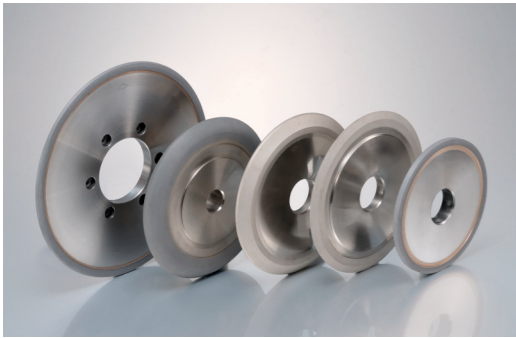


# Diamond·CBN Tools



## Flute Master

Better Grinding Ability for Flute Grinding by Using Water-Insoluble Coolant



- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Drills and Endmills Flute Processing P.23  
■Flute Master HP P.23

## Flank Master Type-M

Highly Efficient Grinding of Cermet by Use of Water-Insoluble Grinding Fluid

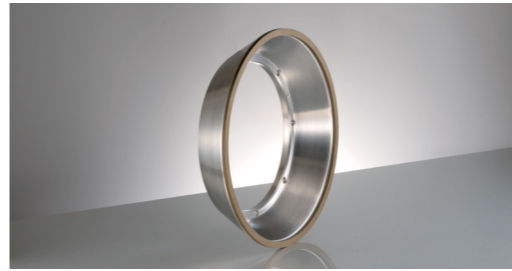


- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Grinding Insert Tip Periphery and Cutting Edge P.25

## Flat Master Type-R

Ideal for Grinding of Cutting Edges of Carbide / Cermet Cutting-Edge Replacement Chips

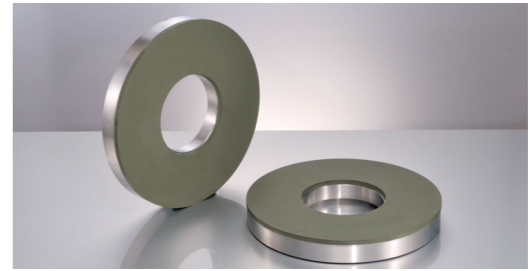


- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Grinding Insert Tip Periphery and Cutting Edge P.25

## Flat Master Type-R

Ideal for Thickness Processing of Carbide / Cermet Cutting-Edge Replacement Chips



- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Thickness Grinding P.26

## MT Bond Wheel

A New Metal Bond Wheel Having Ultimate Sharpness

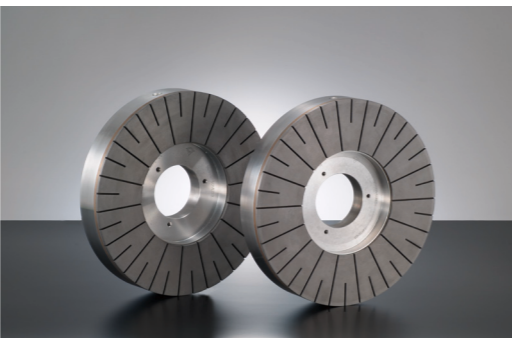


- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For processing Glass and Ceramics P.32

## MB SPARK

Both High Efficiency and Long Life Ensured in Machining Sintered Alloy and Cast Iron

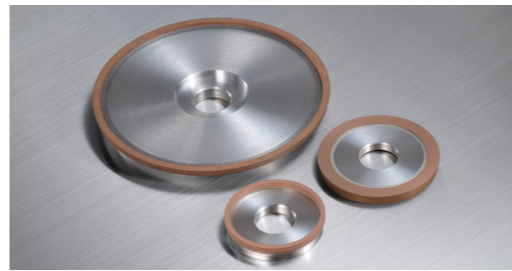


- Automotive**
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Variable Valve Processing P.18  
■For Processing Oil Pump Parts P.35

## RESIACE

Demonstrates High Performance in Heavy Grinding



- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Drills and Endmills Processing P.24

## Flute MAX

Demonstrates High Performance in High-Load Grinding Using Water-Soluble Grinding Fluid

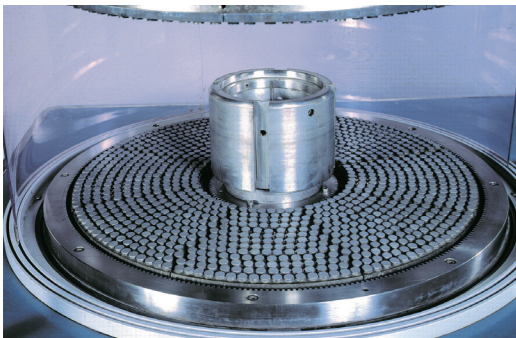


- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Drills and Endmills Processing P.24

## DPG Wheel

A Bonded Grain Lapping Plate Friendly to People and Environment

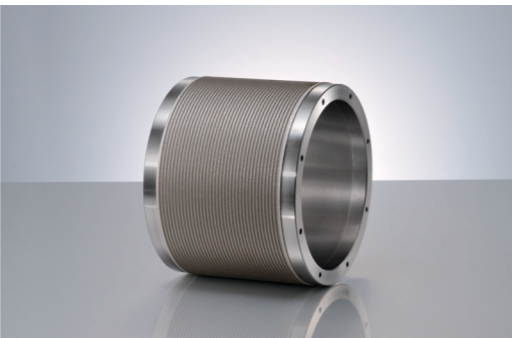


- Automotive**
- Tools**
- Magnetic Material
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Processing Glass and Ceramics P.31

## PSL Wheel

Ideal for Materials that Tend to Cause Loading such as Rubber and Resin

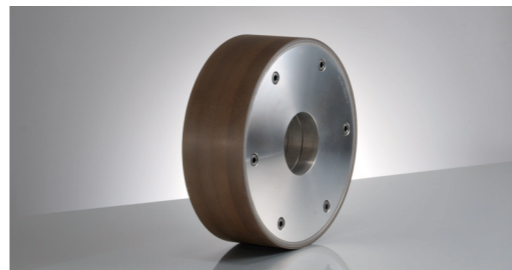


- Automotive**
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Rubber Belts P.19

## Centerless Grinding Wheel

Excellent Sharpness Sustainability Improved Productivity

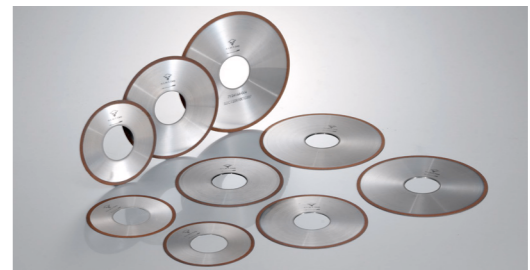


- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Mass-Production-Produced Outside Diameter Finishing of Round Bar Materials P.24, 29

## High-Rigid Body Cutting Wheels

The High-Rigid Body Realizes Both Good Cutting Ability and Long Life

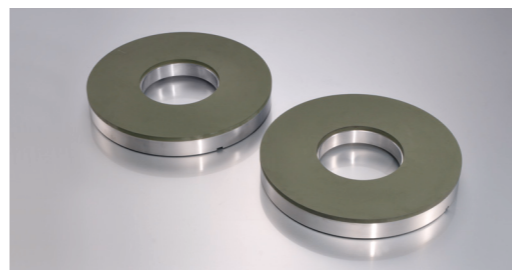


- Automotive**
- Tools**
- Magnetic Material**
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Cutting Magnets for Motors P.10 ■For Processing Magnetic Materials P.28

## Double Disc Wheel

The Dressing Performance and High Wear Resistance Have Been Realized at a High Level



- Automotive
- Tools**
- Magnetic Material**
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Motor Magnet Processing P.10 ■For Processing Ceramics and Magnetic Materials P.29

## Hybrid Wheel

Optimal for Cermet Processing

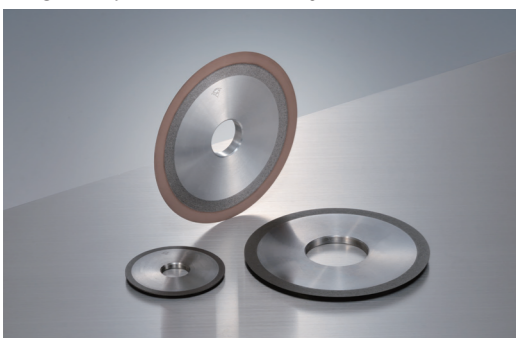


- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■Cermet Processing P.27

## PGV·PGS Wheel

High Shape Retention Ability Realized



- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Profile Processing P.37

## Beveling Wheel

High Quality Surface

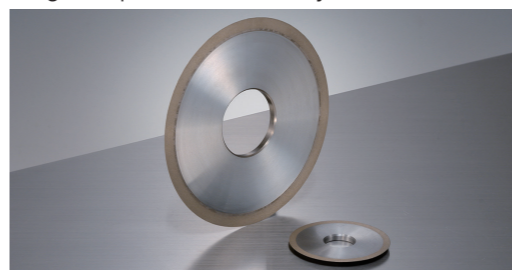


- Automotive**
- Tools**
- Magnetic Material**
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Glass Beveling P.19

## PGV·PGS Wheel

High Shape Retention Ability Realized

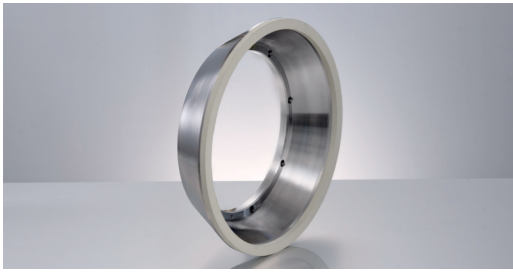


- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Profile Processing P.37

## Flank Master Type-V

High Efficiency and High Precision Grinding of Cutting Edges of PCD / PCBN Tools

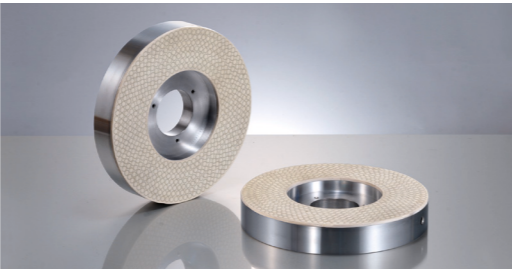


■For Grinding Insert Tip Periphery and Cutting Edge P.26

- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## Flat Master Type-V

Ideal for Thickness Machining of PCD/PCBN Cutting Edge Replacement Tips

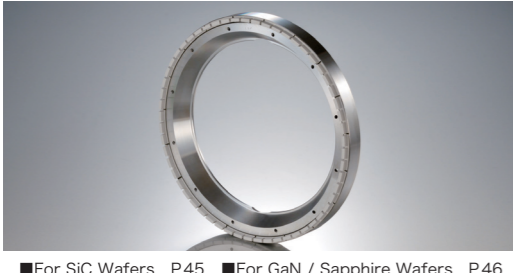


■For Thickness Grinding P.26

- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## Nanomate Premium

Realizes High-Efficiency, High-Quality Processing of Various Wafers



■For SiC Wafers P.45 ■For GaN / Sapphire Wafers P.46  
■For Si Wafers P.47 ■For MEMS Wafers P.48

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics**
- Dresser
- Wire Material

## Nanomate Masspower

Effective in finishing SiC, LT/LN Wafers



■For SiC Wafers P.45 ■For LT/LN Wafers P.46

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics**
- Dresser
- Wire Material

## Nanomate V-Heart

Ideal for Rough Grinding of Si Wafers



■For Si Wafers P.48

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics**
- Dresser
- Wire Material

## Nanomate Cellfied

Achieving Both Low-Load and Long-Life with Rough and Medium-Finish Processing of Si Wafers

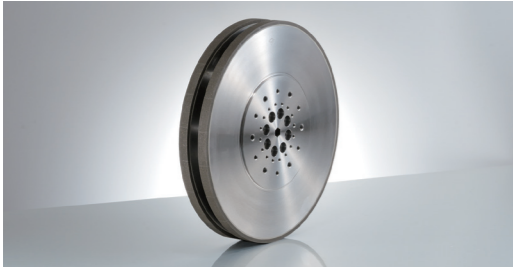


■For Si Wafers P.47

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics**
- Dresser
- Wire Material

## HIG Wheel

Highly Efficient Wheel for Processing with High Dressing Performance and Wear Resistance



■For Cam Grinding P.20

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## EG Wheel

Good Surface Roughness, High Efficiency Grinding and Long Life

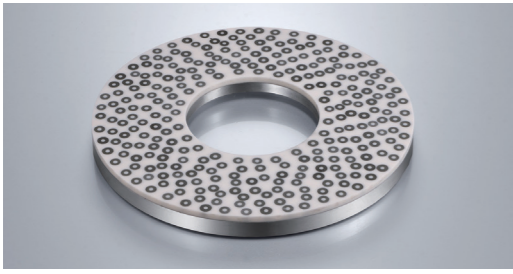


■For Processing Ceramics and Cemented Carbide P.31

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## DPG Wheel (Vitrified Bond)

Continuous Machining with Good Grinding Performance



■For Cermet, Ceramics and Cemented Carbide Processing P.27

- Automotive
- Tools**
- Magnetic Material
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## High Precision Electroplated Wheel FORMASTER

High Efficiency and High Precision Form Grinding

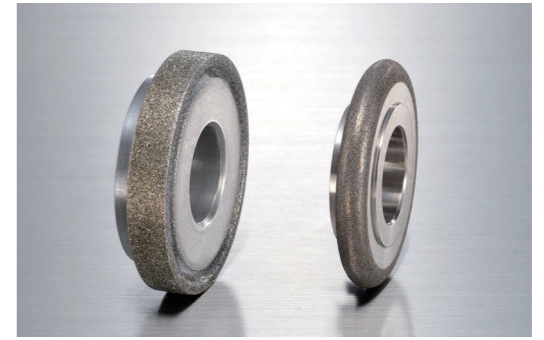


■For Motor Magnets P.10  
■For Processing Magnetic Materials P.29

- Automotive**
- Tools
- Magnetic Material**
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## Formaster Premium

Longer Tool Life for Hardened Steel Parts such as Gears

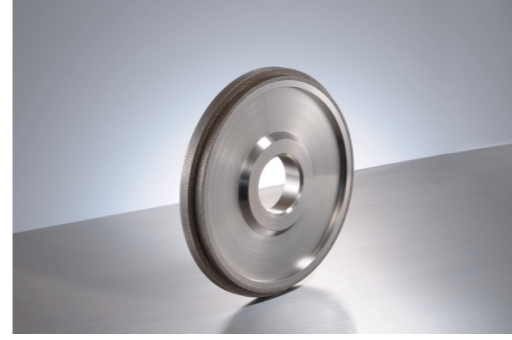


■For CVT Grooves P.19 ■For Reduction Gear P.36

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## CB Master

Optimized for High Efficiency and Long Life of Total Shape Processing of Heat-Resistant Alloy Parts



■For Turbine Blade Shrouds P.33 ■For Turbine Blades Grooves P.34  
■For Combustor Casing P.34

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation**
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## General Electroplated Wheel

A Wide Selection of Diamond and CBN Abrasive Grains to Meet Various Machining Needs

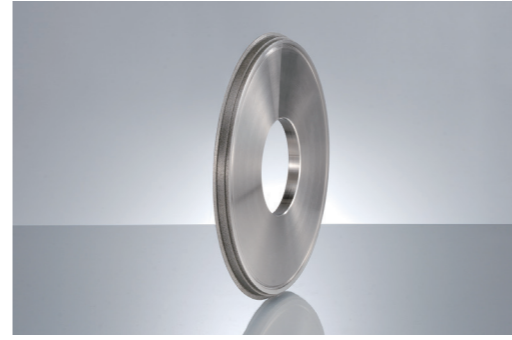


■For Processing Ceramics and Ferrous Materials P.37

- Automotive**
- Tools**
- Magnetic Material
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## Large Electroplated Wheel

High Peripheral Speed Machining with Large-Diameter Electroplated Wheels Significantly Improves Service Life and Efficiency

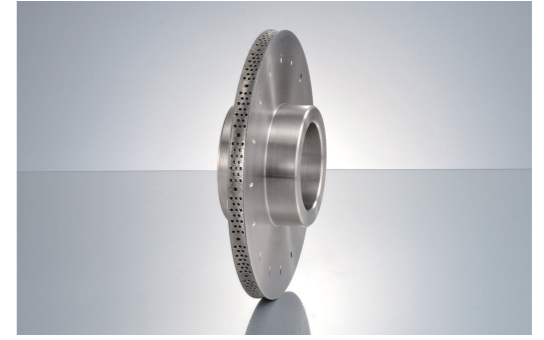


■For Machining Heat-Resistant Alloy Parts P.37

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics**
- Aerospace, Power Generation**
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## Low-Resistance Electroplated Wheels

Dimple Machining on the Base Metal Contributes to Improved Sharpness and Reduced Machining Load



■For Processing Ceramics and Magnetic Materials P.32

- Automotive**
- Tools
- Magnetic Material**
- Glass, Ceramics**
- Aerospace, Power Generation**
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## Electroplated Internal Grinding Wheel

Meets Various Grinding Requirements



■For Processing Glass, Ceramics and Ferrous Materials P.30

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics**
- Aerospace, Power Generation
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## Super Sizing Reamer

Highly Precise Hole Finishing by 1 Pass

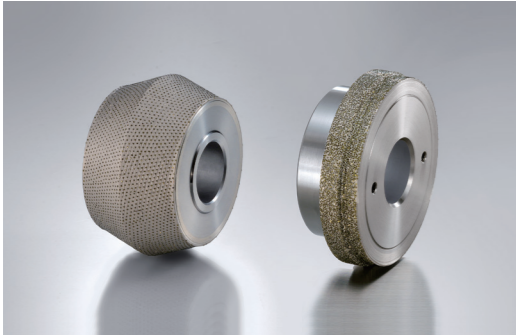


■For Finishing Holes P.20, 36

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds**
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

## Rotary Dresser Optimard Series

Optimization Wear Resistance and Sharpness on Request

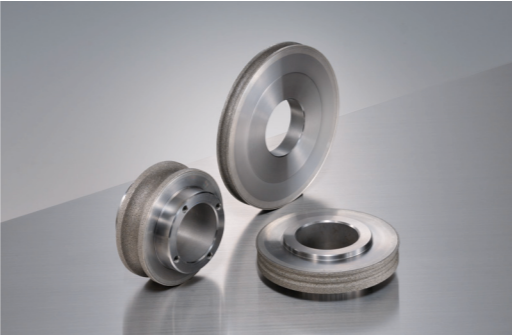


- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Hub Units P.21 ■For Ball Screw P.35  
■For Linear Guide P.35 ■For Bearings P.49

## Rotary Dresser for Bearings

Good Sharpness and High Accuracy



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Automotive P.22  
■For Bearing P.50

## Rotary Dresser for Linear Guide (Linear Motion Bearing) Processing

Contributing to Bearing Resistance Reduction

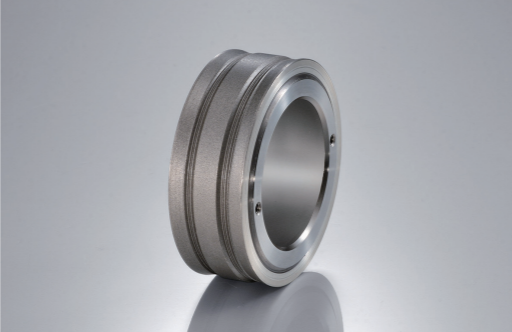


- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Linear Motion Bearing Processing P.50

## Rotary Dressers for Machinery and Industrial Machinery

High Precision and Fine Shapes can be Manufactured

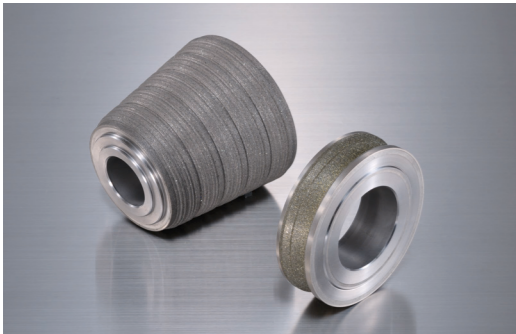


- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Tap Groove P.27, 50  
■For Reduction Gear P.36, 50

## Rotary Dresser for Automotive Parts

Achieves High Precision and Good Sharpness



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Hub Unit Parts P.21, 51 ■For CVT Components P.21, 52  
■For Injector Components P.22, 52 ■For Steering Components P.22, 51

## Rotary Dresser for Gear (Disc Dresser)

Contributes to Higher Quality Gears and Reduced Grinding Costs



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Gear P.18, 52

## Rotary Dressers for Aircraft and Power Generation

High Efficiency Dressing from Small to Large



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Turbine Blades P.34, 51

## Rotary Dresser for Copying

Consistent Dressing Performance



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Profile Dressing P.22 ■For Internal Grinder Machine P.53  
■For Dressing CBN / High Hardness Wheels (Crown Dresser) P.53 ■For Centerless Grinding P.53

## BLPCD Dies

Excellent Wear Resistance, Roundness Retention, and Wire Surface Roughness Retention



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Wire Drawing of Various Types of Wire Rods P.54

## Ultra-Precision Diameter Diamond Dies

Capable of Mass Production Up to the Smallest 0.008 mm

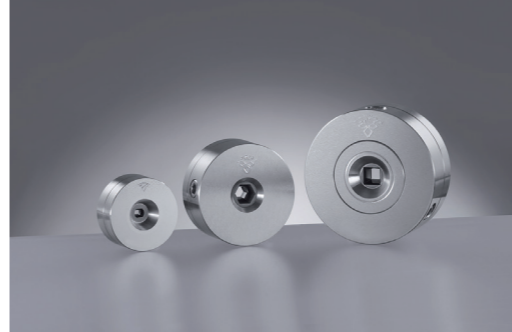


- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Processing Gold Wire, Copper Wire and Stainless Steel Wire P.55

## Shaped Wire Drawing Dies

Wires Drawn to Various Shapes such as Square and Track Accurately.



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Various Square Wires P.55

## Single Crystal Diamond Dies

Used for Ultra Fine Wires 0.008 mm Minimum to Wires About 1.0 mm



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Wire Drawing of Various Types of Wire Rods P.56

## Polycrystalline Diamond Dies

A Lineup of Dies of Consistent Quality and Sizes up to Large Diameters



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■For Wire Drawing of Various Types of Wire Rods P.56

## Diamond Compacting Dies

Excellent Wear Resistance and Stable Weight Per Size and Unit Length



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■Stranded Wires of Power Cables, Automotive Wire Harnesses, Wire Ropes P.57

## Diamond Shaving Dies

Long Tool Life to Reduce the Setup Time and Waste Materials



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■Shaving Copper Wires, Aluminum Wires, Gold Wires and Titanium Wires P.57

## Diamond Tin-Plating Dies

Design to Minimize Adhesion of Tin to the Case



- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical
- Semiconductor, Electronics
- Dresser
- Wire Material

■Adjusting the Thickness of Plating of Tin-Plated Copper Wires P.57

## UPC-ZERO

Ultra-Precise Cutting Surfaces have been Achieved in the Machining of Ni-P Mold, Plastic Parts and Other Materials



■For Ni-P Molds and Plastic Processing P.38

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## BLPCD UPC

Achieves Long Tool Life in Mirror Finish and Fine Machining of Carbides

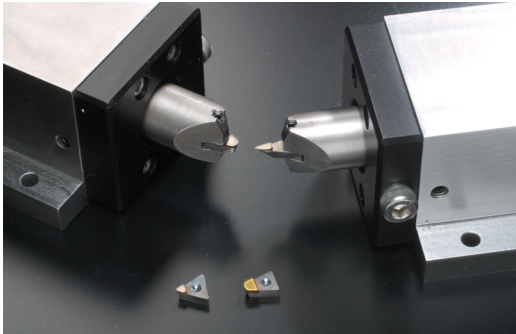


■Cemented Carbide Lens Molds P.38  
■For Sensor Camera Mold P.43

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## Elliptical Vibration Cutting Tool UPC

Realizes Mirror Finishing of Hardened Steel, Stainless Steel, and Glass

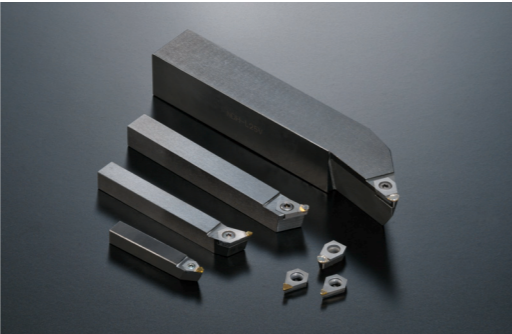


■For Die Processing of Hardened Steel, Cemented Carbide and Glass Materials P.40, 43

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## NewD

Achieves Stable and Long Tool Life by Measuring and Optimizing the Crystal Orientation



■For Aluminum Parts P.17  
■For Processing Eyeglass Lens P.44

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## UPC-R

Outstanding Performance in Ultra-Precision Cutting

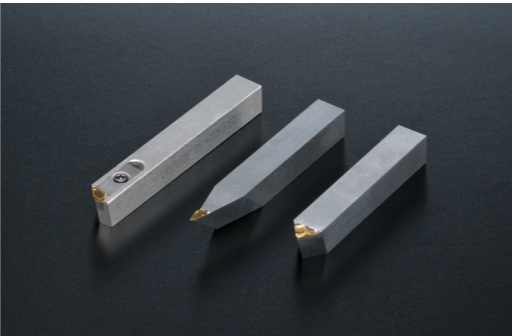


■For Processing Various Lens Molds P.39, 43

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## UPC-T

Ideal for Fine Grooving

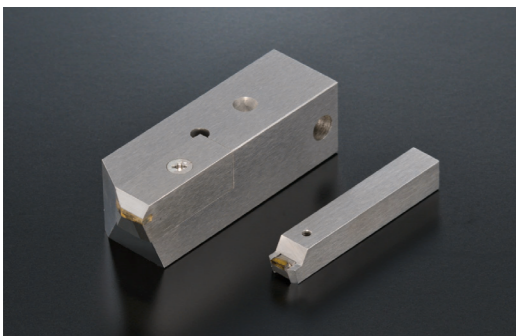


■For Fresnel Lens Molds Processing P.40

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## UPC-F

Excellence in High Efficiency and Ultra-Precision Cutting of Planes and Cylinders



■For Plane and Cylindrical Mirror Finishing of Polygon Mirrors Processing P.37

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## UPC-Nano Series

Realizes the World's Smallest Ultra Precision Processing



■Nano groove P.41 ■Nano ballendmill P.41, 43  
■Nano endmill P.42 ■Nano profile P.42, 43

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## For Machining Motor Case and Gear Case

Ideal for High-Speed Machining and Chip Process Measures



■For Motor Case Processing P.09

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## For Cylinder Head Parts

Realization of High-Precision and High-Speed Machining



■For Cylinder Heads P.11, 12

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## For Valve Guide Hole

Long Life and High-Efficiency Machining of Sintered Alloy and Cast Iron Valve Guides



■For Valve Guide P.13

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## For Steering Components

Realization of Combined Machining and High-Speed Machining



■For Steering Components P.14

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## For Valve Body Hole Machining

Realization of High-Precision Machining



■For Valve Body Hole P.15, 16

- Automotive**
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## PCD Milling Cutter for Eyeglass Lens Rough Cutting

Cutting Rotary Tools for Surface Machining, Free-Form Surface Machining and Grooving



■For Processing Eyeglass P.44

- Automotive
- Tools
- Magnetic Material
- Glass, Ceramics
- Aerospace, Power Generation
- Machinery, Metal Molds
- Optical**
- Semiconductor, Electronics
- Dresser
- Wire Material

## Technical Data P58~72

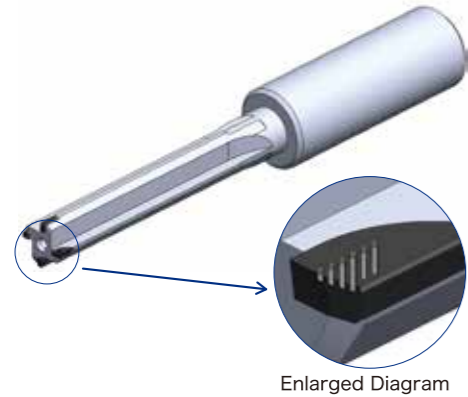
- What are Diamond / CBN?.....58
- Diamond / CBN Grinding wheel.....59~64
- Diamond / CBN Cutting tools.....65~66
- Diamond Rotary Dresser.....67~70
- Diamond Drawing Dies.....71~72

## New Generation Automotive (BEV, HEV, PHEV, FCV)

### For Machining Aluminum Parts / PCD Rotating Tool with Regrindable 3D Chipbreaker "Regslash"

#### Chipbreaking and Energy Cost Reduction in Aluminum Parts Machining

This tool solves the problems of conventional 3D chipbreakers by newly-developed regrindable 3D chipbreaker. It improves downtime due to chip problems and reduces energy costs by controlling tool costs, etc.



#### ■ Features

- 3D chipbreaker for chip braking and improving downtime
- Regenerates the effect of chip breaking, reduces tooling costs and shortens cycle time

#### ■ Applications

- Aluminum Parts hole finishing

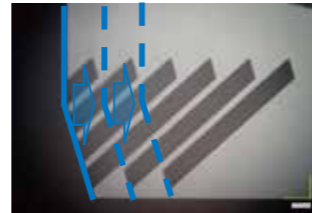
#### Chip Comparison (ADC12)



Without 3D Chipbreaker



With 3D Chipbreaker



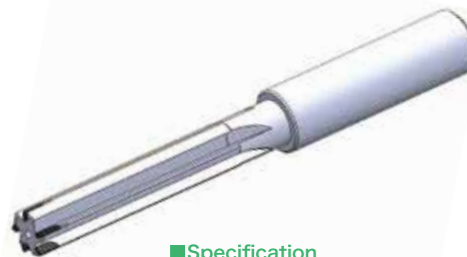
Regrinding Image

### For Machining Aluminum Parts / High Feed PCD Reamer

This new generation tool is expected to reduce machining time by several tens of seconds compared to conventional tools. (\*)

Realizes highly efficient machining while maintaining the quality of deep hole reamer finishing. Contributes to reduction of CO<sub>2</sub> emissions by shortening equipment operation time.

(\*Compared with Vc150 f0.15 φ12, depth 100 mm, 6-hole finishing)



#### ■ Specification



3 Blades 4 Blades 5 Blades  
High precision and high feed rate can be expected with each blade number.

3 Blades...The small number of blades reduces cost and is a reasonable specification.

4 Blades...Standard specification. The widest manufacturing range due to the design without guide pad.

5 Blades...Feed can be increased up to f1.0 mm/rev.

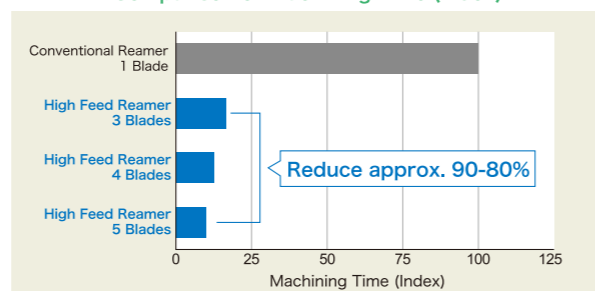
#### ■ Features

- Our original "3, 4, and 5 blades unequal flute spaced design."
- Enables higher precision machining than ever before under high feed conditions.
- Significant reduction in machining time (number of machines, operating time, and CO<sub>2</sub> emissions) for aluminum parts that require high precision machining can be expected.

#### ■ Applications

- Aluminum Parts hole finishing

#### Comparison of Machining Time (Index)



## Form Grinding of Magnets for Motors / 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.



#### ■ Features

- Reduced grinding force: Long-lasting sharpness ensured by "precision electrodeposition technology."
- Long life: Improves tool life by suppressing changes in the shape of edges and recesses

#### ■ Applications

- Form machining of motor magnetic material (Air conditioners, EPS, Power windows, HV drive motors)

#### ■ Machining Examples

- Magnetic material machining

#### ■ Standard Manufacturable Range

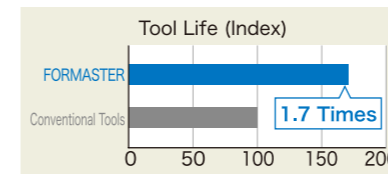
Abrasive Grain	Diamond / CBN
Grit Size	#60~#170
Tool Diameter	φ30~350

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

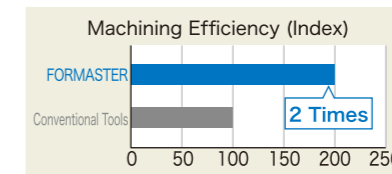
#### ■ Results of Shape Measurement (After Grain Fixing)



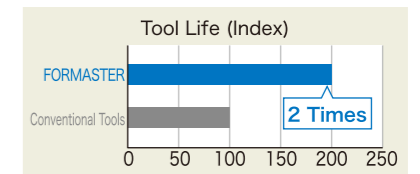
#### Magnetic Material (Ferrite)



#### Magnetic Material (Neodymium)



#### Magnetic Material (Neodymium)



## Cutting of Magnets for Motors / High-Rigid Body Cutting Wheels

### The High-Rigid Body Realizes Both Good Cutting Ability and Long Life

The highly rigid body enables highly efficient machining due to increased feed rate and excellent cutting accuracy. In addition, it enables improve yield rate since abrasive grain layer thickness can be made thinner.



#### ■ Features

- High-rigid body and clearance design leading to high precision performance and long tool life.
- High rigidity body makes it possible to reduce blade thickness, thereby improving yield.
- Highly efficient machining enabled by an increased feed rate.

#### ■ Applications

- Highly precise cutting of Magnetic, Glass, Ceramics and Ferrous materials

#### ■ Comparison Table of Conventional Steel Body and High-Rigid Body Cutting Wheels

	High-Rigid Body	Steel Body
Machining Accuracy	Very Good	Good
Tool Life (Index)	2	1
Machining Efficiency (Index)	2	1
Thinnest Body Thickness	0.3 mm	0.5 mm
Clearance	Provided	Not Provided
Price (Index)	1	1

#### ■ Manufacturable 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.

## 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-sided surface grinding and the good dressing performance and wear resistance realized simultaneously. The CBN grains realize excellent performance in grinding ferrous sintered alloy parts. The diamond grains enable high efficiency grinding of magnetic and ceramic parts.



#### ■ Features

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

#### ■ Applications

- Grinding of automotive oil pump parts, automotive engine parts, magnets for automotive motors, pump parts for air conditioners, magnetic materials, ceramic parts, etc.

Cylinder Head and Block Machining / PCD Rotating Tool

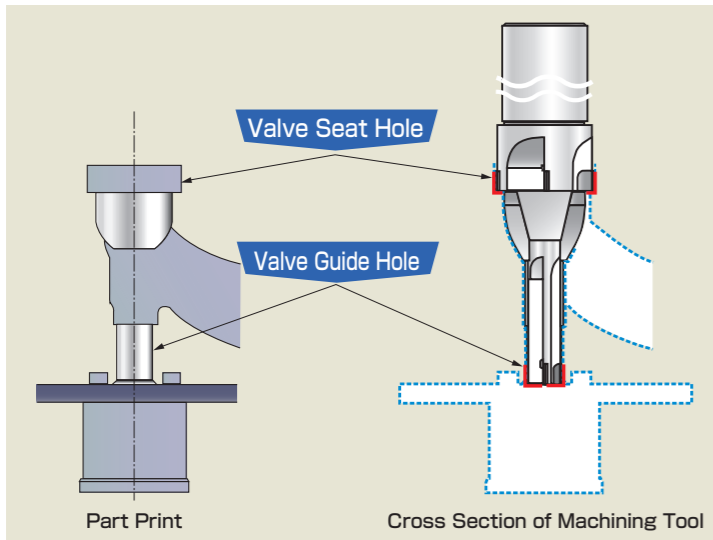
Aluminum parts for powertrain applications are becoming more complex in shape and getting thinner for improvement of fuel efficiency and lightweighting. We contribute to various needs with design proposals suitable for further control of machining time and costs, such as process consolidation of multi-step holes, one-shot machining of roughing and finishing, and high feed with multi-blades.



■ Features

- Multi-Step profile tools consolidate the hole finishing process.
- Achieve precise and stable accuracy by utilizing the characteristics of diamond material with sharp edges and abrasion resistance.
- Combining the optimal design and machining conditions can improve accuracy and machining time.

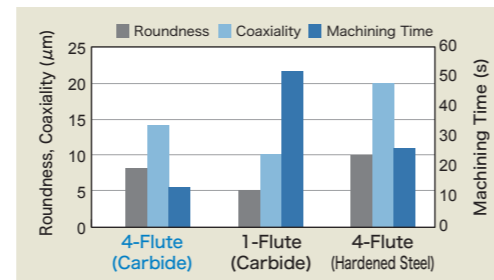
■ Multi-Step Finisher (Valve Guide/Sheet Parent Metal)



High quality cutting edges enable both high precision and high efficiency machining.

■ Multi-Step Finishing

Difference in Performance According to Specifications and Shank Material



■ Machining Conditions

Specification	4-Flute (Carbide)	1-Flute (Carbide)	4-Flute (Hardened Steel)
Machine	Horizontal Spindle Machining Center (HSK-A63)		
Cutting Speed Vc (m/min)	400 (φ36)		
Feed Per Revolution f (mm/rev)	0.3	0.075	0.3
Coolant	JIS A1 Class Emulsion		

※φ11-φ36 finish processing example

Touring Examples of PCD Rotating Tool for Cylinder Head Machining

■PCD Multi-Step Reamer for Finishing Solenoid Holes  
Finishing multiple holes on the coaxiality line with a single multi-step reamer reduces machining time and ensures high coaxiality by consolidating processes.

■PCD Reamer for Finishing Spark Plug Holes  
The multiple cutting edges at the start of machining ensure the constraint of the cutting tool. Stable machining quality is achieved even for shapes with a difference in hole diameter.

■PCD Side Cutter for Machining Cam Bearing Oil Grooves  
High precision grooving can be expected due to a cutting edge design that reduces Chatter caused by cutting resistance.

■1-Flute PCD Reamer for Finishing Valve Lifter Holes  
High quality hole finishing with Chatter suppression is realized by the design considering the guide pad distribution and dynamic balance.

■PCD Endmill for Machining Spring Seat Surface  
We propose a design that prevents chips from being fitted into the water jacket, and also takes into consideration a chatter-free cutting surface.

■PCD Reamer for HLA Hole Finishing  
The design considering the quality degradation of interrupted areas (chips and grooves in machined holes) stabilizes machining accuracy.

■PCD Ball Endmill for Machining Cam Bearings  
The high shape accuracy of PCD material, which is suitable for shape creation, stabilizes machining accuracy in the next process (finishing).

■PCD Reamer for Finishing Sensor Holes  
The multi-blade design achieves high precision and shortens machining time for simple hole drilling.

■PCD Endmill for Rough Machining of Valve Guide Press-Fit Hole + Rough Machining of Throat Hole  
PCD endmill for rough machining with stock removal to achieve high precision finishing of the valve guide press-fit hole and throat hole in the next process.

■PCD Reamer for Multi-Step Finishing  
Highly rigid shank material is used to finish multi-step holes (Valve guide/Sheet parent metal) in one shot.

■PCD Endmill for Throat Hole Finishing  
The high quality full-form cutting edge and the layout design that suppresses cutting resistance improve the precision of the throat shape and avoid chip entrapment problems, contributing to higher productivity.

■ Example of HLA Hole Finishing Process

Machine	Horizontal Spindle Machining Center (HSK-A63)
Cutting Speed Vc (m/min)	188 (φ12)
Feed Per Revolution f (mm/rev)	0.34
Stock Removal (φ)	0.5
Coolant	JIS A1 Class Emulsion

※HLA: Hydraulic Lash Adjuster Abbreviation

■ Example of Multi-Step Finishing

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

Machine	Horizontal Spindle Machining Center
Rotational Speed s (min <sup>-1</sup> )	6,000
Feed Rate F (mm/min)	2,880
Feed Per Tooth fz (mm/z)	0.12
Stock Removal (φ)	0.6
Coolant	JIS A1 Class Emulsion

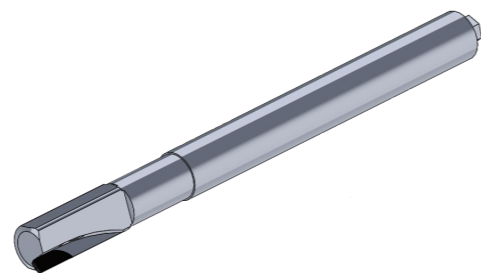
**For Finishing Valve Guide Hole / PCD Rotating Tool**

Valve guides are made of sintered alloy or cast iron from the viewpoint of sliding properties and durability of the valve shaft moving at high speed. Finishing valve guide holes with carbide reamers hinders productivity due to low wear resistance, which deteriorates machining accuracy and causes frequent tool changes. On the other hand, diamond reacts with iron, but by reducing the machining speed, it can be applied and the issues (machining accuracy and productivity) that cemented carbide reamers face can be cleared. We will propose blade design suitable for the required grade and machining conditions.

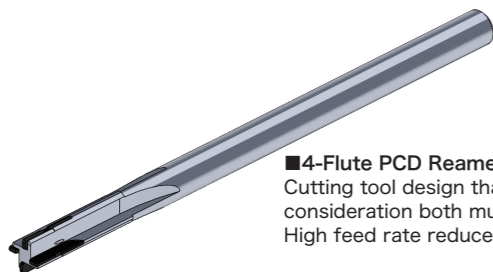


**■Features**

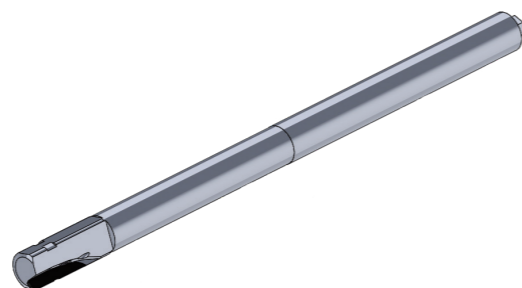
- PCD with excellent abrasion resistance is used to achieve stable processing quality.
- We propose the design of a cutting tool suitable for the quality of the workpiece.



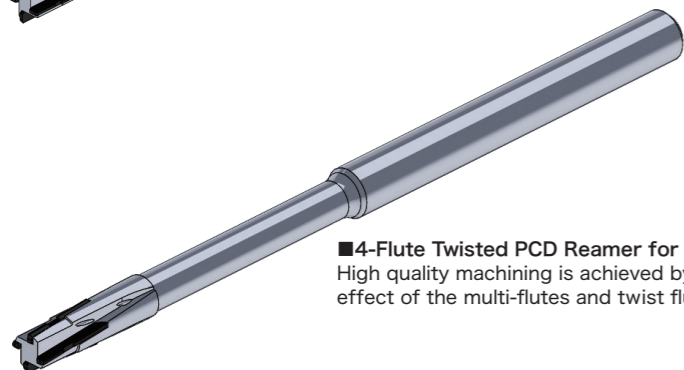
■1-Flute PCD Reamer for Machining Pilot Holes  
Tool for rough/semi-finish.



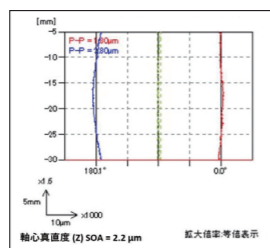
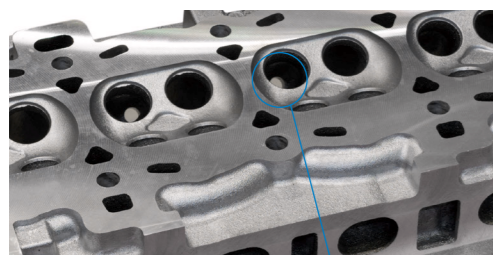
■4-Flute PCD Reamer for Finish Hole Drilling  
Cutting tool design that takes into consideration both multi-flutes and rigidity. High feed rate reduces machining time.



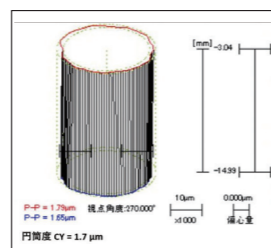
■1-Flute PCD Reamer for Finish Hole Drilling  
The leading edge is fitted into the pilot hole to ensure a guiding effect and achieve high precision hole finishing.



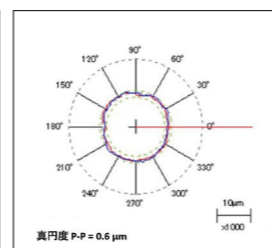
■4-Flute Twisted PCD Reamer for Finish Hole Drilling  
High quality machining is achieved by the chip evacuation effect of the multi-flutes and twist flutes.



Straightness 2.2 μm



Cylindricity 1.7 μm



Roundness 0.6 μm

**For Machining Steering Parts / PCD Rotating Tool**

Aluminum parts for steering housing must be not only lightweight, but also labor-saving and highly functional. There are many machining areas and its shapes are becoming complex as numbers of sensors and assist devices are incorporated. Therefore, productivity improvement by machining time reduction is required. We contribute to productivity improvement by realizing high quality machining at high feed rates through our unique tool design and process-integrated design.



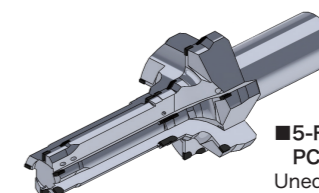
**■Features**

- We propose designs that take into account weight reduction and dynamic balance, since large-diameter hole finishing is often required.
- Process integration can be expected through multi-step hole finishing and design combining different cutting tools, such as taps.

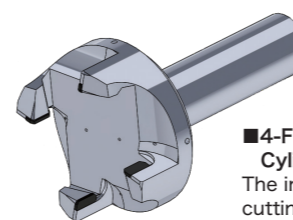
**Touring Example of PCD Rotating Tool for Machining Steering Parts**



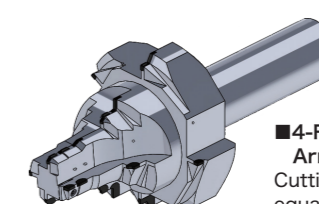
■For Machining Convex + Seat Surface  
1-Flute PCD Endmill with Interchangeable Cutting Edges  
This endmill is used for machining convex and seated surfaces. The insert tip specification allows for fine adjustment of the convexity diameter and reduced initial cost in cutting edge damage.



■5-Flute Unequal Arrangement PCD Reamer  
Unequal cutting edge design is adopted to suppress Chatter and improve roundness.

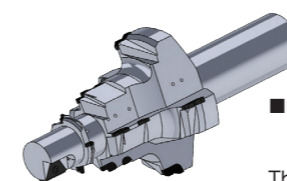


■4-Flute Internal PCD Endmill for Machining Cylindrical Sections  
The internal blade design enables interpolation cutting and reduces machining time by shortening the distance for machining cylindrical sections.

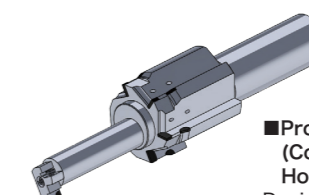


■4-Flute + 5-Flute Unequal Arrangement PCD Reamer  
Cutting edges at each step are not equal in number, and uneven flute spacing prevents resonance during machining and realizes high quality hole finishing.

**Combination Tools Reduce Work Load (Tool Change Frequency)**

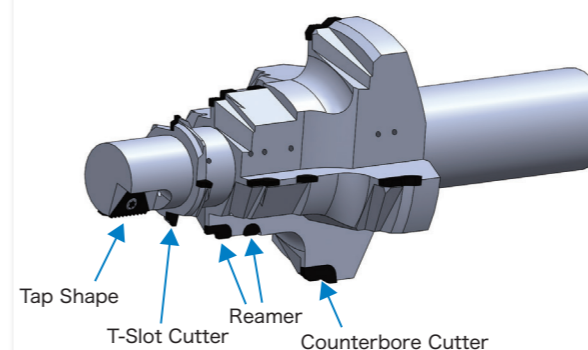


■Integrated Process (Tapping + Grooving + Hole Finishing Reamer)  
Three processes are integrated into a single tool to reduce tool change time and achieve high coaxiality machining.



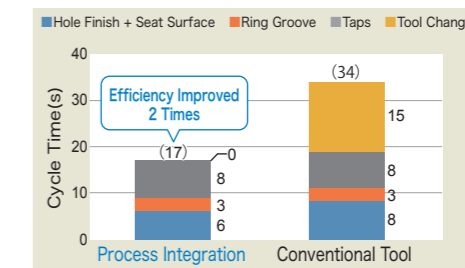
■Process Integration (Counterbore on Back Side + Hole Finishing Reamer)  
Designed to integrate boring on the hole finishing side and back side. High coaxiality machining of the hole finishing side and back side boring is realized.

**Example of a Process-Intensive**



Reduction of tool change time due to process consolidation

**Example of Machining Time Reduction Effect by Process-Integrated Tooling**





For Finishing Valve Body Spool Holes / PCD Rotating Tool

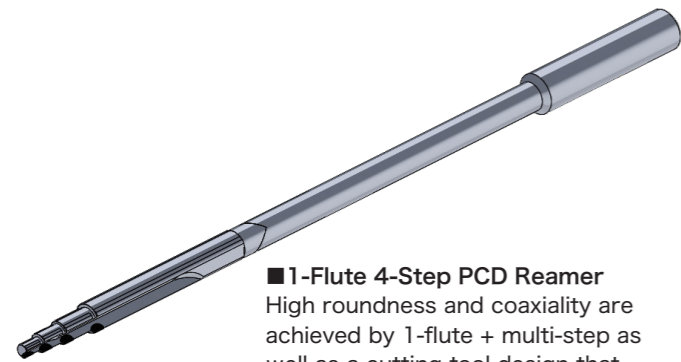
Valve body spool hole finishing requires high machining accuracy in quality items such as surface roughness, roundness, cylindricity, and coaxiality, because the machined area has intersecting oil channels and multiple holes on the same coaxial line. We offer tool design proposals and advice tailored to your needs based on our various machining achievements and verifications.



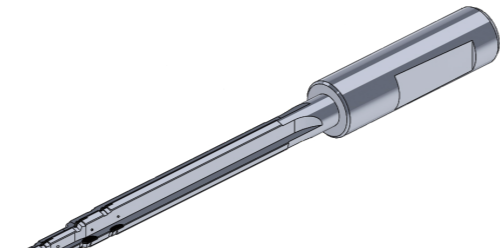
■Features

- Cutting tool design for multi-step hole finishing realizes process integration.
- Precise and stable performance is brought out by diamond material characteristics and edge grinding technology.
- We offer suggestions to improve machining efficiency by tuning machining conditions.

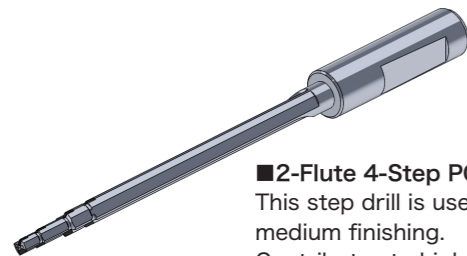
Touring Example of PCD Rotating Tool for Finishing Valve Body Spool Hole



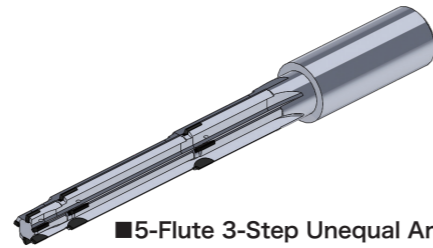
■1-Flute 4-Step PCD Reamer  
High roundness and coaxiality are achieved by 1-flute + multi-step as well as a cutting tool design that promotes constraint and chip evacuation.



■4-Flute 4-Step PCD Reamer with Leading Edge  
The preceding blade, which ensures coaxiality in the previous process, prevents misalignment and realizes high quality hole finishing even in high feed machining environments.

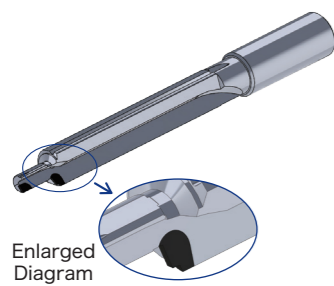


■2-Flute 4-Step PCD Step Drill  
This step drill is used for rough and medium finishing. Contributes to high quality hole finishing by stabilizing stock removal in the finishing process.

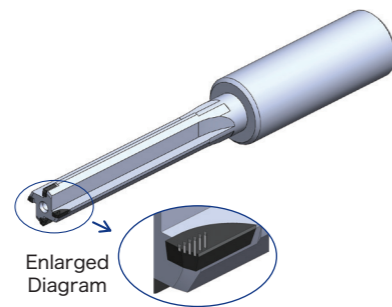


■5-Flute 3-Step Unequal Arrangement PCD Reamer  
The unequal cutting edge design suppresses vibration during machining and improves roundness, cylindricity, and other qualities.

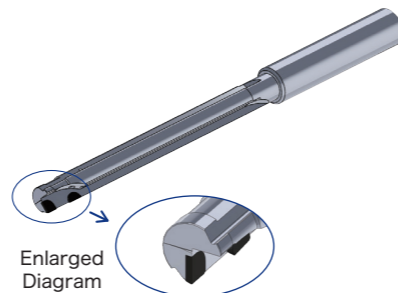
Example of Additional Functions



■Workpiece Chipping Prevention Function  
Exit side of hole is not strong enough, and the cutting force may cause issues such as chipping or ring shaped chips wrapped around the Workpiece along with chips. This is prevented by the cutting edge design that suppresses cutting resistance.



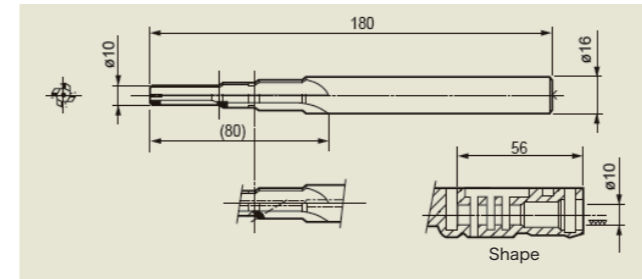
■Chip Breaking Function  
Chip breaker prevents scratches on workpiece as well as equipment stoppage due to chips wrapped around holder.



■Chip Evacuation Function  
A single cutting edge with an ejection groove in the guide pad section to prevent build-up to the cutting edge, thereby preventing quality deterioration.

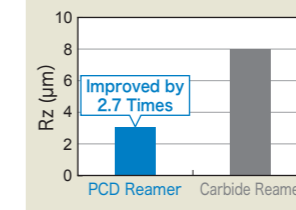
For Finishing Valve Body Spool Holes / PCD Rotating Tool

Example of Valve Body Spool Hole Finishing

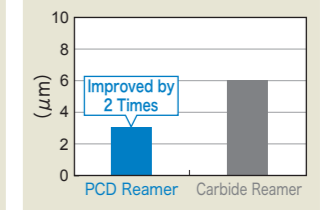


Specification	PCD Reamer	Carbide Reamer
Cutting Speed Vc (m/min)	120	120
Feed Per Revolution f (mm/rev)	0.2	0.2
Stock Removal (φ)	0.4	0.4
Coolant	JIS W1 Class Emulsion	JIS N2 Class Insoluble

Surface Roughness



Roundness



Proposal of High Efficiency Finishing by Unequal Layout Design

[Problem]

- Cutting force and vibrations generated during the use of multi-blade rotating tools affect the quality of machining.

[Improvement Plan]

- Unequally distributed cutting edges with opposite side edges prevent biting into the finished surface.
- Chatter can be suppressed and roundness and cylindricity can be improved by preventing the bite.
- The multi-blade design enables high feed rate and short machining time, resulting in high productivity.

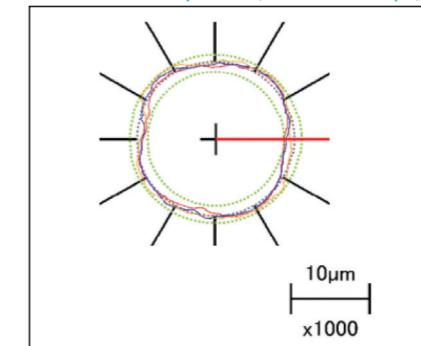
■Machining Examples

	4-Flute Unequal Layout	1-Flute Balanced	4-Flute Equalizer Arrangement
Shape			
Stock Removal(mm/dia.)	0.4	0.4	0.4
Rotational Speed(min <sup>-1</sup> )	6,600	4,000	4,000
Feed Rate(mm/min)	5,300	400	960
Feed Per Revolution f (mm/rev)	0.8	0.1	0.24
Feed Per Tooth fz (mm/z)	0.2	0.1	0.06
Coolant	Water-Soluble Oil Emulsion		
Chatter	None	None	Yes
Roundness (μm)	2	3	4
Machining Time (sec)	0.15	2	0.8

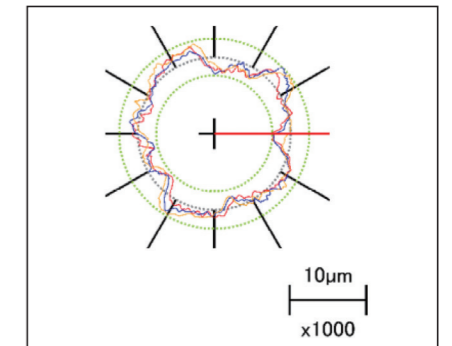


※Note: Image is for illustration purposes.

■Roundness Comparison (Hole Finish Shape)



Roundness: 4-Flute Unequal Arrangement

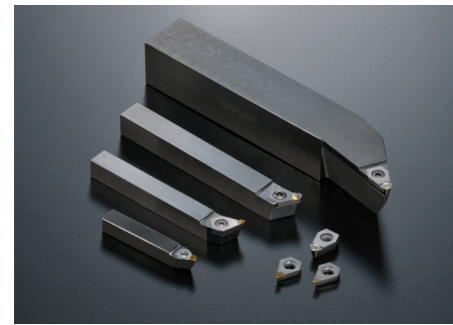


Roundness: 4-Flute Equal Arrangement

For Aluminum Parts / NewD

Achieves Stable and Long Tool Life by Measuring and Optimizing the Crystal Orientation

The optimum crystal orientation of diamond is set with high accuracy, and it is rigidly bonded to cemented carbide of unique shape. 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.
- 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	Clearance Angle θ	I.C. φA (mm)	I.H. φB (mm)	Thickness h (mm)	Holder				
	Long Life Type	Precision Type										
	NWD-CL302	NWD-CP302	R0.2	7°	φ9.525	φ4.4	4 <sup>+0.2</sup> <sub>-0</sub>	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					-QL1□				
	NWD-CL320	-	R2.0									
	NWD-PL302	NWD-PP302	R0.2					11°	φ6.35	φ2.8	3 <sup>+0.2</sup> <sub>-0</sub>	NDH-R0□
	NWD-PL305	NWD-PP305	R0.5									-L0□
	NWD-PL308	NWD-PP308	R0.8									-N0□
	NWD-PL202	NWD-PP202	R0.2									
NWD-PL205	NWD-PP205	R0.5										
NWD-PL208	NWD-PP208	R0.8										
	NWD-CL416	NWD-CL416-AW	R1.6	7°	φ9.525	φ4.4	5.5 <sup>+0.2</sup> <sub>-0</sub>					NDH-R20V
	NWD-CL420	NWD-CL420-AW	R2.0									-L20V
								-R25V				

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

Holder Types

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

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

When Ordering

Insert Types  
NWD-CL 3 02 の場合  
Corner Radius R0.2  
Tool Angle 55° I.C. φ9.525  
Long Life Type  
(Precision Type is "P")

Holder Types  
NDH-R 0 6 の場合  
φ6  
Right Hand  
(Left Hand is "L")

Examples of Cast Aluminum Wheel Machining

Features

- Shiny machined surface is obtained by providing a uniform negative rake surface applied to the cutting edge.

Machine

• NC Turning Centre

Tool

• NewD  
• Type: NWD-CL425-AW

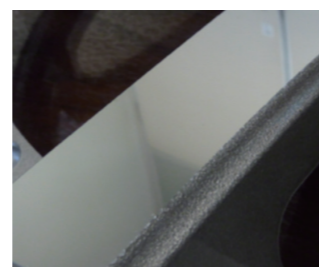
Workpiece

• Cast Aluminum (AC-4CH)

Rotational Speed (min <sup>-1</sup> )	800~1,200
Feed Per Revolution (mm/rev)	0.05~0.222
D.O.C. (mm)	0.05~1
Coolant	Water-Soluble Oil



Good Surface Brightness



Good Surface Brightness

For Gears / Disc Dresser (Forming Tool for Grinding Wheel)

Contributes to Higher Quality Gears and Reduced Grinding Costs

As a dresser for shaping worm-shaped grinding wheels used in gear grinding, it realizes "higher precision gears" and "reduced grinding costs" by extending dresser life.

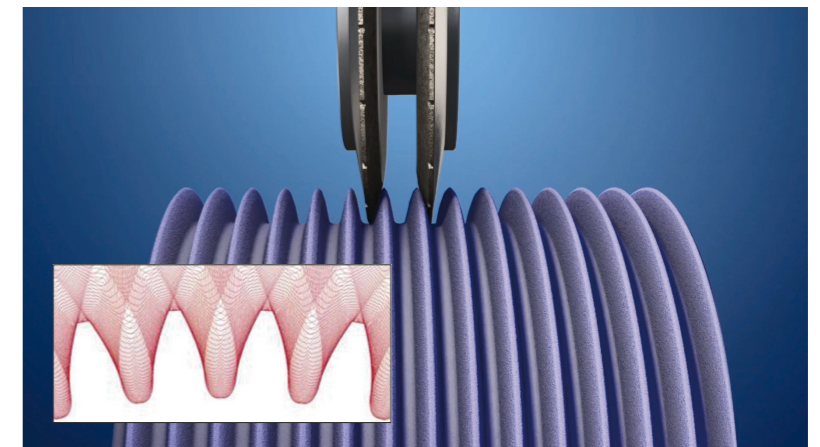


Features

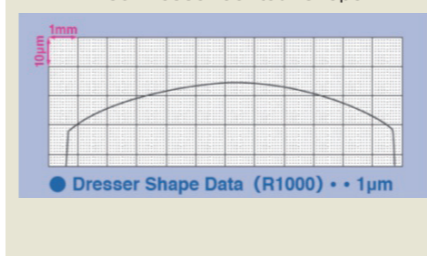
- Based on information such as workpiece gear specifications, grinding wheel shape and specifications, we design a dresser that achieves the required tooth surface quality.
- Extremely high tooth profile accuracy of 0.001 mm or less can be obtained.
- High ability to maintain tooth profile accuracy shape and low dresser life variation contribute to reduced grinding costs.

Applications

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



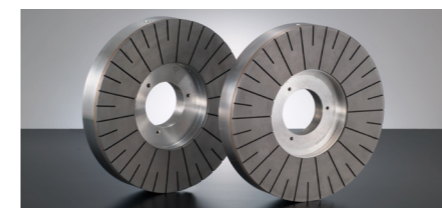
Disc Dresser Contour Shape



Variable Valve Grinding Wheel / MB SPARK

Both High Efficiency and Long Life Ensured in Machining Sintered Alloy and Cast Iron

This is a machining system that realizes next generation double sided surface grinding that overturns conventional wisdom. Truing interval can be significantly improved compared to resin bond wheels by combined with electric 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 because conventional grinding wheel is not used for truing which reduces sludge.

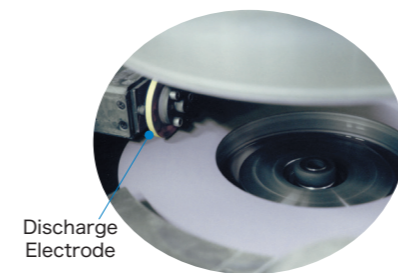
Applications

• Automotive engine components and Automotive oil pump components

Machining Examples

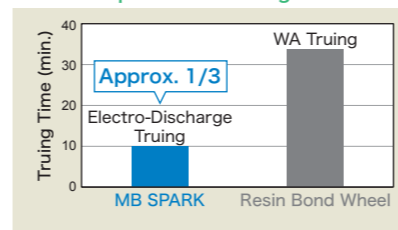
□ Comparison with Conventional Resin Bond Wheel

- 1) Machine: JTEKT MACHINE SYSTEMS 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)
- 5) Coolant: Water-Soluble
- 6) Conditions:
  - Wheel Rotation: (Upper, Lower) 1,500 min<sup>-1</sup> (C.C.W)
  - Stock Removal (Rough): 0.19 mm (Both Sides)
  - Feed Rate (Rough): 0.035 mm/sec
  - Stock Removal (Finish): 0.01 mm (Both Sides)
  - Feed Rate (Finish): 0.015 mm/sec
  - Spark Out: 2 sec

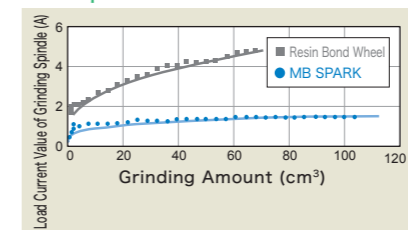


Electro-Discharge Truing  
Machine: JTEKT MACHINE SYSTEMS CORPORATION

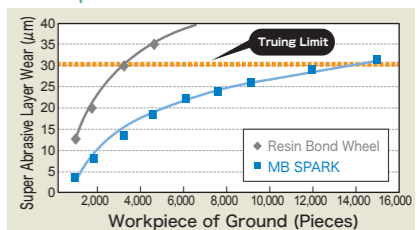
Comparison of Truing Time



Comparison of Load Current Values



Comparison of Wheel Wear Amount



**For CVT Grooves / High Precision Electroplated Wheel Formaster Premium**

**Longer Tool Life for Hardened Steel Parts such as Gears**

This CBN electro-deposited wheel has a long service life in the process of hardened steel components such as gears by improving form-stability.



**Features**

•The number of workpieces that can be machined can be increased while maintaining shape accuracy by making the abrasive grains tougher and stabilizing the amount of grain protrusion. (longer wheel life)

**Applications**

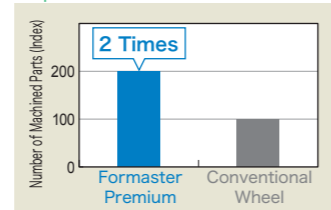
•High-precision Profile Machining of Hardened Steel Parts

**Machining Examples**

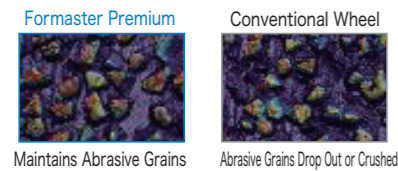
□Comparison of Life with Conventional Products

- 1) Wheel Specification Outer Diameter :  $\Phi 44$   
Shape: R groove  
Grit Size : #170
- 2) Workpiece Hardened Steel
- 3) Machining Conditions Peripheral Speed : 40 m/s  
D.O.C. : 0.15 mm  
Feed Rate : 100 mm/min
- 4) Life Determination Surface Roughness : Rz >3.2  $\mu\text{m}$

**Comparison of Tool Life with Conventional Wheel**



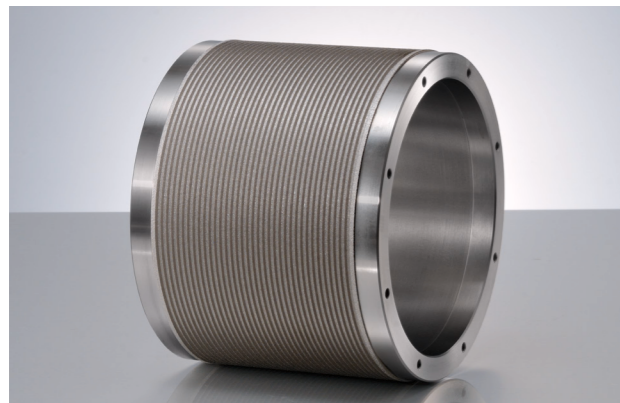
**[Results]**



**For 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 Finishing Various Holes / Super Sizing Reamer**

**Highly Precise Hole Finishing by 1 Pass**

A high performance superabrasive reamer capable of finishing holes precisely by 1 pass.



**Features**

•Capable of 1 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



**Comparison of performance of Super Sizing with other hole finishing operations**

Processing Method Performance	Super Sizing	Honing	Internal Grinding	Fine Boring Milling
Roundness, Cylindricity	Very Good	Very Good	Very Good	Average
Surface Roughness	Very Good	Very Good	Very Good	Average
Retention of Hole Diameter Dimension	Very Good	Average	Good	Poor
Finishing Efficiency	Very Good	Good	Average	Good
Finishing of Oil Holes, Notches, Holes with Keyway	Very Good	Average	Average	Poor
Finishing Long Holes Relative to Diameter	Very Good	Good	Poor	Average

**Finishing Accuracy (Example: Stock Removal  $\phi 0.03$  mm)**

Roundness	0.002 mm or less
Cylindricity	0.002 mm or less
Surface Roughness <sup>①</sup>	Ry 2 $\mu\text{m}$ or less
Hole Diameter	$\phi 4$ $\mu\text{m}$ or less

\*JIS B0601-1994

**Standard Manufacturable Range**

Abrasive Grain	Diamond / CBN
Grit Size	#40~#270
Tool Diameter	$\phi 5\sim 50$ (Tolerance $\pm 0.002$ mm)
Run-Out	0.005 mm or less

For other specifications, please contact us.

**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**

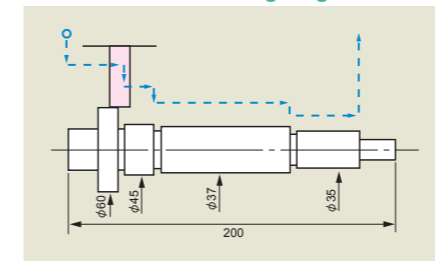
•Grinding of Cams, Crankshafts, Injection needles, Rocker arms, Turbo components, etc.

**Machining Examples**

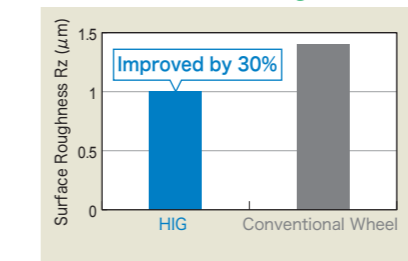
□Sintered Alloy Machining Example

- 1) Machine High-Speed Cylindrical Grinder
- 2) Wheel Specification BN120M200VE2
- 3) Wheel Size  $\phi 400 \times 10$  U
- 4) Workpiece SCM435 (HRC60)
- 5) Conditions Peripheral Speed : 160 m/s  
D.O.C. :  $\phi 0.2$  mm
- 6) Coolant Water-Soluble

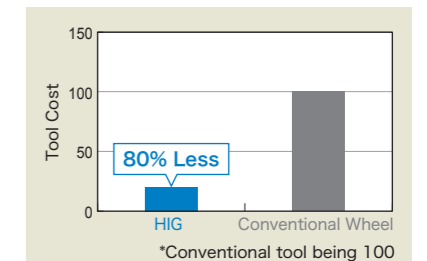
**Contour Grinding Diagram**



**[Results] Surface Roughness**



**Tool Cost**



\*Conventional tool being 100

**For Hub Units / Diamond Rotary Dresser Optimard Spitz**

**Optimization Wear Resistance and Sharpness on Request**

A rotary dresser with optimized sharpness has been developed by means of a diamond arrangement and plating technology. This is particularly effective in reducing dressing resistance and preventing chatter and grinding burns in large products.



**■ Features**

- Wider and finer adjustment of wear resistance and sharpness than before upon request

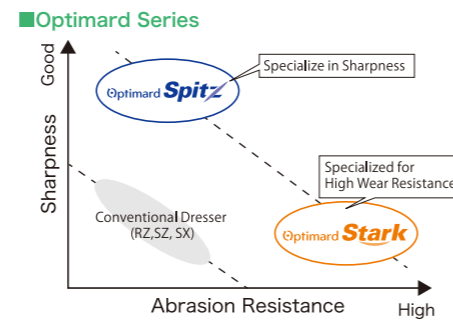
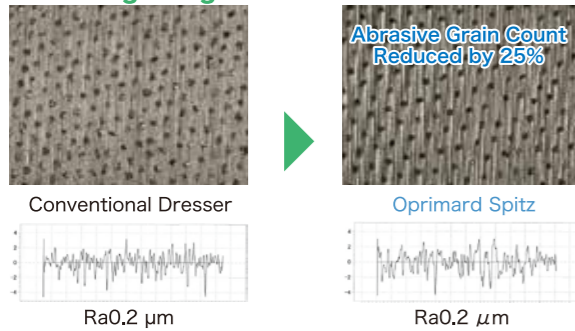
**■ Applications**

- Grinding of ball race surface, grinding of roller shaft surface, outer ring inner/outer diameter grinding, inner ring outer diameter machining, etc.

**■ Manufacturable Ranges**

Outer Diameter	φ50~200 mm
W Size (Grain Size)	10~100 mm
Grit Size	#16~#40

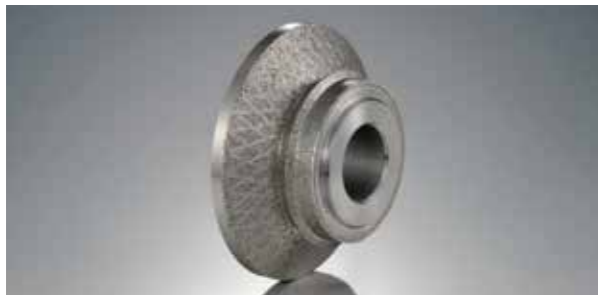
**Reduced Number of Abrasive Grains While Maintaining Roughness**



**For Hub Units / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)**

**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**

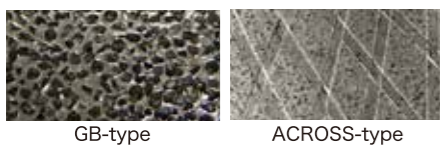
- RZ : Diamonds electroplated densely to provide high precision and long life.

**■ Applications**

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

**■ Improved Dressing Ability (for Fast Dressing)**

- Sharp-type
- GB-type
- ACROSS-type
- \*For details, see page 70.



**For CVT-Related Components / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)**

**Excellent High Precision and Long Life**

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



**■ Features**

- High precision and long life can be realized.

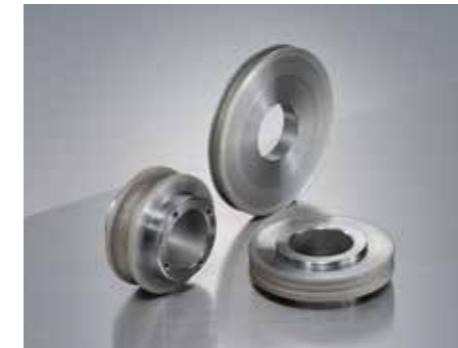
**■ Applications**

- Grinding of CVT-related components

**For Automotive Bearings / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)**

**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 : Diamonds electroplated densely to provide high precision and long life.
- SZ : The diamond is regularly arranged so that you can select the degree of concentration to suit your needs.
- SX:Excellent sharpness thanks to the regular arrangement of diamond, precision powder metallurgy and precision processing technologies

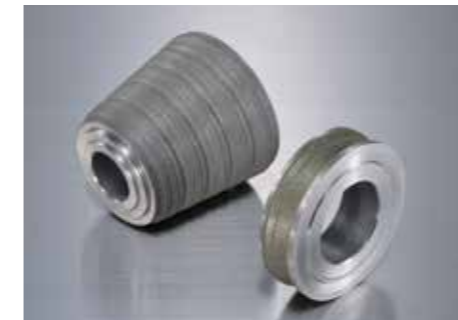
**■ Applications**

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

**For Injector Components / Diamond Rotary Dresser (Forming Tool for 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) for which the precision electroforming technology is employed and which is capable of coping with complex shapes is widely used.
- RZ: Diamonds electroplated densely to provide high precision and long life.

**■ Applications**

- Grinding of injector-related components

**For Steering Components / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)**

**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 Profile Dressing / Diamond Rotary Dresser**

**Consistent Dressing Performance**

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

## Drill, Endmill

### For Flute Grinding / Flute Master

#### Better Grinding Ability for Flute Grinding by Using Water-Insoluble Coolant

By adopting Proprietary developed metal bond that achieves both sharpness and longevity in a high dimension, processing efficiency can be greatly improved while maintaining longevity compared with conventional resin bond wheels. Especially in machining with water-insoluble grinding coolant, it exhibits excellent performance.



#### ■ 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.

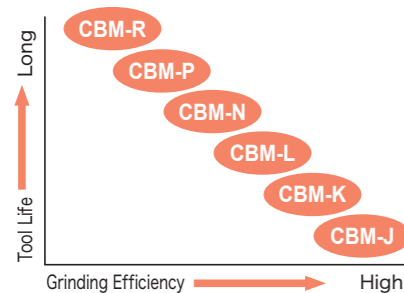
#### ■ Applications

- Flute grinding of Endmills, Drills and Reamers
- Chipbreaker grinding of inserts
- Heavy duty grinding of various tools, Including special steel tools

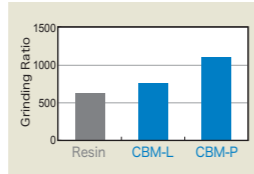
#### ■ Machining Examples

- Comparison with Resin Bond Wheel
- 1) Machine: Horizontal Spindle Surface Grinder
  - 2) Wheel Specification:
    - ① Resin Bond : BN140-100B
    - ② CBM-L : BN140-L100CBM
    - ③ CBM-P : BN140-P100CBM
  - 3) Workpiece: SKH51 (HRC60)
  - 4) Coolant: Oil-Based
  - 5) Conditions:
    - Wheel Peripheral Speed : 1,500 m/min
    - D.O.C. : 1 mm
    - Feed Rate : 40 mm/min

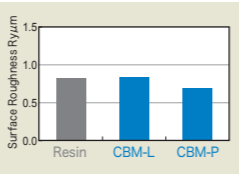
#### ■ Bond Line up



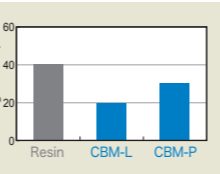
#### Grinding Ratio



#### Surface Roughness



#### Grinding Force



### For Flute Grinding / Flute Master HP

#### Higher Efficiency on a Higher Level

This wheel is specialized for high efficiency from the conventional Flute Master. It realizes improvement in production efficiency.



#### ■ Features

- High-efficiency machining with good sharpness

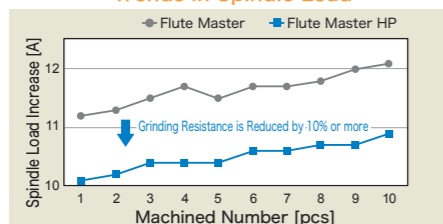
#### ■ Applications

- 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 Conventional Flute Master
- 1) Machine: Tool Grinding Machine
  - 2) Wheel Specification: φ16 -150L Cutting Length 60 mm (Number of Teeth:4)
  - 3) Workpiece: AF308 (Cemented Carbide)
  - 4) Coolant: Oil-Based
  - 5) Conditions:
    - Wheel Peripheral Speed : 1,200 m/min
    - D.O.C. : 3.0 mm/pass
    - Feed Rate ( Axial Direction ) : 90 mm/min
    - Helix Angle : 30°

#### Trends in Spindle Load



### For Flute Grinding / Flute MAX

#### Demonstrates High Performance in High-Load Grinding Using Water-Soluble Grinding Fluid

This resin bond wheel combines sustained sharpness and long life through the use of heat-resistant resin and a special filler uniquely formulated for this wheel. It demonstrates excellent sharpness and shape retention in creep feed grinding of flute on various tools such as end mills, drills, and reamer.



#### ■ Features

- Resin bond with heat-resistant properties reduces loss brought up by grinding heat.
- Because of heat-resistant resin bond and special filler, good grinding ability and profile consistency can be maintained even in the high heat condition such as creep feed grinding.
- Compared with conventional resin bond wheels, higher feed rate and longer dress interval are available, which improves machining efficiency and reduces costs.

#### ■ Applications

- Flute grinding of Endmills, Drills and Reamers
- Chipbreaker grinding of inserts
- Heavy duty grinding of various tools, Including special steel tools

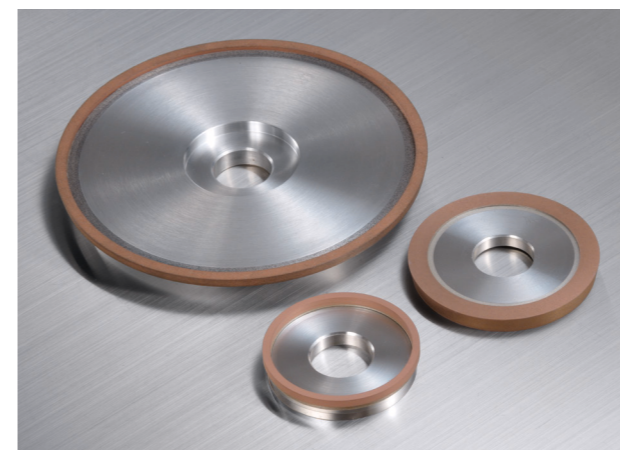
#### ■ Bond Line up

Bond Grade	Feature
L	Superior Cutting Ability
N	Standard
P	Superior Shape Retention

### For Flute Grinding / RESIACE

#### Demonstrates High Performance in Heavy Grinding

RESIACE is an ultra-heat-resistant resin bond wheel that maximizes the characteristics of the highest heat-resistant resins used in functional materials for aerospace applications. It delivers extremely high performance in grinding, which has been thermally degraded by conventional resin bonds.



#### ■ 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

- Flute grinding of Endmills, Drills and Reamers
- Chipbreaker grinding of inserts

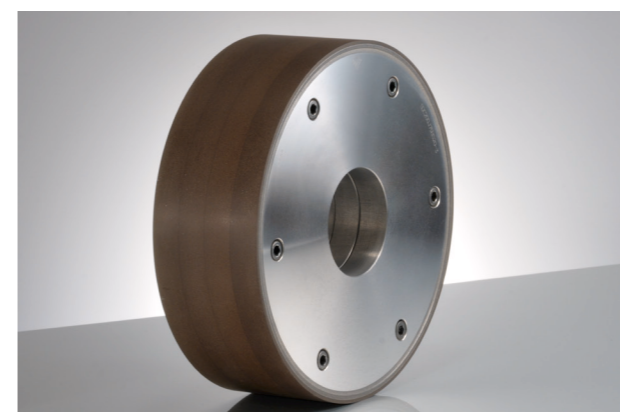
#### ■ Bond Line up

Bond Grade	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.



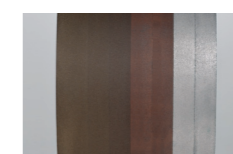
#### ■ Features

- 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.

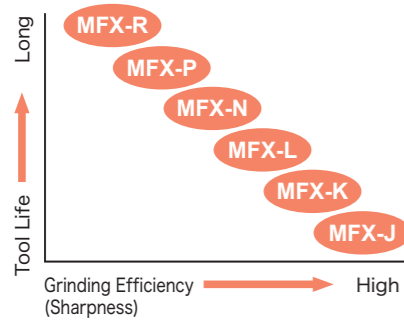


- Features**
  - Longer dress interval can be achieved by using water-insoluble coolant, which realize tool cost reduction and high-efficiency machining.
  - High grinding accuracy and consistent grinding quality.
  - Excellent performance is also achieved for machining of cemented carbide and even in water-soluble coolant.

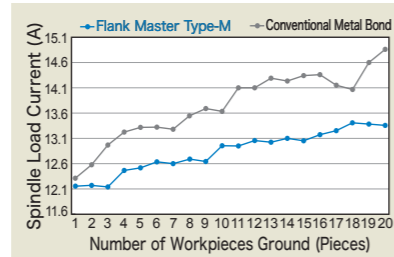
- Applications**
  - Peripheral and cutting edge grinding of Cermet and Carbide inserts

- Machining Examples**
  - Comparison with Conventional Metal Bond Wheel
    - 1) Machine: NC Peripheral Grinder
    - 2) Wheel Specification: ① Flank Master Type-M, ② Conventional Metal Bond
    - 3) Workpiece: High-Toughness Difficult-to-Grind Cermet
    - 4) Coolant: Water Insoluble

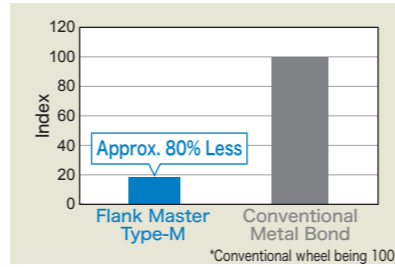
**Bond Line up**



**Spindle Load Current**



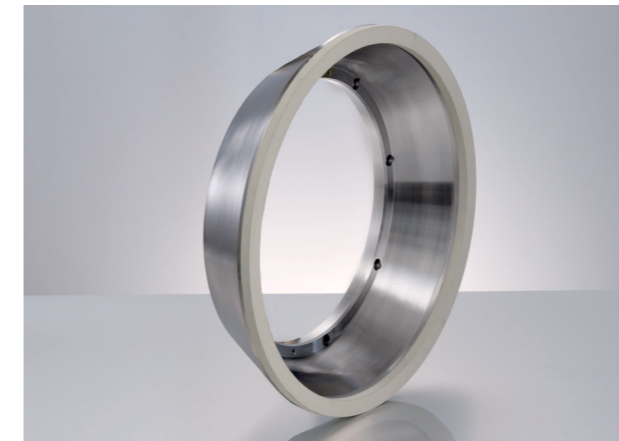
**Wheel Wear Amount**



**For Grinding 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.

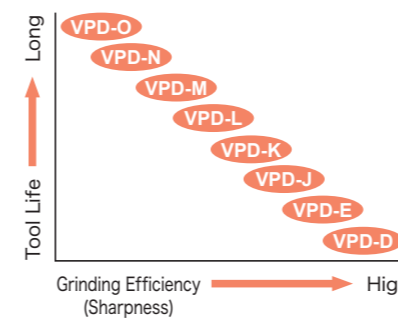


- Features**
  - Both sharpness and wear resistance can be utilized in grinding of cutting edges of PCD / PCBN cutting tools to realize high efficiency and high precision grinding operations.

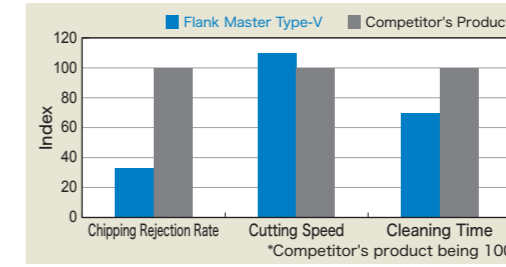
- Applications**
  - Grinding of cutting edges of PCD / PCBN cutting tools

- Machining Examples**
  - Comparison with Competitor's Vitrified Bond
    - 1) Machine: NC Peripheral Grinder
    - 2) Wheel Specification: ① Flank Master Type-V, ② Competitor's Vitrified Bond Wheel
    - 3) Workpiece: PCD (Polycrystalline Diamond)
    - 4) Coolant: Water-Soluble

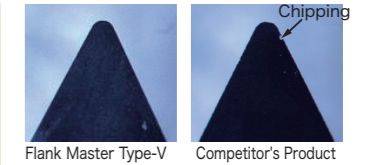
**Bond Line up**



**Comparison with Competitor'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 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.

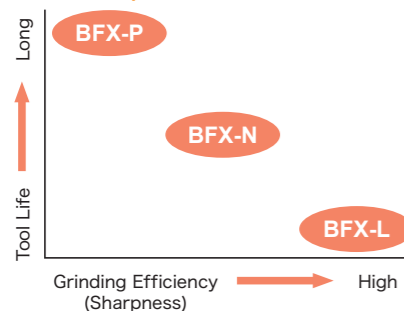


- Features**
  - Realizes good cutting ability and long tool life.

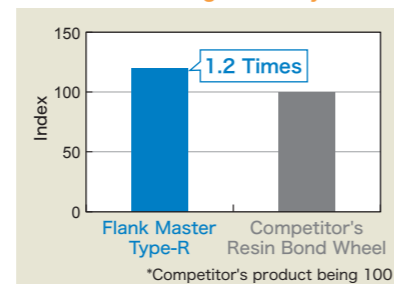
- Applications**
  - Grinding of periphery and cutting edges of Carbide / Cermet cutting-edge replacement chips

- Machining Examples**
  - Comparison with Competitor's Resin Bond Wheel
    - 1) Machine: NC Peripheral Grinder
    - 2) Wheel Specifications: ① Flank Master Type-R, ② Competitor's Resin Bond Wheel
    - 3) Workpiece: Carbide / Cermet
    - 4) Coolant: Water-Soluble

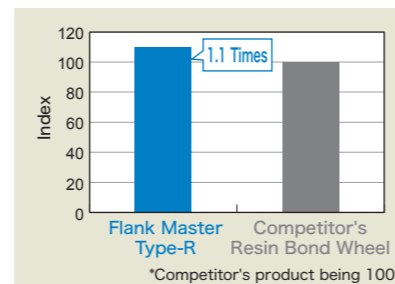
**Bond Line up**



**Machining Efficiency**



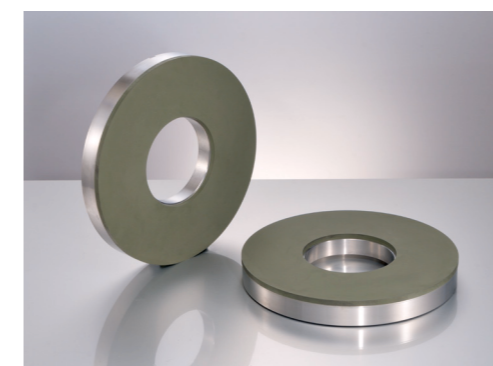
**Tool Life**



**For Thickness Grinding / Flat Master Type-R, Type-V**

**Ideal for Thickness Processing of Cutting-Edge Replacement Chips**

Grinding process for adjusting thickness of cemented carbide and cermet insert tips, there has been an issue that abrasive grains sink into the bond due to the grinding load, and the productivity decreases due to the dull grinding surface. "Flat Master" overcomes this issue and suppresses the decrease in productivity. Vitrified and resin bond types are available.

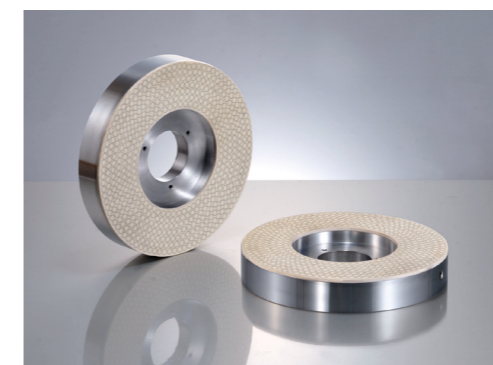


Type-R

- Features**
  - Suppresses abrasive grain subduction during machining and maintains good sharpness.

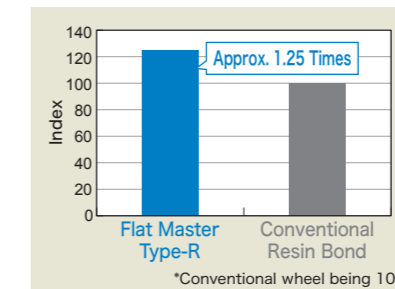
- Applications**
  - Grinding process for adjusting thickness of carbide, Cermet and Ceramic insert tips

- Machining Examples**
  - Comparison with Conventional Resin Bond Wheel
    - 1) Machine: Parallel-Surface Honing Machine
    - 2) Wheel Specification: ① Flat Master Type-R, ② Conventional Resin Bond
    - 3) Workpiece: Carbide / Cermet
    - 4) Coolant: Water-Soluble

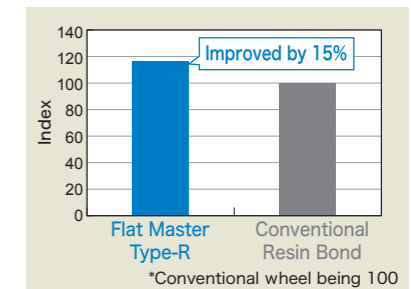


Type-V

**Wheel Life**



**Sharpness Retention**



For Cermet Grinding / Hybrid Wheel

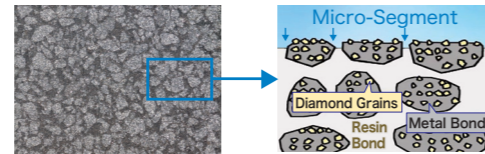
Optimal for Cermet Material Processing

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-machine 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-machine cermet / ceramics and various tungsten carbide

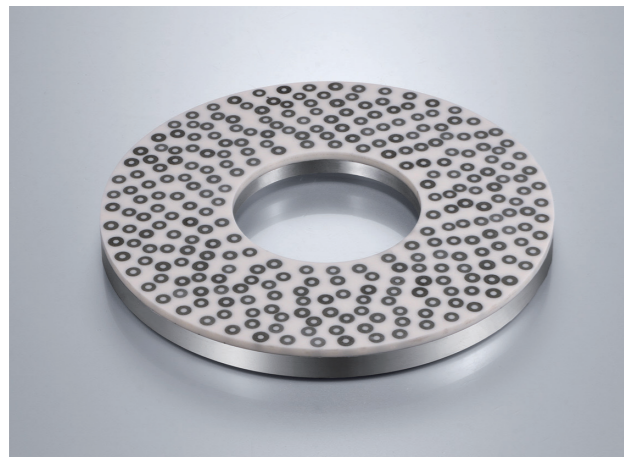
Abrasive Surface of Hybrid Wheel (Micro-Segment Structure)



DPG Wheel (Vitrified Bond)

Continuous Machining with Good Grinding Performance

DPG wheel (vitrified bond), which is made of cylindrical sintered ceramic pellets manufactured by our original method and fixed to a base metal, maintains good sharpness and enables continuous machining. Fine abrasive grains can also be applied to achieve the required surface roughness.

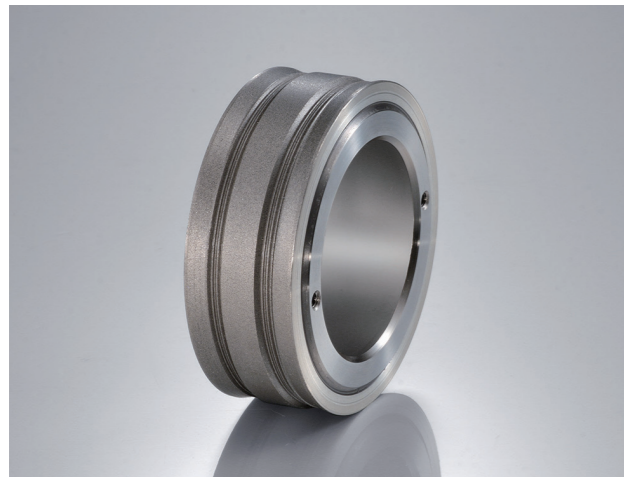


- Features**
  - Excellent sharpness and continuous processing.
  - Fine abrasive grains can be used to obtain good surface roughness.
  - The use of a cassette surface plate makes it possible to increase the diameter of the wheel and facilitate smooth wheel changes.
- Applications**
  - Grinding of difficult-to-machine cermet / ceramics and various tungsten carbide

For Tap Grooves / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)

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 complex and fine shapes.
- Applications**
  - Various tap grooving

Magnetic Material, Glass, Ceramics

Magnetic Material

High-Rigid Body Cutting Wheels

The High-Rigid Body Realizes Both Good Cutting Ability and Long Life

The highly rigid body enables highly efficient machining due to increased feed rate and excellent cutting accuracy. Also the wheel also enables improve yield rate since abrasive grain layer thickness can be thinner.



- Features**
  - High-rigid body and clearance design leading to high precision performance and long tool life.
  - High rigidity body makes it possible to reduce blade thickness, thereby improving yield.
  - Highly efficient machining enabled by an increased feed rate.
- Applications**
  - Highly precise cutting of Magnetic, Glass, Ceramics and Ferrous materials

Comparison Table of Conventional Steel Body and High-Rigid Body Cutting Wheels

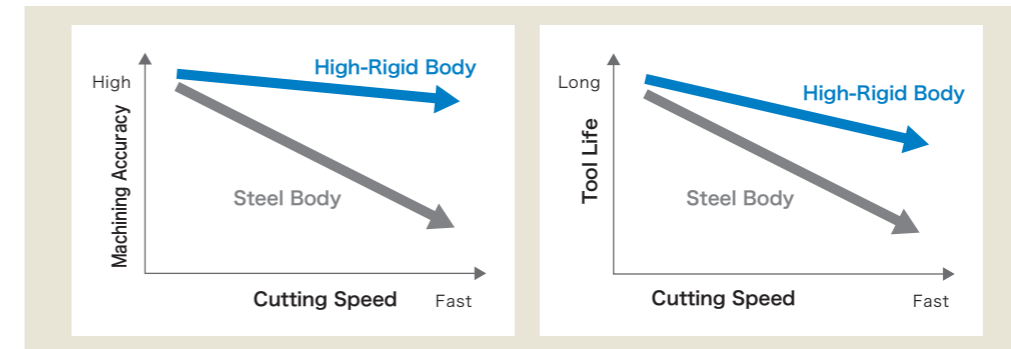
	High-Rigid Body	Steel Body
Machining Accuracy	Very Good	Good
Tool Life (Index)	2	1
Machining Efficiency (Index)	2	1
Thinnest Body Thickness	0.3 mm	0.5 mm
Clearance	Provided	Not Provided
Price (Index)	1	1

Manufacturable 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 mm for hole diameter φ40 mm only.

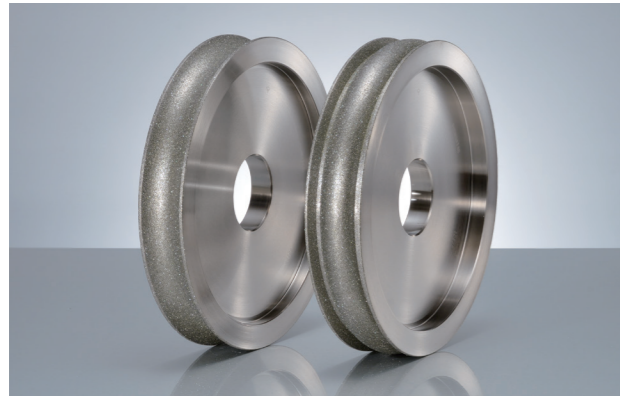
Comparison Graphs of Conventional Steel Body and High-Rigid Body Cutting Wheels



### 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.



#### Features

- Contour accuracy is very high.
- Chipping and cracking is reduced.
- Thinner magnet is possible.
- Cutting performance lasts long to enable faster processing.
- Long life is ensured.

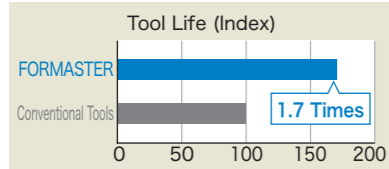
#### Applications

- High efficiency grinding of magnetic materials

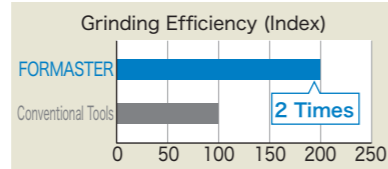
#### Machining Examples

- Magnetic material machining

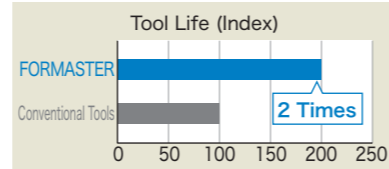
#### Magnetic Material (Ferrite)



#### Magnetic Material (Neodymium)



#### Magnetic Material (Neodymium)



#### Shape Measurement Result (After Grain Fixing)



#### Standard Manufacturable Range

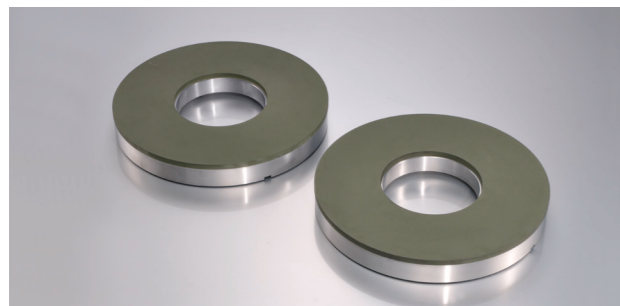
Abrasive Grain	Diamond / CBN
Grit Size	#60~#170
Tool Diameter	φ30~350

\*Depending on specifications, some wheel designs may 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-sided surface grinding and the good dressing performance and 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.

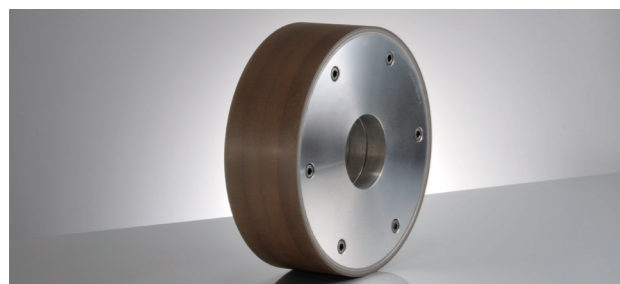
#### Applications

- Mass-production double-sided 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

### Electroplated Internal Grinding Wheel (Standard)

#### Meets Various Grinding Requirements

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



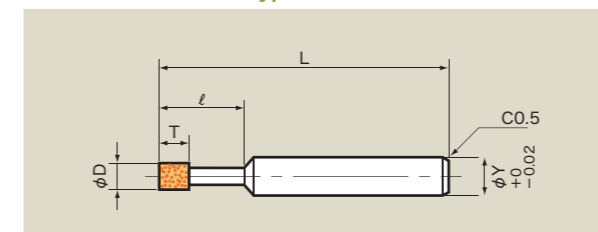
#### Features

- Various grinding requirements can be met.

#### Applications

- Finishing holes of Glass, Ceramic materials, Ferrous materials and Cemented carbide

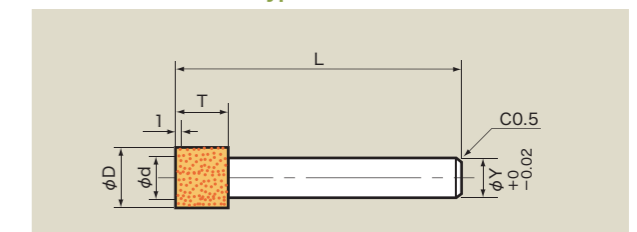
#### W11 Type Internal Wheel



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

(Y=φ3, \*Y=φ6)

#### W12 Type Internal Wheel



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

#### When Ordering

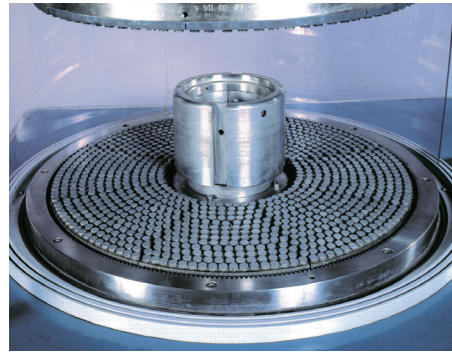
- Please instruct Code
- All items are in stock
- Special specifications available upon request. Please instruct required sizes  
(ex)W12050 SD L=100, Y=10, .....
- Identification Code  
W12050 SD  
D=Diamond  
B=CBN



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.



Features

- Reduce industrial waste dramatically.
- Clean operating environment.
- 5 to 100 times faster grinding speed compared to loose abrasive lapping.
- Reduce maintenance costs with long lasting plate and gear.
- The conventional processes of grinding and lapping can be integrated.

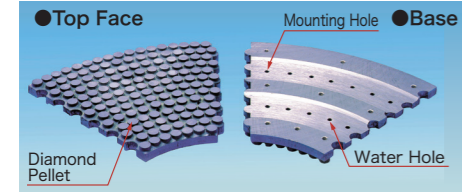
Applications

- Highly precise and highly efficient thickness processing of Glass, Ceramics, Iron materials and Carbide

Merit of Cassette Plate

- Reduction of Replacing Process for Cassette Plate
  - No detaching base plate.
  - Divisible cassette fixed on base plate.
  - Short dressing time (20 minutes : 9B, 1~2 hours : 16B).
- Pellet Pattern Keeps High Accuracy Grinding
  - Divisible cassette designed for pellet layout.
  - Seams never interfere with the density of pellet distribution.
- Free Layout of Coolant Hole for Top Plate
  - A concave part for grinding fluid is formed in the divisible cassette mounting face.
  - A multiple number of water holes can be provided freely on the divisible cassette base plate.

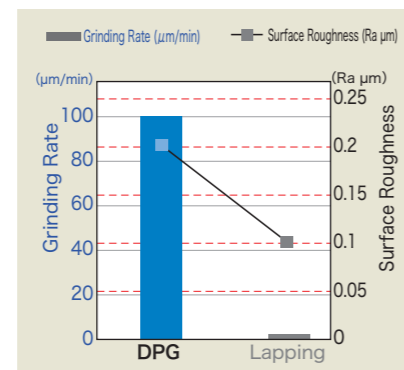
Cassette Plate



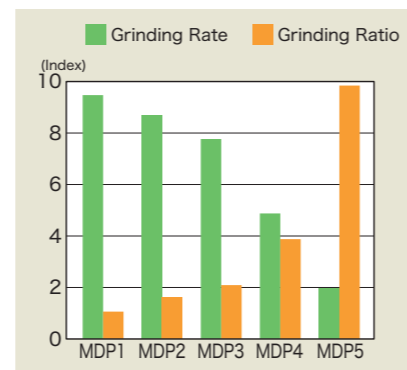
Size	Max. Dia. (mm)	Min. Dia. (mm)
4B	299	117
5B	389	213
6B	380	148
6B/9B	650	384
9B	637	218
12B	1,058	360
13B	950	274
15B	1,022	346
16B	1,127	270
18B	1,260	294
20B	1,355	458
24B	1,592	554
28B	1,864	660

\*Special sizes also available

Comparison Between Lapping and Fixed Grain Grinding (DPG)



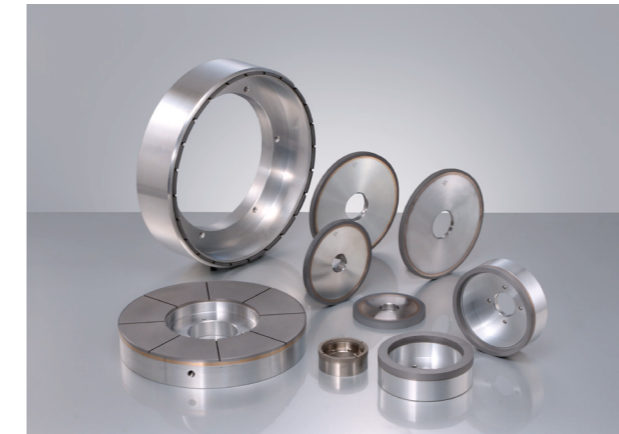
Grinding Performance of DPG Wheel (MDP Bond)



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.



Features

- High efficiency grinding of various materials realized.

Applications

- Diamond-MT Bond Wheels : High efficiency machining of Ceramics, Carbide, Cermet and Quartz
- CBN-MT Bond Wheels : High efficiency machining of various ferrous materials
- Surface machining using cup type wheels and creep feed grinding, ideal for machining with the problem of sharpness of the wheel

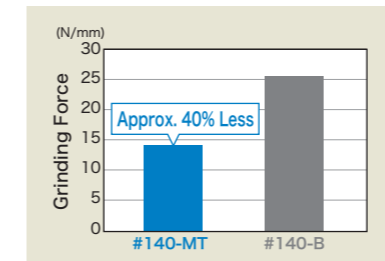
MT Bond Wheel that Cuts Better than Resin

Comparison of Grinding Force Against Resin Bond Wheel

- 1) Machine Horizontal Spindle Surface Grinding Machine
- 2) Workpiece Silicon Nitride
- 3) Grinding Conditions
  - Wheel peripheral Speed: 1,760 m/min
  - Feed Rate : 10 m/min
  - D.O.C. : 20 μm/pass

Result

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



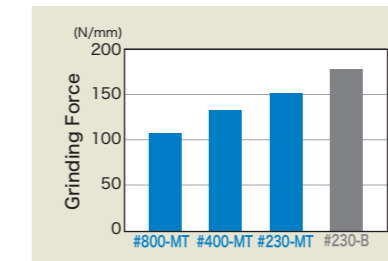
MT Bond Wheel that has Fine Grains, yet Cuts Well

Comparison Against Resin Bond Wheel in Creep Feed Grinding

- 1) Machine Horizontal Spindle Surface Grinding Machine
- 2) Workpiece Silicon Nitride
- 3) Grinding Conditions
  - Wheel peripheral Speed : 1,600 m/min
  - Feed Rate : 60 m/min
  - D.O.C. : 1 mm/pass

Result

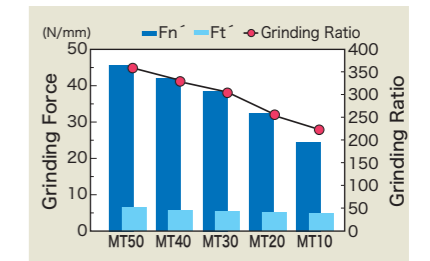
MT Bond Wheel shows 20% lower grinding force than resin bond wheel with the same grit size. The finer grit produces a lower grinding force.



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 peripheral Speed : 1,650 m/min
  - Feed Rate : 10 m/min
  - D.O.C. : 20 μm/pass



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.



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
    - ① EG Wheel : SD230J1-C2
    - ② Resin Bond Wheel : SDC230-B
  - 3) Dresser Specification
    - ① EG Wheel : Diamond Rotary Dresser (ALMT)
    - ② Resin Bond Wheel : Brake Dresser
  - 4) Workpiece Alumina Al<sub>2</sub>O<sub>3</sub>
  - 5) Conditions Material Removal Rate Z' = 0.7 mm<sup>3</sup>/min·s

Manufacturable Ranges

Outer Diameter	φ3~750 mm
T Size	3~300 mm
X Size	2~15 mm
Grit Size	SD (#80~#3000)

Result

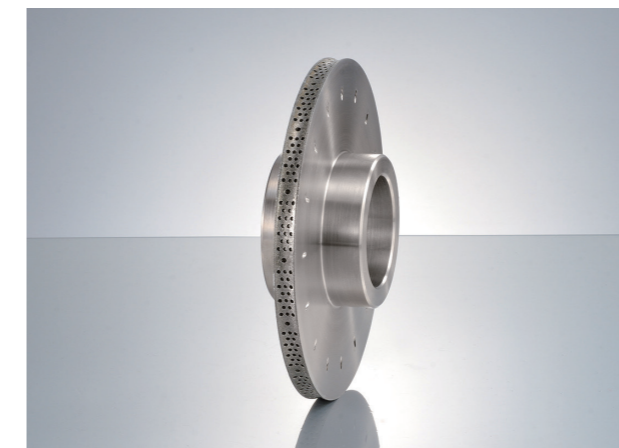
Surface roughness which is about 1/3 of that by the resin bond wheel is achieved.

Comparison of Surface Roughness

	EG Wheel	Resin Bond Wheel
Rz(μm)	1.2	3.0
Ra(μm)	0.1	4.0

Low-Resistance Electroplated Wheels

Electroplated wheel with improved sharpness enables forming machining with reduced damage such as chipping and cracking to brittle materials such as ceramics and magnetic materials.



Features

- A wide range of grinding requirements can be accommodated by the exclusive design of the base metal.
- Oil hole design allows coolant supply to the abrasive surface.
- Re-electroplating is also available.

Applications

- Form grinding of ceramics, magnetic materials, etc.

Machining Results

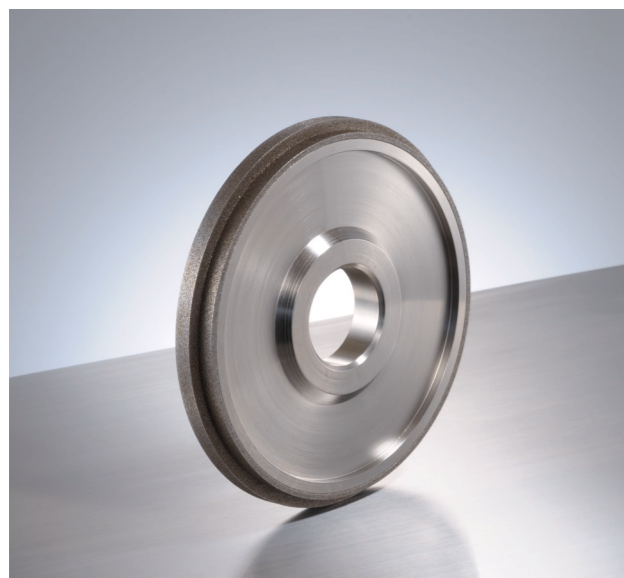
- Building material panel grinding
- Magnetic material grinding

## Turbines, Other

### Heat Resistant Alloy Processing / Electroplated Wheel CB Master

#### Optimized for Form Grinding of Heat-Resistant Alloy Parts

Special superabrasive layer with high sharpness suppresses grinding resistance and reduces the formation of burrs and work deformation layers required for heat-resistant alloy parts.



#### ■ Features

- The combination of a steel body and a strong super abrasive layer realizes gross form machining at high peripheral speed, improving machining efficiency and extending tool life.
- Improves surface finish and shape accuracy compared to cutting.
- Electroplated wheel eliminates the need for dressing and drastically reduces setup time for profile grinding.

#### ■ Applications

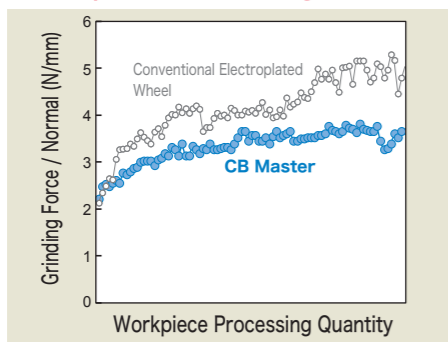
- Forming of shrouds and other parts of turbine blades for aircraft engines
- Blade grooving of gas turbine for power generation
- Balancing process of impellers for turbochargers

#### ■ Machining Examples

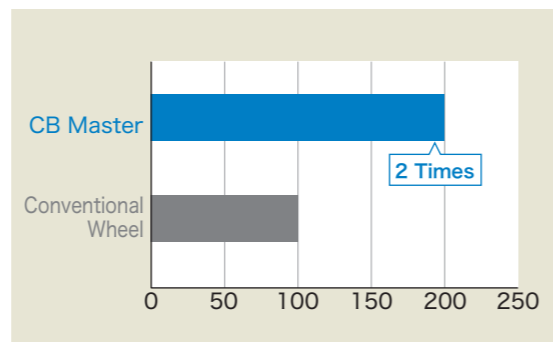
□ Comparison of Heat-Resistant Alloy Processing with Conventional Electroplated Wheels

- |                        |   |
|------------------------|---|
| 1) Machine             | Grinding Center   |
| 2) Wheel Specification | ① CB Master #80<br>② Conventional Electroplated Wheel #80                       |
| 3) Wheel shape         | Φ50-10W Straight  |
| 4) Coolant             | Water-Soluble   |
| 5) Conditions          | Wheel Peripheral Speed : 40 m/sec<br>D.O.C. : 0.05 mm<br>Feed Rate : 200 mm/min |

Comparison of Grinding Resistance



Tool Life (Index)



#### ■ Manufacturable Ranges

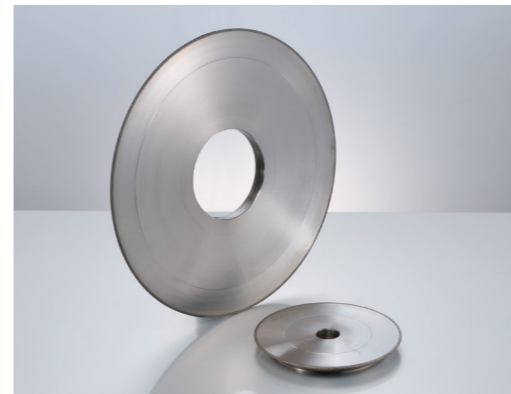
Outer Diameter	Φ20~410 mm
Thickness	2 mm (Body Area 5 mm) to 150 mm
Grit Size	#40/50~#170/200

\*Please consult us about the specifications.

### For Turbine Blades Grooves / High Precision Electroplated Wheel CB Master

#### 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 is maintained until the tool life comes, and grinding consistency is sustained.

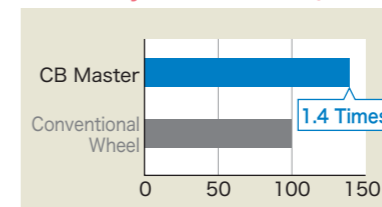
#### ■ Applications

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

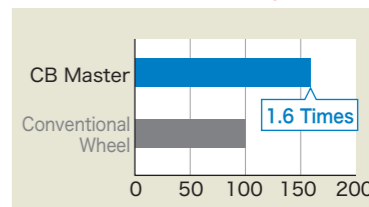
#### ■ Machining Examples

- High efficiency and long life in processing Inconel 718.

Efficiency (Processed Quantity: Index)



Life (Processed Quantity: Index)



### For Combustor Casing / High Precision Electroplated Wheel CB Master

#### Process Integration and Automated Operation

Newly developed CB Master 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 Blades / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)

#### High Precision and Highly Efficient Dressing

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 : Diamonds electroplated densely to provide high precision and long life.
- SZ : The diamond is regularly arranged so that you can select the degree of concentration to suit your needs.
- SX : Excellent sharpness thanks to the regular arrangement of diamond, precision powder metallurgy and precision processing technologies.

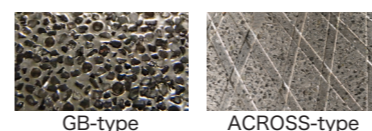
#### ■ Applications

- Form grinding of serrations of turbine blades

#### ■ Improved Dressing Ability (for Fast Dressing)

- Sharp-type
- GB-type
- ACROSS-type

\*For details, see page 70.



GB-type

ACROSS-type

## Machine, Industrial Machine, Robot

### For Linear Guide, Ball Screw / Diamond Rotary Dresser Optimard Stark

#### Optimized Abrasive Surface According to Dressing Environment

This rotary dresser has improved wear resistance while maintaining sharpness, thanks to its unique plating technology. Maintains a high degree of contouring even under heavy loads with CBN wheels.

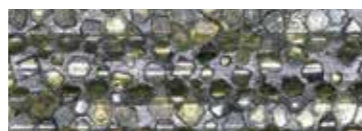


#### Features

- The working area related to wear resistance and sharpness can be adjusted more extensively and finely than before.

#### Applications

- Linear guide, ball screw, various bearing processing

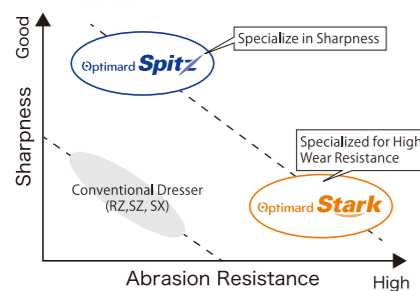


Optimard Stark

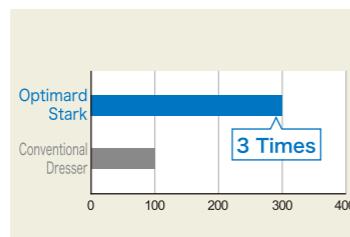


Conventional Dresser

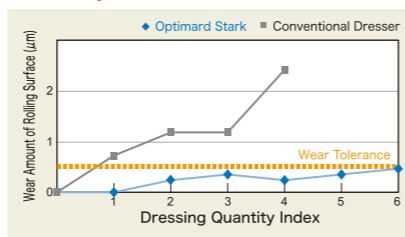
#### Optimard Series



#### Life (Number of Dresses: Index)



#### Comparison of Wear Amount

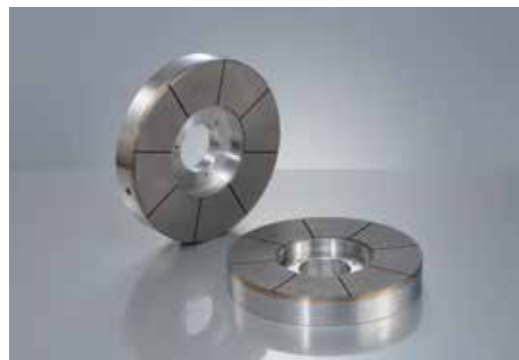


#### Manufacturable Ranges

Outer Diameter	φ50~200 mm
W Size (Grain Size)	10~100 mm
Grit Size	#30~#80

### Oil Pump Parts Grinding Wheel / MB SPARK

MB SPARK is a wheel made with highly rigid special metal bond suitable for double-sided 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

### Reduction Gear Processing / Electroplated wheel Formaster Premium

Improved shape stability provides longer life in precision grinding of hardened steel and other ferrous materials.



#### Features

- High contour accuracy, ideal for high-precision machining.
- Suppresses abrasive wear and maintains sharpness.
- Contributes to lower tooling costs by extending wheel life.

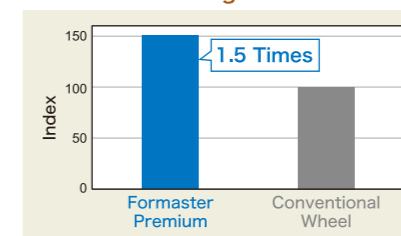
#### Applications

- Machining of high-precision steel parts

#### Machining Examples

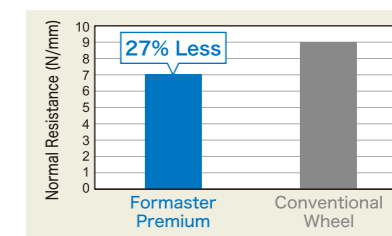
- Comparison with Conventional Wheel
- 1) Wheel Specification Φ50 Straight
- 2) Workpiece Steel
- 3) Coolant Water-Soluble
- 4) Conditions
  - Wheel Peripheral Speed : 2,233.8 m/min
  - Feed Rate : 100 mm/min
  - D.O.C. : 0.15 mm
  - Removal Stock : 10,800 mm<sup>3</sup>/mm

#### Grinding Ratio



Grinding Ratio = Removal Volume / Grinding Wheel Wear Volume

#### Resistance Value



### For Reduction Gears / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)

#### 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 Hydraulic Parts / Super Sizing Reamer

#### Highly Precise 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 1 pass.
- Minimized rounding of affected areas in finishing oil holes, notches and holes with keyway.
- Continuous automated operations (skill-less).

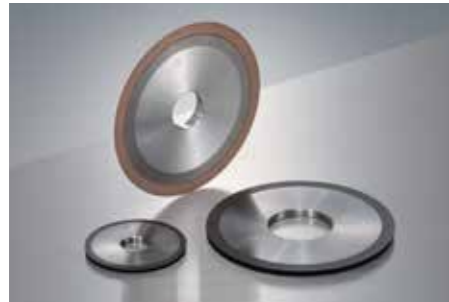
#### Applications

- Finishing holes of cast iron hydraulic components and automotive components

For Profile Processing / 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.
- Various mold processing

General Electroplated Wheel

A wide selection of diamond and CBN abrasive grains to meet various machining needs.



■ Features

- Highly efficient and long-life machining is realized by a wide selection of abrasive grain layers.
- No truing or dressing required on the machine.

■ Applications

- Diamond electroplated grinding wheels: nonferrous metal materials, ceramics, magnetic materials
- CBN electroplated grinding wheels: Steel and ferrous materials

For 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.

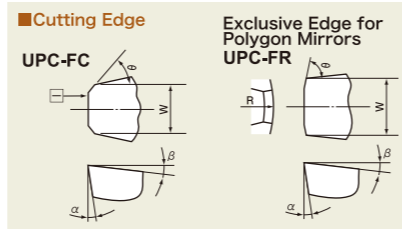


■ Features

- 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



■ Dimension and Highest Accuracy

Type	Tool Edge Angle ( $\theta$ )	Tool Width (W)	Clearance Angle ( $\alpha$ )	Rake Angle ( $\beta$ )	Rake Face (R)
UPC-FC	45°~80°	1.0~4.0	0°~5°	-5°~0°	—
UPC-FR	10°~45°	2.0~4.0	2°~5°	0°	30~40 mm

Large Electroplated Wheel

High peripheral speed machining with large-diameter electroplated wheels significantly improves service life and efficiency.



■ Features

- Special wheel design realizes general form grinding at high peripheral speeds.
- Large wheels with an outer diameter of  $\Phi 500$  can be manufactured.
- \*Please consult with us about tooling specifications as we may not be able to produce them.

■ Applications

- Powder production
- Heat-resistant alloy parts machining

Optical Parts

Lens Mold, Optical

Ni-P Molds, Plastic Parts and Others Processing / Ultra-Precision Cutting Tools UPC-ZERO

Ultra-Precise Cutting Surfaces have been Achieved in the Machining of Ni-P Mold, Plastic Parts and Other Materials

UPC-ZERO sharpens the cutting edge and improves the profile accuracy. The surface roughness of the workpiece is improved and the cutter mark can be suppressed.



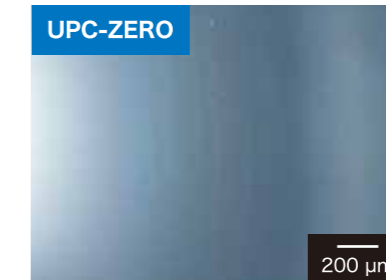
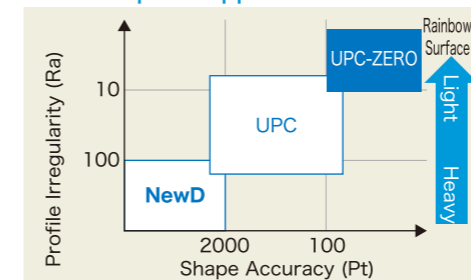
■ Features

- Sharp cutting edge and improved contour accuracy.
- Workpiece surface accuracy is improved and rainbow surface and cutter marks are suppressed.
- Improves workpiece shape accuracy.
- It may shorten the time required to correct the shape in the actual machine.

■ Applications

- Ultra-precision processing of Ni-P molds, plastic parts etc.

Scope of Application and Use



Cemented Carbide Lens Molds / Ultra-Precision Cutting Tool BLPCD 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 single crystal diamond.
  - No anisotropy and specific cleavage.

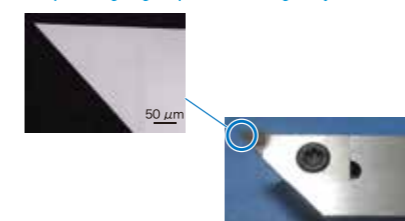
【Features of BLPCD UPC】

- 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

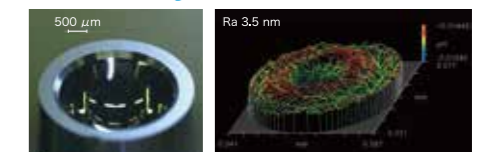
■ Sharp Cutting Edge Equivalent to Single Crystal Diamond



■ 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 an 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 are polished precisely by our originally developed technology cut workpieces on the nanometer order to produce very precise micro shapes.

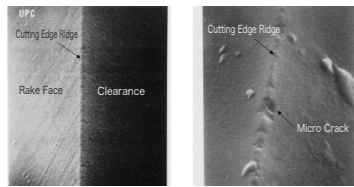


Features

- The cutting edge is uniformly finished in high quality, achieving a surface roughness in the order of nanometers.
- A record of the profile of the cutting edge arc is attached to ensure 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.

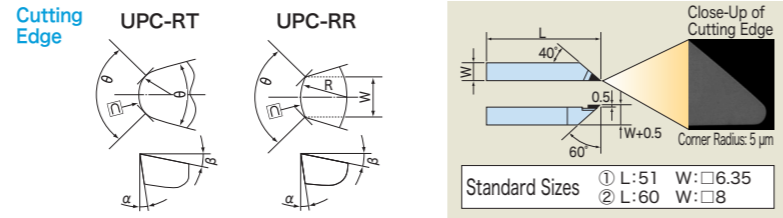


Sharp Cutting Edge

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 5 nm possible



Dimension and Highest Accuracy

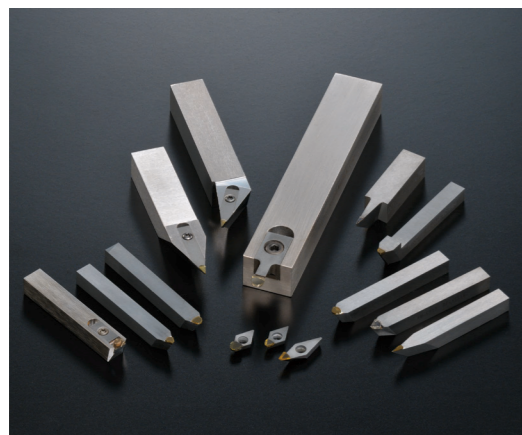
Type	Contour (μm)	Corner Radius (R)			Tool Edge Angle θ	Tool Width (RR)	Clearance Angle (α)	Rake Angle (β)
		θ ≤ 90°	θ ≤ 120°	θ ≤ 150°				
UPC-R	Ultraprecision	0.05	0.1	0.20	0.002~200	min 20°	0.5~5	0°~20°
	Precision	0.25	0.5	1				

※Dimensions and accuracy vary depending on the combination of elements. Contact CKD for more information.

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.
- Cutting edge contour accuracy of 0.05 μm is also possible.
- 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 Examples

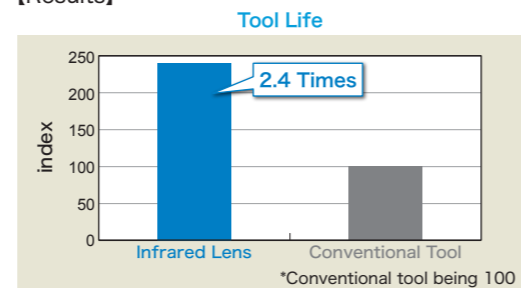
Workpiece Infrared Transmission Lens, φ95 mm Germanium Lens  
Tool Specification Corner Radius 1.5 mm, Clearance Angle 10°  
Conditions Rotational Speed 2,000 min<sup>-1</sup>, Feed Per Revolution 1.75 μm/rev, Stock Removal 1.5 μm

UPC Cutting Edge for Infrared (IR) Lens and Carbide Molds



Uniform Negative Rake Face Provided on Cutting Edge

[Results]



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.



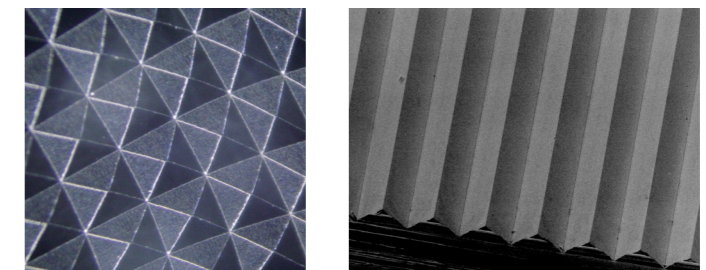
Features

- The cutting edge is uniform and extremely sharp, free from chipping and undulation.

Applications

- Fresnel lens molds, LCD light guide plate molds

Machining Examples

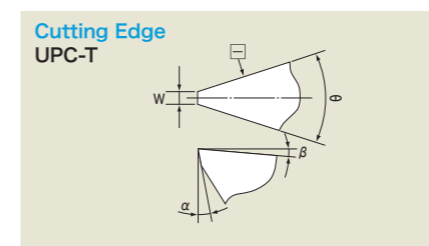


Molding of LCD Display Optical Waveguide

Dimension and Highest Accuracy

Type	Tool Edge Angle (θ)	Angle Tolerance	Leading Edge Width (W)	Clearance Angle (α)	Rake Angle (β)
UPC-T	Ultraprecision	min 20°	±6'	min 0.2 μm	0°~15°
	Precision	min 45°	±15'	Sharp Corner	

※Dimensions and accuracy vary depending on the combination of elements. Contact CKD for more information.



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.



Product of Taga Electric Co., Ltd. Ultrasonic Vibration Cutting Device EL-50Σ

Features

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

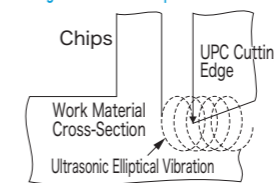
[Features of Elliptical Vibration Cutting]

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

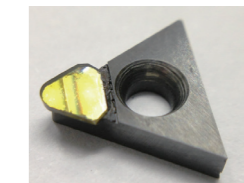


EL-50jw Mirror-Finish Boring (Min. Bore Diameter φ5)

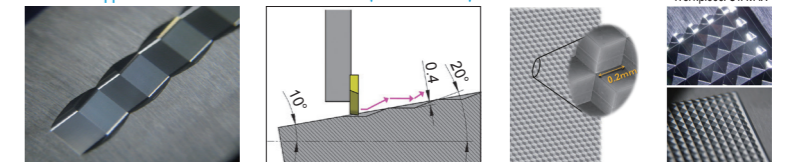
Image of Ultrasonic Elliptical Vibration Cutting



UPC-R for EL-50Σ



Process Application for Mirror Finish of Harden Steel (STAVAX 52HRC)



EL-50jz Hale Mirror Machining in Machining Center

**Optical Sheet Molds / Ultra-Precision Cutting Tool UPC-Nano groove**

**Enables High-Precision Linear Grooving with the World's Smallest Blade Width**

A grooving tool with a minimum groove width of 5 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.

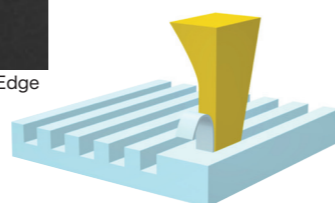
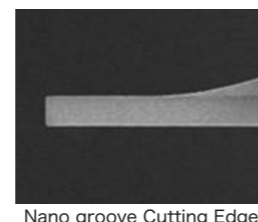
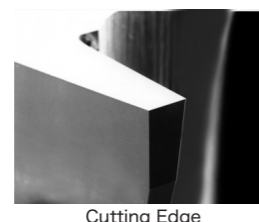
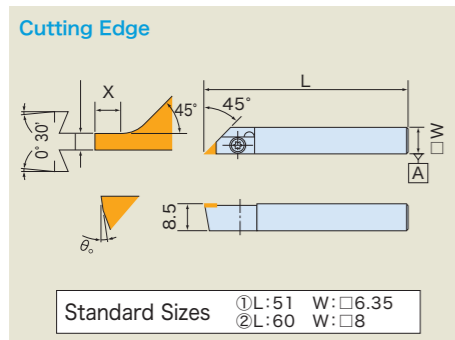


**■ Features**

- A grooving tool with a minimum groove width of 5 μm.
- 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**

This endmill is capable of machining rectangular grooves with free curves.

High aspect ratio grooves that cannot be obtained by the photolithography or ion beam methods can be machined in a short time into an edge shape.

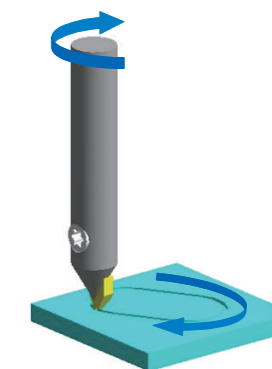
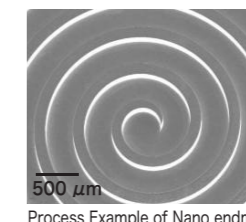
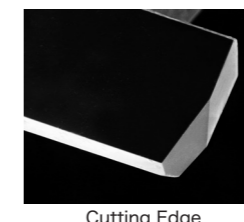
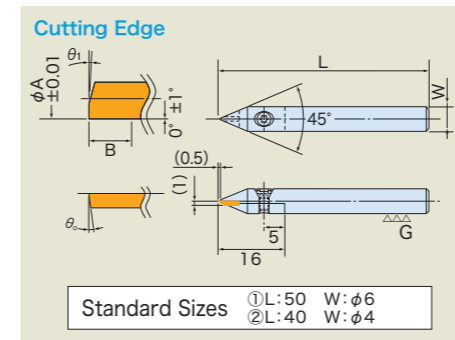


**■ Features**

- 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 Endmill**

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.

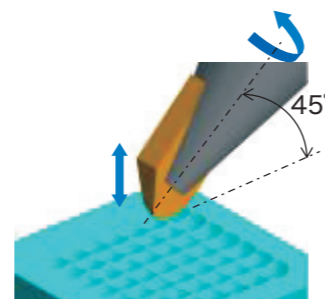
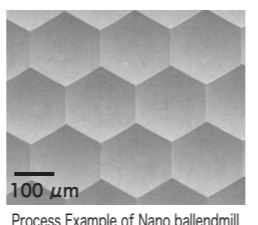
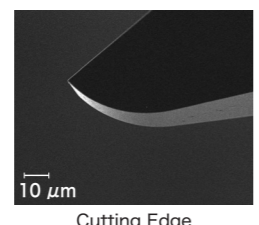
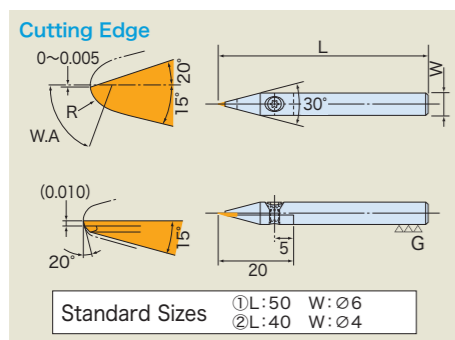


**■ Features**

- The world's smallest-in-its-class ballendmill with R=30 μm.
- 50 nm with the highest degree of contouring in the world is also available.
- Enables high-precision 3D machining with its extremely sharp cutting edge.

**■ Applications**

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



**Optical Sheet 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.

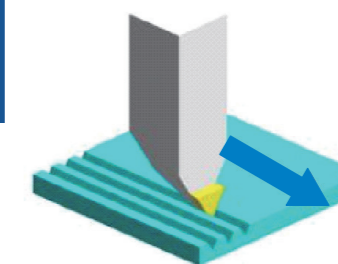
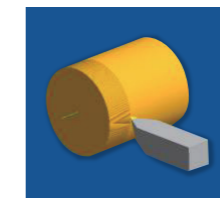
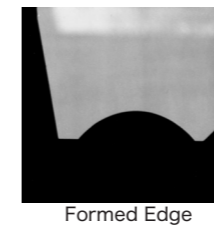
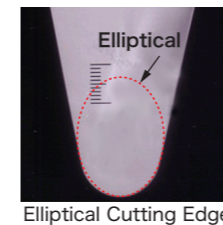


**■ Features**

- 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.

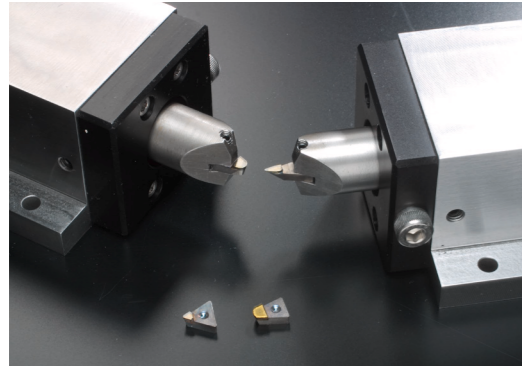
**■ Applications**

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



**For 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 steel is possible.

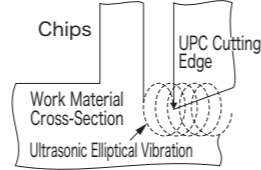
**■ Applications**

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

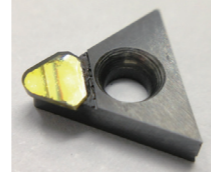
■ Product of Taga Electric Co., Ltd.  
Ultrasonic Vibration Cutting Device EL-50Σ



■ Image of Ultrasonic Elliptical Vibration Cutting



■ UPC-R for EL-50Σ



**For Sensor Camera Mold / Ultra-Precision Cutting Tool UPC-R, BLPCD 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.



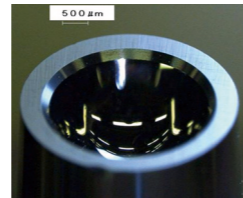
**■ Features**

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

**■ Applications**

- Machining of various automotive lens molds

**■ Machining of Cemented Carbide Molds with BLPCD UPC**



**For 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, Combiner lenses

**For Cutting Eyeglass Lenses (Rough Machining) / PCD Rotating Tool**

Used for rough cutting of aspherical shapes of eyeglass lenses. Tool head interchangeable type, holder integrated type, etc. are available upon request. Regardless of eyeglass lenses, milling machines for flat and groove machining, side cutters, etc. can be designed to meet your application and requirements.



Tool Head Replacement Type    Holder Integrated Type

**■ Features**

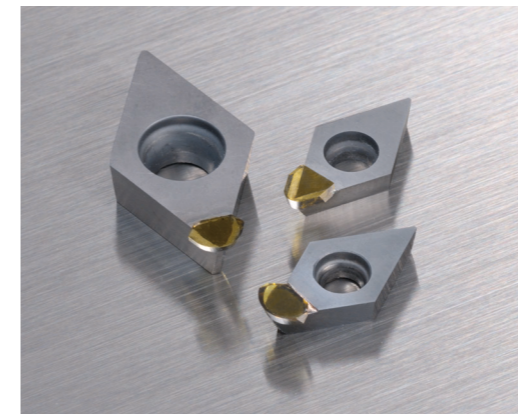
- High quality cutting edge finish suppresses burrs and stabilizes surface finish quality.
- Unique tool design ensures stable machining.

**■ Applications**

- Eyeglass lens cutting (rough machining), resin molding parts, nonferrous metal parts, etc.

**Eyeglass Lens Finish Cutting / NewD**

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



**■ Features**

- The combination of our originally-designed inserts and holders enables easy and precise tool setting like indexable inserts.
- The rake face is free from adhesions and accumulation of chips and maintains the high quality of worked surfaces even during continuous use.

**■ Applications**

- Eyeglass lens finishing
- Resin parts machining

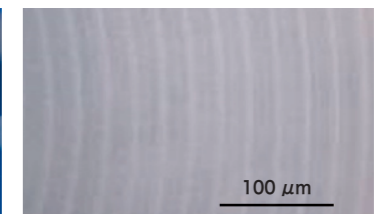
**■ Machining Examples**

□ Process Example of Eyeglass Lens  
 Tool Specification : R2.0 - Relief Angle 18°  
 Cutting Speed : 1,200 m/min  
 Feed Per Revolution : 0.25 mm/rev  
 D.O.C. : 0.08 mm

[Results]  
 Shape Accuracy: 0.8 μm  
 Surface Roughness (Ra): 0.1 μm  
 Machined Workpieces: 2,000 pieces



Eyeglass Lens



Micrograph of Machined Surface

### SiC

#### For Finishing SiC Wafers / Nanomate Masspower

##### Demonstrates Performance in Mirror Finish Processing of SiC Wafers

By adopting a newly developed vitrified bond that further improves the abrasive grain retention force and spontaneous blade property, which is a feature of the Nanomate series, the new bond offers a longer life than conventional wheels.



#### ■ Features

- Enable reduction of tool cost and frequency of tool change due to longer tool life

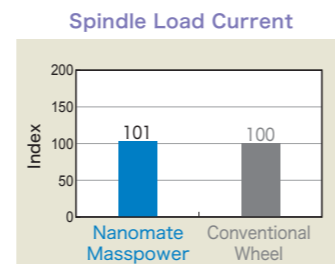
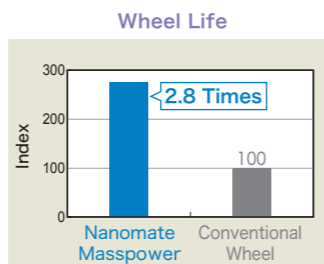
#### ■ Applications

- Ultra-precision surface grinding of SiC wafers

#### ■ Machining Examples

□ Comparison with Conventional Wheel

- 1) Machine: Vertical Axis Rotary Surface Grinder
- 2) Workpiece: 6 inch Single Crystal SiC
- 3) Grit Size (Grain Size): #8000 (0.5 μm)
- 4) Conditions: Feed Rate : 0.3 μm/sec
- 5) Coolant: City Water



#### For Rough Grinding SiC Wafers / Nanomate Premium

##### Realizes High-Efficiency Processing of SiC Wafers

Combining diamond abrasive grains with vitrified bonds at an appropriate blending ratio enables continuous processing of single-crystal SiC that was not possible with conventional wheels. It further improves machining efficiency and reduces tool costs.



#### ■ Features

- Realizes continuous processing of single-crystal SiC
- Improved machining efficiency and reduced tool costs

#### ■ Applications

- Precision surface grinding of various semiconductor wafers

#### ■ Machining Examples

□ Comparison with Conventional Wheel

- 1) Machine: Vertical Axis Rotary Surface Grinder
- 2) Workpiece: 6 inch Single Crystal SiC
- 3) Grit Size (Grain Size): #2000 (9 μm)
- 4) Conditions: Feed Rate : 0.5 μm/sec
- 5) Coolant: City Water

#### For LT/LN Wafers / Nanomate Masspower

##### Low-Damage Grinding of LT/LN Wafers

Because fragile LT wafers used as the SAW filter tend to get broken in processing, improving the processed surface roughness is required. "Nanomate Masspower", 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.



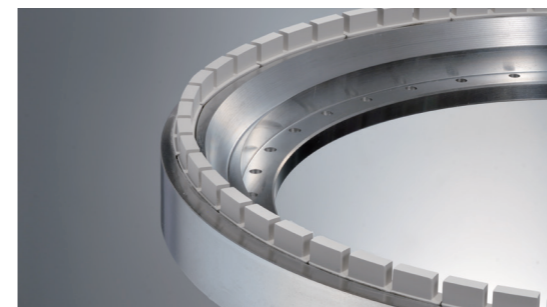
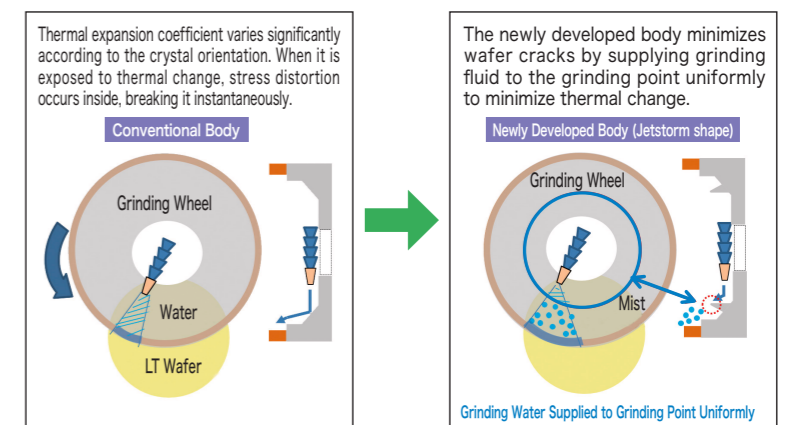
#### ■ Features

- 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/LN wafers

#### ■ LT Wafer Grinding Problem Solving



Newly Developed Body (Jetstorm Shape)

### GaN / Sapphire

#### For 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 difficult-to-machine materials.
- High-speed and near mirror finishing.

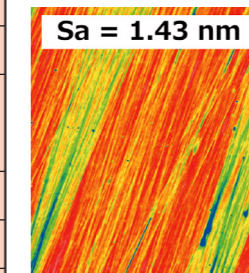
#### ■ Applications

- Precision surface grinding of GaN / Sapphire wafers

#### ■ Results from Grinding Single-Crystal GaN Wafers

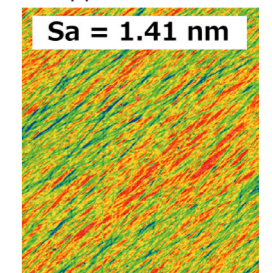
GaN Wafer (Ga Surface)	2 Inch		4 Inch	
	Rough	Finish	Rough	Finish
Grit Size (Grain Dia.)	#2000(9 μm)	#6000(1.5 μm)	#2000(9 μm)	#6000(1.5 μm)
Stock Removal (μm)	50-100	10	50-100	10
Feed Rate (μm/min)	30 60 90	20	30 60 90	20
Wear Rate (%)	7 15 27	100	12 20 35	100
Surface Quality Ra (nm)	90 - -	1-2	100 - -	2

#### ■ GaN Wafer



Grain Size 1.5 μm

#### ■ Sapphire Wafer



Grain Size 0.5 μm

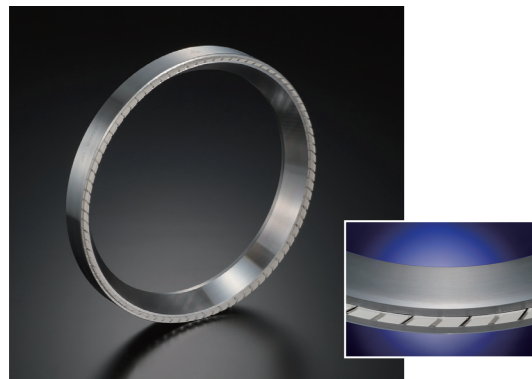
Measured by : ZYGO nexVIEW FOV : 450 μm



For Finishing Si Wafers / Nanomate Premium

Outstanding Performance in Final Mirror-Finishing of Silicon Wafers and Device BG

Ultra fine diamond grit and Ultra fine ceramics revolutionized the conventional wisdom of grinding wheels. Application of both acquired material technology and production technology has allowed Ultra fine grinding. Its effectiveness to reduce grinding damage in layers of brittle material such as polish-reduction of  $\phi 300$  mm silicon wafer and prevent cracks on a thin layer device wafer.



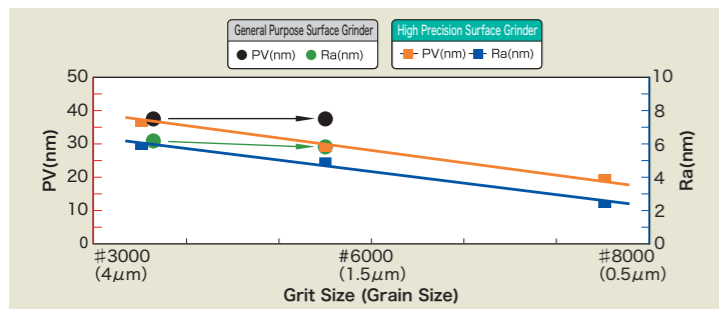
■ Features

- Extremely flat, low damage, and smooth grinding possible.
- Grinding of 300 mm silicon wafers as thin as  $3 \mu\text{m}$  is possible.
- Polished surface quality equivalent to polishing is possible.

■ Applications

- Ultra-precision surface grinding of various semiconductor wafers

Relation Between Grit Size and Surface Wafer



12 Inch Si Wafer / Comparison Data by Grain Size

	Grain Size	
	4 $\mu\text{m}$	0.5 $\mu\text{m}$
Surface Roughness	Sa:15.3 nm Sv:102 nm	Sa:1.1 nm Sv:9.6 nm
Surface Damage Depth	1.0 $\mu\text{m}$	0.14 $\mu\text{m}$

For Si Wafers / Nanomate Cellfied

Demonstrates Performance in Si as Sliced Wafer Grinding

It has a bond structure with high porosity and excellent chip evacuation, and achieves both lower load and longer life in the processing of silicon wafers.



■ Features

- Achieves both low load processing and long life

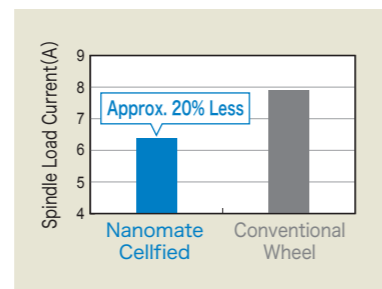
■ Applications

- Thickness processing of as-sliced Si wafers

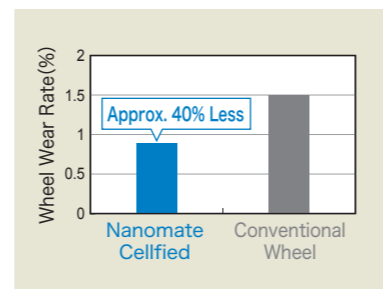
■ Machining Examples

- Comparison with Conventional Wheel (Nanomate V-Heart)
- 1)Machine Vertical Axis Rotary Surface Grinder
- 2)Wheel Specification ①Conventional Wheel ②Nanomate Cellfied  $\Phi 200\text{-}3\text{W}$  #4000 (3  $\mu\text{m}$ )
- 3)Workpiece 12 inch Silicon Wafer
- 4)Coolant City Water
- 5)Conditions Wheel Rotation Speed: 1,500  $\text{min}^{-1}$   
Chuck Rotation Speed: 300  $\text{min}^{-1}$   
Spark Out : 5 sec

Spindle Load Current



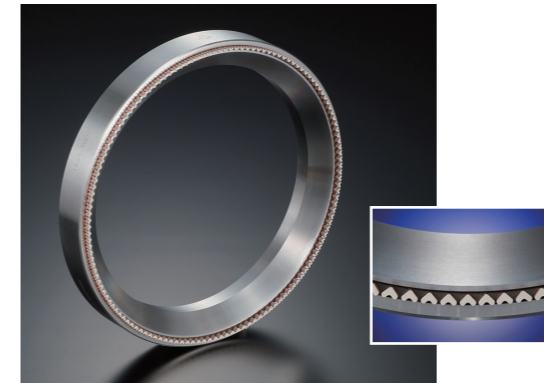
Wheel Wear Rate



For Si Wafers / Nanomate V-Heart

Ideal for Rough Grinding of Si Wafers

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.



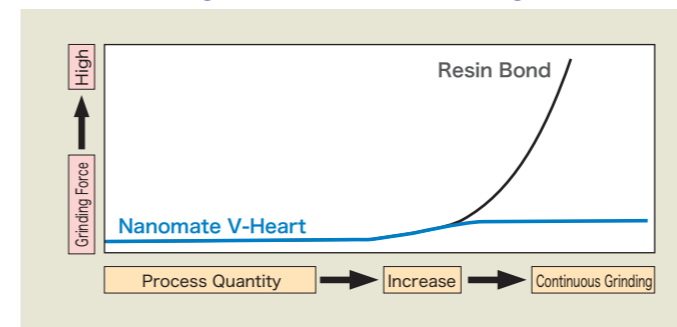
■ Features

- Realizes high efficiency and low load process
- V-shape that allows optimum diamond grain spacing ensures long lasting sharpness.

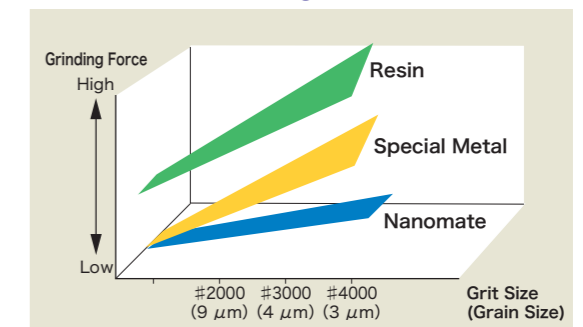
■ Applications

- Rough grinding of Si wafers

Grinding Force is 1/10 of Resin Bonding Wheel



Grinding Force



MEMS

For 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.

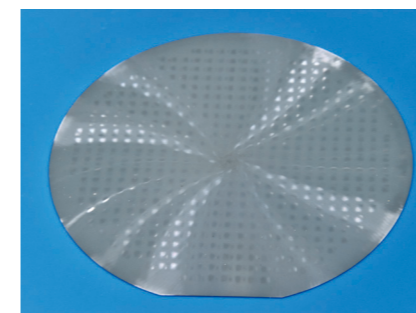
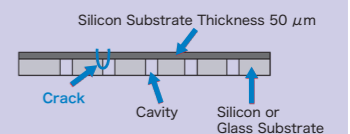
■ Applications

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

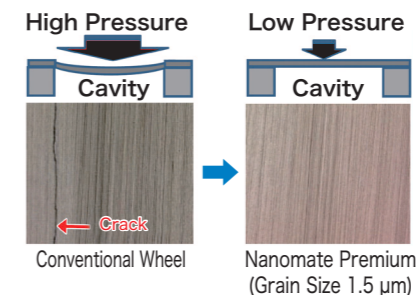
■ MEMS Grinding Problem Solving

Problems of MEMS Grinding

When grinding the silicon wafer, breaks occur in the hollow layer in the silicon or glass substrate.  
Silicon wafer grinding has become possible by softening the binding grade to the limit.



MEMS (Micro Electro Mechanical Systems)



# Forming Tool for Grinding Wheel (Diamond Rotary Dresser)

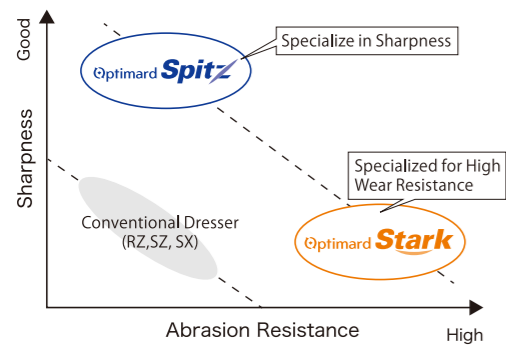
## Bearing

### For Bearings / Diamond Rotary Dresser Optimard Series

#### Optimization Wear Resistance and Sharpness on Request

Stable accuracy is guaranteed by high concentration when wear resistance is required and by low concentration when sharpness is required.

#### Optimard Series



#### Features

·Abrasion resistance and sharpness are wider and finer than before.

#### Applications

·Grinding of ball race surface, grinding of roller shaft surface, outer ring inner/outer diameter grinding, inner ring outer diameter machining, etc.

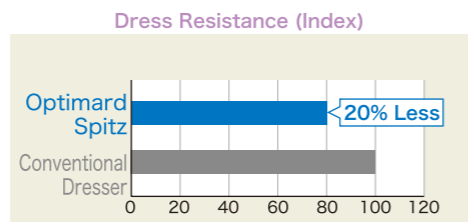
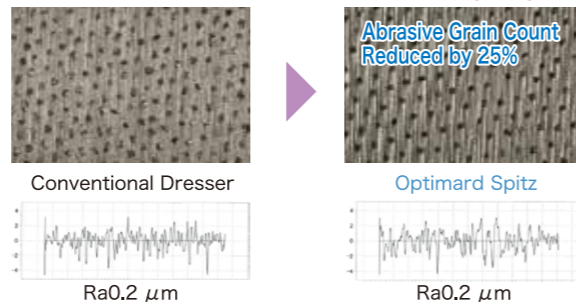
#### Manufacturable Ranges

	Stark	Spitz
Outer Diameter	Φ50~200 mm	
W Size (Grain Size)	10~100 mm	
Grit Size	#30~#80	#16~#40

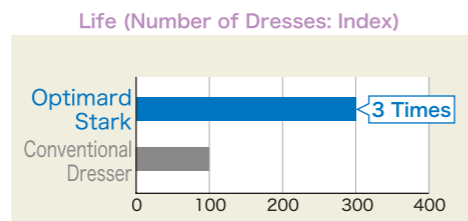
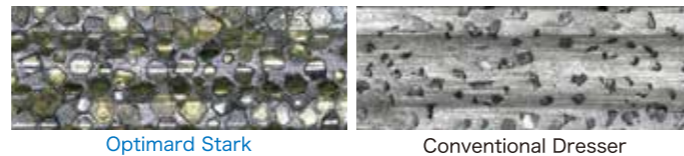
#### Sharpness-Oriented Type Optimard Spitz



#### Reduction of Abrasive Grain Number While Maintaining Roughness



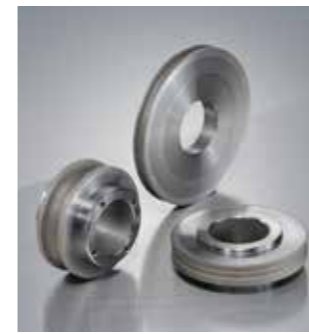
#### High Wear Resistance Type Optimard Stark



### For Bearings / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)

#### Good Sharpness and High Accuracy

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 : Diamonds electroplated densely to provide high precision and long life.
- SZ : The diamond is regularly arranged so that you can select the degree of concentration to suit your needs.
- SX : Excellent sharpness thanks to the regular arrangement of diamond, precision powder metallurgy and precision processing technologies.

#### 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)

- Sharp-type ·GB-type
- ACROSS-type \*For details, see page 70.

### For Grinding Linear Guides (Linear Motion Bearings) / Diamond Rotary Dressers (Grinding Wheel Forming Tools)

#### Contributing to Bearing Resistance Reduction

High-precision dressers required for machining rails and blocks of various shapes can be manufactured. We respond to customer needs with a variety of manufacturing methods and various options.



#### Features

- RZ : Diamonds electroplated densely to provide high precision and long life.
- SZ : The diamond is regularly arranged so that you can select the degree of concentration to suit your needs.
- SX : Excellent sharpness thanks to the regular arrangement of diamond, precision powder metallurgy and precision processing technologies.

#### Applications

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

### For Tap Grooves / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)

#### High-Precision and Fine Shapes can be Manufactured

Dressers according to required pitch sizes are manufacturable.



#### Features

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

#### Applications

- Various tap grooving

### For Reduction Gears / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)

#### Good Sharpness and Contour Accuracy

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 Turbine Blades / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)**

**High-Efficiency Dressing from Small to Large**

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**

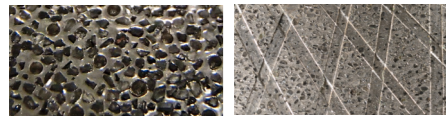
- RZ : Diamonds electroplated densely to provide high precision and long life.
- SZ : Diamonds set regularly to allow the selection of concentration according to needs.
- SX : Outstanding sharpness realized by our original diamond setting patterns and precision powder metallurgy and precision machining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

**Applications**

- Form grinding of serrations of turbine blades

**Improved Dressing Ability (for Fast Dressing)**

- Sharp-type
- GB-type
- ACROSS-type
- \*For details, see page 70.



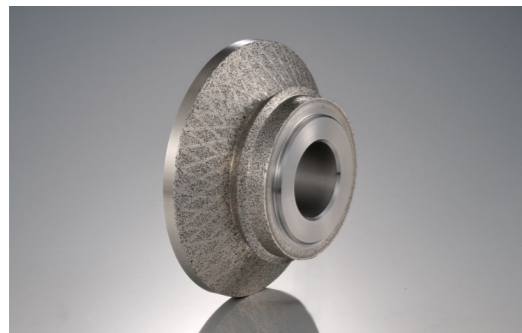
GB-type

ACROSS-type

**For Hub Units / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)**

**Achieves High Precision and Good Sharpness**

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



**Features**

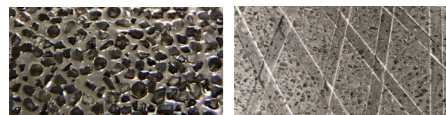
- RZ : Diamonds electroplated densely to provide high precision and long life.

**Applications**

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

**Improved Dressing Ability (for Fast Dressing)**

- Sharp-type
- GB-type
- ACROSS-type
- \*For details, see page 70.



GB-type

ACROSS-type

**For Steering Components / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)**

**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 Grinding Gears / Disc Dresser (Forming Tool for Grinding Wheel)**

**Contributes to Higher Quality Gears and Reduced Grinding Costs**

As a dresser for shaping worm-shaped grinding wheels used in gear grinding, it realizes "higher precision gears" and "reduced grinding costs" by extending dresser life.

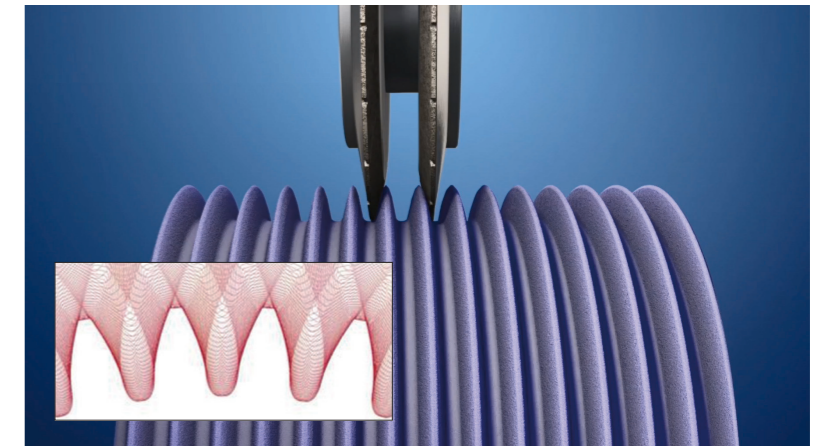


**Features**

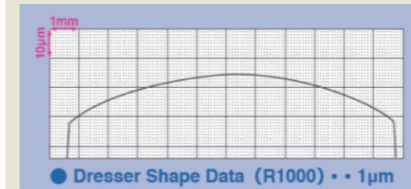
- Based on information such as workpiece gear specifications, grinding wheel shape and specifications, we design a dresser that achieves the required tooth surface quality.
- Extremely high tooth profile accuracy of 0.001 mm or less can be obtained.
- High ability to maintain tooth profile accuracy shape and low dresser life variation contribute to reduced grinding costs.

**Applications**

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



Disc Dresser Contour Shape



**For Injector Components / Diamond Rotary Dresser (Forming Tool for 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) for which the precision electroforming technology is employed and which is capable of coping with complex shapes is widely used.
- RZ : Diamonds electroplated densely to provide high precision and long life.

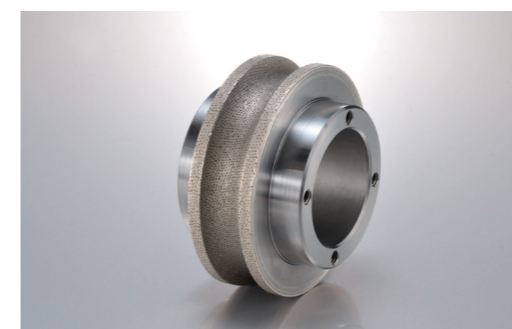
**Applications**

- Grinding of injector-related components

**For CVT-Related Components / Diamond Rotary Dresser (Forming Tool for Grinding Wheel)**

**Excellent High Precision and Long Life**

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



**Features**

- High precision and long life can be realized.

**Applications**

- Grinding of CVT-related components

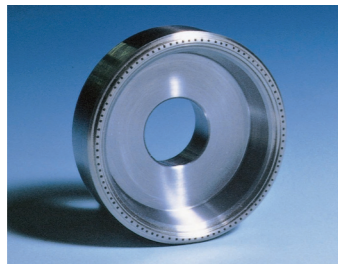
For Internal Grinder Machine / Rotary Dresser

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

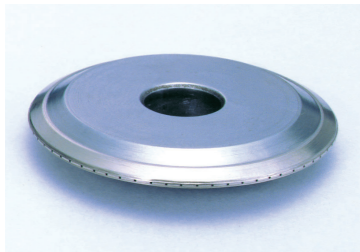
Straight Type				Cup Type			
Model Number	S40-N	S40-C	S40-I	Model Number	C40-N	C40-C	C40-I
Profile							
Diamond Layer	Disposition	CVD Prism	Inpregnated	Diamond Layer	Disposition	CVD Prism	Inpregnated
Grit Size	100 SPC	0.4×0.4	SD#40	Grit Size	100 SPC	0.4×0.4	SD#40
Concentration	60 pcs / Circumference	90 pcs / Circumference	3.3 ct/cm <sup>2</sup>	Concentration	40 pcs / Circumference	90 pcs / Circumference	3.3 ct/cm <sup>2</sup>

Other sizes and specifications available upon request

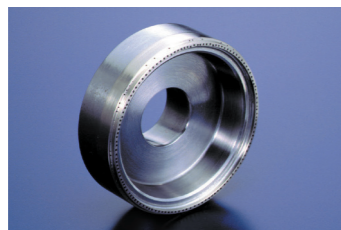
For Dressing CBN / High Hardness Wheels / Crown Dresser

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.



Straight Type



Cup Type

■ Features

- CVD diamond provides high-wear-proof performance like single crystal diamond.
- Constant and stable active area with prism diamond.
- Cost effective with no reworking.

■ 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

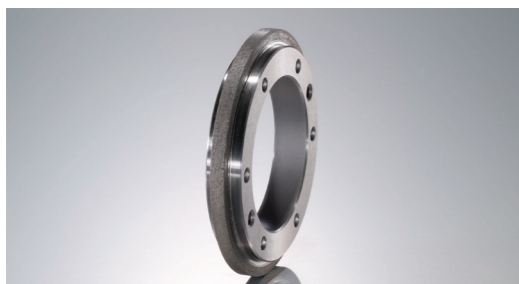
Straight Type			Cup Type		
Size	CVD Size	Pitch	Size	CVD Size	Pitch
D φ35~180	0.2□, 0.4□, 0.6□, 0.8□	0.8~2 mm	D φ40~80	0.2□, 0.4□, 0.6□, 0.8□	0.8~2 mm
H φ 8~30			H φ10~20		
T 6~20			T 15~20		

\*Other sizes and specifications available upon request

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 Material

## Wire Drawing

### BLPCD Dies

#### Excellent Wearing Resistance, No Crystal Orientation Like Single Crystal Diamond

100% nano-polycrystalline diamond "BLPCD" which diamond particles are strongly bonded and does not contain a binder. It has higher hardness than single-crystal diamond and no anisotropy, so it provide excellent wear resistance and roundness retention. Since it does not contain binder, it hardly causes scratches on the wire surface brought up by falling off of diamond, binder particles or contamination and it maintains excellent wire surface roughness. The applicable range is from ultra-thin wire of 0.008 mm to around 1.0 mm.

\*For 0.010 mm or smaller diameter, please contact us.



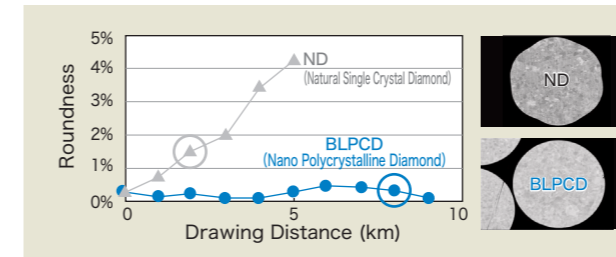
■ Features

- Excel in Maintaining Roundness
- Wear resistance is more than 3 times compared to single crystal diamond
- Realize good surface roughness equivalent to single crystal diamond

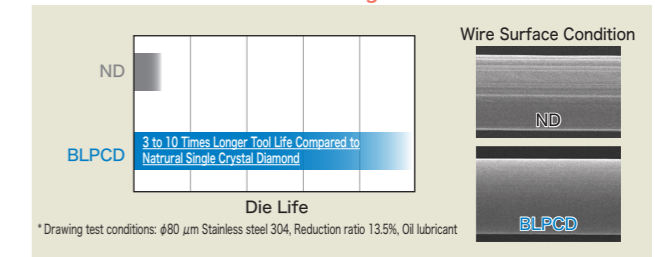
■ Applications

- Wire Materials  
Soft Wire Materials: Copper wire, Aluminum wire, Brass wire, etc.  
Hard Wire Materials: Stainless steel wire, Brass plated steel wire, Galvanized steel wire, Copper plated steel wire

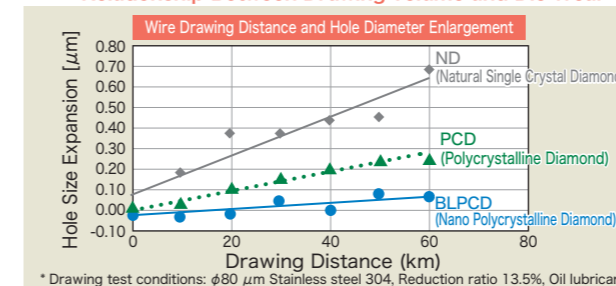
#### Excellent Roundness Retention



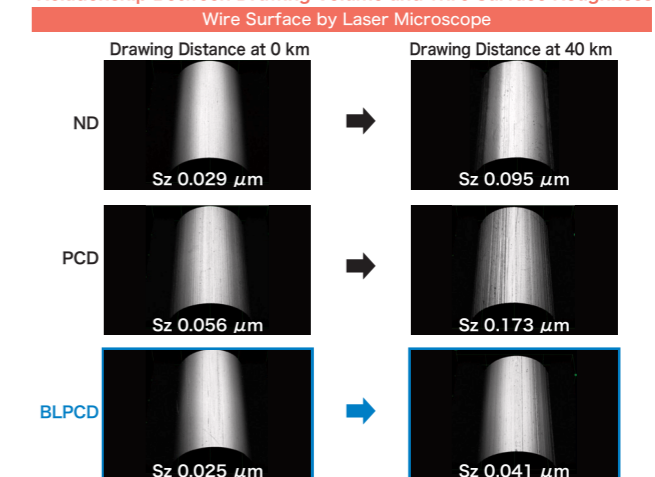
#### Excellent Wearing Resistance



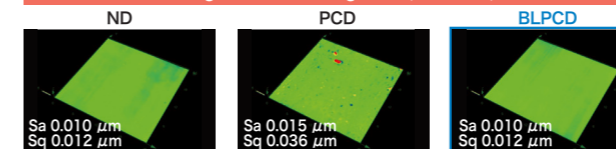
#### Relationship Between Drawing volume and Die Wear



#### Relationship Between Drawing Volume and Wire Surface Roughness



#### Roughness of Bearing Area (New Dies)



### Shaped Wire Drawing Dies

#### Supports a Wide Variety of Shapes, from Squares to Track Shapes

A.L.M.T. Corp. know-how is utilized for diamond used in the manufacture of various wires, such as motor windings in the automotive industry, connector pins and flat cables used in general electrical equipment, and chains of necklaces (for jewelry).



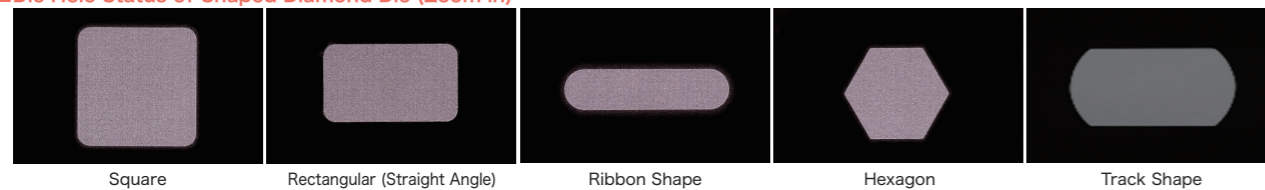
#### ■ Features

- Compared with the rolling method, the surface gloss is higher, and the wire with high dimensional accuracy can be achieved.
- Can support various shapes from squares to track shapes with high accuracy.
- Squares can be drawn with minimum a side of 0.08 mm.
- Material type is polycrystalline diamond.

#### ■ Applications

- Copper wires such as flat cables, Connector pins for OA equipment, jewelry such as necklaces, Alternators for automobiles, Copper wires for voice coil motors, micro motors, Actuators, etc.

#### ■ Die Hole Status of Shaped Diamond Die (Zoom in)



#### ■ Standard Specifications (Material : Polycrystalline Diamond)

Shaped Wire Drawing	Symbol	Dimensional Limits		Tolerance	
		Minimum (mm)	Maximum (mm)	Standard (μm)	Precision (μm)
Square	S	0.08	5.0	10	3
	R	0.03	2.0	-	-
Rectangular (Straight Angle)	W	0.3	7.5	10	4
	H	0.2	4	10	4
	R	0.03	2.0	-	-
	W/H	-	≤7	-	-
Track Shape	W	0.8	7.5	10	-
	H	0.5	4.0	10	-
	W/H	-	≤7	-	-
Ribbon Shape (Isosceles Triangle is Also Acceptable)	W	0.1	2.0	10	4
	H	0.08	1.0	10	4
	W/H	-	≤10	-	-
Hexagon	W	0.5	4.5	10	5
	R	0.06	2	-	-

\*Depending on the combination of dimensions, it may not be available. Contact us for detailed specifications.

### Ultra-Precision Diameter Diamond Dies

We are now able to produce the world's smallest Φ0.008 mm dies.



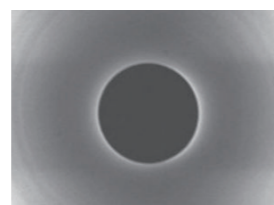
#### ■ Features

- Can be mass-produced. (For 0.010 mm or smaller diameter, please contact us.)
- Realizes high-quality polished surfaces
- We recommend using BLPCD materials

#### ■ Applications

- Gold wire, Copper wire, Stainless steel wire

Hole Diameter 0.010 mm



### Single Crystal Diamond Dies

Applicable to Ultra-fine Wires with a Minimum Diameter from 0.008 mm to about 1.0 mm \*For 0.010 mm or smaller diameter, please contact us.

Artificial single crystal diamond, which is the ultimate material that has high hardness, high bending strength, and high thermal conductivity. Furthermore, the crystal orientation and shape that can reflect the highest performance into the die design. Diamond dies have basic high precision and long life. It is particularly suitable for wire drawing, and can be applied to fine wires as small as diameter 0.008 mm to 1.0 mm.



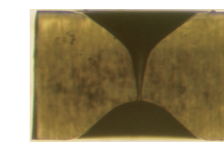
#### ■ Features

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

#### ■ Applications

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

#### ■ Cross Section of Single Crystal Diamond Drawing Dies



Optical Microscope Image

Ultra-precision diameter dies, like bonding wires, which require surface quality and straightness, require dies with smooth and highly symmetrical cross-sectional shapes.

### Polycrystalline Diamond Dies

#### Lineup that is Applicable for Stable Quality Dies and Large Diameter Dies.

Polycrystalline diamond (PCD) material that is made by powdered brazing alloy together with a binder alloy at ultra-high pressure. The lineup supports large diameters, it reflects performance in a larger diameter size range than single crystal diamond. The applicable range is from 0.04 mm to 29.0 mm.



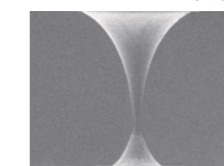
#### ■ Features

- 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.

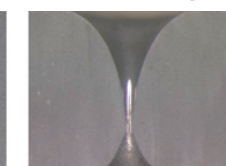
#### ■ Applications

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

#### ■ Cross Section of Polycrystalline Diamond Drawing Dies



SEM Image



Optical Microscope Image

Polycrystalline diamond dies can be applied to larger sizes than single crystal diamond dies.

It is used in a wide range of applications, including saw wire, because it has the advantage of not being affected by crystal orientation.

**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 carbide or tool steel dies.



**■ Features**

- Shaving dies are apply for shaving wire surface during intermediate process of wire drawing.
- Improve wire surface roughness and strict quality requirement.
- Depend on wire material, diamond shaving dies provide 20-100 times if compare with tungsten carbide shaving die.
- Reduce set up time, wire material loss because of long die life.

**■ Applications**

- Shaving copper wires, Aluminum wires, Gold wires and Titanium wires

**Diamond Compacting Dies**

**Excellent Wearing Resistance, Stable Weight Per Size and 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 polycrystalline material and applying our advanced machining technology.



**■ Features**

- Compacting dies are tools to compact the conductor to a round shape.
- Outstanding wear resistance assures production of wire products of a consistent size and weight pre unit length.
- The long tool life reduces setup time and wire material loss due to die replacement.
- Stable wire diameter leads to the cost reduction of insulation.
- Can get stable surface quality.

**■ Applications**

- Stranded wires of power cables, Automotive wire harnesses, Wire ropes

**Diamond Tin-Plating Dies**

**Design to Minimize Adhesion of Tin to the Case**

Adjust the plating thickness in the tin plating process. The optimum shape is set to prevent tin from adhering to the problematic case, and titanium material is used to suppress it.



**■ Features**

- Using titanium metal for the die casing, it is avoided the tin stick on the die casing.
- Standard case dimension is  $\phi 25 \times 7$  mm

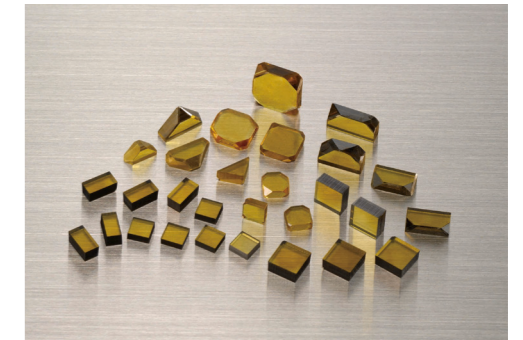
**■ Applications**

- Adjust tin-plated thickness of copper wire.

**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 Kongoseki. 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.



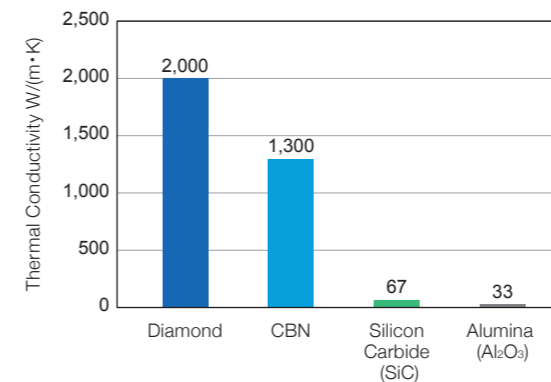
Synthetic Diamond (Sumitomo Electric Industries, Ltd. Sumicrystal)

**CBN**

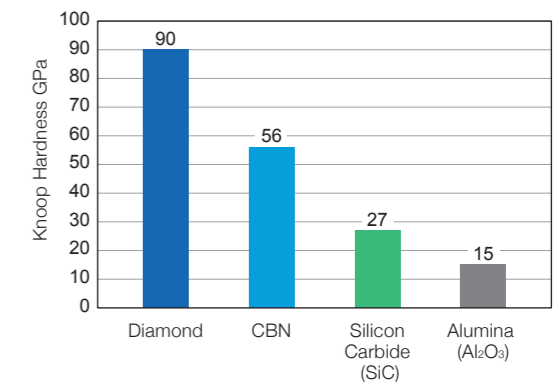
CBN is an acronym for "Cubic Boron Nitride" constitute of boron and nitrogen. CBN has the high hardness of diamond. Compared to diamond, which starts oxidation at 700° C, CBN has a thermal tolerance up to 1,300° C, so CBN is superior for high temperature processing.

**Comparison of Diamond / CBN and Abrasive Grain for General Whetstones**

① Thermal Conductivity



② Hardness



For more information, access here!  
Basic information about Diamond / CBN tools and processing

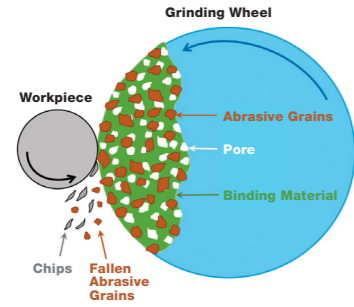


## Diamond / CBN Grinding Wheels (Super Abrasive Wheels)

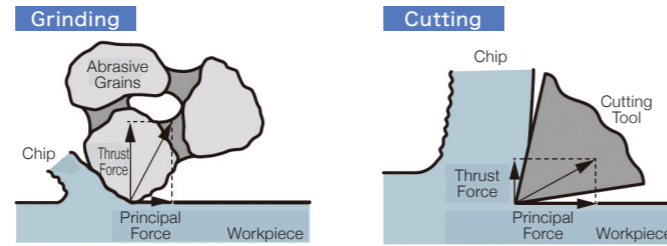
### What is Grinding?

Grinding is a processing method that performs very fine cutting by rotating a grinding wheel (whetstone) at high speed using many hard abrasive cutting edges.

#### Schematic Diagram of Grinding Process



#### Difference Between Grinding and Cutting



## Diamond / CBN Grinding Wheels (Super Abrasive Wheels)

Grinding Wheels with Diamond and CBN are called "Superabrasive Wheels", to distinguish from conventional wheels such as aluminum oxide and silicon carbide.

### Why the Term "Wheel" for Super Abrasive Grains?

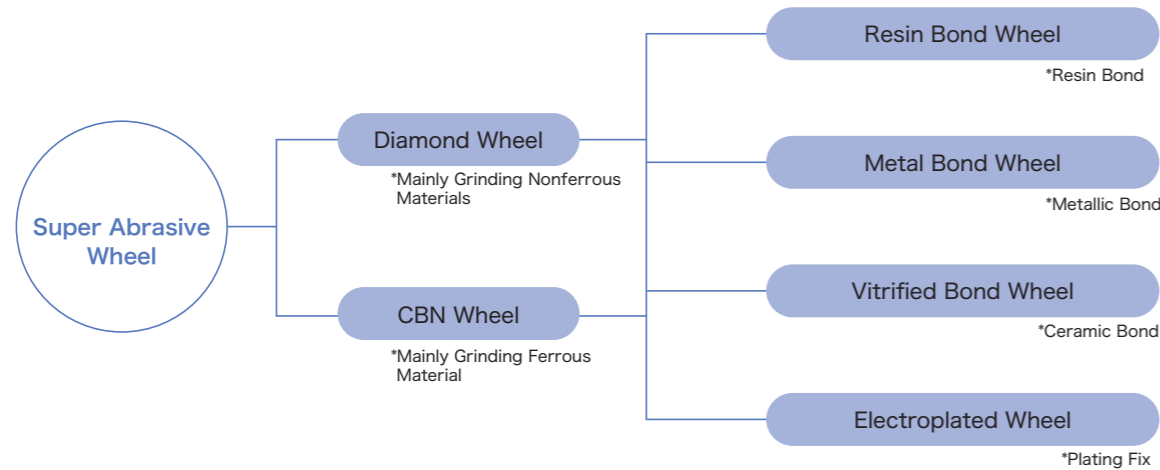
They were given the term "super abrasive wheel" by JIS because the Diamond Industry Association proposed to differentiate them from general abrasive whetstones.

#### "Excerpt from JIS B 4131: 1998"

Definition: The definitions of the main terms used in this standard are as follows:

a) Wheel: Grinding and (abrasive) stones mainly with a (abrasive) grain layer around the periphery or end face of a metal base. It is called "wheel" to distinguish it from grinding and (abrasive) stones specified in JIS R 6210, JIS R 6212, etc. The wheel with a (abrasive) grain layer holding diamond and (abrasive) grains with a bonding agent is called "Diamond wheel" and the wheel with a (abrasive) grain layer holding CBN and (abrasive) grains with a bonding agent is called "CBN wheel."

## Classification of Super Abrasive Wheels



## Type and Features of Diamond / CBN Wheels

### Resin Bond Wheel

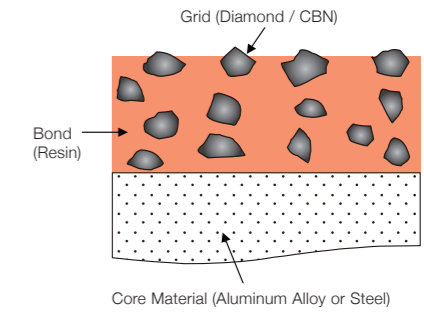
Diamond / CBN abrasive grains, resin powder and filler are mixed and sintered in production. Phenol resin is generally used, but polyimide resin, excellent in heat resistance, is also coming into wide use.

#### Features

- Because the abrasive grains are held by a resin with low elastic modulus (Young's modulus), good surface roughness can be obtained.
- Bond can be retracted well (excellent autogenous blade property) enough to last sharpness long.

#### Applications

Metal material such as cemented carbide, cermet, and high speed steel from rough to finish grinding for certain materials such as fine ceramics, ferrite, and glass



### Metal Bond Wheel

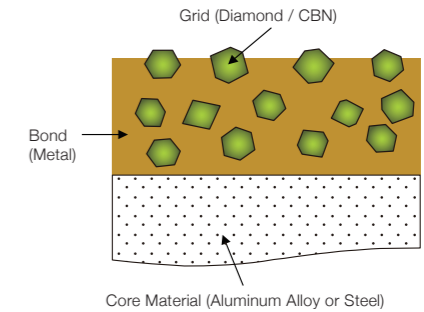
Diamond / CBN abrasive grains, metal powder and filler are mixed and sintered in production. The metal powder used includes copper, tin, iron, cobalt, and tungsten.

#### Features

- High wear resistance and high abrasive grain holding power allow extended wheel lifetime.
- Good sharpness is demonstrated with materials processed in brittle mode such as glass and ferrite.
- High thermal conductivity reduces thermal degradation of abrasive grains and bond caused by heat generated during grinding.

#### Applications

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



### Vitrified Bond Wheel

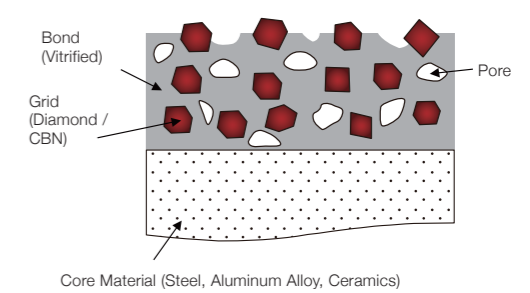
Structure is stomatal where Diamond / CBN abrasive grains, ceramic powder mainly composed of glass, and fillers were mixed and sintered. It is a bond that has been used from the beginning as a bond for general whetstones (conventional whetstones).

#### Features

- Good sharpness because of the stomatal structure.
- Excellent properties of truing / dressing make it suitable for high efficiency machining.
- Because CBN abrasive grains can be molded with a rotary dresser, mass production can be used to grind all parts.

#### Applications

It is used for grinding of ferrous materials, cemented carbides, semiconductor materials, sintered diamond and CBN, etc.



### Electroplated Wheel

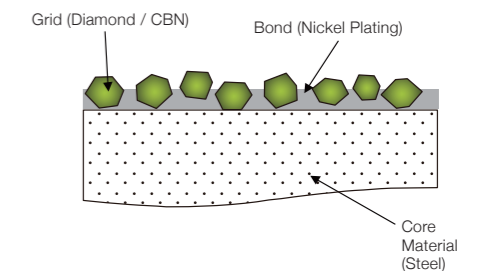
Abrasives are fixed by Ni plating on the surface of steel bodies which have various kind of precise forms.

#### Features

- Excellent durability of grinding ability due to large protrusion (following good chip discharging property).
- Excellent profile maintaining property due to large number of active grains.
- Easy to be formed and body is reusable.

#### Applications

Form grinding of cemented carbide, ceramics, magnetic material and steel, etc. Dry grinding of rubber and FRP, etc.



## 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)", "grit 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**

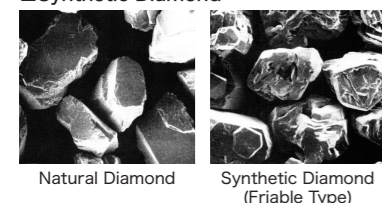
① Abrasive Type   ② Grit Size   ③ Bonding Degree   ④ Concentration   ⑤ Bond Name   ⑥ Thickness of Abrasive Layer

### ① Abrasive Grains

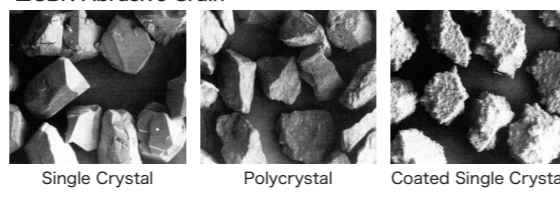
Abrasive grains of the Diamond wheel are of two types: Natural Diamond (D) and Synthetic Diamond, which is often used in industrial applications. "Synthetic Diamond (SD)" and "Metal Coated Composite Diamond (SDC)" are used for the grinding wheel. Also, "Cubic Boron Nitride (CBN)" with hardness following 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	• 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	• 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.		• Used for grinding non-ferrous materials. • The shape of abrasive grains is blocky and the crushing strength is high.
	Metal-Coated Synthetic Diamond	SDC	• 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 Crystal)	CBN (BN)	• Used for grinding ferrous materials. • The shape of abrasive grains is blocky and the crushing strength is high.
	Cubic Boron Nitride (Polycrystal)		• 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)	• Above synthetic abrasive grains coated by metal such as nickel and copper for the purpose of improving the abrasive grain holding power.

### Synthetic Diamond



### CBN Abrasive Grain



### ② Grit Size

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

	Indicated Grit Size (Mesh)	JIS Grit Size (Mesh)	Europe FEPA	USA	Average Grain Size (μm)	Guide for Applicable Zone	
Mesh size	16	16/20	-	-	1,190	Rough grinding	
	20	20/30	-	-	840		
	30	30/40	-	-	590		
	40	40/50	-	-	420		
	50	50/60	301	50/60	300		
	60	60/80	252	60/85	250		
	80	80/100	181	85/100	177		
	100	100/120	151	100/120	149		
	120	120/140	126	120/140	125		
	140	140/170	107	140/170	105		
Micron size*	170	170/200	91	170/200	88	Semi-finishing	
	200	200/230	76	200/230	74		
	230	230/270	64	230/270	63		
	270	270/325	54	270/325	50		
	325	325/400	46	325/400	44		
	400	-	-	-	37		Finishing
	600	-	-	-	30		
	800	-	-	-	20		
	1,000	-	-	-	15		
	1,500	-	-	-	10		
2,000	-	-	-	8			
2,500	-	-	-	6			
3,000	-	-	-	5			

\*The average grain size of micron size is a reference value and does not represent our standards

### 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 grit 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/cm <sup>3</sup> )
200	8.8
175	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	Stone, Ceramic Products	Wear Resistant Metal Heat Resistant Metal	Plastic	Other
● Cemented Carbide ● Cermet ● Ceramics (Alumina, etc.) ● PCD,PCBN	● Ceramic (Aluminum Nitride, etc.) ● Silicon ● Compound Semiconductor (SiC, GaN, etc.)	● Ferrite	● Glass ● Crystal ● Quartz ● Sapphire ● LT, LN	● Stone ● Refractory Material ● Tile ● Asphalt ● Concrete	● Titanium Base Alloy	● F.R.P. (C.F.R.P) (G.F.R.P) ● Urethane	● Graphite ● Conventional Wheel (Grindstone) ● Jewelry ● Rubber ● Composite Material (MMC, etc.)

#### CBN

Cutting Tool	Wear Resistant Metal	Structural Component	Corrosion Resistant Metal	Heat Resistant Metal	Magnetic Material	Medical Materials	Other
● SKH ● SKS ● SK	● SKD	● SCM ● SNCM ● SCR ● SUJ	● SUS	● SUH	● Dust Core ● Alnico	● Cobalt-Chromium Alloy	● Copper Alloy

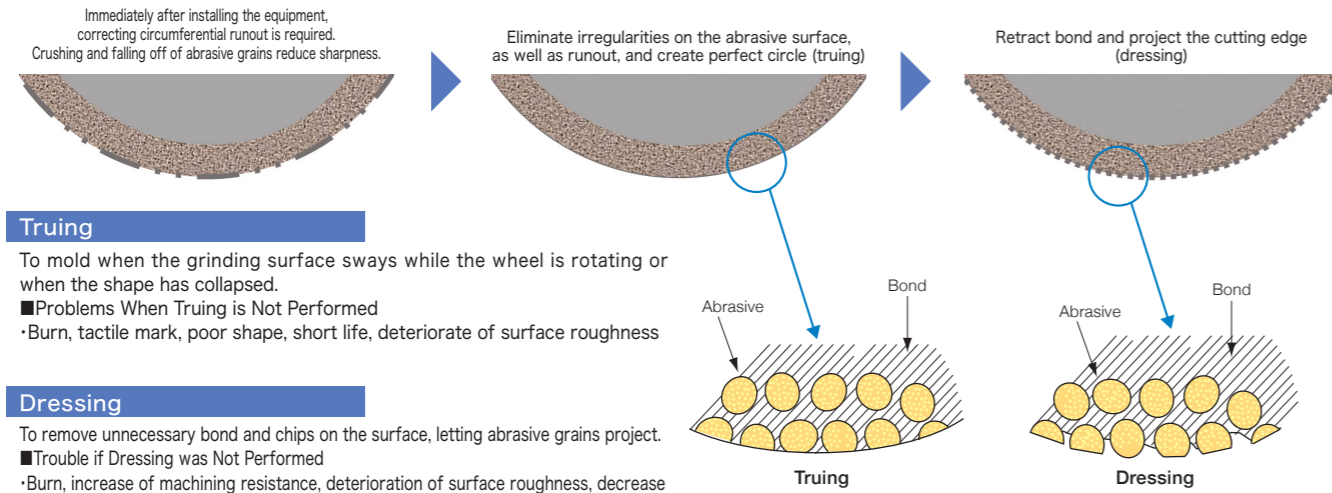
#### Diamond or CBN

Wear Resistant Metal	Heat Resistant Metal	Magnetic Material	Other
● Sprayed Metal ● Cobalt Base Alloy ● Tungsten	● Nickel Base Alloy	● Rare Earth Magnet	● Cast Iron ● Sintered Alloy ● Aluminum Alloy



## 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.



### Truing

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

#### Problems When Truing is Not Performed

- Burn, tactile mark, poor shape, short life, deteriorate of surface roughness

### Dressing

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

#### Trouble if Dressing was Not Performed

- Burn, increase of machining resistance, deterioration of surface roughness, decrease of work efficiency

#### Example of Selecting Conventional Whetstone for Truing

Abrasive Grain Size	~#140	#170~#270	#325~#500	#600~
Resin	C80	WA120	GC300	GC500
Metal, Vitrified	C80	C80	WA120	GC300

#### Example of Selecting Conventional Whetstone for Dressing

Abrasive Grain Size	~#170	#200~#270	#325~#500	#600~#1000	#1500~
Resin	WA200	GC300	GC500	GC1000	GC1500
Metal, Vitrified	WA120	WA300	WA300	WA500	GC800

#### Compliance Table of Diamond / CBN Wheels Truing and Dressing

◎:Best ○:Good △:Possible Blank:No Suitable

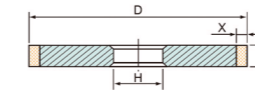
Truing Method and Tool			Truing			Dressing						
			Diamond Wheel	CBN Wheel		Diamond Wheel	CBN Wheel					
			B	M	V	B	M	V	B	M	V	
Diamond Tool Method	Rotary	Rotary Dresser	◎	○	◎	◎	○	◎	◎	◎	◎	◎
		Metal Wheel	○		◎	○	◎					
		Electroplated Arbor Dresser	○		◎	○	◎					
	Stationary	Single Stone Dresser										
		Multi-Stone Dresser			◎		◎					
		Impregnated Dresser			◎		◎					
Conventional Grinding Wheel Method	Rotary	Block Grinding	○	○	○	○	○	◎	○	◎	◎	◎
		Brake Control	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
		Cup Wheel Drive	○	○	○	○	○	◎	◎	◎	◎	◎
	Stationary	Stick	◎	○	△	◎	○	△	◎	○	◎	
Mild Steel Method	Rotary	Mild Steel Roll	○	△	△	○	△	△	○	◎	△	
	Stationary	Mild Steel Block	◎	△	△	○	△	△	◎	△	△	
Crushing Method		Crushing Roll		○	◎		○	◎				
Loose Abrasive Grain Method		Abrasive Grain Lapping	○	○	○	○	○	○	△	△	△	
		Abrasive Grain Blasting	△	○		△	○		△	△	△	
		Abrasive Grain Sludge Pouring							○	○	△	
Electric Discharge Method		Electrode		◎			◎		◎		◎	

## Wheel Size and Model Designation

### Example of Wheel Size Label

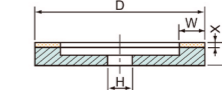
#### ■Straight Wheel

**φ150** - **5T** - **3X** - **φ25.4H**  
 Outside Diameter Grain Layer Width Grain Layer Thickness Mounting Hole Diameter



#### ■Cup Wheel

**φ150** - **3W** - **5X** - **φ40H**  
 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."

#### ①Standard Body Shape

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

#### ②Cross 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

#### ③Abrasive Layer Position & Symbol Reference to B

Symbol	Position	Diagram
1	Periphery	[Diagram]
2	Side	[Diagram]
3	Both Sides	[Diagram]
4	Incline or roundness, inside	[Diagram]
5	Incline or roundness, outside	[Diagram]
6	Part of Periphery	[Diagram]
7	Part of Side	[Diagram]
8	Whole	[Diagram]
9	Edge	[Diagram]
10	Internal	[Diagram]

#### ④Modification & Symbol

Symbol	Modification	Diagram
B	Spot Facing Hole	[Diagram]
C	Countersinking Hole	[Diagram]
H	Straight Hole	[Diagram]
M	Straight & threading hole	[Diagram]
P	Relief at one side	[Diagram]
Q	Insert of abrasive layer	[Diagram]
R	Relief at both sides	[Diagram]
S	Segmented abrasive layer	[Diagram]
SS	Slot segmented abrasive layer	[Diagram]
T	Threading hole	[Diagram]
V	Reverse attachment of abrasive layer	[Diagram]
W	With shaft	[Diagram]
Y	Reverse insert of abrasive layer	[Diagram]

#### ■Standard Wheel Shape 1

1A1 / Straight	1A1R / Cutting
3A1/1A41 / 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
1DD6Y / Centering	1FF6Y/1EE6Y/1LL6Y/1DD6Y / Pencil edge

#### ■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
11V2S / Wedge-shaped segment cup	9A3 / Both side cup
3A2 / Core drill	3V2T / Chamfering
3F2 / Curve generator	W / Internal with shank

Diamond / CBN Cutting Tools

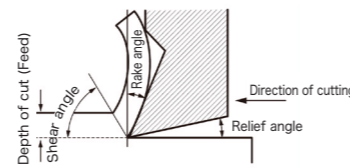
What is Cutting?

- ◆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.

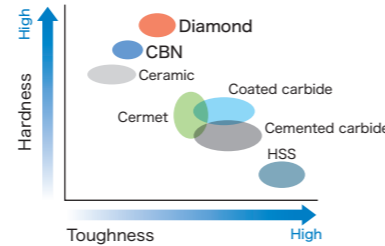
Characteristics of Material

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."

Basic Form of Cutting Tool for Cutting Metal



Position of Tool Materials



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

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.

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 tool 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.

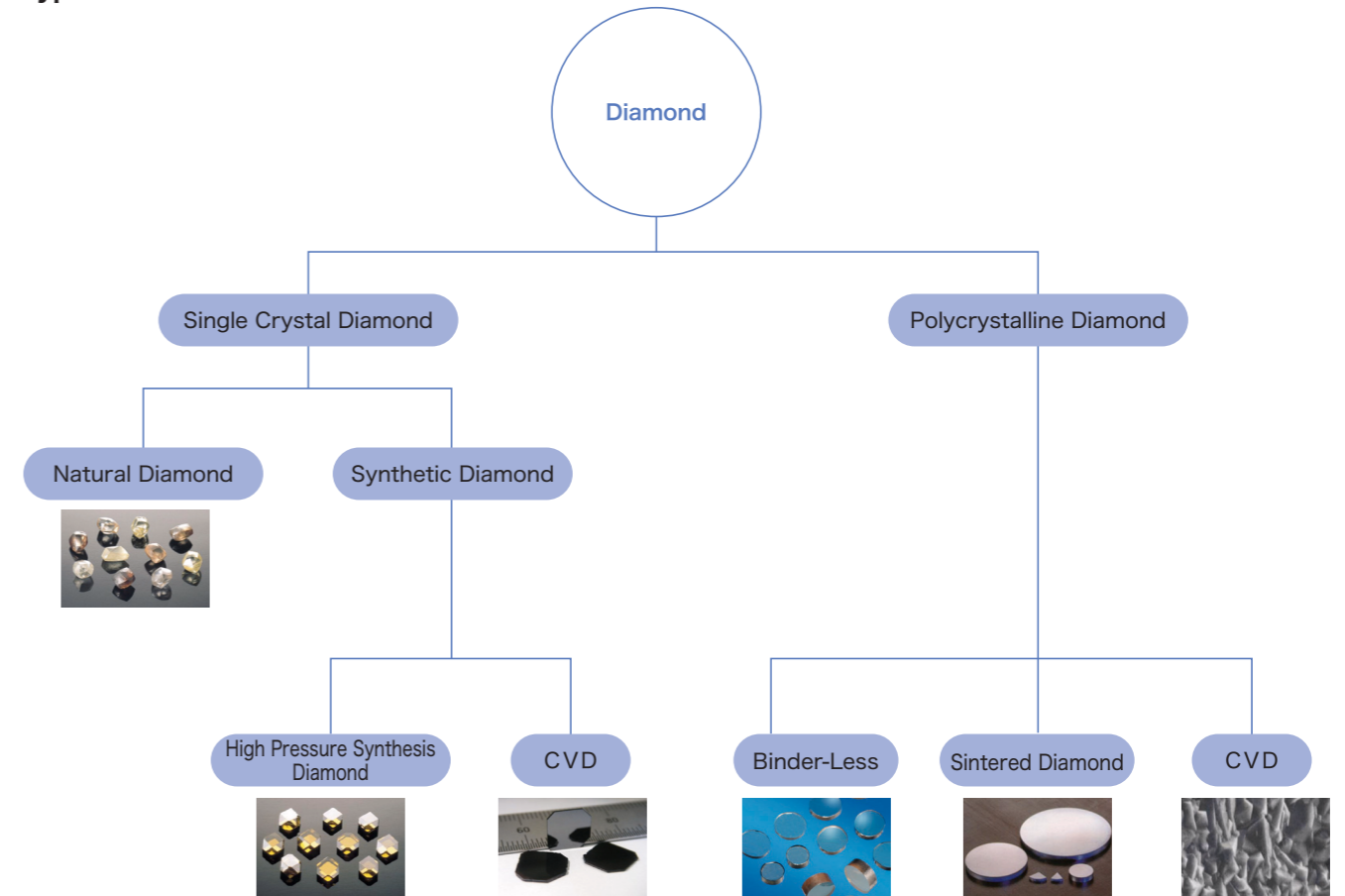
Broach

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.

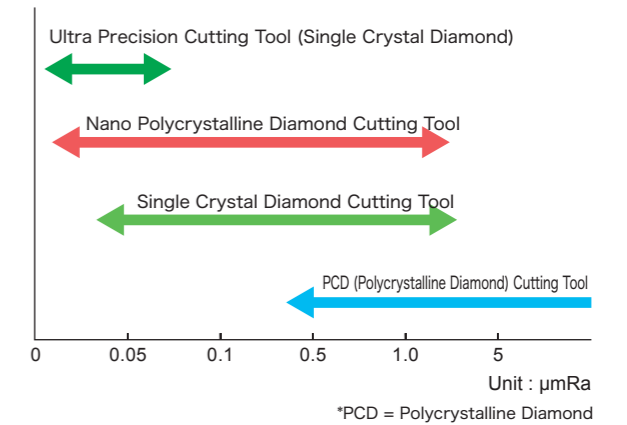
Types of Diamond



Comparison of Single Crystal Diamond and PCD

Material	Single Crystal Diamond	Sintered Diamond (PCD)
Structure and Crystal Image	 Larger Figures: Easier Polishing	 Diamond Grains (0.5 μm - 2 μm) Metallic Binder
Isotropy	Poor	Good
Hardness	70~130 GPa	50 GPa
Cutting Edge Sharpness		

Surface Roughness Comparison for Each 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	Very Good	Very Good	Very Good	Average	Poor
② Suitable Toughness	Poor	Average	Good	Good	Very Good
③ High Thermal Diffusibility	Very Good	Good	Very Good	Average	Average
④ Sharpness of Cutting Edge	Very Good	Poor	Good	Average	Good
⑤ Affinity with Ferrous Metals	Poor	Poor	Poor	Average	Average
⑥ Isotropy	Poor	Good	Good	Very Good	Very Good

## 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.

## Process Grouping

### RZ



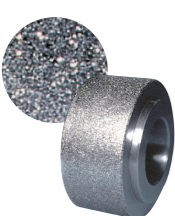
Our proprietary superior plating and machining technologies enable us to accommodate all kinds of complex and minute shapes. It is also ideal for machining requiring a long service life because it is a highly concentrated diamond type. Various options are also available.

### SZ



The diamond is regularly arranged so that the degree of concentration can be selected to suit your needs. Lapping is also performed on the surface of the diamond due to profile shaping, but since the amount of processing is kept to a small amount, the sharpness will not be impaired. Mainly suitable for large diameter size of plunge dressing.

### Z



This type can be made relatively easily and is suitable for small lot production and trial production.

### SX



The combination of diamond alignment patterns, precision powder metallurgy technology, and high-precision processing technology for diamond has earned a great reputation in the process field where the sharpness of grinding wheels is a priority. It is also effective for traverse and contouring dressing.

### X



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	SZ	Z	SX	X
Abrasive Grain Retention 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	●Various Prototypes	●Turbine Blades ●Camshafts	●Internal Grinding ●Centerless Grinding
Profile Accuracy	Very Good	Good	Good	Good	—
Surface Roughness	Very Good	Good	Good	Good	Average
Dressing Force	Good	Very Good	Good	Very Good	Very Good
Features	Highest Precision Fine Profile / Complex Profile	Large Diameter High Dressing Ability	Low-Cost Version and Quick Delivery Available	Any Concentration Settable / High Dressing Ability	Consistent Dressing Ability

## Outline of Production Processes for Rotary Dressers

### Electro-Deposition Method

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

### Electro-Plating Method

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

### Sintering Method

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

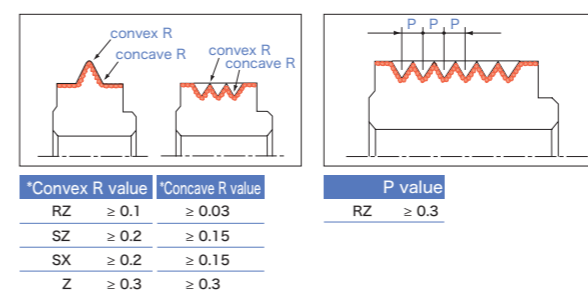
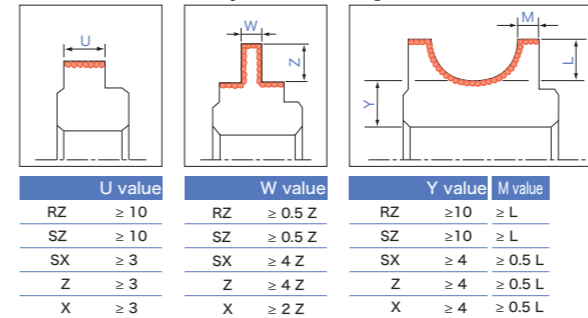
## Design / Inspection

### Possible Production Ranges

\*Ranges vary depending on profile or specification etc

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

### Tolerances of Rotary Dresser Designs



\*Value depending on diamond grain sizes

### Accuracy of Rotary Dressers

Other tolerances available upon request

Item	Factor	Symbol	Accuracy (mm)	Illustration
Profile	Runout	↗	0.005	
	Width	L	± 0.005	
	Radius	R	± 0.002	
	Step	S	± 0.001	
	Contour	∩	0.002	
	Angle	θ	± 2'	
	Straightness	—	0.002	
Body	Bore	φH	+ 0.005 - 0	
	Parallel	//	0.002	
	Perpendicularity	⊥	0.002	
	Runout	↗	0.002	

### Inspection of Rotary Dresser

For higher accuracy...

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

### Description of Inspection

#### Inspection with Transfer Test Pieces

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

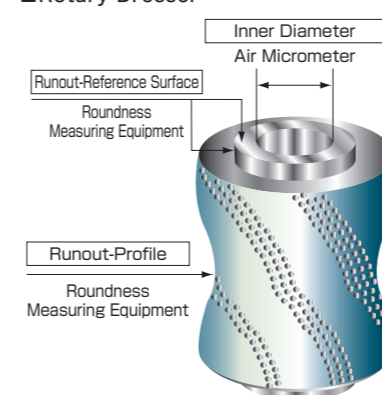
#### Body Accuracy

1. Bore (Air micrometer)
2. Parallelism, squareness (Roundness measuring equipment)
3. Reference surface (control φ) runout (Roundness measuring equipment)
4. Profile runout (Roundness measuring equipment)

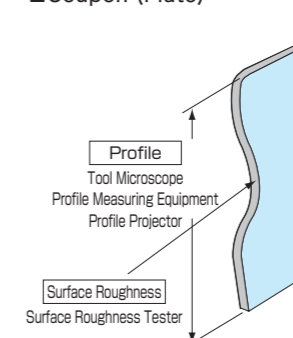
#### Slip Test Results

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

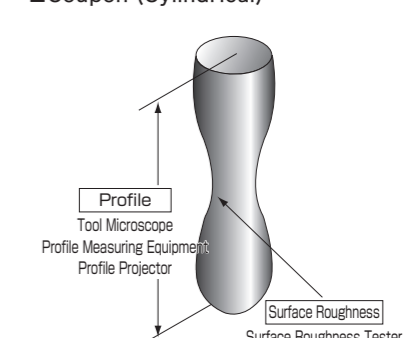
#### Rotary Dresser



#### 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	0.5~1 μm/rev.of Wheel	0.1~0.5 μm/rev.of Wheel	0.01~0.5 μm/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

### Peripheral Speed Ratio

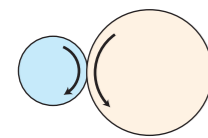
$$\text{Peripheral Speed Ratio} = \frac{V_r}{V_s}$$

$V_r$  (RD peripheral speed) = RD revolution (min<sup>-1</sup>) × RD O.D. × π

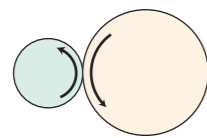
$V_s$  (grinding wheel peripheral speed) = grinding wheel revolution (min<sup>-1</sup>) × O.D. × π

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

#### Down Dressing



#### Up Dressing



### Feed Rate

#### 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

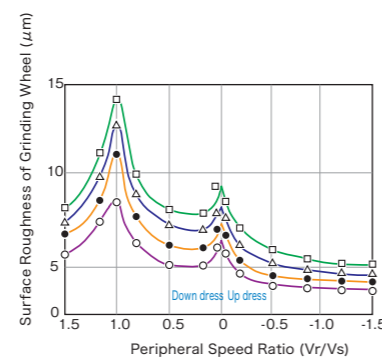
## Technical Data

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 ( $A_r$ ), and 3. Dress out ( $N_a$ ).

### 1. Peripheral Speed Ratio

#### ① Influence of Peripheral Speed Ratio on Grinding Wheel Surface Roughness

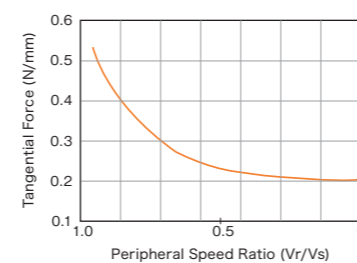
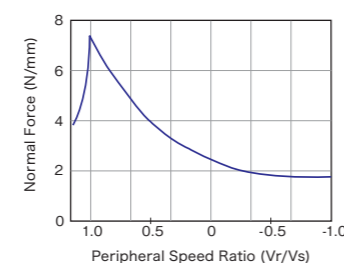
- Control of the grinding surface accuracy by up-dressing is easier than by down-dressing
- Higher feed rate creates more open grinding surface (grinding ability increases)



Test Condition	
Grinding Wheel	WA60K
Rotary Dresser	#20/30
Grinding Wheel Peripheral Speed	$V_s=29$ m/s
Dress Out	$N_a=0$
Infeed Per Rev.of Grinding wheel	
$A_r = 0.18$ μm/rev	○
$A_r = 0.36$ μm/rev	●
$A_r = 0.54$ μm/rev	△
$A_r = 0.72$ μm/rev	□

#### ② Influence of Peripheral Speed Ratio on Dressing Force

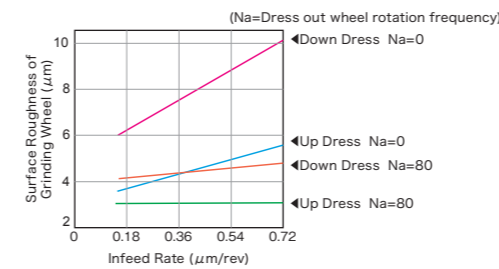
- Larger peripheral speed ratio allows higher normal force (increasing in grinding ability)
- Tangential force shows the same tendency as normal force, but the value is much smaller



### 2. Infeed Rate

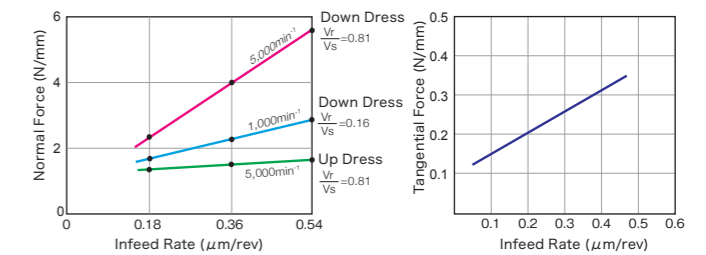
#### ① Influence of Infeed Rate of Grinding Wheel Surface Roughness

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



#### ② Influence of Infeed Rate on Dressing Force

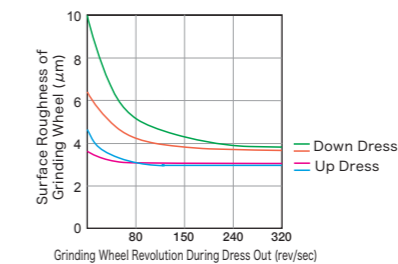
- Larger feed rate increases normal force. (Grinding ability increases)
- Tangential force shows the same tendency as normal force, but the value is much smaller.



### 3. Dress Out

#### Influences of Dress Out on Grinding Wheel surface Roughness

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



## Optional Specifications of Rotary Dressers

Various options available upon request

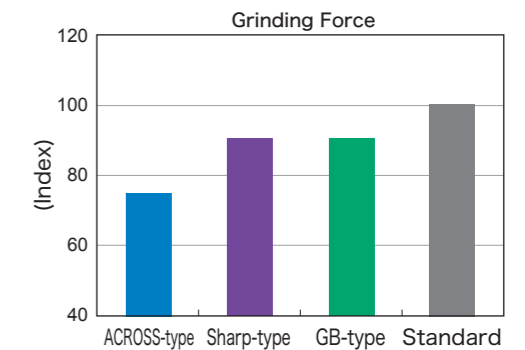
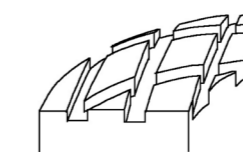
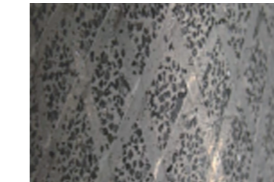
\*Availability depending on profile or specification

### Optional Specifications for RZ Type

#### 1. Improved Dressing Ability (for Fast Dressing)

- Sharp-type  
Improved sharpness by controlling the amount of protrusion of the diamond
- GB-type  
Reduced concentration for improved sharpness
- ACROSS-type  
Improved sharpness by lowering the concentration and increasing the dischargeability of chips and grinding fluid

#### ACROSS-type Surface and Profile



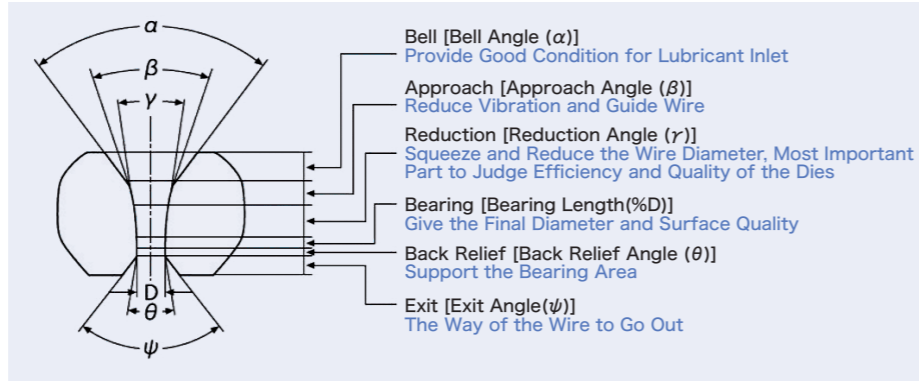
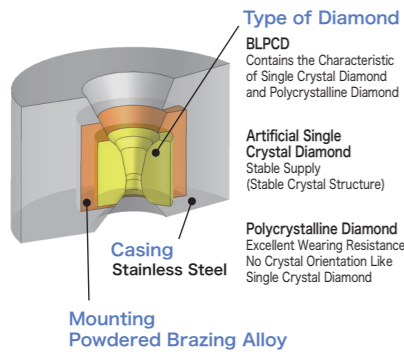
※Set the value of standard product to 100

## What is a Diamond Drawing Dies?

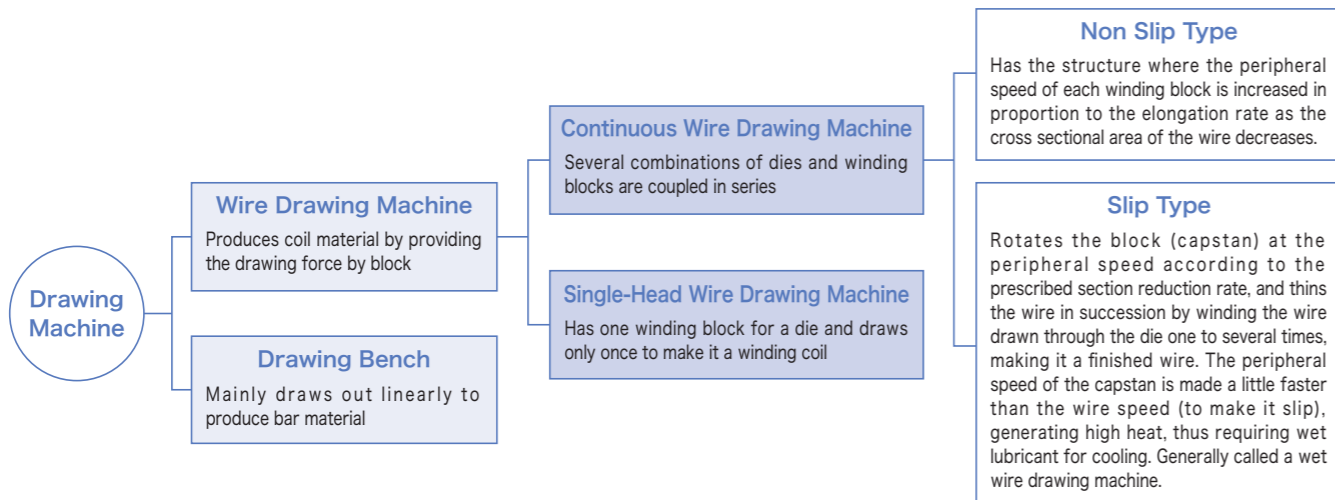
To make desired smaller wire diameter by a tool with conical hole is called "wire drawing " or "wire drawing process". The hole of the tool has different diameter each side, its entrance is wide and its exit is small - the tool is "die". "Diamond dies" has with diamond for superior precision and longevity.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

## Structure and Role of Diamond Drawing Dies

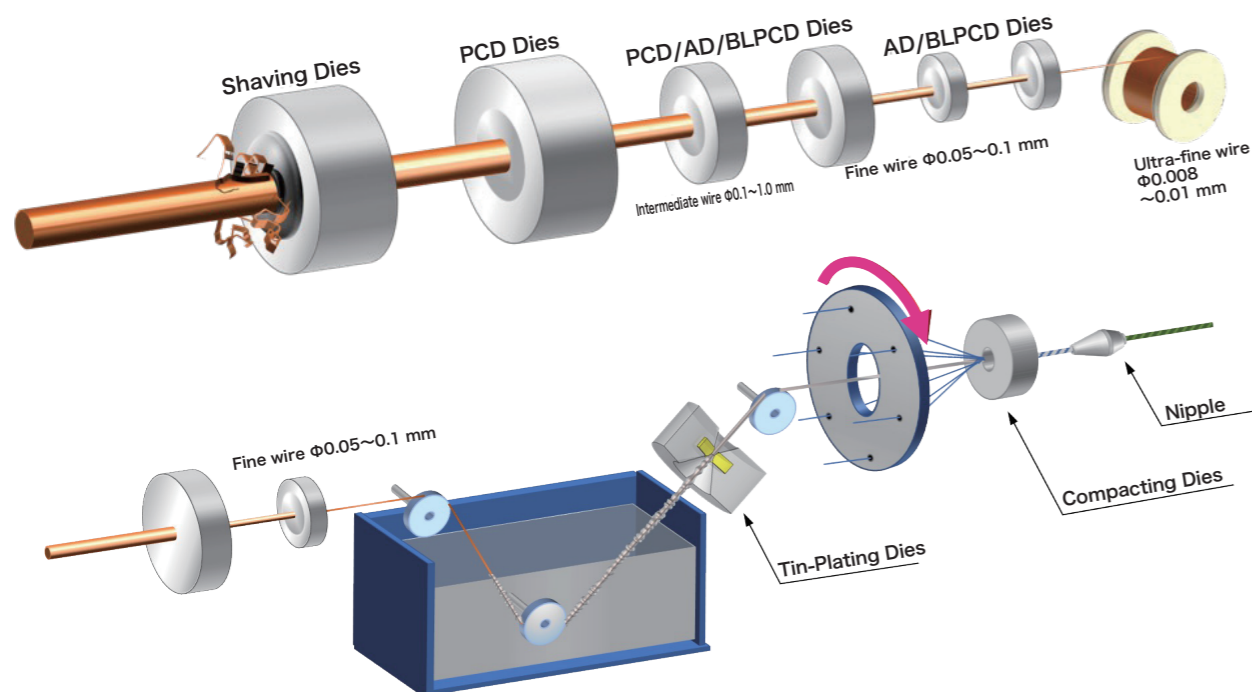
### Basic Case Shape



## Wire Drawing Machine Types



## Example of Wire Drawing Process (Electronic Cable)



## BLPCD Dies

Nano-polycrystalline material "BLPCD" in which diamond particles are directly bonded is used. High quality wire surface roughness can be obtained because it does not contain a binder. Especially suitable for use in the ultra-fine wire region.

## 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.

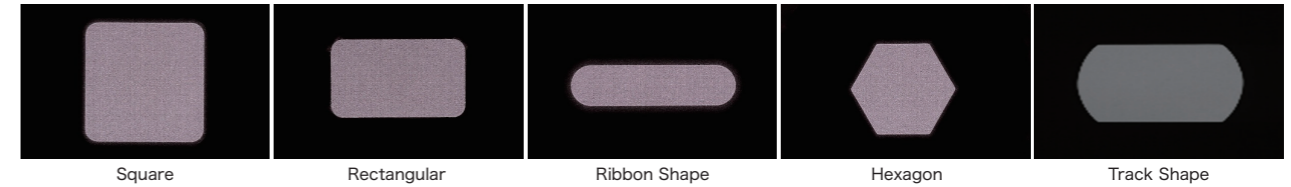
## Polycrystalline Diamond Dies

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.

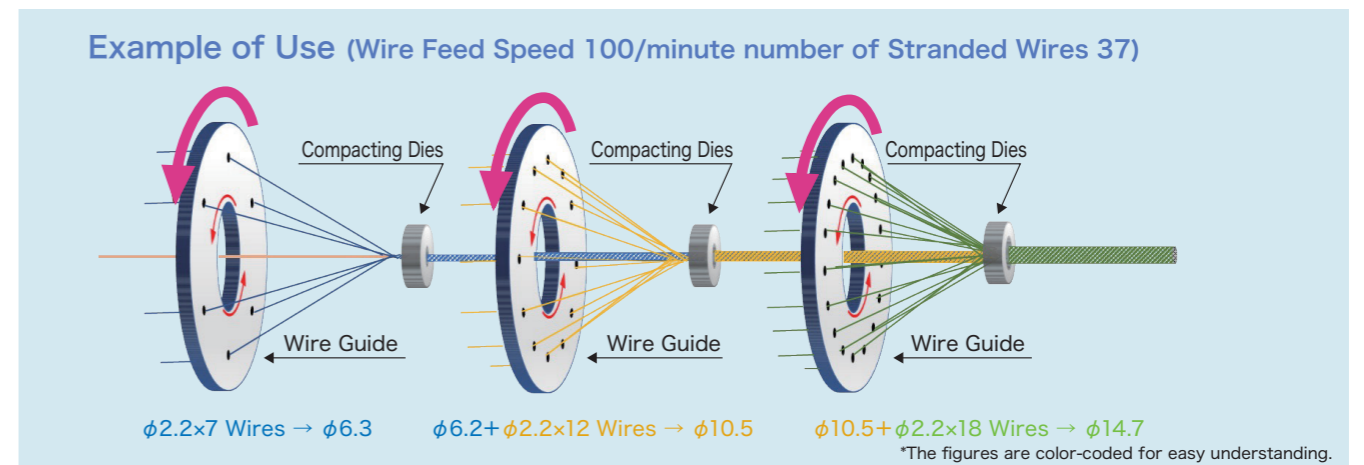
### Die Hole Status of Shaped Diamond Die (Zoom in)



## 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.

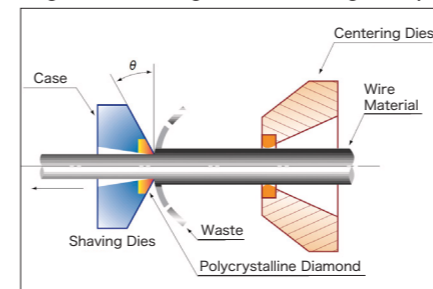
### Use Example of Compacting Dies



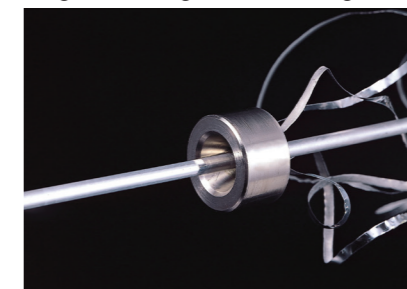
## Shaving Dies

A shaving die 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



# 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 misuse. The extent of danger and damage may be caused by misuse are categorized in 2 steps and stated below.



**Warning**

Misusage may cause death or serious injury



**Caution**

Misusage may cause slight injury or physical damage



Prohibited Matters



Precautions



Protective Equipments are Required

Protective Equipments are Required

## Safety Precautions of Diamond and CBN Wheels in Use

### 1. Work Environment / Work Clothes / Protective Equipment

#### Warning

- 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

#### Caution

- 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

#### Warning

- Turn off a switch when wheel is attached to spindle
- Attach wheel guard 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 diameter. Please instruct us if necessary
- Screw flange by equal 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

#### Warning

- 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

#### Warning

- 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

#### Caution

- 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

#### Warning

- 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

#### Caution

- Must wear dust-proof mask and ear plug
- Do not operate in the area of inflammable object because tool sparks in use
- Ventilate to remove mist coolant and dust
- Clean floor around machine

### 2. Before Use

#### Warning

- 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

#### Warning

- 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 tool 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 equal torque at the position of diagonal line
- Remove edge protection after attaching

### 4. Trial Run

#### Warning

- Check tool is firmly attached and operation of feed mechanism work correctly
- Check work material is firmly attached and operation of feed mechanism work correctly. Tool or work material breakage may occur injury
- Check rotation direction of tool. It may occur injury if it is not correct
- Check irregular sound or vibration by no-load operation around 1-3 mins

### 5. Cutting Operation

#### Warning

- Do not touch tool when rotating to remove risk of serious injury
- Make completed stop when irregular sound or vibration occurred to remove risk of injury
- Cutting operation needs to be processed after reaching allowable rotation
- Turn off a switch of main spindle after completion of cutting process
- Do not touch or put object to stop rotating tool
- Turn off a switch when tool is taken out from main spindle

#### Caution

- Confirm feed, D.O.C. and cycle time by trial run
- Be careful of overload
- Check burning or chatter mark on work material

#### Important notice

- Please consult us in case cutting condition or tool specification is not correctly chosen

### 6. Storage and Handling

#### Warning

- Attach edge protection. Touching directly to cutting edge may occur injury
- Impact to tool may occur crack or breakage etc.

#### Caution

- Check irregular wear, breakage, crack, peeling etc. on working face
- Store dry area and prevent drop-off and crash after anti-corrosion treatment and edge protection etc.
- Do not operate to change tool shape. Please instruct us if necessary

## Safety Precautions of PCD Reamer and Endmill

#### Warning

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

## Head Office (Tokyo Office)

Sumitomo Fudosan Shiodome Hamarikyu Building,  
8-21-1, Ginza, Chuo-ku, Tokyo, 104-0061 Japan

Phone: +81-3-6733-3617 Fax: +81-3-6733-3621

### Domestic production network

(Diamond / CBN Tools)

#### Harima Works

(Grinding Wheel, Cutting Tool, Rotary Dresser)  
(Customer Solution Center)  
1816-174, Kotaka, Kato-city, Hyogo 679-0221 Japan  
Phone: +81-795-48-5067 Fax: +81-795-48-5071

#### Awaji Plant (Diamond Drawing Dies, Wear-Resistance Products)

628, Yura, Yura-cho, Sumoto-city, Hyogo 656-2543 Japan  
Phone: +81-799-27-0317 Fax: +81-799-27-2485

### Domestic production network

(Powder & Hardmetal, Tungsten/Molybdenum production, Heatspreader)

#### Sakata Works

(Heatspreader, Tungsten / Molybdenum Products)

#### Toyama Works

(Powdery Products, Cemented Carbide Tools, Tungsten /  
Molybdenum Wires, Rods, Sheets / Plates)

### Global Network (Diamond Tool)

#### <North America>

Sumitomo Electric Carbide, Inc. (Chicago)  
..... (Sales of Diamond Tools)  
1001. Business Center Drive, Mt. Prospect, IL 60056-2181, U.S.A.  
Phone: +1-847-635-0044 Fax: +1-847-635-9335

#### Sumitomo Electric Carbide, Inc. (Detroit)

..... (Sales of Diamond Tools)  
26800 Meadowbrook Road, Suite 120 Novi, MI 48377, U.S.A.  
Phone: +1-734-451-0200 Fax: +1-734-451-5338

#### <Central America>

Sumitomo Electric Hardmetal de Mexico, S.A. de C.V. (Mexico)  
..... (Sales of Diamond Tools)  
Av. Eugenio Garza Sada, #42 - Los Pocitos Aguascalientes, AGS,  
20328, Mexico  
Phone: +52-449-993-2740 +52-449-993-2741

#### <Asia>

A.L.M.T. Diamond Dies (SUZHOU) Co., Ltd. (Suzhou, China)  
..... (Manufacture and Sales of Diamond Drawing Dies)  
Unit 24E, 25D, 25E of Suchun Industrial Square, #428 Xinglong Street  
Suzhou Industrial Park, Jiangsu, P.R. 215024, China  
Phone: +86-512-62836195 Fax: +86-512-62836176

#### Sumitomo Electric Hardmetal Trading (Shanghai) Co., Ltd.

..... (Sales of Diamond Tools)  
Room J, 6/F Huamin Empire Plaza, No.728 Yan An Road(W),  
Shanghai, 200050, China  
Phone: +86-21-6212-9271 Fax: +86-21-6212-9272

#### Sumitomo Electric Hardmetal Trading (Shanghai) Co., Ltd. (Guangzhou)

..... (Sales of Diamond Tools)  
Room 21, A22F, China Shine Plaza, No.3-15 Lin He Xi Road,  
Tian He District, Guangzhou, 510610, China  
Phone: +86-20-3881-5582 Fax: +86-20-3891-0904

### Global Network (Tungsten/Molybdenum, Heatspreader products)

#### <North America>

Sumitomo Electric U.S.A., Inc. (Los Angeles)  
..... (Sales of Tungsten, Molybdenum, Heatspreader Products)  
21241 South Western Avenue, Suite 120 Torrance, CA 90501, U.S.A.  
Phone: +1-310-782-0227 Fax: +1-310-782-0211

#### <Europe>

##### SEI Interconnect Products (Europe) Ltd. (Germany)

..... (Sales of Heatspreader Products)  
Oststrasse 89, D-22844, Norderstedt, Germany  
Phone: +49-40-5265-0160 Fax: +49-40-5265-0169

#### <Asia>

Chengdu Lianhong Molybdenum Co., Ltd. (Chengdu, China)  
..... (Manufacture and Sales of Molybdenum Products)  
No.198, Nanjing Road, Chengdu Economic & Technological  
Development Zone, Longquanyi District, Chengdu, 610100, China  
Phone: +86-28-88432450 Fax: +86-28-88432456

### Domestic Sales Network

#### Tohoku Office

#### Kita-kanto Office

#### Tokyo Office

#### Mikawa-anjo Office

#### Hamamatsu Office

#### Osaka Office

#### Hiroshima Office

#### Kyushu Office

#### Sumitomo Electric Hardmetal Taiwan Co., Ltd.

..... (Sales of Diamond Tools)  
13F, No.156, Section 1, Zhongshan Rd., Banqiao District, New Taipei City,  
22065, Taiwan  
Phone: +886-2-29596721 Fax: +886-2-29596720

#### A.L.M.T. Asia Pacific Pte. Ltd. (Singapore)

..... (Sales of Diamond Tools and Diamond Drawing Dies)  
No.2 Boon Leat Terrace #03-02 Harbourside 2  
Singapore 119844  
Phone: +65-6271-9252 Fax: +65-6274-2915

#### A.L.M.T. Asia Pacific Pte. Ltd. (Malaysia)

..... (Sales of Diamond Tools and Diamond Drawing Dies)  
8F-1A, Tower 4 @PFCC Jalan Puteri 1/2, Bandar Putei 47100,  
Puchong, Selangor, Malaysia  
Phone: +60-3-8069-1090~91 Fax: +60-3-8069-1094

#### A.L.M.T. (Thailand) Co., Ltd. (Wellgrow, Thailand)

..... (Manufacture of Diamond Tools)  
90/2 Moo 9 Wellgrow Industrial Estate Bangna-trad Road.,  
T.Bangwua A.Bangpakong Chachoengsao 24180, Thailand  
Phone: +66-38-522291~5 Fax: +66-38-522290

#### A.L.M.T. (Thailand) Co., Ltd. (Korat, Thailand)

..... (Manufacture of Diamond Drawing Dies)  
Mooban Bannaklang 567 Moo 1 T.Naklang A.Songnuen  
Nakhonratchasima 30380, Thailand  
Phone: +66-44-335190 Fax: +66-44-335300

#### A.L.M.T. (Thailand) Co., Ltd. (Bangkok, Thailand)

..... (Sales of Diamond Tools and Diamond Drawing Dies)  
54 B.B Building 15th Floor Room 1511 Sukhumvit 21 (Asoke), North  
Klongtoey Wattana, Bangkok 10110, Thailand  
Phone: +66-2-2612231~2 Fax: +66-2-2612230

#### A.L.M.T. Diamond Dies (SUZHOU) Co., Ltd. (Suzhou, China)

..... (Manufacture and Sales of Cemented Carbide Cutting Blade and Thin Sheets)  
Unit 24E, 25D, 25E of Suchun Industrial Square, #428 Xinglong Street  
Suzhou Industrial Park, Jiangsu, P.R. 215024, China  
Phone: +86-512-62836195 Fax: +86-512-62836176

#### A.L.M.T. (Thailand) Co., Ltd. (Wellgrow, Thailand)

..... (Manufacture of Heatspreader Products)  
90/2 Moo 9 Wellgrow Industrial Estate Bangna-trad Road.,  
T.Bangwua A.Bangpakong Chachoengsao 24180, Thailand  
Phone: +66-38-522291~5 Fax: +66-38-522290

#### Sumitomo Electric Trading (Shenzhen) Co., Ltd. (Beijing, China)

..... (Sales of Heatspreader Products)  
Room 1910, 19F, Beijing Fortune Building, No.5 DongSanHuanBei  
Road, ChaoYang District, Beijing, 100004, China  
Phone: +86-10-6590-8196 Fax: +86-10-6590-8195

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