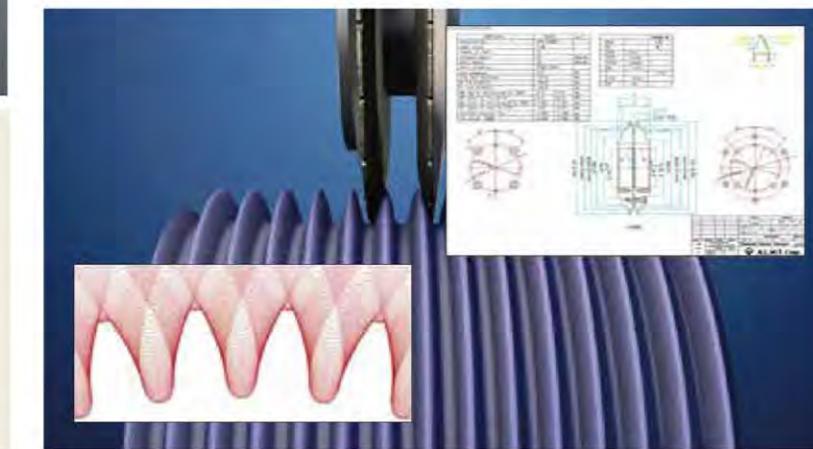


■ Features

- Profile accuracy of 0.001 mm or less. This ensures a high tooth form accuracy.
- Long-lasting tooth form accuracy with good dresser life contribute to great reduction of gear grinding cost.
- Based on gear dimensions and specifications, we will analyze and design a dresser according to the required tooth profile.

■ Applications

- Dressing of worm-shaped conventional grinding wheels used for generating the tooth form of automotive and machine gears.



For machining CVT grooves / High precision electroplated wheel FORMASTER

► Realization of high efficiency and high precision form grinding.

Realizes micron-order contour form grinding of difficult-to-grind materials such as hardened steel and heat-resistant alloy.



■ Features

- High precision contour form grinding possible with.
- Selection of optimum grains according to grinding conditions ensures long life. (Precise electroplating technology) (High accuracy body manufacturing technology)

■ Applications

- CVT pulley rolling groove form grinding

For CVT-related components / Diamond rotary dresser (Tool for forming conventional grinding wheels)

► High precision and long life

A highly precise diamond dresser that offers long life consistently in production lines.



■ Features

- High precision and long life requirements met.

■ Applications

- Grinding of CVT-related components

Steering

For machining steering components / PCD rotating tool

In recent years, the steering housing has become lighter and in machining such housing, rapid feed is required. Our tool design to minimize chattering during machining and diameter and roundness defects enables rapid feed.



■ Features

- Multi-step combination bores can be finished using a single reamer, making it possible to reduce the number of processes.
- Not only can tool management be simplified, but the number of machines can also be reduced.
- Low cutting force and simplification of machine makes space-saving possible.
- Provides well finished surfaces impossible to achieve using cemented carbide tools.
- As one would expect from diamond tools, dimensions remain precise and stable, and shape accuracy can be maintained over long periods of use.
- Increased rotational speed enables shorter machining times.
- Excellent performance can be achieved using environmentally friendly water-soluble cutting oil.

Tool lineup for machining steering housings



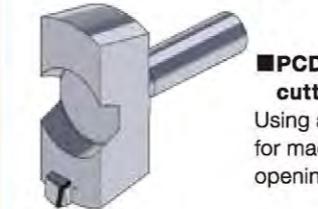
■ 4-flute 8-step PCD reamer

Multi-flute, multi-step PCD reamer with high-precision finish achieves superb coaxial machining.



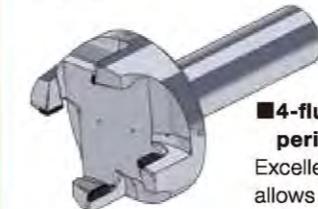
■ 4-flute unequal spacing PCD reamer with interface

An interface minimizes the length that the tool protrudes from the holder.



■ PCD milling tool with indexable cutters for end face milling

Using a single flute and cornered insert for machining the end face of the bore opening reduces tool operating costs.



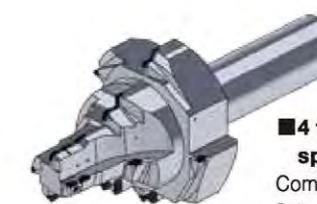
■ 4-flute PCD hollow mill for peripheral machining

Excellent internal diameter accuracy allows high-quality outer circumference plunge grinding.



■ 5-flute unequal spacing PCD reamer

Five unequally spaced flutes reduce chatter, improving the roundness of deep bores.



■ 4 flutes + 5-flute unequal spacing PCD reamer

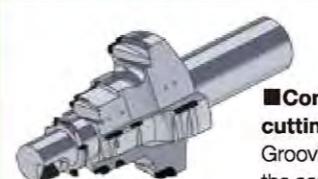
Combining unequally spaced flutes improves machining quality that differs on the same axis.



■ 5 flutes + 3-flute PCD reamer

Five PCD cutting edges and five PCD guides improve roundness. The three flutes of the bore opening reduce chatter.

Combination tools reduce work load (tool change frequency)



■ Combines thread cutting (indexable) with grooving

Grooving and thread cutting using the same tool shortens processing time. Cornered insert for thread cutting lowers tool costs.



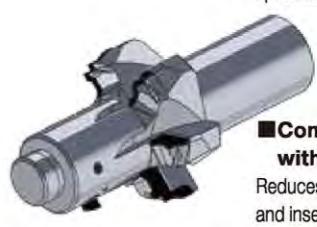
■ Combines back spot-facing (with spot-facing diameter adjustment screw) with reamer

Reduces process steps by offsetting the center and inserting into the pilot hole, and then, after reaming, performing back spot-facing on the same path. Machining diameter for back spot-facing is adjustable.



■ Combines reamer with end mill with center cutting edge

Using a reamer finishing process to complete the bottom surface reduces machining time while improving the diameter, flatness, and surface roughness of the bottom surface.



■ Combines end-face grooving with back boring

Reduces process steps by offsetting the center and inserting into the pilot hole, and then, after grooving on the front side, boring on the back side. Boring diameter is adjustable.

Steering

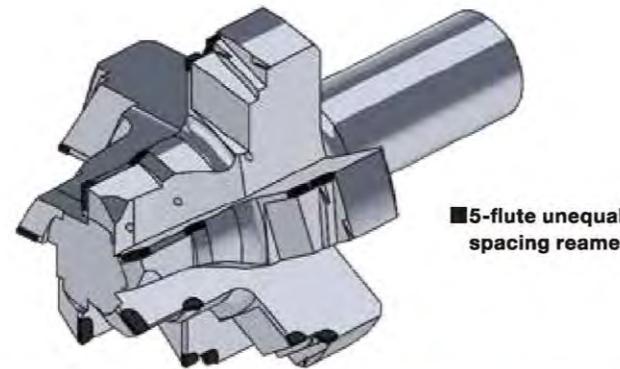
For machining steering parts / PCD rotating tool

►Unequally spaced reamers offer reduced chatter and high-speed feed



Features

- Greatly reduces chatter and improves cylindricity, roundness, and other parameters.
- Cycle time can be reduced by about 30% compared to four-flute reamers.
- Design takes rotational balance into consideration.



■5-flute unequal spacing reamer

Machining examples

	4-flute equal spacing	4-flute unequal spacing	5-flute unequal spacing
Geometry			
Stock removal (mm/dia.)		0.5~0.7	
Rotational speed (min-1)		1,000	
Feed rate (mm/min)	400		125
Feed rate (min/rev)	0.4		0.125
Coolant (mm/z)	Water-soluble oil emulsion		
Chatter	Yes		None
Roundness (μm)	24	18	8
			4

For machining steering components / Diamond rotary dresser (Tool for forming conventional grinding wheels)

►High precision and good cutting ability

A diamond dresser of high precision and good cutting ability. Recommended for large dressers needed for rack processing and worm processing dressers.



Features

- High precision and good cutting ability for large dressers needed for rack processing and worm processing dressers.

Applications

- Steering rack grinding and worm processing

Other automotive components

For machining aluminum wheels / New-D

►Achieves stable and long tool life by measuring and optimizing the crystal orientation.

The diamond crystal orientation has been accurately set by use of X rays and diamond abrasive grains have been bonded firmly to unique shaped carbide material. A combination of the original shape tip and holder facilitates the setting of the tool accurately as with throwaway tips. The tips are designed for linear cutting and curved cutting and the profile accuracy of the tip for profile curved cutting is 5 μm. No chips will be fused or deposited on the rake face to keep producing high quality surfaces even during continuous operations.



Features

- Less dispersion in tool life, which is a weakness of single crystal diamond tools, and 1.5 to 2 times longer tool life than conventional tools on average.
- The combination of our originally-designed inserts and holders enables easy and precise tool setting like indexable inserts.
- There are inserts for straight cutting and those for curved-surface copying. The form accuracy of the latter is 5 μm.
- The rake face is free from adhesions and accumulation of chips and maintains the high quality of worked surfaces even during continuous use.
- The diamond is firmly attached by a unique brazing method.
- Exhibits high durability even during interrupted cutting.
- Unlike the conventional type with a retaining cap, there is no retaining cap to hold the diamond, enabling chips to move smoothly on the rake face, improving the machining accuracy.

Applications

- Automotive components(pistons, aluminum wheels, compressors, commutators, etc.)
- Plastic lenses, resin parts

Insert types

Insert specifications	Types		Corner radius θ	I.C. φA (mm)	I.H. φB (mm)	Thickness h (mm)	Holder
	Long Life type	Precision type					
NWD-CL302	NWD-CP302	R0.2					NDH-R1□
NWD-CL305	NWD-CP305	R0.5					-L1□
NWD-CL308	NWD-CP308	R0.8					-N1□
NWD-CL310	-	R1.0					NDH-QR1□
NWD-CL316	-	R1.6					-Q1□
NWD-CL320	-	R2.0					
NWD-PL302	NWD-PP302	R0.2		φ9.525	φ4.4	+0.2	NDH-RO□
NWD-PL305	NWD-PP305	R0.5					-LO□
NWD-PL308	NWD-PP308	R0.8					-NO□
NWD-PL202	NWD-PP202	R0.2					NDH-R20V
NWD-PL205	NWD-PP205	R0.5					-L20V
NWD-PL208	NWD-PP208	R0.8					-R25V

*1 : Precision type/cutting edge contour precision 5um or less *2 : Special process to cutting edge

When ordering
Insert types NWD-C L 3 02
Clearance angle 7°
Holder types NDH-R 0 6
Right Hand (Left Hand is "L")

Holder types	Types		Size(mm)			Insert
	Right Hand	Left Hand	W	L	S	
NDH-R06	NDH-L06		6	50	6.5	6
NDH-R08	NDH-L08		8	60	8.5	8
NDH-R10	NDH-L10		10	80	10	10
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
NDH-R25V	NDH-L25V		25	150	32	25

Size(mm)

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

For processing various rubber belts / PSL wheel

►Ideal for materials that tend to cause loading such as rubber and resin.

It has high abrasive grain holding power, together with large abrasive grain protrusion amount and abrasive grain spacing, providing excellent sharpness and discharge performance of chips.



Features

- Ideal for machining that tends to cause loading due to deposition of chips such as rubber and resin.

Applications

- Machining of various automotive rubber belts

For glass beveling / Beveling wheel

►High quality surface

The employment of bond that has high grain holding power provides long-lasting sharpness to produce high quality surfaces.



Features

- High quality surface produced.
- Bonds are lined up to meet various machining conditions and workpieces.

Applications

- Beveling of automotive glass, ceramics and magnetic materials

For machining steering components / Diamond rotary dresser (Tool for forming conventional grinding wheels)

►High precision and good cutting ability

A diamond dresser of high precision and good cutting ability. Recommended for large dressers needed for rack processing and worm processing dressers.



Features

- High precision and good cutting ability for large dressers needed for rack processing and worm processing dressers.

Applications

- Steering rack grinding and worm processing

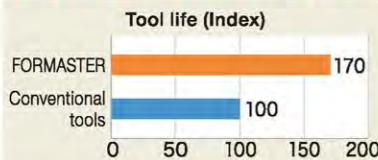
For various motor magnets / High precision electroplated wheel FORMASTER

►High efficiency and high precision form grinding

This is a high precision electroplated wheel realized by our original precision electrodeposition technology and shows excellent shape retention performance and long-lasting sharpness in form grinding. Since truing/dressing on a machine is not required, high precision and high efficiency form grinding is possible.



Magnetic substance (ferrite)
Life increased 1.7 times from the conventional tools.



Features

- Reduced grinding force: Long-lasting sharpness ensured by "precision electrodeposition technology."
- Long life: Improved grain density and grain holding power in edges and concaves.

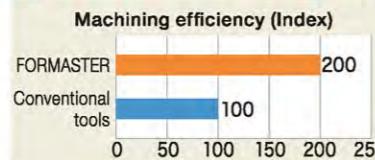
Applications

- Form machining of motor magnetic substance (air conditioners, EPS, power windows, HV drive motors)

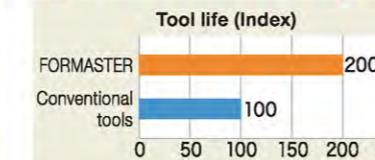
Machining examples

Results of magnetic substance machining

Magnetic substance (Neodymium)
Improvement over conventional tool by 2 times



Magnetic substance (Neodymium)
Improvement over conventional tool by 2 times



Results of shape measurement (after grain fixing)



Standard manufacturable range

Abrasive grain	Diamond and CBN
Grain size	#60~#170
Tool diameter	φ30~350

*Depending on specifications, some wheel designs may be not be manufactured. If you require specific specifications please consult with us.

For finishing various holes / Super sizing reamer

►Highly precise hole finishing by one pass

A high performance superabrasive reamer capable of finishing holes precisely by one pass.



Features

- Capable of one-pass hole machining.
- High accuracy (roughness · roundness · cylindricity).
- Reduction of rolled edge around lubricant hole or keyway.
- Skill is not required.

Applications

- Hole finish machining of automotive parts and cast iron hydraulic component.

Machining examples

□ Hole finish machining of hydraulic components

1) Tool specification	CBN80-P
2) Tool size	φ18.5 0,+0.005
3) Workpiece	FC250 or equivalent
4) Dia.	φ18.5H6 (+0.13,0)
5) Conditions	Tool peripheral speed 7.6m/min Feed rate 26mm/min Stock removal φ0.01mm Coolant Straight oil
6) Coolant	

[Results]	
Hole roundness	0.002mm or less
Hole cylindricity	0.004mm or less
Roughness	Ry2.6μm

Super sizing finishing accuracy
(Example: Stock removal φ0.03mm)

Roundness	0.002mm or less
Cylindricity	0.002mm or less
Surface roughness (*)	Ry 2μm or less
Hole diameter	φ4μm or less

*JIS B0601-1994

Standard manufacturable range

Abrasive grain	Diamond or CBN
Grit size	#40~#270
Tool diameter	φ5~50 (Tolerance ±0.002mm)
Run-out	0.005mm or less

For specifications other than the above, please contact us.

For machining automotive bearings / Diamond rotary dresser (Grinding wheel forming tool)

►Highly precise and highly efficient dressing possible.

A dresser capable of high precision dressing required for processing various shapes of small and large bearings can be produced. We meet needs of customers with our diversified manufacturing techniques and various options.



Features

- RZ type: Diamonds electroplated densely to provide high precision and long life.
- SZ type: Diamonds set regularly to allow the selection of concentration according to needs.
- SX type: Outstanding sharpness realized by our original diamond setting patterns and precision powder metallurgy and precision machining technology.

Applications

- Grinding of various ball races, roller bearing rolling surfaces and CVJ components

For improving wear resistance

- Super high concentration: Number of diamonds per unit area increased to ensure consistent life.
- Strong: Diamonds set in areas that are likely to be affected by wear to improve wear resistance.

*For details, see page 58.

For machining hub units / Diamond rotary dresser (Tool for forming conventional grinding wheels)

►High precision and long life

A high precision diamond rotary dresser with various sharpness options. Ensures high precision grinding of various components of hub units.



Features

- RZ type: Diamonds electroplated densely to provide high precision and long life.

Applications

- Grinding of ball races and roller bearing rolling surfaces, internal/external grinding of outer races, etc.

Improved dressing ability (for fast dressing)

- GB: Glass ball (GB) set in the grain layer to realize low concentration.
- SEGMENTED: Evacuation and discharge of chips and grinding fluid improved.

*For details, see page 58.

For various profile dressing / Diamond rotary dresser

►Consistent dressing performance

These dressers are manufactured by holding prismatic diamonds in arrays on a metal base with sintered metal. Because carefully selected prismatic diamonds are used, the area of diamonds acting on the wheel surface stays constant, maintaining the consistent dressing performance. Moreover, the most suitable dressing performance can be obtained by adjusting the size of diamonds and the number of arrays.



Features

- Because the area of acting diamonds stays constant, it maintains stable dressing performance.
- Optimum dress performance can be obtained by adjusting the size of diamonds and the number of arrays.

Applications

- Profile dressing in grinding of various automotive components

LED lens mold ultra-precision cutting tool UPC

A diamond cutting tool for molds of automotive LED light parts. When used on an elliptical vibration cutting unit, this tool enables ultra-precision cutting of hardened steel and cemented carbide.

**Features**

- Mirror finish cutting of harden steel and stainless.

Applications

- Cutting of LED lens molds, cutting of hardened steel and cemented carbide

■Ultrasonic vibration cutting device EL-50Σ
Product of Taga Electric Co.,Ltd.

■Image of ultrasonic elliptical vibration cutting
Workpiece cross-section

■UPC for EL-50Σ
UPC cutting edge
Chips
Ultrasonic elliptical vibration

Sensor camera mold ultra-precision cutting tool UPC-R / BL-UPC

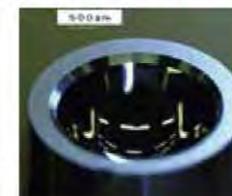
The automotive lens used in autonomous drive and automatic brake requires higher accuracy. Ultra-precision lens mold machining tools from A.L.M.T. are capable of meeting these severe requirements.

**Features**

- Highly precise lens, regardless of glass or plastic, can be produced.

Applications

- Machining of various automotive lens molds

Machining of cemented carbide molds with BL-UPC**Head up display mold ultra-precision cutting tool UPC-Nano Profile / UPC-Nano ballendmill**

Molds of various lenses used in head up display units and optical parts are machined precisely.

**Features**

- Ultra-precision mold machining is possible.

Applications

- Machining of molds of various head up display unit components such as micro lens alloys, combiners and lenses.

For grinding inverter substrates / Nanomate Premium**► Highly efficient and high quality grinding of SiC wafers**

Combining diamond grit and vitrified bond with suitable ratio to obtain best grit clearance for efficient grinding. Continuous grinding of monocrystal SiC is now available. Especially, superabrasive wheel can process with same feed rate as the one for silicon wafer grinding to obtain extremely smooth surface.

**Features**

- Continuous grinding of single crystal SiC wafers is possible.
- High quality grinding shortens the post-process CMP time significantly.

Applications

- Ultra-precision surface grinding of SiC wafers
*For details, see page 36.

For MEMS grinding / Nanomate Premium**► Low-load to ensure crack-free grinding**

MEMS substrate silicon wafers that easily break due to a cavity in the silicon/glass substrate can be ground without cracks.

**Features**

- No cracks thanks to low-load grinding.
- Continuous grinding of through holes and deep wafers.

Applications

- Micro sensors (acceleration sensors), etc. MEMS substrate grinding.
*For details, see page 37.

Double disc wheel for grinding motor magnets / Resin bond wheel**► Dressing performance and high wear resistance realized at a high level.**

This is a resin bond wheel that has abrasive grains optimized to improve the retention of sharpness in double-ended surface grinding and the good dressing performance & wear resistance realized simultaneously. The CBN grains used realize excellent performance in grinding ferrous sintered alloy parts. The diamond grains used enable high efficiency grinding of magnetic parts and ceramic parts.

**Features**

- The long-lasting good sharpness and high dressing performance/wear resistance improve productivity significantly.

Applications

- Grinding including pump parts for oil pump parts for cars, engine parts of cars, air-conditioner, magnetic parts, and ceramics parts

For drawing wires for motors / Diamond shaped wire drawing dies**► Wires drawn to various shapes such as square and track accurately.**

Non-circle section profiles are important characteristics to coiling wire for high voltage transformer, or connecting pins and flat cables in ordinary household appliances, fashionable necklaces and chains are produced with the Shaped wire drawing dies. A.L.M.T.Corp. puts the Know-how to create these dies.

**Features**

- Wire material with superior surface luster and high dimensional precision can be obtained in comparison with wire rolling methods.
- Can be used with a wide range of wire cross sections, including square to track shape.
- With regards to a square, it is available to produce up to minimum 0.1mm per a side.
- Material type is polycrystalline diamond.

Applications

- Copper wires for various motors, flat cables, alternator, voice coil motor, actuators.

Tools / Machinery

Various types of wheels lined up to meet requirements of machinery and environment.

Drill / end mill

For flute grinding / Flute Master

► Outstanding performance in creep feed grinding by use of water-insoluble grinding fluid.

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.



Features

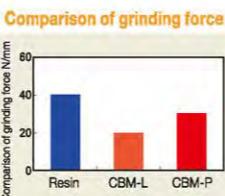
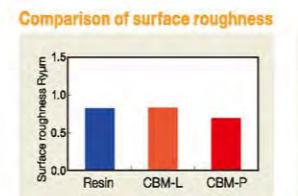
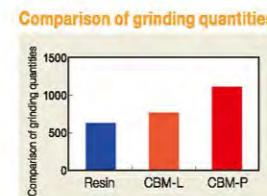
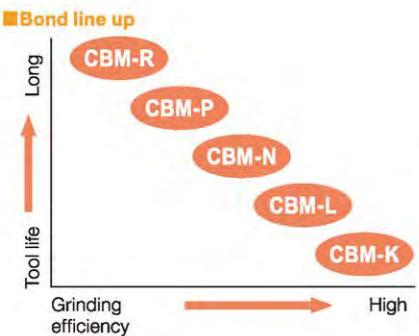
- High wear resistance extends the dressing intervals to reduce tooling cost.
- Good sharpness and wear resistance realize highly efficient grinding.
- High quality surfaces can be achieved since chipping and other problems can be reduced.

Applications

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

Machining examples

- Comparison with resin bond wheel
- 1) Wheel specification ①Resin bond : BN140-100B
②CBM-L : BN140-L100CBM
③CBM-P : BN140-P100CBM
- 2) Workpiece • SKH51 (HRC60)
- 3) Conditions • Wheel Peripheral Speed : 1500m/min
• D.O.C. : 1mm • Feed rate : 40mm/min
• Coolant : Oil-based • Machine : Horizontal spindle surface grinder



Examples of wheels mounted on arbors for flute grinding



A.L.M.T.'s various flute grinding wheels mounted on arbors of tool grinders enable highly efficient and highly precise grinding regardless of grinding fluids and workpiece materials.

For flute grinding / Flute MAX

► Demonstrates high performance in high-load grinding using water-soluble grinding fluid.

A resin bond wheel equipped with both good sharpness and long life realized by using super-heat resistant resin and special filler. This wheel has good sharpness and good shape retention in creep feed grinding of various tools such as grooving of end mills, drills and reamers.



Features

- Super heat resistant resin helps to reduce deterioration under high temperature.
- 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 wheels which lead to high efficiency and cost reduction.

Applications

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

Bond line up

Bond grade	Special feature
L	Superior cutting ability
N	Standard
P	Superior shape retention

For flute grinding / RESIACE

► Demonstrates high performance in heavy grinding

Polyimide resin has the greatest heat resistance of all resins, and is used for functional materials of space aeronautics. RESIACE are super-heat resistance resin bonded wheels that maximize the features of polyimide resin. They demonstrate extremely high performance in grinding that usually causes deterioration from heat with conventional resin bonding.



Features

- The very high heat resistance protects the bond from becoming deteriorated due to heat under severe grinding conditions.
- Since the good sharpness lasts for a long time and the shape truing intervals are extended the grinding efficiency can be improved and cost can be reduced.

Applications

- Grooving of end mill/drill/reamer
- Breaker grinding of cutting edge replacement chips

Bond line up

Bond grade	Special feature
BRA10	Superior cutting ability
BRA20	Standard
BRA30	Longer life

Centerless grinding wheel

► Excellent sharpness sustainability improved productivity

Since the bond that has high grain holding power and excellent dressing performance is employed, the sharpness continues for a long time and the grinding efficiency is improved significantly. This wheel ensures high productivity in mass production OD finishing of round bars of cemented carbide and similar parts.



Features

- The long-lasting sharpness improves the grinding efficiency significantly.

Applications

- Mass production OD finishing of round bar material such as cemented carbide, ceramics and ferrous material

Combination type option

A combination of metal bond and resin bond is also possible. An optimum specification can be presented by combining a suitable bond type and grain size.

For grinding periphery and cutting edge / Flank Master Type-M

►Highly efficient grinding of cermet by use of water-insoluble grinding fluid

As more equipment and machinery that use water insoluble grinding fluid for the purpose of reducing mechanical load have been introduced, there is an increasing demand for grinding wheels that have excellent thermal diffusivity. A newly developed wheel "Flank Master Type-M", that is made of metal bond, ensures long-lasting sharpness and consistent quality under where water-insoluble grinding fluid is used.



Features

- Since dress interval is lengthened by grinding with insoluble water based coolant, it is possible to lower tool costs and increase grinding efficiency.
- High grinding accuracy and consistent grinding quality.
- Excellent performance even in carbide grinding and non-soluble water based coolant grinding.

Applications

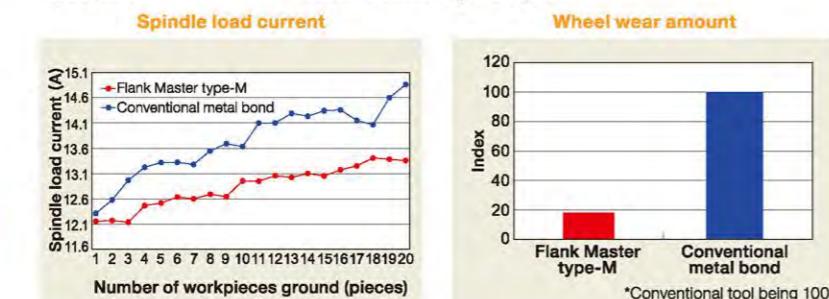
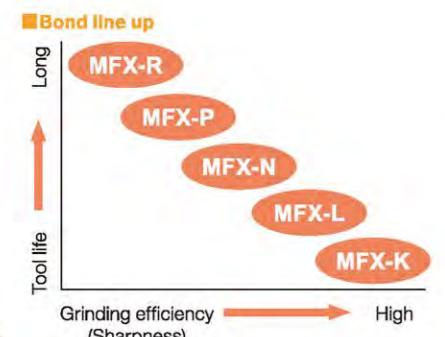
- Peripheral and cutting edge grinding of cermet and carbide inserts.

Machining examples

□Comparison with conventional metal bond wheel

- 1)Machine NC peripheral grinder
- 2)Wheel specification ①Flank Master Type-M
- 3)Workpiece ②Conventional metal bond
- 4)Coolant High-toughness difficult-to-grind cermet

Water insoluble grinding fluid



For grinding of periphery and cutting edge / Flank Master Type-V

►High efficiency and high precision grinding of cutting edges of PCD/PCBN tools.

Since the bond that has high grain holding power and porous structure that meet these requirements is employed, both sharpness and wear resistance can be utilized simultaneously to realize high efficiency and high precision grinding.



Features

- Both sharpness and wear resistance can be utilized in grinding of cutting edges of PCD/PCBN cutting tools to realize high efficiency and high precision grinding operations.

Applications

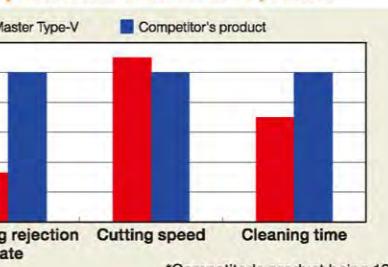
- Grinding of cutting edges of PCD/PCBN cutting tools.

Machining examples

□Comparison with competitor's vitrified bond

- 1)Machine NC outer grinder
- 2)Wheel specification ①Flank Master Type-V
- 3)Workpiece ②Competitor's vitrified bond wheel
- 4)Coolant PCD (Polycrystalline Diamond) water-soluble

Comparison with other maker's product



Comparison of ground surfaces



For grinding periphery and cutting edge / Flank Master Type-R

►Ideal for grinding of cutting edges of carbide/cermet cutting-edge replacement chips.

The employment of the "BFX Bond" with newly developed special metal filler added improves the heat dissipation performance over conventional resin bond wheels. Thermal degradation of abrasive grains and binding material due to grinding heat can be reduced and good sharpness and long life can be realized simultaneously. Three grades are available to meet various grinding conditions and workpiece requirements.



Features

- Realizes good cutting ability and long tool life.

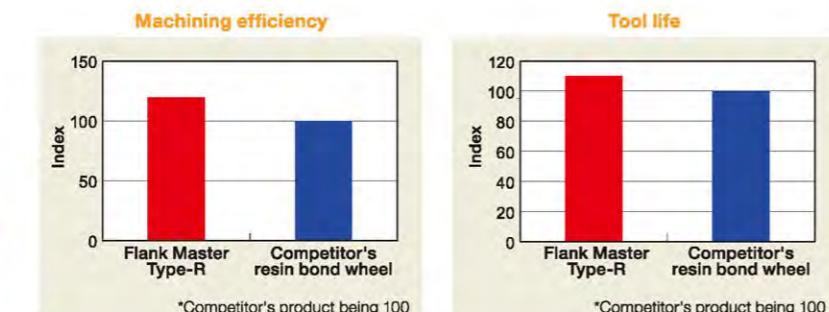
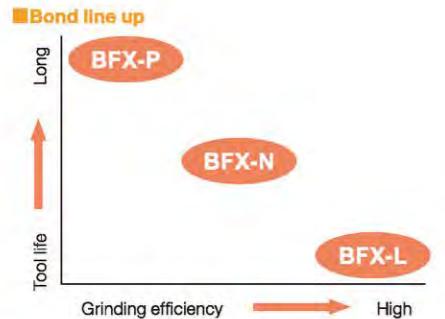
Applications

- Grinding of periphery and cutting edges of carbide/cermet cutting-edge replacement chips.

Machining examples

□Comparison with competitor's resin bond wheel

- 1)Machine NC peripheral grinder
- 2)Wheel specifications ① Flank Master Type-R
- 3)Workpiece ② Competitor's resin bond wheel
- 4)Coolant carbide / cermet water-soluble



For thickness grinding / Flat Master

►Ideal for thickness processing of carbide/cermet cutting-edge replacement chips

Processing the thickness of carbide/cermet cutting edge replacement chips involves a problem that abrasive grains are sunk into the bond by the grinding pressure to deteriorate the sharpness, causing the productivity to drop. "Flat Master" employs highly rigid bond material to solve this problem, thus minimizing the drop in productivity.



Features

- Sinking of abrasive grains during grinding is minimized by employing highly rigid bond material to retain good sharpness for a long time.

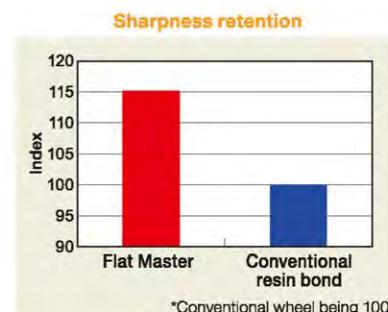
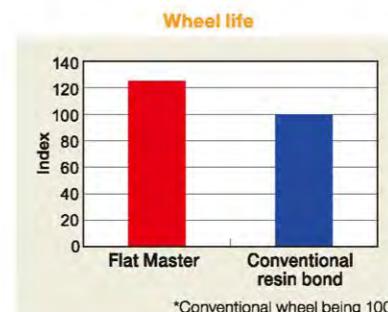
Applications

- Thickness processing of cutting-edge replacement chips of carbide/cermet

Machining examples

□Comparison with conventional resin bond wheel

- 1)Machine Parallel-surface honing machine
- 2)Wheel specification ① Flat Master
- 3)Workpiece ② Conventional resin bond
- 4)Coolant carbide / cermet water-soluble



Machine tool

For guide rail processing / Diamond rotary dresser (General grinding wheel forming tool)

►High precision and high efficiency dressing

A high precision dresser required for processing of rails and blocks of various shapes can be produced. We meet needs of customers with our diversified manufacturing techniques and various options.



Features

- RZ type : Diamonds electroplated densely to provide high precision and long life.
- SZ type : Diamonds set regularly to allow the selection of concentration according to needs.
- SX type : Outstanding sharpness realized by our original diamond setting patterns and precision powder metallurgy and precision machining technology.

Applications

- Linear guide parts (block/rail), ball screws, spline, etc.

Oil pump parts grinding wheel / MB SPARK

MB SPARK is a wheel made with highly rigid special metal bond suitable for double-ended surface grinding and offers outstanding sharpness realized by high grain holding power and good wheel surface retention provided by electro-discharge truing.



Features

- Electro-discharge truing realizes life about 3 times longer than general resin bond wheels.
- Long lasting cutting performance and high-wear resistance.
- Less industrial waste-stops sludge produced from wheel during truing.

Applications

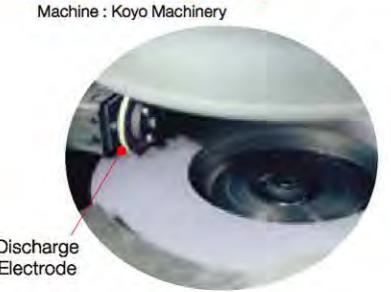
- Household pump parts, industrial oil pump parts, automotive engine parts

Machining examples

Comparison with conventional resin bond wheel	
1)Machine	Koyo KVD-300
2)Wheel specification	①MB SPARK #230-MED ②Resin Bond Wheel #140-B
3)Wheel size	Φ305-75W-3X
4)Workpiece	Oil pump component (Powdermetal SMF4040) water-soluble
5)Coolant	water-soluble
6)Conditions	Wheel rotation : (Upper, Lower) 1500min-1 (C.C.W) Stock removal (rough) : 0.19mm (both sides) Feed rate (rough) : 0.035mm/sec Stock removal (finish) : 0.01mm (both sides) Feed rate (finish) : 0.015mm/sec Spark out : 2sec

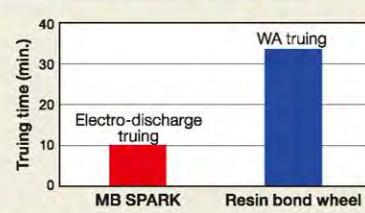
Electro-discharge truing

Machine : Koyo Machinery

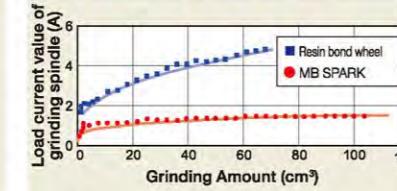


Discharge Electrode

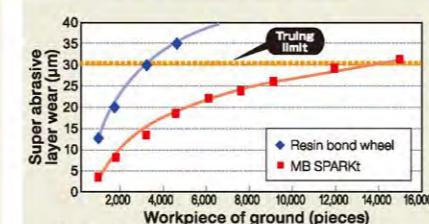
Comparison of truing time



Comparison of load current values



Super abrasive layer wear



High Truing Performance

MB SPARK allows for shorter work time on grinder quick truing with high accuracy using special low-melting metal bond suitable for electro-discharge truing.

High Grindability

Possible to grind with high processing feeds due to good cutting ability that is maintained by the high grit holding force and electric discharge truing.

Long Lasting Quality

Since wheel wear is minimal and abrasive layer flatness is kept, it is possible to radically lengthen the truing interval.

Other

For machining polygon mirrors for copier photosensitive drums / Ultra-precision cutting tool UPC-F

►Excellence in high efficiency and ultra-precision cutting of planes and cylinders.

Drastically reduces or dispenses with running-in processing time. You can obtain uniform, high-quality worked surfaces by setting the roundness (sharpness) of the cutting edge according to the work material and processing conditions.



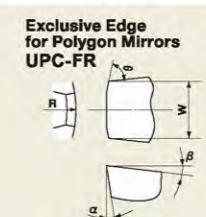
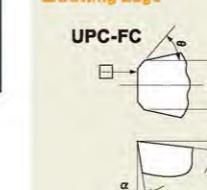
Features

- Good burnishing effect can be achieved and highly efficient mirror finishing is possible.
- Our original ultra-precision polishing technology has realized very sharp cutting edges.

Applications

- Plane and cylindrical mirror finishing of polygon mirrors for copier photosensitive drums, laser reflection mirrors

Cutting Edge



Dimension and Highest Accuracy

Type	Tool Edge Angle θ	Tool Width	Clearance Angle α	Rake Angle β	Side Rake Angle γ	Rake Face R
UPC-FC	45°~80°	1.0~4.0	0°~5°	-5°~0°	0°~15°	—
UPC-FR	10°~45°	2.0~4.0	2°~5°	0°	0°	30~40mm

For machining hydraulic parts / Super sizing reamer

►Allows high precision hole finishing by 1 pass

"Super Sizing" is a superabrasive electroplated reamer that is capable of "highly precise," "high quality" and "highly efficient" finishing of holes of various parts. In hole finishing such as honing, milling, fine boring and internal grinding, various problems are encountered such as poor machining accuracy of surface roughness, roundness, cylindricity and concentricity and large hole diameter variation. These problems can be resolved by use of "Super Sizing."



Features

- Easy to maintain accuracy in severe hole tolerance grinding.
- Possible to obtain good surface roughness with high grinding accuracy.
- Highly efficient grinding by one pass.
- Minimized rounding of affected areas in finishing oil holes, notches and holes with keyway.
- Continuous automated operations (skill-less).

Applications

- Finishing holes of cast iron hydraulic components and automotive components.

Comparison of performance of Super Sizing with other hole finishing operations

Performance	Processing method	Super sizing	Honing	Internal grinding	Fine boring Milling
Roundness, cylindricity	○	○	○	△	
Surface roughness	○	○	○	△	
Retention of hole diameter dimension	○	△	○	x	
Finishing efficiency	○	○	△	○	
Finishing of oil holes, notches, holes with keyway	○	△	△	x	
Finishing long holes relative to diameter	○	○	x	△	

Super Sizing Finishing Accuracy (Example: Stock removal < 0.02mm)

Roundness	0.002mm or less
Cylindricity	0.002mm or less
Surface roughness*	Ry 2µm or less
Tool diameter	Φ5 - 50(Tolerance ± 0.002mm)
Run-out	0.005mm or less

Standard manufacturable range

Abrasive	Diamond/CBN
Grit size	#40~#270
Surface roughness*	Ry 2µm or less
Tool diameter	Φ5 - 50(Tolerance ± 0.002mm)
Run-out	0.005mm or less

For other specifications, please contact us.

Profile grinding / PGV·PGS wheel

►High shape retention ability realized

The highly wear-resistant bond that has been developed for profile grinding operations is employed. Even if minute shapes, the shape is retained and shape collapse by grinding can be minimized. Since the body has been finished by grinding, high run-out accuracy can be achieved.



Features

- The tool cost can be reduced as the life is extended.
- High sharpness ensures highly efficient grinding.
- Good surface roughness can be produced.
- High run-out accuracy is realized.

Applications

- Profile grinding of cemented carbide, cermet, etc.

For processing reduction gears / Diamond rotary dresser (General grinding wheel forming tool)

►High accuracy and high efficiency dressing

A diamond rotary dresser that offers good sharpness and high contour accuracy realized by utilizing the precision electroforming technology.



Features

- High contour accuracy is realized.
- Life can be extended.

Applications

- Profile and form grinding of involute and cycloidal shape, etc.

For tap grooves / Diamond rotary dresser (General grinding wheel forming tool)

►High accuracy and high efficiency dressing

Dressers according to required pitch sizes are manufacturable.



Features

- The precision electroforming technology and machining technology allow processing of various complicated and fine shapes.

Applications

- Various tap grooving.

Optical parts

We propose a tool with nano order that utilizes various precise technologies where high precision machining is required.

Lens Mold / Optical

Cemented carbide lens molds / Ultra-precision cutting tool BL-UPC

►Achieves long tool life in mirror finish and fine machining of carbides

"SUMIDIA Binderless" is the new material that has been developed by Sumitomo Electric Industries, Ltd. Ultra fine particles in size of several tens of nanometers have been bonded firmly without the use of binding material, providing hardness that exceeds single crystal diamond. Also there is no crystal anisotropy and cleavage. We have combined this material with our strong point, diamond precision polishing technology, to realize the tool that is very strong against chipping more than ever and long tool life.



Features

- Features of SUMIDIA Binderless
- Fine grains of several tens of nanometers are firmly and directly bonded together without binder.
- Harder than mono crystalline diamond.
- No anisotropy and specific cleavage.

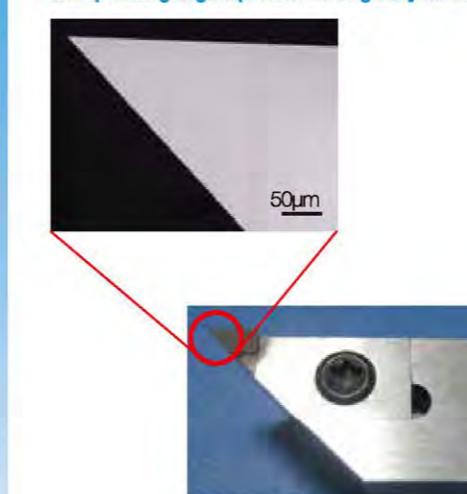
Features of BL-UPC

- Superior chipping and wear resistance compared to single-/poly- crystal diamond.
- Sharp and precise cutting edge equivalent to UPC (Single crystal diamond).
- Free from uneven wear caused by crystal orientation due to no anisotropy.

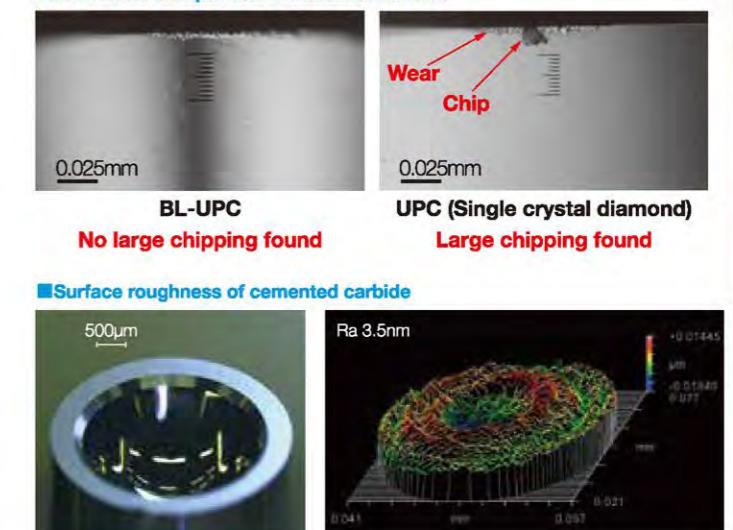
Applications

- Molds for carbide glass lenses, machining of other high-hardness and brittle materials

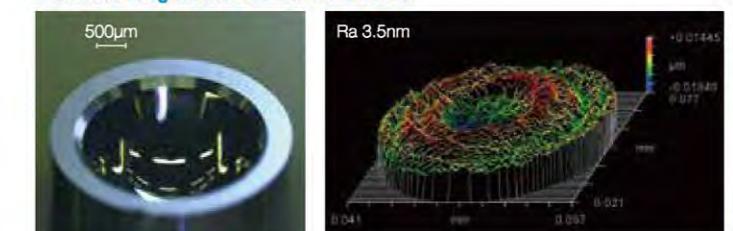
Sharp cutting edge equivalent to single crystal diamond



Flank wear comparison of machined carbide



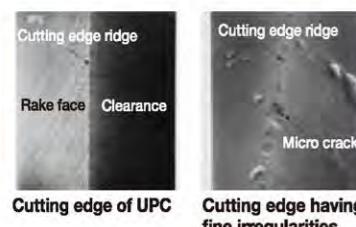
Surface roughness of cemented carbide



Various molds such as spherical/aspherical lens, camera lens, etc. / Ultra-precision cutting tool UPC-R

Outstanding performance in ultra-precision cutting

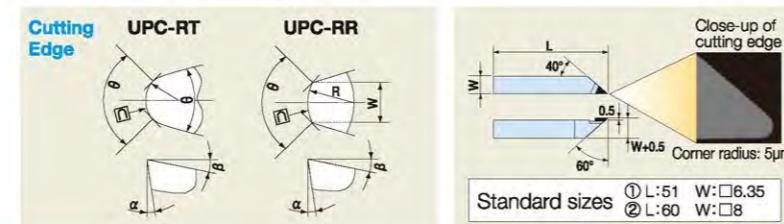
This is a ultra-precision cutting tool for molds of products that require very high accuracy such as spherical and aspherical lens and camera lens. The cutting edges polished precisely by our originally developed technology cut workpieces on the nanometer order to produce very precise micro shapes.

**Features**

- Achieves an edge arc profile of 50nm (0.05μm) over a wide working angle range of 90°.
- The cutting edge is uniformly finished in high quality, achieving a surface roughness in the order of nanometers.
- A record of the edge arc profile measured with our originally-developed measuring instrument (with a resolution of 5nm) is attached to the product for thorough quality control.

Applications

Molds of pickup lenses for BD, molds of lenses for digital cameras, molds of camera lenses for cell phones, PC and tablets, spherical/aspherical mirrors, etc.

**Dimension and Highest Accuracy**

Type	Contour(μm) □			Corner radius R	Tool edge angle θ	Tool width(RR)	Clearance angle α	Rake angle β
UPC-R	aaθ ≤ 90°	aaθ ≤ 120°	aaθ ≤ 150°	0.002~200	min 15°	0.5~5	0°~20°	-30°~10°
	Ultraprecision	0.05	0.1					
Precision	0.25	0.5	1					

Sharp cutting edge

Micro feed to prevent workpiece deformation to realize damage-free cutting.

Nanometer order ultra-fine machining possible.

Chipping-free cutting edge

No irregularities transferred to workpieces to produce mirror finish.

Mirror finishing below Ra 5nm possible.

Fresnel lens molds, etc. / Ultra-precision cutting tool UPC-T

Ideal for fine grooving

The cutting edge ridge is free of chipping and waviness. It is uniform and very sharp. The shape of cutting edge tips is guaranteed in the order of submicron.

**Features**

- The cutting edge is uniform and extremely sharp, free from chipping and undulation.
- Guarantees the cutting edge shape in the order of submicrons.

Applications

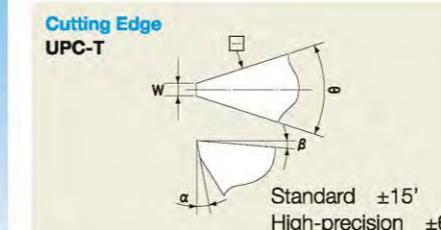
- Fresnel lens molds, LCD light guide plate molds

Machining results

Molding of LCD display optical waveguide

Dimension and Highest Accuracy

Type	Tool Edge Angle θ	Angle tolerance	Leading edge width	Clearance Angle α	Rake Angle β
UPC-T	Ultraprecision	less 45°	±6'	min 0.2μm	0°~15°
	Precision	min 45°	±15'	Sharp Corner	



Various molds such as Infrared lens molds / Ultra-precision cutting tool UPC-R

Outstanding performance in fine machining of hard and brittle materials.

The tool life has been a serious issue in machining germanium and silicon lenses used for infrared sensors and night vision lenses. The tool life has been extended significantly by applying our original minute cutting edge treatment to the single crystal diamond cutting edge.

**Features**

- The cutting edge height (center height) stays the same on any conical surface.
- The tool has a sharp cutting edge of nanometer accuracy.
- The profile accuracy of the cutting edge is as high as 0.05 μm.
- This tool can also be used for machining calcium fluoride and cemented carbide.

Applications

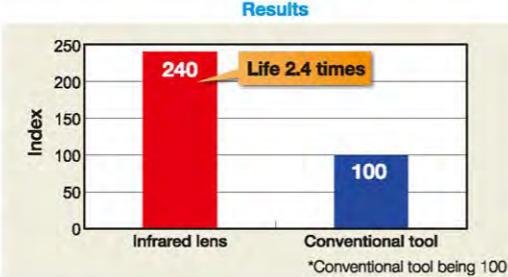
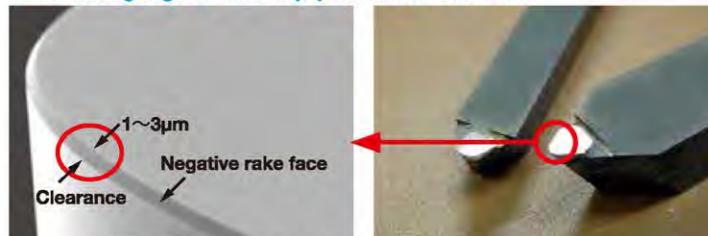
- Infrared sensor lens, night vision camera lens, germanium lens, silicon lens, calcium fluoride lens, cobalt-less carbide mold

Machining results

Workpiece: Infrared transmission lens, φ95-mm germanium lens

Tool spec.: Corner radius 1.5 mm, clearance angle 10°

Conditions: Revolution 2,000 rpm, feed rate 1.75 μm/rev, stock removal 1.5μm

UPC cutting edge for infrared (IR) lens and carbide molds

Hardened steel, carbide and glass material molds / Elliptical vibration cutting tool UPC

Mirror finishing of hardened steel and glass.

A combination of an elliptical vibration unit from Taga Electric Co., Ltd. and A.L.M.T.'s UPC tool enables ultra-precision cutting of hardened steel, cemented carbide and glass materials, which are difficult to machine with conventional tools.



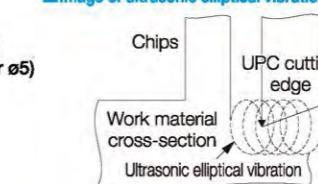
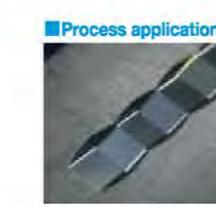
Ultrasonic vibration cutting device EL-50Σ
Product of Taga Electric Co.,Ltd.

Features

- Features of EL-50Σ
 - High frequency around 41kHz makes 1μm or more elliptical vibration.
 - Ultra precise technique of automatic tracking for elliptical vibration route with lower than 1nm precision.
 - Small vibrator can be attached to ultra precision machine or machining center.
 - Work with AC 100V and no need for special installation work.

Features of elliptical vibration cutting

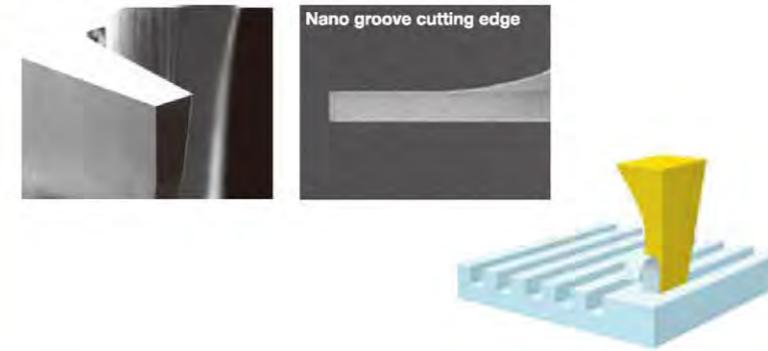
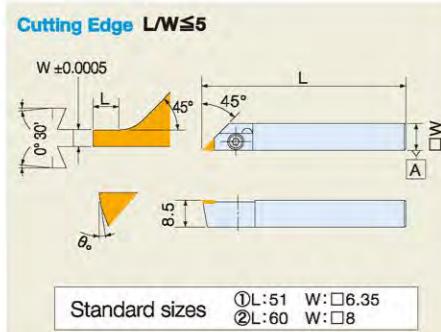
- Mirror finish cutting of harden steel and stainless.
- Stable mirror finish cutting of cemented carbide and glass.
- High accurate corner cutting.

Image of ultrasonic elliptical vibration cutting**UPC for EL-50Σ**

Optical sheet molds / Ultra-precision cutting tool UPC-Nano groove

► Highly precise linear grooving is enabled by the world's smallest class cutting edge.

A rectangular grooving tool having a cutting edge width as small as 3 μm . Grooves of high aspect ratio not achievable by the photolithography and ion beam methods can be produced within a short period of time. The cutting edge that is very precise and durable makes this tool ideal for linear ultra fine grooving of holographic gratings and ultra fine & clear grooving of LCD light guide plates.



Features

- Grooving tool with cutting edge width of 5 μm .
- Provides the world's highest dimensional accuracy of $\pm 0.5 \mu\text{m}$.
- High-precision-polished durable cutting edge.
- Enables high-precision fine grooving that cannot be achieved using the photolithography or ion-beam method.

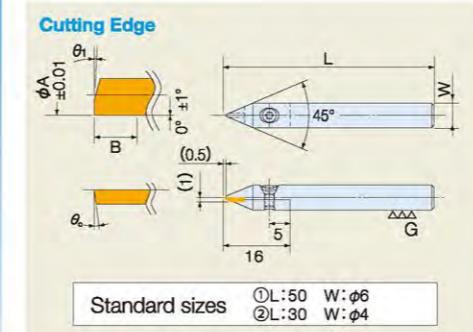
Applications

- Fine linear grooving, Optical sheet molds, light guide plate molds

LCD light guide plate molds / Ultra-precision cutting tool UPC-Nano endmill

► Free curve ultra fine grooving of world's smallest class possible.

An end mill capable of machining rectangular grooves of 30 μm width by free curve. Grooves of high aspect ratio not achievable by the photolithography and ion beam methods can be machined within a short period of time to sharp-edged shapes.

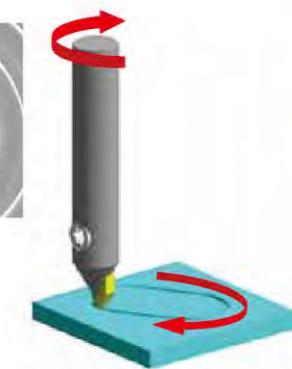
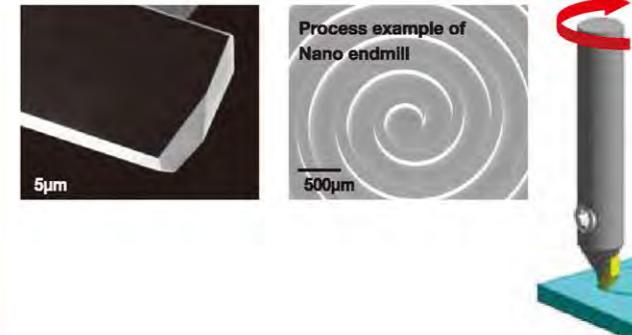


Features

- Enables the world's thinnest-in-its-class 30- μm wide flexible grooving.
- Enables machining with a high aspect ratio of 2.5 times the rotation diameter.
- High-precision-polished durable cutting edge.
- Enables high-precision fine grooving that cannot be achieved using the photolithography or ion-beam method.

Applications

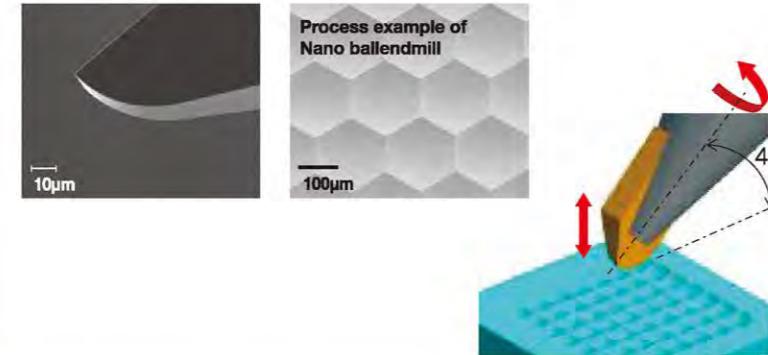
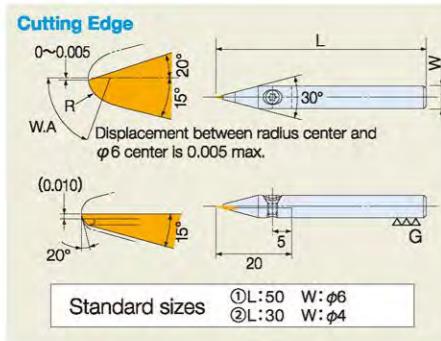
- LCD light guide plate molds, Hologram grating, Fine free curve grooving



Micro lens array molds, etc. / Ultra-precision cutting tool UPC Nano ballendmill

► World's smallest class ball type end mill.

Highly precise 3D machining is possible with very sharp cutting edge. Also, not only many fine spherical holes can be machined within a short period of time, but also ultra precision 3D curved surfaces can be machined.



Features

- The world's smallest-in-its-class ballendmill with $R=30\mu\text{m}$.
- Provides the world's highest profile of 50mm.
- Enables high-precision 3-D machining with its extremely sharp cutting edge.

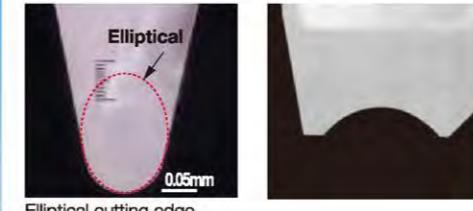
Applications

- Micro lens array molds, LCD light guide plate molds, fine machining molds

Optical lens molds, etc. / Ultra-precision cutting tool UPC Nano Profile

► A formed single crystal diamond cutting tool having a free curve cutting edge.

Making formed grooves in many places or over a long distance can be done easily by the cutting edge having the intended form shape. "UPC; Nano Profile" is an ultra fine formed cutting tool having a free curved shape formed on its single crystal diamond cutting edge.

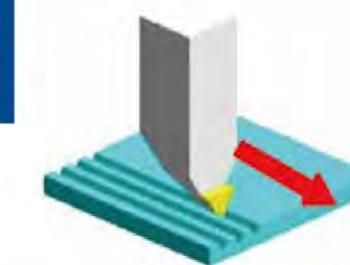


Features

- Enables flexible one-pass machining of free-form surfaces including elliptical and paraboloidal surfaces with a form accuracy of 1 μm or less.
- Ensures high form accuracy in machining of paraboloidal and other free-form surfaces.

Applications

- Optical lens molds, optical sheet molds for LCD panels, Micro lens array molds,



Eyeglass lens

Eyeglass lens rough cutting / PCD milling cutter

This tool improves the efficiency of machining of not only planes, but also free curved surface and grooving. We manufacture tools of specifications required by customers such as the holder-integrated body type and cutting edge replacement type.



Features

- The employment of diamond improves machined surface roughness and minimizes burrs.
- The tool life is extended significantly.
- The tool design unique to diamond enables high-speed cutting.
- This tool ensures consistent machining when emulsion water-soluble cutting fluid is used.

Applications

- Eyeglass lens rough cutting, resin molded parts, non-ferrous parts such as aluminum die-cast alloys

Eyeglass lens V-groove shape cutting / PCD rotating tool

The eyeglass lens V-groove shape can be machined in shorter time than grinding. Also, various lenses can be processed without changing the tool.



Features

- The shape accuracy can be maintained.
- The tool life is long and processes can be integrated.

Applications

- Eyeglass lens V-groove shape machining

Eyeglass lens finish cutting / New D tool

A high shape accuracy and mirror finish required in eyeglass lens finishing can be achieved by extremely sharp cutting edges.



Features

- The rake face is free from adhesions and accumulation of chips and maintains the high quality of worked surfaces even during continuous use.
- The diamond is firmly attached by a unique brazing method.

Applications

- Eyeglass lens finishing
- Resin parts machining

Machining results

- Process example of eyeglass lens
Tool specification : R2.0 - Relief angle 18°
Feed rate : 1200m/min
Feed rate : 0.25mm/rev
Depth of cut : 0.08mm

【Results】
Shape accuracy: 0.8µm
Surface roughness (Ra): 0.1µm
Machined workpieces: 2,000 pieces



Glass·Ceramics·Magnetic material

We meet your requirements of high efficiency and ultra long life.



Glass·Ceramics

High-rigid body cutting wheels

►The high-rigid body realizes both good cutting ability and long life

Since a highly rigid body is employed, the feed rate can be increased to provide high efficiency cutting and high cutting accuracy. Also the abrasive grain layer can be thinned.



Features

- High-rigid body & clearance design leading to high precision performance and long tool life.
- Thinner blades are possible due to the high-rigid body.
- Highly efficient machining enabled by an increased feed rate.
- Prices equivalent to conventional steel body cutting blades.

Applications

- Highly precise cutting of glass, ceramics, magnetic and ferrous materials.

Comparison table of conventional steel body and high-rigid body cutting blades

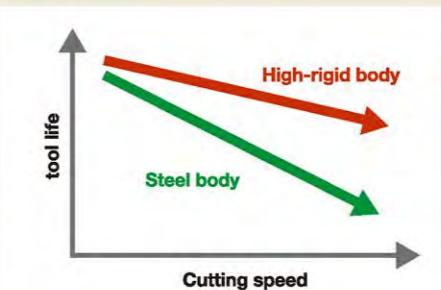
	Steel body	High-rigid body
Machining accuracy	○	◎
tool life	1	2
Machining efficiency	1	2
Blade thinness limit	0.5mm	0.3mm
Clearance	Not provided.	Provided.
Price	1	1

Production ranges

Outer diameter(Φmm)	100	115	125	135	150
Thickness (mm)	0.35~1.0			0.45~1.0	
Hole diameter(Φmm)				40/60	

*OD Φ100 for hole diameter Φ40 only.

Comparison graphs of conventional steel body and high-rigid body cutting blades

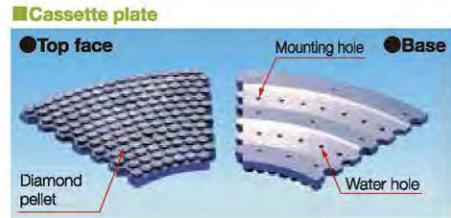


Glass-Ceramics

DPG wheel

►A bonded grain lapping plate friendly to people and environment.

The "MDP Bond" series developed based on metal bond is employed in order to maintain good grain holding power and sharpness in bonded grain lapping. This plate solves problems (such as work environment and industrial wastes generation) in conventional lapping by use of loose abrasive grains and ensures high precision and high efficiency lapping.



Size	Max. Dia.	Min. Dia.
4B	299	117
5B	389	213
6B	380	148
6B/9B	650	384
9B	637	218
12B	1,058	360
13B	950	274
15B	1,022	346
16B	1,127	270
18B	1,260	294
20B	1,355	458
24B	1,592	554
28B	1,864	660

*Special sizes also available

EG wheel

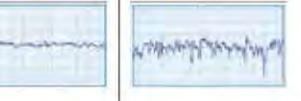
►Good surface roughness, high efficiency grinding and long life.

The use of an exclusive diamond rotary dresser enables simple and easy truing with equipment and methods similar to those for CBN wheels and general grinding wheels and at the same time, dressing can be performed also. Furthermore, this epoch-making diamond wheel allows truing and dressing to be performed on a machine to ensure very high accuracy, enabling high precision grinding.



Comparison of surface roughness

	EG wheel	Resin bond wheel
Rz(μm)	1.2	3.0
Ra(μm)	0.1	4.0



Features

- Truing and dressing can be performed simultaneously by using an exclusive rotary dresser.
- Performing these operations on a machine provides very high accuracy (run-out shape etc.).
- Since cutting edges can be generated to a high level of accuracy good surface roughness high efficiency grinding and long life can be expected.

Applications

- High efficiency and high quality processing of ceramics and carbide parts.

Machining results

- Example of alumina surface grinding
- 1) Machine: Horizontal spindle surface grinding machine
- 2) Wheel specification
 - ①EG wheel:SD230J1-C2
 - ②Resin bond wheel : SDC230-B
- 3) Dresser specification
 - ①EG wheel:Diamond rotary dresser (ALMT)
 - ②Resin bond wheel: Brake dresser
- 4) Workpiece : Alumina Al_2O_3
- 5) Conditions: Material removal rate $Z'=0.7\text{mm}^3/\text{min}\cdot\text{s}$

Production ranges	
Outer diameter	$\phi 3\sim 750\text{mm}$
T size	3~300mm
X size	2~15mm
Grit size	SD(#80~#3000)

Result

Surface roughness which is about 1/3 of that by the resin bond wheel is achieved.

MT bond wheel series

►A new metal bond wheel having ultimate sharpness

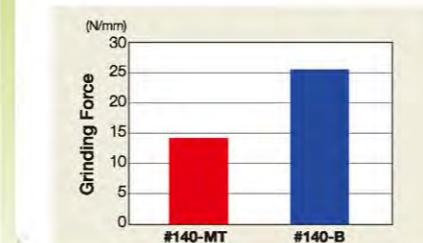
MT Bond is a new metal bond which is manufactured to reach optimum grinding ability, fusing the advantages of both resin bond and metal bond. The Diamond Wheel efficiently grinds ceramic, carbide, cermet, and quartz, on the other hand, CBN wheel is for non-ferrous materials.



MT bond wheel that cuts better than resin

Comparison of grinding force against resin bond wheel
1) Machine: Horizontal spindle surface grinding machine
2) Workpiece : Silicon Nitride
3) Grinding conditions : Wheel Speed : 1760m/min
Feed rate : 10m/min
D.O.C.:a=20μm/pass

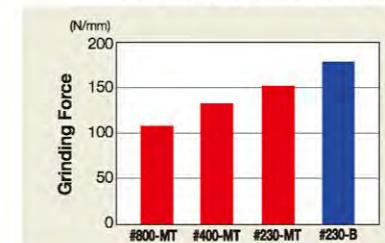
Result The grinding force (normal force) is 40% lower than the resin bond wheel



MT bond wheel that has fine grains, yet cuts well

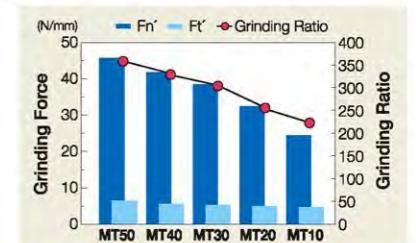
Comparison against resin bond wheel in creep feed grinding
1) Machine: Horizontal spindle surface grinding machine
2) Workpiece : Silicon Nitride
3) Grinding conditions : Wheel Speed : 1600m/min
Feed rate : 60m/min
D.O.C.:a=1mm/pass

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.



Grinding ability of each grades MT Bond

Comparison of grinding performance by MT bonds
1) Machine: Horizontal spindle surface grinding machine
2) Workpiece : Silicon Nitride
3) Grinding conditions : Wheel Speed : V=1,650m/min
Feed rate : F=10m/min
D.O.C. : a=20μm



PCD small saw for machining green ceramics

►Long life, high quality and high efficiency grinding

PCD rotating tools for cutting and grooving of green ceramics, resin and non-ferrous materials. Compared with carbide/coated tools, these tools enable extraordinary long life, high quality and high efficiency grinding.



Features

- The tool improves the machining quality as it cuts very well and minimizes burrs and chipping.
- A higher feed rate is possible to improve the machining efficiency.
- The tool life is long.
- There are no problems such as fusing of chips and high machining performance can be ensured.

Applications

- Cutting and grooving of green ceramics, resin and non-ferrous materials.

Manufacturable range

Outer diameter : $\phi 20\sim 76\text{mm}$, Blade thinness : 0.2~1.0mm

Fine blade

►Outstanding performance in high quality grooving

A large-size thin blade wheel for precision cutting & grooving. Since this type has high blade thickness accuracy and run-out accuracy, it works very well in fine grooving of ceramics and magnetic material parts. Workpieces that are easily chipped can be processed accurately while minimizing chipping with excellent sharpness.



Features

- High efficiency and fine grooving and precision cutting are possible.
- Workpieces that are chipped easily can be processed to high quality.
- Excellent sharpness reduces chipping during processing.

Applications

- Grooving and cutting of carbide and ceramics precision molds.
- precision grooving and cutting of ferrite parts of magnetic materials.

Magnetic material

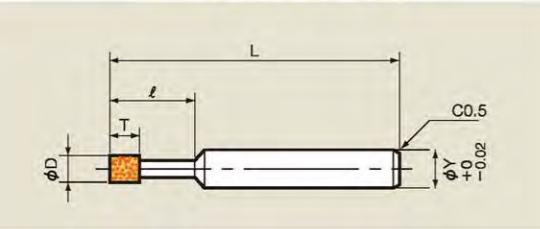
Internal grinding pin

►Meets various grinding requirements.

A combination of a high precision base and precision electrodeposition technology realizes excellent grinding performance.



Internal wheel with W11 axis



CD code		D	T	ℓ	L	Grit
W11003	SD	0.3				#800
		0.4	2	5	35	#400
		0.5				
		0.6		8		
		0.7				
		0.8	3		40	#200
		0.9				
		1.0	3	10		
				15	40	#200
		1.2	5	10		
W11010	LD			15	45	#200
		1.3	5	10		
				15	45	#200
		1.5	5	10		
				17	45	#200
		1.7	5	13		
				20	45	#200
		2.0	5	13		
				20	45	#200
		2.3	5	13		
W11020	LD			20	45	#200
		2.5	5	13		
				20	45	#120
		3.0	5	15		
				22	50	#120
		6.0	5	20		
				27	65	#120
		7.0	5	20		
				27	65	#120
		8.0	5	20		

(Y=Φ3, *Y=Φ6)

When ordering

- Please instruct CD code
 - All items are in stock
 - Special specifications available upon request.
- Please instruct required sizes
(ex)W12050 SD L=100, Y=10,
- Code of mounted point
W12050 SD

D=Diamond
B=CBN

High precision electroplated wheel FORMASTER

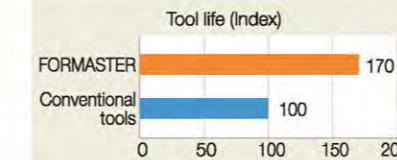
►Achieved high efficiency and high precision total shape grinding

This is a high precision electroplated wheel realized by our original precision electrodeposition technology and shows excellent shape retention performance and long-lasting sharpness in form grinding. Since truing/dressing on a machine is not required, high precision and high efficiency form grinding is possible.

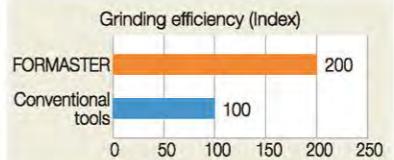


Magnetic substance (ferrite)

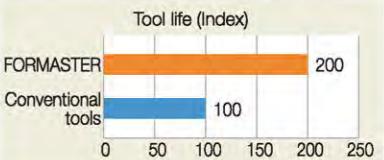
Life increased 1.7 times from the conventional tools.



Magnetic substance (Neodymium)
Life increased 2 times from the conventional tools.



Magnetic substance (Neodymium)
Life increased 2 times from the conventional tools.



Shape measurement result (after grain fixing)



Standard manufacturable range

Abrasive grain	Diamond and CBN
Grain size	#60~#170
Tool diameter	Φ30~Φ350

*Depending on specifications, some wheel designs may be not be manufactured.
If you require specific specifications please consult with us.

Double disc wheel

►The dressing performance and high wear resistance have been realized at a high level.

This is a resin bond wheel that has abrasive grains optimized to improve the retention of sharpness in double-ended surface grinding and the good dressing performance & wear resistance realized simultaneously. The diamond grains used enable high efficiency grinding of magnetic material parts and ceramic parts. The CBN grains used realize excellent performance in grinding ferrous sintered alloy parts.



Features

- The long-lasting good sharpness and high dressing performance/wear resistance improve the productivity significantly.

Applications

- Mass-production double-ended surface grinding of magnetic parts, ceramic parts, various pump parts, etc.

Centerless grinding wheel

►Excellent sharpness sustainability improved productivity

Since the bond that has high grain holding power and excellent dressing performance is employed, the sharpness continues for a long time and the grinding efficiency is improved significantly. High productivity possible of OD finishing for magnetic materials and carbide rod blanks.



Features

- Processing efficiency is improved because of the durability of sharpness.

Applications

- Mass production OD finishing of round bar material such as magnetic material, cemented carbide and ceramics.

Semiconductor / Electronics

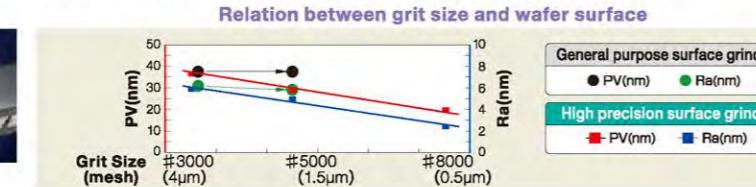
Semiconductor products that continue evolving are supported by tools made by A.L.M.T.

Silicon

For processing Si wafers / Nanomate Premium

► Outstanding performance in final mirror-finishing of silicon wafers and device BG.

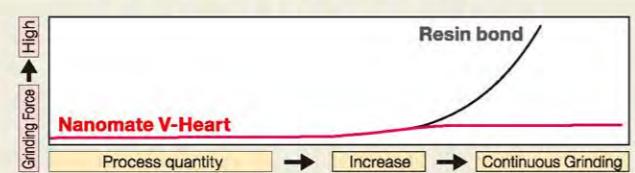
Super-fine diamond grit and super-fine ceramics revolutionized the conventional wisdom of grinding wheels. Application of both acquired material technology and production technology has allowed super-fine grinding. Its effectiveness to reduce grinding damage in layers of brittle material such as polish-reduction of φ300mm silicon wafer and prevent cracks on a thin layer device wafer.



For processing Si wafers / Nanomate V-Heart

► Most suitable for primary grinding of as-sliced waters.

Low grinding forces possible with high porous structure and abrasive layer shape characteristic. Damage depth is reduced, making it possible for high quality/high precision continuous grinding.



SiC

For processing SiC wafers / Nanomate Premium

► Highly efficient and high quality grinding of SiC wafers.

The grain spacing required for good biting of workpieces while maintaining the strength is realized by bonding diamond grains and vitrified bond at an appropriate ratio, which enables continuous grinding of single crystal SiC wafers that have been difficult to grind with convectional wheels is now possible.



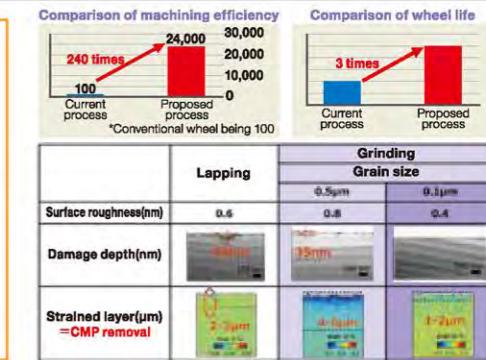
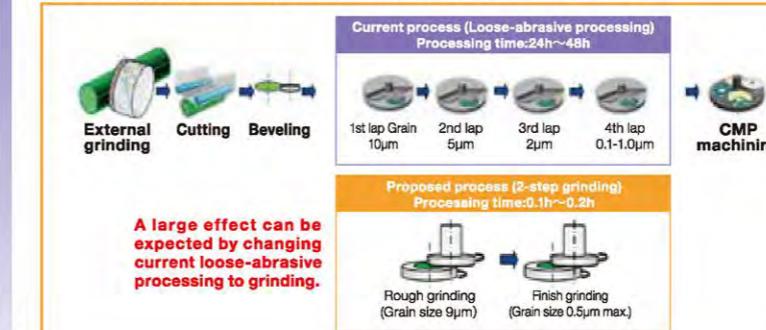
Features

- Continuous grinding of single crystal SiC.
- High quality grinding to reduce CMP time in following process.

Applications

- Super-precision surface grinding of various semiconductor wafers.

Machining process improvement proposal for SiC wafers



GaN/Sapphire

For processing GaN/sapphire wafers / Nanomate Premium

► Reduces grinding time.

The adjustment of the binding grade and bond has enabled grinding of difficult-to-grind materials with fine grains that have been difficult to grind with conventional wheels. This wheel ensures high-speed and mirror finishing of GaN wafers.



Features

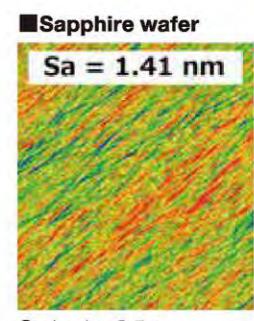
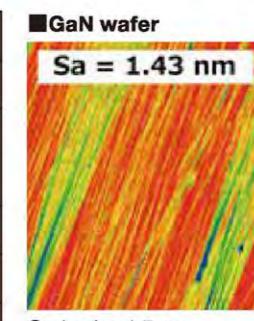
- Grinding of hard-to-grind materials possible.
- High-speed and near mirror finishing.

Applications

- Precision surface grinding of GaN/sapphire wafers.

Results from grinding single-crystal GaN wafers

GaN wafer (Ga surface)	2-inch		4-inch	
	Rough	Finish	Rough	Finish
Grinding process	#2000(9µm)	#6000(1.5µm)	#2000(9µm)	#6000(1.5µm)
Grain size (Grain dia.)				
Stock removal (µm)	50-100	10	50-100	10
Feed rate (µm/min)	30 60 90	20	30 60 90	20
Wear rate (%)	7 15 27	100	12 20 35	100
Surface quality Ra (nm)	90 - -	1-2	100 - -	2



Measured by : zygo nexview FOV : 450µm

For processing LT/LN wafers / Nanomate Premium

►Low-damage grinding of LT wafers.

Because fragile LT wafers used as the SAW filter tend to get broken in processing, improving the processed surface roughness is required. "Nanomate Premium," having a high porosity abrasive layer with excellent durability of sharpness, provides low-damage processing enabled by the added body shape with a function of efficiently feeding to the grinding point.



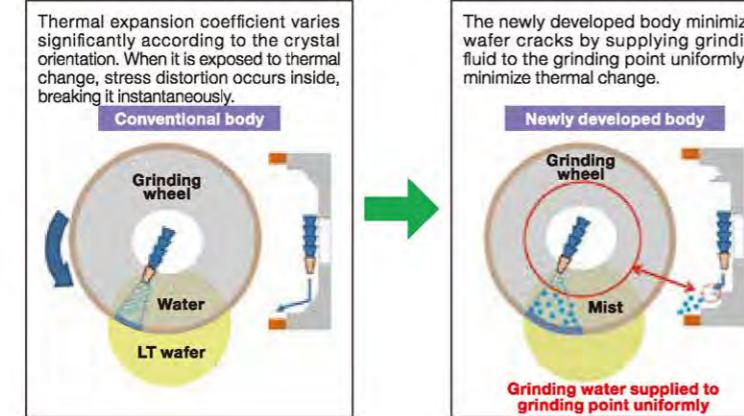
■ Features

- High porosity abrasive layer for long sharpness retention.
- Newly developed body shape to uniformly supply grinding fluid to grinding points.
- Highly efficient and high quality grinding.

■ Applications

- Precision surface grinding of LT wafers.

■ LT Wafer Grinding Problem Solving



MEMS

For processing MEMS wafers / Nanomate Premium

►Low-load grinding without cracks.

MEMS substrate silicon wafers that easily break due to a cavity in the silicon/glass substrate can be ground without cracks.



■ Features

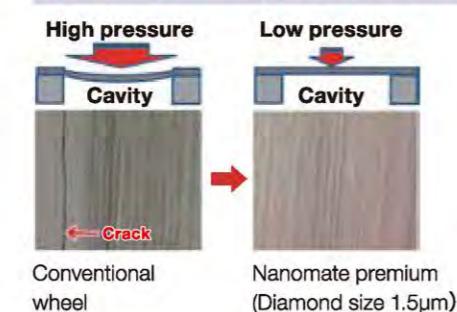
- No cracks thanks to low-load grinding.
- Continuous grinding of through holes and deep wafers.

■ Applications

- Micro sensors (acceleration), ink jet printers, etc. MEMS substrate grinding.

■ MEMS Grinding Problem Solving

Problems of MEMS grinding
When grinding the silicon wafer, breaks occur in the hollow layer in the silicon or glass substrate.



For CMP dressing / CMP conditioner

►Conditioner for high quality and high efficiency.

The employment of high-grade diamond grains, precision electrodeposition technology and precision base minimizes scratches in the CMP process and ensures the consistent conditioning performance.



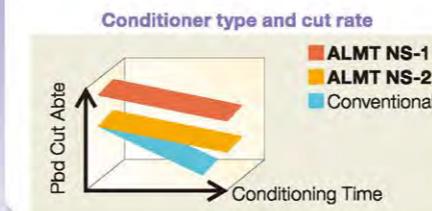
■ Features

- High quality diamond
Scratches caused by diamond crash can be minimized
- Uniformly-shaped diamond leads stable performance
- High precision body
Uniform contact with polishing pad
- High precision electro-plating
Complete single diamond layer
- Uniform distribution of the diamond grit creates the best surface condition of the pad and stable polishing performance
- Dedicated production line
CMP Conditioner is produced on a line isolated from other tools

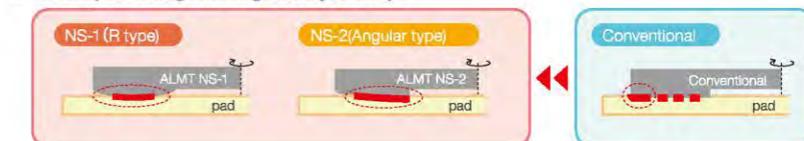
■ Applications

- Conditioning of CMP pads of semiconductor devices.

■ A.L.M.T.'s original grain layer shape



■ Conceptual diagram of grain layer shape



Bonding

Diamond dies for drawing bonding wires

►Applicable to ultra-fine wires of 0.008 mm minimum.

Single crystal diamond, an ultimate material having high hardness, high bending strength and high thermal conductivity, has been selected carefully and used. This is the standard of diamond dies that have both high precision and long tool life. In particular, this is suitable for drawing thin wires and used for drawing ultra fine wires 0.008 mm minimum to wires about 1.0 mm. A sintered diamond material that has been created by sintering diamond powder and binder alloy under ultra high pressure is used. A lineup of dies of consistent quality and sizes up to large diameters to effectively draw wires in a size range larger than those drawn by single crystal dies.

*For 0.012 mm or smaller, please contact us.



■ Features

- These dies contribute to the semiconductor industry that requires high surface quality and straightness with the forming and polishing technology acquired through A.L.M.T.'s affluent know-how.

■ Applications

- Wire materials
Soft wire products: Copper wire, Aluminum wire, Brass wire, Gold wire, etc.
Hard wire products: Stainless steel wire, Brass plates steel wire, Galvanized plates steel wire, Copper plated steel wire, Tungsten wire, Molybdenum wire

■ Applicable range of silicon/bonding wires (unit:mm)

	0.001	0.01	0.05	0.1	0.5	1.0	10.0	20.0	30.0	40.0
Copper wire	(0.008)	0.012					6.0			
Aluminum wire		0.015					6.0			
Gold wire	(0.008)	0.012					6.0			

Aircraft / Difficult-to-machine materials

We are pleased to propose optimum solutions for machining of difficult-to-machine materials used for aircraft components.

Turbine blade

For processing turbine blades / High precision electroplated wheel FORMASTER

► Highly efficient processing of heat-resistant alloys.

Works very well in deep groove form grinding of heat-resistant alloys that requires a high level of profile accuracy. Compared with general grinding wheels, consistent highly efficient processing with no dressing is available.



Features

- High peripheral speed wheel of special design by employing a highly rigid steel body offers highly efficient processing.
- Firm super-abrasive grain layer created by "precision electrodeposition technology" for longer service life.
- Profile accuracy and stable grinding maintained up to the end of life.

Applications

- Form grinding of groove to secure heat-resistant alloy turbine blade mounting part.

Machining results

High efficiency and long life in processing Inconel 718.



For grinding turbine blade shrouds / High precision electroplated wheel FORMASTER

► Optimized for form grinding of heat-resistant alloy parts.

Optimized for form grinding of thin wall-thickness heat-resistant alloy parts. Ground surface quality and form accuracy improved over cutting operations.



Features

- Grinding force in the beginning of grinding minimized by superabrasive layer provided with excellent sharpness.
- A combination of steel body and strong superabrasive layer ensures high accuracy essential for aircraft components while requiring no dressing.

Applications

- Form grinding of heat-resistant alloy turbine blade shrouds.

For combustor casing / High precision electroplated wheel FORMASTER

► Process integration and automated operation.

Newly developed FORMASTER specially designed for semi-finish grinding of large heat-resistant components. Internal coolant supply available optionally.



Features

- Surface roughness unachievable by cutting is realized. Since there are no cut marks, hand finishing work in the following process can be reduced.
- Corners to which sufficient coolant cannot be supplied by the external oil supply system can be protected from formation of damaged layer by wheel internal supply system.
- Mountable on 5-axis compound machines. Process integration and automated operation.

Applications

- Semi-finishing of flanges of heat-resistant alloy combustor casing.

For turbine processing / Diamond rotary dresser (General grinding wheel forming tool)

► Highly accurate and highly efficient dressing.

A high precision dresser capable of processing the serration shape specific to turbines can be produced. From small to large types, high precision and long life diamond rotary dressers necessary for grinding various types of heat-resistant alloy turbines having unique serration shapes are available.



Features

- RZ type: Diamonds electroplated densely to provide high precision and long life.
- SZ type: Diamonds set regularly to allow the selection of concentration according to needs.
- SX type: Our original diamond setting pattern and precision powder metallurgy technology and precision machining technology offer outstanding cutting performance.

Applications

- Form grinding of serrations of turbine blades.

Improved dressing ability (for fast dressing)

GB: Glass ball (GB) set in the grain layer to realize low concentration.
SEGMENTED: Evacuation and discharge of chips and grinding fluid improved.

*For details, see page 58.

Cermet

For cermet grinding / Hybrid wheel

► Ideal tool for grinding cermet materials.

Hybrid wheels feature a hybrid structure of special metal bond having good cutting performance and resin bond. Their composite action enables highly efficient and high quality grinding of difficult-to-grind cermet materials.



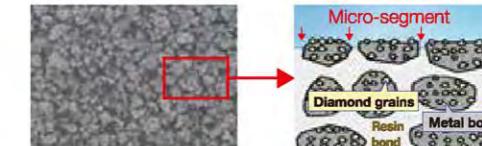
Features

- Excellent grinding ability and long tool life due to effect by micro-segment of special metal bond.
- Good surface roughness due to resin bond matrix.

Applications

- Grinding of difficult-to-grind cerment/ceramics and various tungsten carbide.

Abrasive surface of hybrid wheel (Micro-segment structure)



Other

A.L.M.T.'s products active in various fields.

Construction machinery

For processing engine and transmission components / CBN reamers

► Both of high efficiency and long life in machining of sintered alloy and cast iron realized.

CBN that has hardness next to diamond hardly reacts with iron and therefore is capable of producing excellent surfaces. A combination of high hardness and excellent heat resistance realizes high-speed cutting and long life in machining of hardened steel and cast iron. In machining sintered alloy, this tool can minimize the generation of burrs and edge chipping to provide good surface roughness and high machining accuracy.



Features

- Ideal for high-speed finishing of cast iron and sintered alloy.
- Longer life than carbide and high-speed steel tools.

Applications

- Finishing of bores of sintered alloy and cast iron (FC/FCD) (Engine & transmission components, etc.)

Bearing

for processing bearings / Diamond rotary dresser (General grinding wheel forming tool)

► Highly accurate and highly efficient dressing.

A dresser capable of high precision dressing required for processing various shapes of small and large bearings can be produced. We meet needs of customers with our diversified manufacturing techniques and various options.



GB
SEGMENTED "ACROSS"

Features

- RZ type: Diamonds electroplated densely to provide high precision and long life.
- SZ type: Diamonds set regularly to allow the selection of concentration according to needs.
- SX type: Outstanding sharpness realized by our original diamond setting patterns and precision powder metallurgy and precision machining technology.

Applications

- Used for plunge dressing of general grinding wheels and CBN wheels used for precision form grinding of various bearings, automotive parts, aircraft parts, etc.

Improved dressing ability (for fast dressing)

GB: Glass ball (GB) set in the grain layer to realize low concentration.

SEGMENTED: Evacuation and discharge of chips and grinding fluid improved. *For details, see page 58.

Profile forming

For internal grinder machine / Rotary dresser

► Consistent dressing performance.

These dressers are manufactured by holding prismatic diamonds in arrays on a metal base with sintered metal. Because carefully selected prismatic diamonds are used, the area of diamonds acting on the wheel surface stays constant, maintaining the consistent dressing performance. Moreover, the most suitable dressing performance can be obtained by adjusting the size of diamonds and the number of arrays.



Straight Type



Cup Type

Features

- Because the area of acting diamonds stays constant, it maintains stable dressing performance.
- Optimum dress performance can be obtained by adjusting the size of diamonds and the number of arrays.

Applications

- Used for traverse dressing of general grinding wheels and CBN wheels used for internal grinding of various bearings, automotive and machine parts, etc.

Standard manufacturable range

Model Number	Straight Type			Cup Type		
	S40-N	S40-C	S40-I	C40-N	C40-C	C40-I
Profile						
Diamond layer	Disposition	CVD Prism	Inregnated	Disposition	CVD Prism	Inregnated
Diamond grit size	100SPC	0.4x0.4	SD#40	100SPC	0.4x0.4	SD#40
Concentration	60pcs/Circumference	90pcs/Circumference	3.3ct./cm³	40pcs/Circumference	90pcs/Circumference	3.3ct./cm³

Other sizes and specifications available upon request

For dressing CBN/high hardness wheels / Crown dresser

► Consistent dressing performance.

This dresser is manufactured by holding CVD thick film prismatic diamonds in arrays on a metal base with plated metal. The CVD thick film prismatic diamond has no anisotropy and the area of diamonds acting on the wheel surface stays constant, maintaining the consistent dressing performance. Moreover, the most suitable dressing performance can be obtained by changing the size of diamonds and the number of arrays.

Features

- CVD diamond provides high-wear-proof performance like monocrystal diamond.
- Constant and stable active area with prism diamond.
- Cost effective with no reworking.
- Adjusting the diamond size and distribution enable to optimize the dressing performance.

Applications

- Used for traverse dressing of general grinding wheels and CBN wheels used for internal grinding of various bearings, automotive and machine parts, etc.

Standard manufacturable range

Straight Type			Cup Type		
Size	CVD Size	Pitch	Size	CVD Size	Pitch
D $\phi 35\sim 180$	0.2□, 0.4□,	0.8~2mm	D $\phi 40\sim 80$	0.2□, 0.4□,	0.8~2mm
H $\phi 8\sim 30$	0.6□, 0.8□		H $\phi 10\sim 20$	0.6□, 0.8□	
T 6~20			T 15~20		

*Other sizes and specifications available upon request



Straight Type



Cup Type

For centerless grinding / Rotary dresser X type

► High quality dressing performance.

This is an impregnated type diamond dresser that has high quality dressing performance and long lasting consistent cutting performance.



Features

- Long-lasting consistent cutting on various wheels ensured by carefully selecting diamond grains and concentration.

Applications

- Traverse dressing of simple shapes of general grinding wheels and CBN wheels.

Wire drawing equipment

High performance diamond dies produced with our extensive experience and know-how that lead the wire drawing die market.

Wire drawing/stranding

Single crystal Diamond dies

►Used for ultra fine wires 0.008 mm minimum to wires about 1.0 mm.

Single crystal diamond, an ultimate material having high hardness, high bending strength and high thermal conductivity, has been selected carefully and used. Also, the crystal orientation and shape that exhibit the highest performance have been incorporated in die design. This is the standard of diamond dies that have both high precision and long tool life. In particular, this is suitable for drawing thin wires and used for drawing ultra fine wires 0.008 mm minimum to wires about 1.0 mm. *For sizes smaller than 0.012 mm, please contact us.



Features

- Effective for ultra fine wires that are required to have high surface quality and straightness.

Applications

- Wire materials
Soft wire products: Copper wire, Aluminum wire, Brass wire, Gold wire, etc.
Hard wire products: Stainless steel wire, Brass plates steel wire, Galvanized plates steel wire, Copper plated steel wire, Tungsten wire, Molybdenum wire

Cross section of Single crystal diamond drawing dies.



For drawing fine wires such as bonding wires that are required to have high surface quality and straightness, dies of smooth and highly symmetric cross section created by A.L.M.T.'s know-how are required. This polishing technology is applied to all dies manufactured by A.L.M.T.

Polycrystalline Diamond dies

►A lineup of dies of consistent quality and sizes up to large diameters.

A sintered diamond (PCD) material that has been created by sintering diamond powder and binder alloy under ultra high pressure is used. A lineup of dies of consistent quality and sizes up to large diameters to effectively draw wires in a size range larger than those drawn by single crystal dies. The applicable range is 0.04 mm to 29.0 mm maximum.



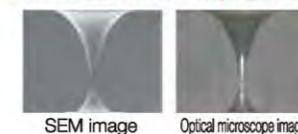
Features

- Applicable to sizes larger than those drawn by single crystal diamond dies.
- Usable in a wide range of applications since drawing is not affected by the crystal orientation.

Applications

- Wire materials
Soft wire products: Copper wire, Aluminum wire, Brass wire, Gold wire, etc.
Hard wire products: Stainless steel wire, Brass plates steel wire, Galvanized plates steel wire, Copper plated steel wire, Molybdenum wire.

Cross section of Polycrystalline diamond drawing dies.



Polycrystalline diamond dies are available to much larger size than Single crystal diamond dies. As they are free from crystal orientation, they are applied to vast materials, for example, copper wires, saw wires, and other kind of wires.

Shaped wire drawing dies

►Wires drawn to various shapes such as square and track accurately.

Non-circle section profiles are important characteristics to coiling wire for high voltage transformer, or connecting pins and flat cables in ordinary household appliances, fashionable necklaces and chains are produced with the Shaped wire drawing dies. A.L.M.T.Corp. puts the Know-how to create these dies.



Features

- Wire material with superior surface luster and high dimensional precision can be obtained in comparison with wire rolling methods.
- Can be used with a wide range of wire cross sections, including square to track shape.
- With regards to a square, it is available to produce up to minimum 0.1mm per a side.
- Material type is polycrystalline diamond.

Applications

- Copper wires such as flat cables, connector pins for OA equipment, decorations such as necklaces, alternators for automobiles, copper wires for voice coil motors, small motors, actuators, etc.

Diamond shaving dies

►Long tool life to reduce the setup time and waste materials.

Diamond shaving dies are the best choice for wires needs excellent surface finish of copper, aluminum, gold, titanium wires, compared to tungsten carbonate or tool steel dies.



Features

- Shaving dies are tools for surface shaving that can be carried out in the intermediate step of the wire drawing.
- Improved surface luster creates the high quality surface required.
- Diamond shaving dies provides 20 to 100 times, depending on materials, longer tool life compared to tungsten carbonate shaving dies.
- Long life reduces the preparation time and wire material loss.

Applications

- Shaving copper wires, aluminum wires, gold wires and titanium wires

Diamond tin-plating dies

►Design to minimize adhesion of tin to the case.

This die is used to adjust the thickness of plating of tin-plated copper wires. The use of special case material minimizes adhesion of tin to the case.



Features

- Using titanium metal for the die case, it is avoided to stick the tin slag on the die case.
- Standard case dimension is φ25x7mm

Applications

- Adjusting the thickness of plating of tin-plated copper wires

Diamond compacting dies

►Excellent wear resistance and stable weight per size and unit length.

Compacting dies are tools to strand conductors and at the same time, compact them to a circular shape and are used for power cables and automotive low voltage wires (wire harness). We offer a wide range of sizes to meet your applications by enlarging sintered diamond material and applying our advanced machining technology.



Features

- Compacting dies are tools to compact the conductor to a round cross section.
- Outstanding wear resistance assures production of wire products of a consistent size and weight per unit length.
- Long life reduces preparation time and wire material loss.
- Stable wire diameter leads to the cost reduction of insulation.
- Consistently, wire with high quality surface luster can be produced.

Applications

- Stranded wires of power cables, automotive wire harnesses, wire ropes

Grinding wheel profile forming unit / Rotary Dresser drive unit

A drive unit that enables a diamond rotary dresser to exhibit its performance fully in form grinding by use of such dresser.



Features

- Employed high precision pivot adjusted run-out of outer and edge to less than 2µm.
- Make spindle dia. as big as possible and employ angular bearing.
- Easy to use
- Fix with T-slot to surface grinding machines.
- No need to take out joint for removing.

Truing Unit / Brake Dresser



The brake dresser removes run-out with pressing force between dresser and diamond wheel as well as peripheral speed difference

Coolant / ODIUP

Water soluble grinding coolant specialized to replace from loose abrasive to fixed abrasive



Applications

- DPG (Diamond Pellet Grinding) wheel

Ultra precision dressing system / TACUMINO Dress *For the dresser, please refer to "Crown dresser" on page 42.

Since the contact start point between the grinding wheel and the dresser can be detected in units of 1 to 2 µm, grinding wheels are restored by minimum dressing to ensure effective usage of limited resources. Also this is the compact design of the world's smallest class, yet enables rotation as high as 20,000 rpm maximum. Wasteful dressing of grinding wheels is minimized to make this operation friendly to environment. Contact of the dresser is detected in units of submicron. *Use A.L.M.T.'s "Crown Dresser".



[Selling agency] Sumitomo Electric Tool Net

Features

- Highly accurate dressing by an AE sensor system to reduce product defects significantly.
- Unnecessary dressing eliminated by use of an AE sensor system to reduce dressing time significantly.
- Elimination of unnecessary dressing to extend wheel life significantly.
- World's smallest class compact design.
- High speed rotation as high as 20,000 rpm maximum.
- Contact between wheel and dresser detected in submicron units.

Technical data

Fundamental knowledge and technical information about A.L.M.T.'s wheels, tools, dressers and dies that use diamond/CBN.



For more information, access here!

Basic information about Diamond / CBN tools and processing



What are Diamond/CBN?

Diamond

Diamond comes from the Greek word "adamas" (a thing hard to be conquered) and became "Diamond" in the middle of the 16th century. The Japanese name is Konoseki. It is a mineral made of pure carbon, generally known as a gem. Because it is the hardest among natural substances, it is also used for industrial applications. Approximately 80% of all natural diamond is used for industrial applications; nearly all artificial diamond is for industrial applications. Synthetic diamond, also called artificial diamond, is diamond artificially created using carbon materials. The synthetic diamond is mainly produced by high temperature, high pressure synthesis (HPHT) or chemical vapor deposition (CVD).

Synthetic diamond is far inferior to natural diamond in terms of transparency and radiance. In addition, it is greatly inferior in terms of beauty derived from diamond's refractive index of light. Synthetic diamond, therefore, is mostly used for industrial applications, not for jewelry.



Synthetic diamond
(Sumitomo Electric Co., Ltd. Sumicrystal)

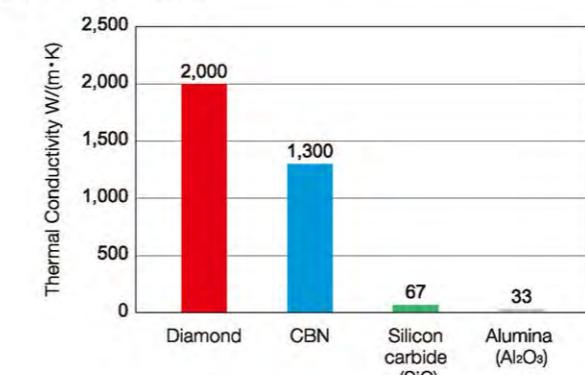
CBN

CBN is an acronym for "cubic boron nitride," constitute of boron and nitrogen.

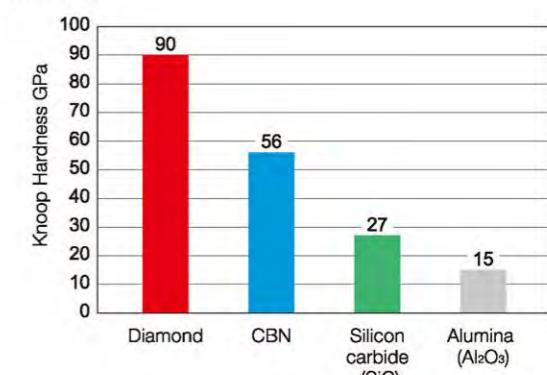
CBN has the high hardness of diamond. Compared to diamond, which starts oxidation at 700°C, CBN has a thermal tolerance up to 1,300°C, so CBN is superior for high temperature processing.

Comparison of Diamond/CBN and abrasive grain for general whetstones

① Thermal Conductivity



② Hardness



Specifications of Diamond/CBN grinding wheels

Diamond/CBN grinding wheels (super abrasive wheels) can be applied to various specifications by combining "abrasive grain (abrasive grain type)", "grain size (abrasive grain size)", "bond strength", "degree of concentration (grain concentration in bond)", and "bond type (bonding material)". We will select the most suitable specifications for the type and shape of the work material, the required finished specifications, and the equipment installed to.

■ Example of grinding wheel size label

SDC 200 N 100 BS40 3.0

① Abrasive ② Grit size ③ Bonding degree ④ Concentration ⑤ Bond name ⑥ Thickness of abrasive layer

1) Abrasive grains

Abrasive grains of the diamond wheel are of two types: natural diamond (D) and synthetic diamond, which is often used in industrial applications. "Synthetic diamond (SD)" and "metal coated composite diamond (SDC)" are used for the grinding wheel. Also, "cubic boron nitride (CBN)" with hardness following diamond and "metal coated cubic boron nitride (CBNC)" are abrasive grains also used for the grinding wheel.

Abrasive Type		Symbol	Features
Diamond abrasive grain	Natural diamond	D	<ul style="list-style-type: none"> The shape of abrasive grains is irregular and the crushing strength is low. This is rarely used at present.
	Synthetic diamond (Friable type) ※Used mainly for resin bond.	SD	<ul style="list-style-type: none"> Used for grinding non-ferrous materials. The shape of abrasive grains is irregular and the crushing strength is low.
	Synthetic diamond (Blocky type) ※Mainly used for metal/vitrified bond and electroplated wheels.	SD	<ul style="list-style-type: none"> Used for grinding non-ferrous materials. The shape of abrasive grains is blocky and the crushing strength is high.
	Metal-coated synthetic diamond	SDC	<ul style="list-style-type: none"> Above synthetic abrasive grains coated by metal such as nickel, copper and titanium for the purpose of improving the abrasive grain holding power.
CBN abrasive grain	Cubic boron nitride (Single crystalline)	CBN (BN)	<ul style="list-style-type: none"> Used for grinding ferrous materials. The shape of abrasive grains is blocky and the crushing strength is high.
	Cubic boron nitride (Polycrystalline)	CBN (BN)	<ul style="list-style-type: none"> Used for grinding ferrous materials. The shape of abrasive grains is irregular and the crushing strength is low.
	Metal-coated cubic boron nitride	CBNC (BN)	<ul style="list-style-type: none"> Above synthetic abrasive grains coated by metal such as nickel and copper for the purpose of improving the abrasive grain holding power.



2) Grit size

The grain size is the size of diamond/CBN abrasive grains (grain diameter).

The grain size and its classification method are specified by JIS (JIS B 4130).

It should be noted, however, that abrasive grains used in the super abrasive wheel are standardized up to # 325 (325/400) only. For grains finer than

400, the displayed grain size is not common to all manufacturers because each establishes the standard independently (or freely) and operates. For example, Company A's grain size # 10000 may not be the same as Company B's grain size # 10000; therefore, it is necessary to check the size of abrasive grains to select the correct size.

Indicated Grain Size (Mesh)	JIS Grain Size (Mesh)	Average Grain Dia. (μm)	Guide for Applicable Zone
16	16/20	1,190	Rough grinding
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	Rough grinding
600		30	Semi-finishing
800		20	
1,000		15	
1,500		10	
2,000		8	
*		*	Finishing

The zone finer than #400 has not been standardized in JIS.

3) Bond Strength

Degree of bonding is an index that shows the degree (strength and hardness) with which bonding material (bond) holds abrasive grains, and is a ranking based on N.

Generally, the harder (raising) the degree of bonding, the longer the lifetime but the lower the sharpness; the softer (lowering) the degree of bonding, the shorter the lifetime but the higher the sharpness.



There is no rigid provision for the classification and the ranking is shown only within the same manufacturer, meaning the hardness of Company A and Company B is not the same even if the sign is the same "N." For this reason, degree of bonding may not be displayed.

* Example of abbreviation: SDC 200-100BS 40

4) Degree of concentration

Degree of concentration shows the content ratio of Diamond/CBN abrasive grains (abrasive grain ratio) in the abrasive layer. When the same grain size is considered, the higher the degree of concentration, the number of abrasive grains, while the lower the degree, the lower the number of abrasive grains. It is important to select the degree of concentration most suitable for the work material.

Concentration	Content of Abrasive Grains (ct/cm³)
200	7.7
150	6.6
125	5.5
100	4.4
75	3.3
50	2.2
25	1.1

*1ct=200mg

5) Type of bond

Bonding layer to hold and combine abrasive grains in the super abrasive wheel is generally called bond. Abrasive grains drop off during processing and the other grains show up instead, that have the wheel grinding sharp. A bond most suitable for the work material and applications must be selected.

Types of binding materials (Bond)	Symbol	Meaning of Symbol	Main Materials of Bond	Abrasive Grain Used	Main Workpieces/Applications
Resin	B	Bakelite	Resin	Diamond	Cutting tool materials (cemented carbide, cermet, ceramics), metallic molds (cemented carbide)
				CBN	Metallic molds (ferrous hardened steel, high-speed steel, die steel), surface grinding of ferrous sintered parts
Metal	M	Metal	Metal	Diamond	Hard brittle materials (glass, ceramics, crystal, sapphire)
				CBN	ID honing of ferrous automotive parts, cutting of ferrous bar materials
Vitrified	V	Vitrified	Ceramics	Diamond	Cutting tool materials (sintered diamond tip, CBN tip)
				CBN	Ferrous automotive parts, heat-resistant materials (Inconel)
Electroplated	P(E)	Electro-plated	Ni plating	Diamond	Rubber, FRP, magnetic materials
				CBN	Form grinding of ferrous automotive parts, heat-resistant materials (Inconel)

6) Material Processed by Diamond or CBN Wheel

■Diamond

Cutting Tool	Electric Parts	Magnetic Material	Crystalline Material	Ceramic Products	Wear Resistant Metal	Plastic	Graphite
● Cemented Carbide	● Ceramic (Aluminum nitride, etc.)	● Ferrite	● Glass	● Stone	● Sprayed Metal	● F.R.P.	● Conventional Wheel
● Cermet	● Rare earth Magnet	● Silicon	● Crystal	● Refractory Material	● Cobalt base Alloy		● Grindstone
● Ceramics (Alumina, etc.)	● Compound semiconductor	● Sapphire	● Quartz	● Tile	● Asphalt		● Jewelry
				● Concrete	● Titanium Carbide		

■CBN

Cutting Tool	Wear Resistant Tool	Structural Component	Corrosion Resistant Metal	Heat Resistant Metal	Magnetic Material	Cast Iron
● SKH ● SKS ● SK	● SKD ● Cobalt base Alloy ● Sprayed Metal	● SCM ● SNCM ● SCr ● SUJ	● SUS	● SUH ● Nickel base Alloy ● Titanium base Alloy	● Dust Core ● Alnico	

About truing and dressing

Truing and dressing are very important to effectively use diamond/ CBN wheels so that they fully demonstrate their excellent performance. No matter how precisely the wheel is attached to the machine, runout occurs at the initial stage after installation. Also, the abrasive grain layer deteriorates in accuracy and sharpness decreases due to wear in the grinding process. To maintain good sharpness, truing and dressing with a method and condition suitable for the grinding wheel is required.

Immediately after installing the equipment, correcting circumferential runout is required. Crushing and falling off of abrasive grains reduce sharpness.

Eliminate irregularities on the abrasive surface, as well as runout, and create perfect circle (truing)

Retract bond and project the cutting edge (dressing)

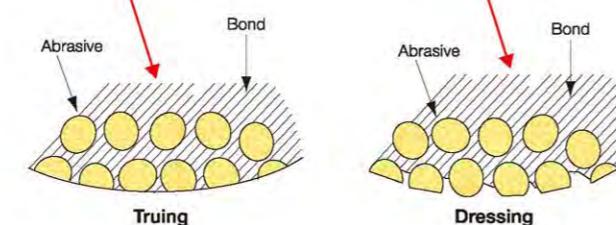


Truing

To mold when the grinding surface sways while the wheel is rotating or when the shape has collapsed.

Dressing

To remove unnecessary bond and chips on the surface, letting abrasive grains project.



Example of selecting conventional whetstone for truing

Abrasive particle size	#60~#140	#170~#270	#325~#500	#600~
B	C80K	WA120I	GC300H	GC500H
M, V	C80K	C80K	WA120I	GC300H

Example of selecting conventional whetstone for dressing

Abrasive particle size	#60~#120	#140~#170	#200~#270	#325~#500	#600~#1000	#1500~
B	WA200G	WA200G	GSC00H	GS500H	GC1000G	GC1500F
M, V	WA120I	WA200G	WA300G	WA300F	WA500F	WA8001F

Compliance table of Diamond/ CBN wheels truing and dressing

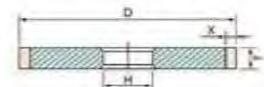
		Truing			Dressing					
		Diamond Wheel		CBN Wheel	Diamond Wheel		CBN Wheel			
		B	M	V	B	M	V	B	M	V
Truing method and tool										
Diamond tool method	Rotary	Rotary dresser	○	○	○	○	○	○	○	○
	Stationary	Single stone dresser								
		Multi-stone dresser		○		○				
Conventional grinding wheel method	Rotary	Impregnated dresser		○		○				
	Stationary	High precision block dresser		○		○		○		○
		Electroplated block dresser		○		○		○		○
	Rotary	Block grinding	○	○	○	○	○	○	○	○
	Stationary	Brake control	○	○	○	○	○	○	○	○
Mild steel method	Rotary	Cup wheel drive	○	○	○	○	○	○	○	○
	Stationary	Stick	○	○	△	○	○	△	○	○
Crushing method	Rotary	Mild steel roll	○	△	△	○	△	○	○	△
	Stationary	Mild steel block	○	△	△	○	△	○	○	△
Loose abrasive grain method	Crushing	Crushing roll		○	○	○	○	○		
		Abrasive grain lapping	○	○	○	○	○	△	△	△
		Abrasive grain blasting	△	○		△	○	△	○	△
Electric discharge method		Abrasive grain sludge pouring				○	○	△	○	△
		Electrode				○		○		○

Wheel size and model designation

Example of wheel size label

Straight wheel

$\phi 150$ - 5T - 3X - $\phi 25.4H$
Outside diameter Grain layer width Grain layer thickness Mounting hole diameter



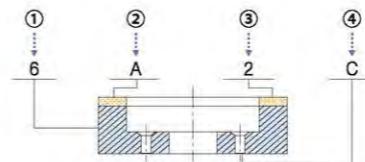
Cup wheel

$\phi 150$ - 3W - 5X - $\phi 40H$
Outside diameter Grain layer width Grain layer thickness Mounting hole diameter



Identification method of wheel shape

The shape labelling method of the super abrasive wheel is specified by "Japan Industrial Standard JIS B 4141."



① Standard Body Shape

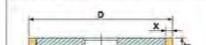
1	2	3	4	5	6	9
2	11	12	14	15		
3						
4						
5						
6						
9						

② Cross Sectional Shape of Abrasive Layer

A	D	FF	L	QQ
AH	DD	G	LL	S
B	E	H	M	U
C	EE	J	P	V
CH	F	K	Q	Y

③ Standard wheel shape 1

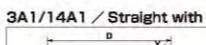
1A1 / Straight



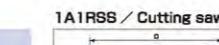
1A1R / Cutting



3A1/14A1 / Straight with boss



1A1RSS / Cutting saw



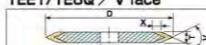
1F1/1FF1 / Straight with R



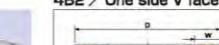
1V1 / Straight with angle



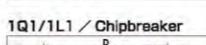
1EE1/1E6Q / V face



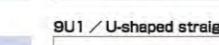
4B2 / One side V face



1Q1/1L1 / Chipbreaker



9U1 / U-shaped straight



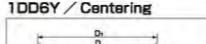
3A2 / Core drill



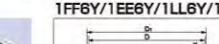
1DD6Y / Centering



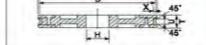
1FF6Y/1EE6Y/1LL6Y/1DD6Y / Pencil edge



3F2 / Curve generator



W / Internal with shank



Standard wheel shape 2

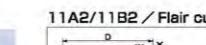
6A2 / Plain cup



6A2S / Segment cup



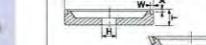
11A2/11B2 / Flair cup



11C9/11Y9 / L-shaped flair cup



6A9/11V9 / Corner cup



12A2 / Dish



9A3 / Both side cup



3V2T / Chamfering

Diamond/CBN cutting tools

Diamond/CBN cutting tools

What is cutting?

Metal cutting is an operation to cause slippage within metal by a shear force induced by compression to separate metal.

- ◆ Cutting, feeding amount (speed) and cutting speed are three cutting conditions; other conditions are called operational conditions.
- ◆ The larger the rake angle, the less the cutting resistance.
- ◆ Increasing cutting speed reduces the cutting resistance.
- ◆ Cooling oil cools the cutting edge and workpiece, suppressing softening caused by high temperature and deformation resulting from heat. It is also used to provide a lubrication effect between the cutting edge and chips, thus preventing welding.

Characteristics of material

Diamond excels in "hardness" and "heat diffusibility" as a cutting tool material. CBN, with hardness akin to that of diamond is mainly used for cutting ferrous metal thanks to its lower reactivity than diamond with ferrous metal. Both materials can be polished to form "sharp cutting edge."

Various cutting

Turning

Turning is a process of rotating a workpiece and cutting it with a cutting tool.

Lathe machining is typical turning, which machines the workpiece by a general-purpose lathe or an NC lathe using various types of cutting tools. The material and shape of the blade changes according to application.

Hole drilling

Drilling is generally a process of attaching a drill to a drilling machine or a machining center to drill a hole in a workpiece. Drilling is also performed with a lathe or a milling machine. A reamer is mainly used for finishing holes. In addition, spot facing, boring, tapping and broaching are also classified as drilling.

Milling

Milling is a cutting process that uses a milling machine or a machining center, using a milling tool with multiple blades.

Milling tools have various shapes, and the machining form changes according to the shape of the workpiece, including flat machining, side machining, and groove machining. End milling is also a type of milling.

Broaching

Broaching is a process using a tool called broach, where a number of cutting edges are arranged in order of dimension along the axis of the outer periphery of a bar body in the broach machine to machine the surface of a workpiece or the inner surface of a hole.

Types of Cutting tool

Cutting tools

A cutting tools is a type of cutting tool with a blade at the end of the shank. The blade material includes diamond/CBN, high speed tool steel, cemented carbide, cermet, and ceramics.

Reamer

A reamer is a tool to finish the hole opened by a drill according to the required accuracy.

Similar to the cutting tool, the blade material includes diamond/CBN, high speed tool steel, and cemented carbide. The number of cutting edges range from one to several depending on the hole diameter and application. In the stepped reamer, the blade is divided into multiple stages, enabling multiple processes with a single reamer.

Drill

A drill is a cutting tool that pierces a hole in a workpiece, which has a cutting edge at the tip, and a groove in the body for discharging chips. It is the most common tool among cutting tools, with various shapes and types for application, from the one used at home to the one for special processing.

Milling tools

A milling tool is a generic term for tools with multiple cutting edges on the outer surface or the end face of a disk or cylindrical body; it cuts the workpiece while rotating. It is mainly used in the milling machine and the machining center; the blade material includes diamond/CBN, high speed tool steel, and cemented carbide. An end mill is also a kind of milling tools.

Endmill

An endmill is a generic term for shank type milling with cutting edge on the outer surface and the end face.

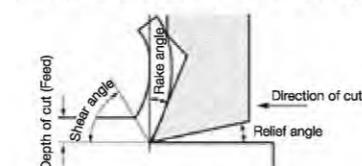
Broach

A broach is a tool for machining the surface of a workpiece or the inner surface of a hole in the broaching machine, in which numerous cutting edges are arranged in order of the dimension along the axis of the bar-like main body outer circumference.

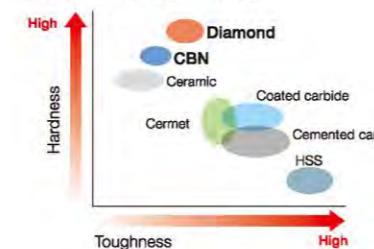
Tap/thread cutting die

A tap is a tool for cutting female threads while cutting into the inside of the hole. The thread cutting die is a tool that cuts the male thread in the cylindrical workpiece while turning.

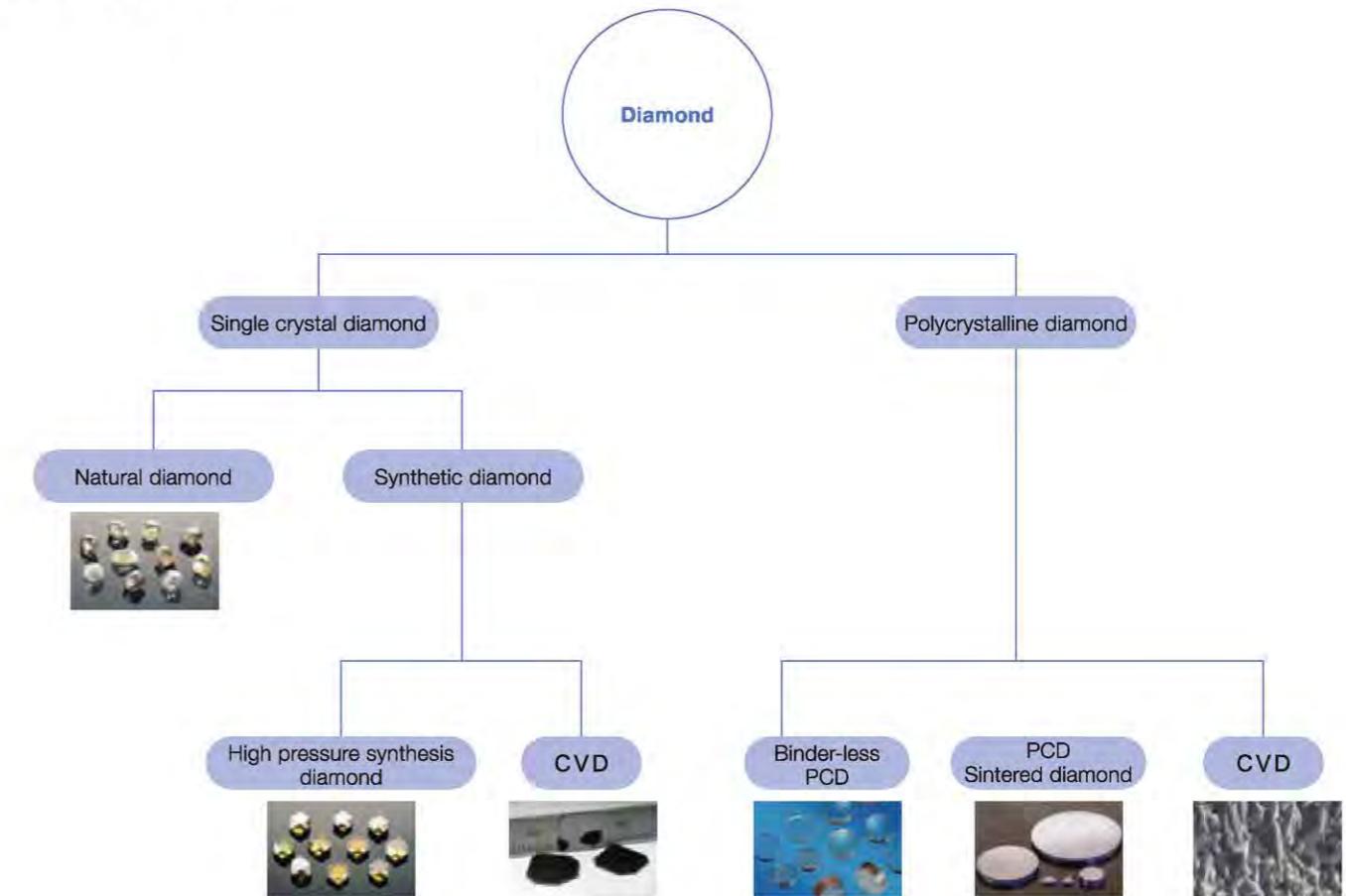
Basic form of cutting tool for cutting metal



Position of tool materials



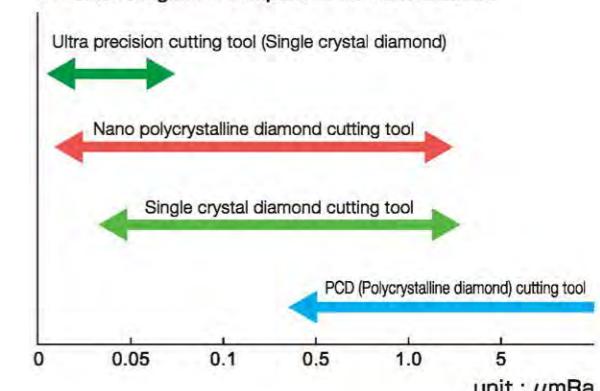
Types of Diamond



Comparison of single crystal diamond and PCD

Material	Single crystal diamond	Sintered diamond (PCD)
Structure and crystal image		
Isotropy	×	○
Hardness	70~130Gpa	50Gpa
Cutting edge sharpness		

Surface roughness comparison for each diamond



*PCD = Polycrystalline diamond

Diamond/CBN cutting tools

Although various materials such as carbide and high-speed steels are used as cutting tools, diamond/CBN tools have excellent "hardness" and "diffusion of heat" compared with these materials.

Polished diamond/CBN tools can make "sharp cutting edge."

Diamond/CBN cutting tools with these characteristics provide superior precision, superior lifetime, and high performance for your work pieces.

Comparison of required characteristics for cutting tool material

	Diamond			Cemented Carbide	High speed steel
	Single crystal	Polycrystalline	Nano-polycrystalline		
① High hardness	○	○	○	△	×
② Suitable toughness	×	△	○	○	○
③ High thermal diffusibility	○	○	○	△	△
④ Sharpness of cutting edge	○	×	○	△	○
⑤ Affinity with ferrous metals	×	×	×	△	△
⑥ Isotropy	×	○	○	○	○

Diamond rotary dresser

What is Diamond rotary dresser?

A diamond dresser is a diamond tool used for processing (truing/dressing) and molding (forming) to correct dulling, clogging, and peripheral runout of general whetstones and diamond/CBN wheels to restore their good sharpness. A dresser is a diamond tool for forming general whetstones and CBN wheels. As complex and precise shape accuracy is required for precision automotive parts, high precision bearings, airplane parts and other types of total shape grinding, a high precision rotary dresser is indispensable. Further, the rotary dresser is capable of highly precise and highly efficient profile dressing compared with the stationary dresser. A.L.M.T. meets various needs of customers with our diversified manufacturing techniques and many types of options.

Process grouping

RZ Type



Our advanced and unique technology in high precision electro-deposition make it possible to accommodate complex and fine profiles. Diamond grits which fixed by reverse plating method are arranged randomly and its concentration is very high, so it is also suitable for longer life applications. Various optional specifications are also available.

Z type



The diamond grits of Z type rotary dresser are fixed on the precise body by use of electro-plating process. This type can be made relatively easily and is suitable for small lot production and trial production.

SZ Type



A rotary dresser with diamond grits 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.

SX type



SX type rotary dresser is produced by integration of our prominent technologies the original arrangement design of diamonds, the precise sintering technology and the excellent truing technology. Therefore SX type has a high valuation in grinding applications that require sharpness. It can also be effective in traverse dressing and contour dressing.

X type



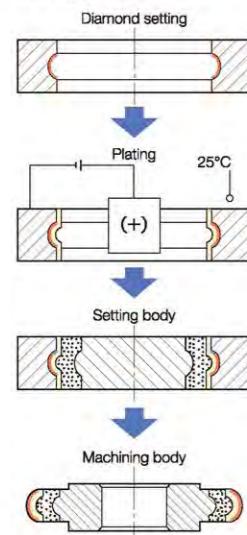
X type rotary dresser is a metal bond type impregnated with diamond grits. High performance is made possible by free selection of concentration and uniform distribution of diamond grits. This type is suitable for traverse dressing of our VITMATE and EG Wheel.

Item	RZ Type	SZ Type	Z type	SX type	X type
Manufacturing method	Electro-deposition	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
Principal use	● Bearing ● Injection needles	● Shafts	● Gear grinding	● Turbine blades ● Camshafts	● Internal grinding ● Centerless grinding
Profile accuracy	○	○	○	○	—
Surface roughness	○	○	○	○	△
Dressing force	○	○	○	○	○
Features	Highest precision Fine profile/Complex profile	Large diameter High dressing ability	Gear grinding	Any concentration settable/ High dressing ability	Consistent dressing ability

Outline of production processes for Rotary Dressers

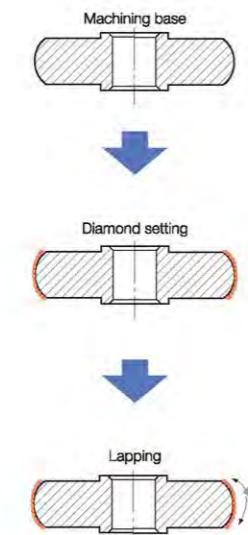
Electro-deposition method / RZ·SZ type

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



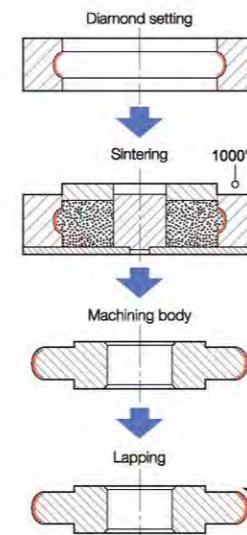
Electro-plating method / Z type

Diamond is fixed directly on the body and finished by on the surface of diamond layer.



Sintering method / SX type

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



Design / Inspection

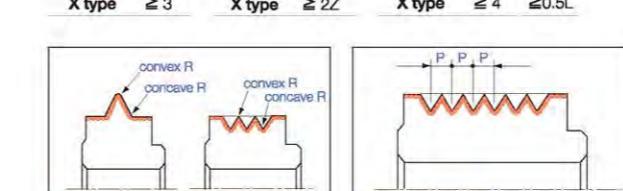
Possible production ranges

	50	100	150	200	250	300	(mm)
RZ Type	O.D.				ϕ50~ϕ200		
	Width				200		
SZ Type	O.D.				ϕ50~ϕ200		
	Width				200		
Z type	O.D.				ϕ10~ϕ200		
	Width				200		
SX type	O.D.			120	ϕ20~ϕ180		
	Width					ϕ20~ϕ300	
X type	O.D.						
	Width				150		

*Ranges vary depending on profile or specification etc

Tolerances of Rotary Dresser designs (mm)

U value	W value	Y value M value
RZ Type ≥ 10	RZ Type $\geq 0.5Z$	RZ Type $\geq 10 \geq L$
SZ Type ≥ 10	SZ Type $\geq 0.5Z$	SZ Type $\geq 10 \geq L$
SX type ≥ 3	SX type $\geq 4Z$	SX type $\geq 4 \geq 0.5L$
Z type ≥ 3	Z type $\geq 4Z$	Z type $\geq 4 \geq 0.5L$
X type ≥ 3	X type $\geq 2Z$	X type $\geq 4 \geq 0.5L$



*Convex R value	*Concave R value
RZ Type ≥ 0.1	≥ 0.03
SZ Type ≥ 0.2	≥ 0.15
SX type ≥ 0.2	≥ 0.15
Z type ≥ 0.3	≥ 0.3
P value	
RZ Type ≥ 0.3	

*Value depending on diamond grain sizes

Accuracy of Rotary Dressers

Item	Factor	Symbol	Accuracy (mm)	Illustration
Profile	Runout		0.005	
	Width	L	± 0.005	
	Radius	R	± 0.002	
	Step	S	± 0.001	
	Contour	C	0.002	
	Angle	θ	$\pm 2'$	
	Straightness	—	0.002	
	Pitch	P	± 0.002	
Accumulative pitch		nP	± 0.004	
Body	Bore	ϕH	$+0.005 -0$	
	Parallel	//	0.002	
	Perpendicularity	\perp	0.002	
	Runout		0.002	

Description of Inspection

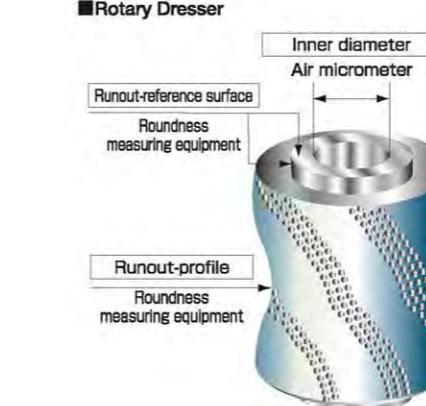
Inspection with transfer test pieces

1. Measuring dimensional accuracy and profile (tool microscope, profile measuring equipment, projector)
2. Surface roughness(surface roughness tester)

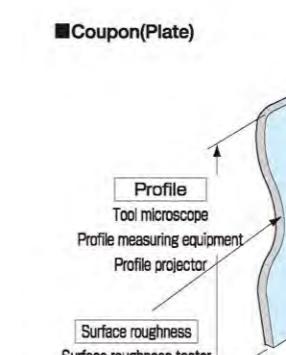
Slip Test Results

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

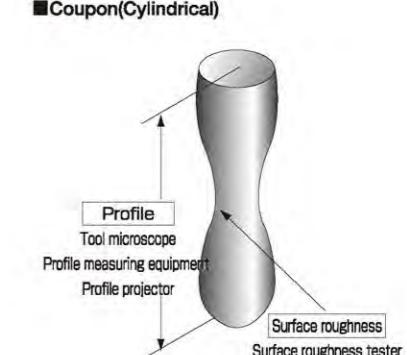
Rotary Dresser



Coupon(Plate)



Coupon(Cylindrical)



Recommended conditions

Recommended dressing conditions

Plunge dress

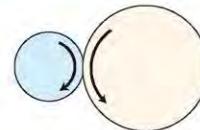
	Conventional grinding wheel	Hard conventional grinding wheel	CBN wheel
Dress direction	Down	Down	Down
Peripheral speed ratio	0.25~0.5	0.3~0.9	0.3~0.9
Dress amount(mm)	0.02~0.03	0.02~0.03	0.01~0.015
Infeed rate	0.5~1μm/rev.of wheel	0.1~0.5μm/rev.of wheel	0.01~0.5μm/rev.of wheel
Dress out(sec.)	0~3	0~3	0~3

Traverse dress

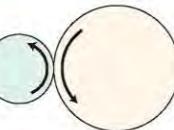
	Conventional grinding wheel	Hard conventional grinding wheel	CBN wheel
Dress direction	Down	Down	Down
Peripheral speed ratio	0.25~0.5	0.3~0.9	0.3~0.9
Dress amount(mm)	0.02	0.02	0.01
Infeed rate(mm/pass)	0.005~0.03	0.003~0.005	0.002~0.003
Dress out(Traverse cycles)	0~4	0~4	0~4
Feed rate(mm/min)	80~140	See below	See below

Feed rate

Down dressing



Up dressing



$$\text{Peripheral speed ratio} = \frac{V_r}{V_s}$$

V_r (RD peripheral speed) = RD revolution (min^{-1}) × RD O.D. × π

V_s (grinding wheel peripheral speed) = grinding wheel revolution (min^{-1}) × O.D. × π

* In case of up dress, please add "-", minus, to the number after the calculation.

Profile dressing formula

$$\text{Feed rate} = C \times \text{RD width} \times \text{grinding wheel revolution}$$

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

Technical data

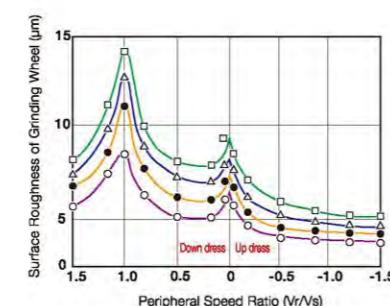
In dressing, the surface roughness of grinding wheels is influenced by elements such as:

1. Peripheral speed ratio (V_r/V_s), 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

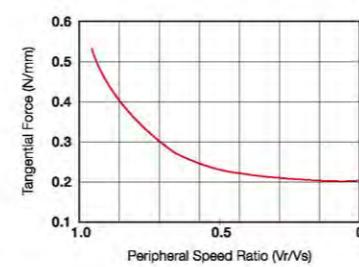
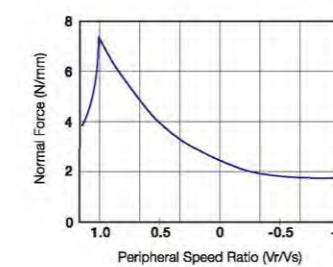
- Control of the grinding surface accuracy by up-dressing is easier than by down-dressing
- Higher feed rate creates more open grinding surface(grinding ability increases)



Test conditions	
Grinding wheel	WA60K
Rotary Dresser	#20/30
Grinding wheel peripheral speed	$V_s=29\text{m/s}$
Dress out	$Na=0$
Infeed per rev.of grinding wheel	
$Ar = 0.18\mu\text{m/rev}$	○
$= 0.36\mu\text{m/rev}$	●
$= 0.54\mu\text{m/rev}$	△
$= 0.72\mu\text{m/rev}$	□

② Influence of peripheral speed ratio on dressing force

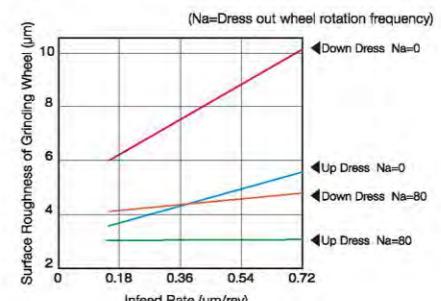
- Larger peripheral speed ratio allows higher normal force (increasing in grinding ability)
- Tangential force shows the same tendency as normal force, but the value is much smaller



2. Infeed rate

Influence of infeed rate of grinding wheel surface roughness

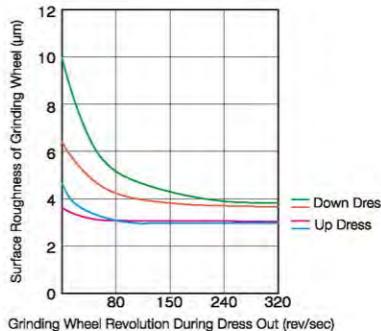
- Higher feed rates create a more open grinding surface (grinding ability increases)
- Longer dress-out time diminishes sharpness of the grinding surface



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.



Optional specifications of Rotary Dressers

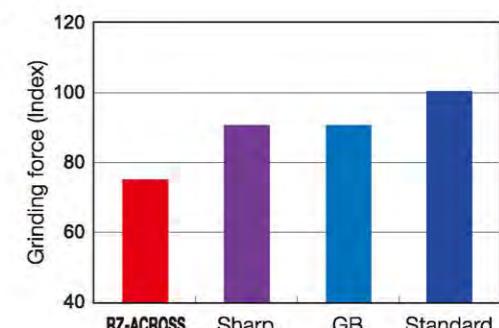
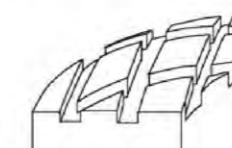
Various options available upon request

*Availability depending on profile or specification

Optional specifications for RZ type

1.Improved dressing ability (for fast dressing)

- GB (controlled diamond concentration)
 - High dressing rate with lower concentration by setting the glass balls for hard-to-concentration control electro-deposition type.
- Sharp type (controlled diamond projection)
 - Our unique process not by etching the bond layer realizes the diamond projection control without pulling-off the diamond grit.
- RZ-ACROSS (controlled diamond concentration)
 - Improves the discharge of chips and coolant



2. Improving wear resistance (for longer life)

- Strong

Reinforcing the peak of convex portion by pre-shaped diamond stones leads stable accuracy and high wear resistance

Optional specifications for SX type

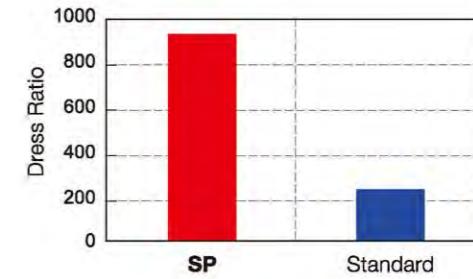
For improving wear resistance

- Super high concentration
 - By the unique pattern of diamond setting, maximum 100 pcs/cm² diamond stones provides longer life.
- Strong
 - Reinforcing the peak of convex portion by pre-shaped diamond stones leads stable accuracy and high wear resistance as same as RZ type.

Optional specifications for vitrified CBN wheels (SP type)

Stable performance and longer life

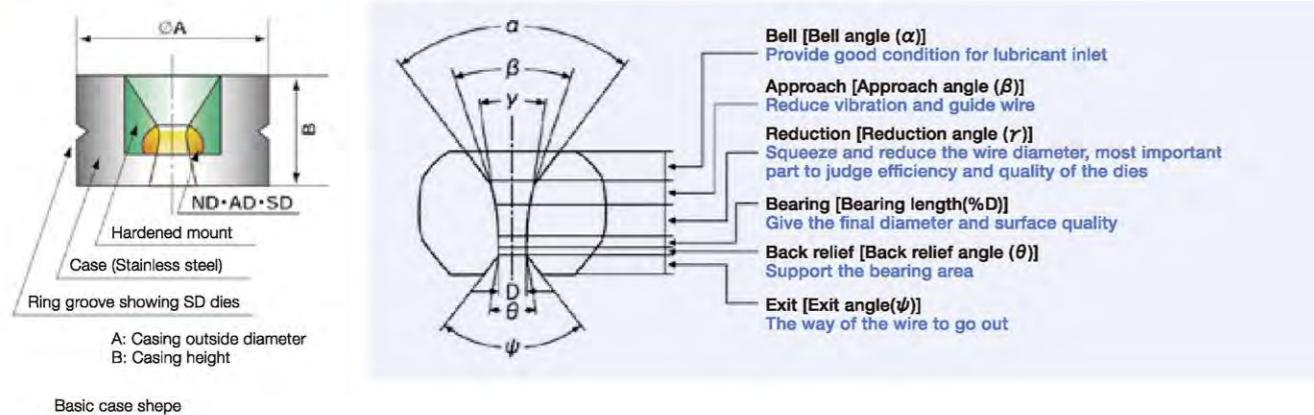
- SP
 - Special development for high-wear-proof vitrified and CBN forming wheels performing stable dressing as well as long life. Available both for RZ and SX.



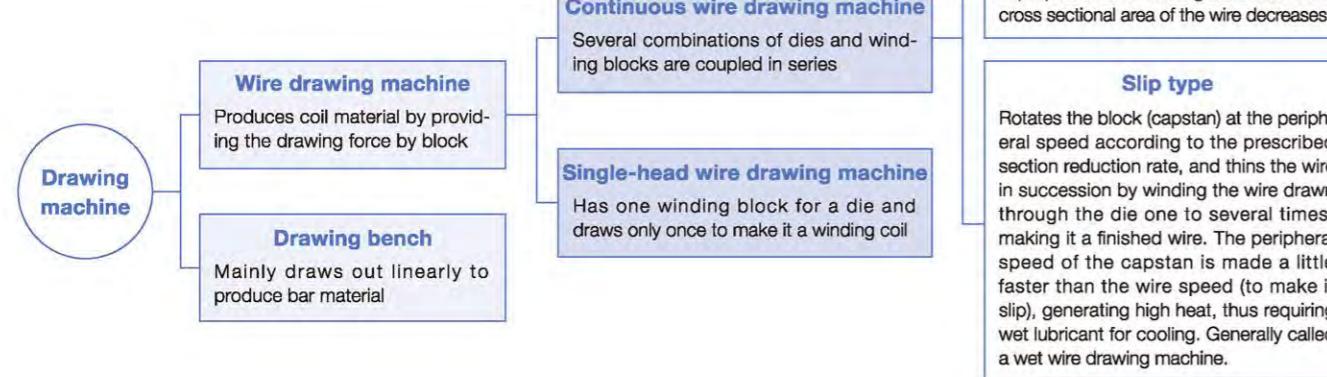
What is a diamond drawing dies?

To make desired smaller wire diameter by a tool with conical hole is called "wire drawing" or "wire drawing process". The hole of the tool has different diameter each side, its entrance is wide and its exit is small - the tool is "die". "Diamond dies" has with diamond for superior precision and longevity. We suggest appropriate diamond type and die shape for application.

Structure and role of diamond drawing dies



Wire drawing machine types



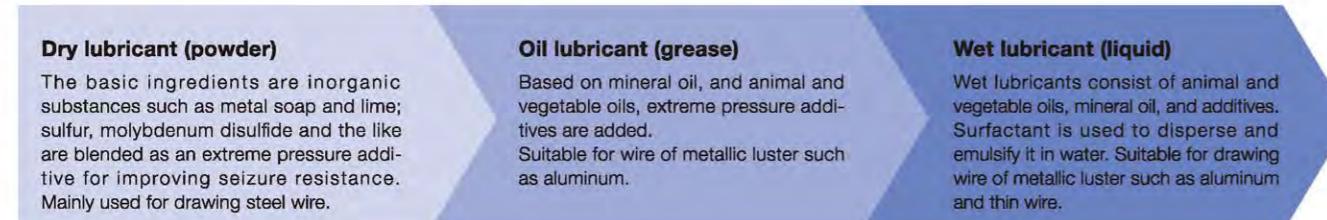
Types of lubricant

Lubricants are necessary to reduce friction between the die and wire material when drawing, preventing wear of the die, and seizures and scratches on the wire surface.

Types of lubricant: dry lubricant, wet lubricant for wire material, oil lubricant, etc.

Lubricants can be used properly according to wire material, processing method, and desired finish state.

Performance



Single crystal diamond dies

A single crystal diamond drawing dies using a single crystal diamond having high thermal conductivity is used for a wide range of applications such as copper wire and stainless steel wire for its high quality and long life. In particular, it is suitable for processing that requires ultrafine wire drawing and high quality surface roughness.

Polycrystalline diamond dies

For a Polycrystalline diamond drawing dies, sintered diamond powder obtained by ultra-high pressure is used. Although the target material is the same as that of a single crystal diamond drawing dies, it can be applied to a wide range of applications from large diameter wire to thin wire because it can be applied to larger sizes.

Shaped wire drawing dies

The cross sectional area provides a heteromorphic shape other than a circle.

It is used for manufacturing various heterogeneous wires – from windings of transformers in the heavy electric industry to connector pins and flat cables used in general electric machinery to accessories such as chains of necklace.

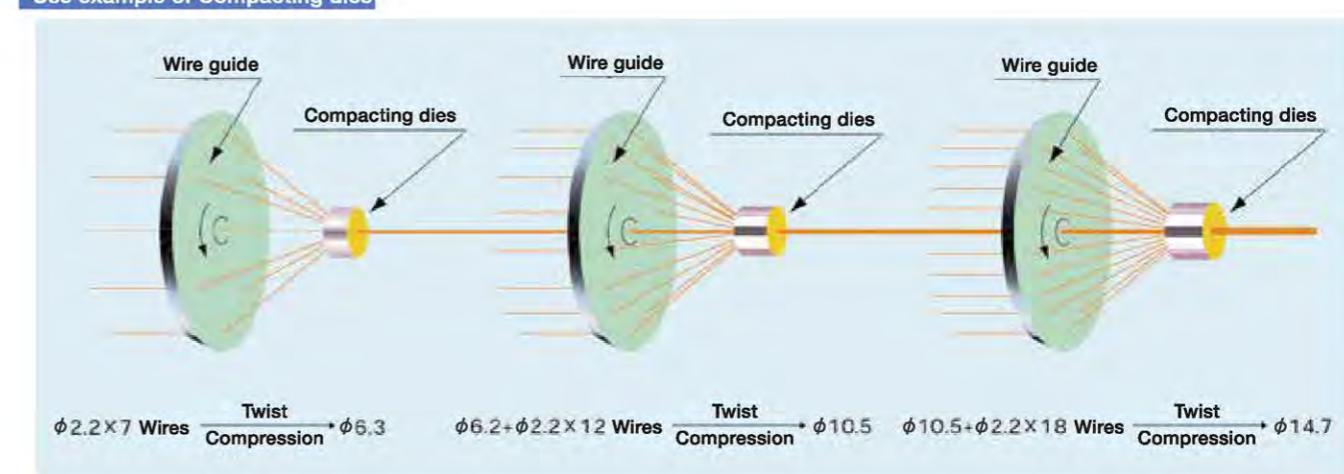
Cross section of shaped wire drawing dies



Compacting dies

A compacting dies is a tool that compresses circularly while twisting conductors (wires), used for power cables and low voltage electric wires (wire harnesses) for cars.

Use example of Compacting dies



Shaving dies

A shaving dies is a tool that removes oil, oxides, bubbles, scratches on the surface after wire drawing. It is a diamond die that scrapes off the wire surface using the diamond's inner peripheral blade.

Diagram of shaving dies processing example

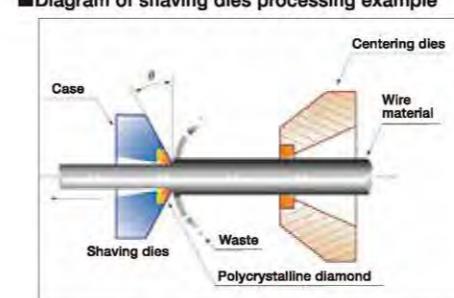


Image of shaving dies processing

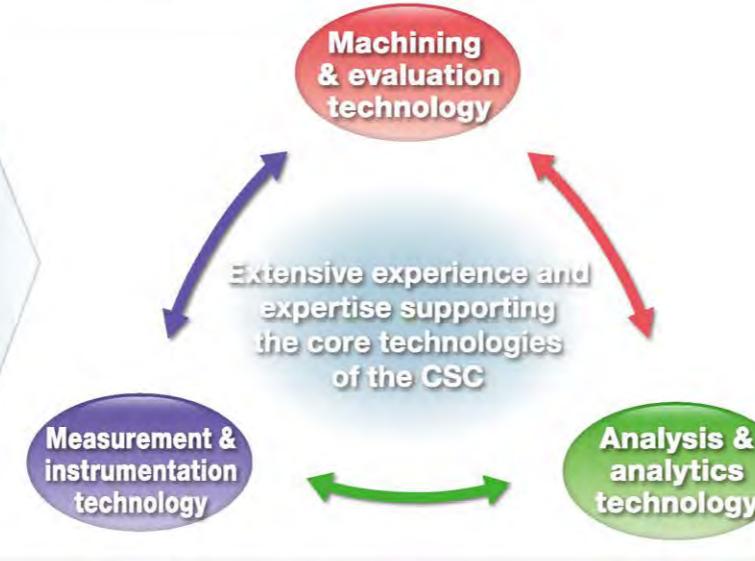


The CSC (Customer Solution Center) helps solve problems encountered by customers.

It is equipped with machines and analysis instruments, along with experienced staff; to find the best solutions for our customers.

I The strength of the Customer Solution Center

- 1** Best evaluations made using various equipment and facilities.
- 2** All evaluations in one step.
- 3** Swift evaluations made by very experienced staff.
- 4** Best solutions proposed to solve problems.



Introduction of 3 Core Technologies

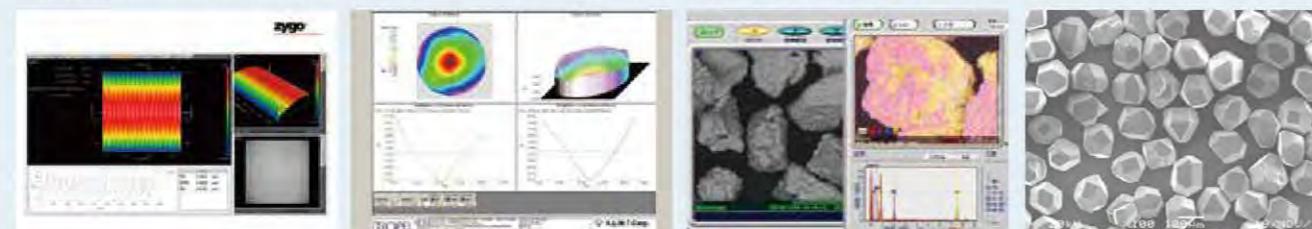
Machining and evaluation

The CSC owns various equipment to make accurate evaluations of turning, grinding and other general cutting inquiries.



Analysis and analytics

The CSC has electron microscopes, element analyzers, surface profile analyzers, etc., ready to respond to various measurement and evaluation requests.



3D surface analysis

Latest equipment are used to analyze workpieces and used tools to optimize machining conditions and tooling development.

3D flatness analysis

Profiles of workpieces such as "waviness" and "warp" can be analyzed.

Electron microscope and element analysis

Tooling and workpiece analysis enable best selections of machining methods.

Observations under electron microscopes

Observations of abrasives and workpieces lead problem solving clues.

Customer's "I'm in trouble" converted to "that's great!"

I Process flow from accepting requests to proposing solutions



Contact us

Please contact us by email or telephone first, or you can contact us at our local sales office.



Meeting, Quote

Our staff will contact you; we will then hold a meeting to cover the process evaluation and analysis.

* We will prepare a quotation when necessary.



Tool/work preparation, Production

Please send us your tools or workpieces for process evaluation and analysis.

We can produce them as required.



Evaluation, measurement, analysis and analytics

We will conduct process evaluation and analysis.

We can adjust the attendance dates at your request.

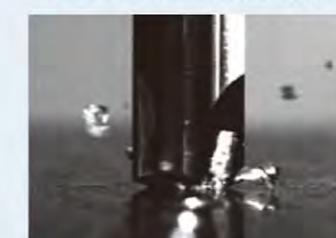


Report

We will prepare a report and submit it when the evaluation is completed. We will conduct a meeting on subsequent services based on the results; we will also make proposals for improvement.

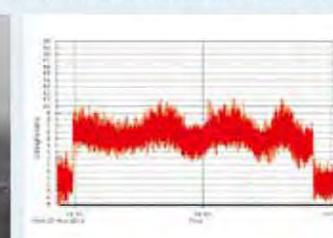
Measurement, instrumentation

The various measurement & instrumentation at the CSC are capable to respond to vastly diversified evaluation requests.



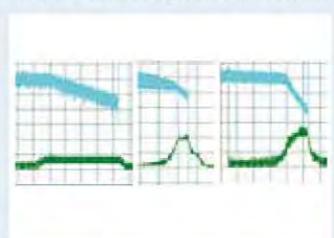
High speed cameras

Used to verify machining styles to optimize tooling and machining conditions.



Cutting / grinding resistance

The machining load such as grinding/cutting resistance and current forces can be identified.



Ultra-fine abrasive wheel grinding

Characteristics of machining of semiconductor materials, etc., are identified for best machining conditions and specifications selections.



Measurement of roundness and cylindricity

These can be measured immediately after machining to reflect findings in tooling and machining conditions.

Safety Precautions

Please read through user manual and inspection sheet of Diamond and cBN grinding wheel, PCD cutting tool, grinding machine and coolant before using for your safety. User manual needs to be kept in the distance that user can reach anytime. Accident or injury may be occurred by misusage. The extent of danger and damage may be caused by misusage are categorized in 2 steps and stated below.



Warning

Misusage may cause death or serious injury



Prohibited matters



Precautions



Caution

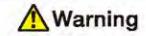
Misusage may cause slight injury or physical damage



Protective equipments are required

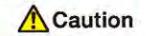
Safety precautions of Diamond and CBN wheels in use

1. Work environment / Work clothes / Protective equipment



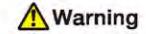
- ! Wheel guard must be properly attached
- ! Only authorized people attend around machine and do not stand at rotation direction
- ! Must wear dust-proof glasses, safety shoes, safety hat and appropriate clothes
- Caution**
- ! Ventilate to remove mist coolant and dust
- ! Must wear dust-proof mask and ear plug
- ! Clean floor around grinding machine
- ! Instruct moving range of table of grinding machine etc. on the floor
- ! Do not put anything or stand within its moving area
- ! Do not operate in the area of inflammable object because wheel sparks in use

2. Before use



- ! Check wheel sizes to match with requirement of grinding machine
- ! Check appearance (crack, fracture, breakage etc.) after cleaning wheel
- ! Wash corrosion inhibitor in case wheel body is ferrous material
- ! Clean wheel mounting portion of spindle
- ! Clean flange and chuck to confirm no damage, warp and bend etc.
- ! Check warp and bend on wheel
- ! Read user manual and confirm wheel is for appropriate usage

3. Attachment



- ! Turn off a switch when wheel is attached to spindle
- ! Attach wheel gurad appropriately
- Caution**
- ! Check scratch and dust etc. around or inside of mounting portion of wheel, flange and chuck
- ! Remove small scratch etc. by sandpaper
- ! Hold wheel with enclosed cushion material to prevent crack etc. in case of vitrified bond wheel
- ! Wheel and flange need to be smoothly attached
- ! Do not attach with force by hammering etc.
- ! Do not operate to change inner dia
Please instruct us if necessary
- ! Screw flange by equable torque at the position of diagonal line
- ! Check overhang length does not surpass limitation

Important notice

- ! May balance on machine after being attached to the machine
- ! May loose attachment of wheel and flange to screw by checking run-out of reference face close to abrasive layer

4. Trial run



- ! Check work material is firmly attached and operation of feed mechanism work correctly
- ! Check wheel is firmly attached and operation of feed mechanism work correctly
- ! Check rotation direction of wheel
- ! Check irregular sound or vibration by no-load operation around 1-3 mins
- Caution**
- ! Check coolant is correctly supplied

5. Grinding operation



- ! Do not touch wheel when rotating
- ! Make completed stop when irregular sound or vibration occurred
- ! Turn off a switch only after stopping coolant supply
- ! Do not touch or put object to stop rotating wheel
- ! Turn off a switch when wheel is taken out from spindle
- Caution**
- ! Be careful of excess cutting especially dry tool cutting
- ! Confirm feed, D.O.C. and cycle time by trial run
- ! Check burning or chatter mark on work material
- ! Be careful of overload

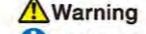
6. Storage and handling



- ! Check crack, scratch, breakage, burning etc. on working face
- ! Store dry area and prevent drop-off and crash etc.
- ! Apply corrosion inhibitor to ferrous wheel body to store
- ! Do not operate to change wheel shape. Please instruct us if necessary

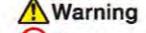
Safety precautions of Circular Saw in use

1. Work environment / Work clothes / Protective equipment



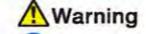
- ! Designated wheel guard must be properly attached Otherwise, in case tool is broken, serious injury may occur
- ! Only authorized people attend around machine Do not approach to the area of rotation direction and moving area of machine table
- ! Must wear dust-proof glasses, safety shoes, safety hat and appropriate clothes Sleeve or bottom of clothes need to be tight not to occur serious injury
- ! Must wear dust-proof mask and ear plug
- ! Do not operate in the area of inflammable object because tool sparks in use
- Caution**
- ! Ventilate to remove mist coolant and dust
- ! Clean floor around machine

2. Before use



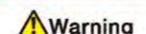
- ! Please use within peripheral speed stated
- Caution**
- ! Check tool sizes to match with requirement of the machine
- ! Remove edge protection and store it in the case
- ! Check crack and breakage etc. after washing corrosion inhibitor
In case no irregular is confirmed, please attach edge protection Protection removes risk of crack or injury of user
- ! Check warp and bend
- ! Clean mounting portion of main spindle
- ! Clean flange and check scratch, warp, bend, irregular balance etc.

3. Tool attachment



- ! Turn off a switch when tool is attached to main spindle
- ! Check scratch and dust etc. around mounting portion of tool and apply sandpaper if necessary to remove
- ! Apply edge protection when tools is attached
- ! Do not attach with force by hammering etc.
- ! Do not operate to change hole diameter
Please instruct us if necessary
- ! Screw flange by equable torque at the position of diagonal line
- ! Remove edge protection after attaching

Safety precautions of PCD reamer and endmill



- ! Put safety cover and protection glasses etc.
- ! Do not touch sharp cutting edge by hand
- ! Check tool hand and rotation direction of machine