A.L.M.T. AL

Diamond Cutting Tools AL1 to AL14

A.L.M.T. Diamond Cutting Tools

A.L.M.T. corp

Nano/Micro-forming Tools

Ultra-Precision Cutting Tool UPC®

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

Our many years of experience and extensive knowledge give us a comprehensive understanding of the optimal physical properties of single-crystal diamond.

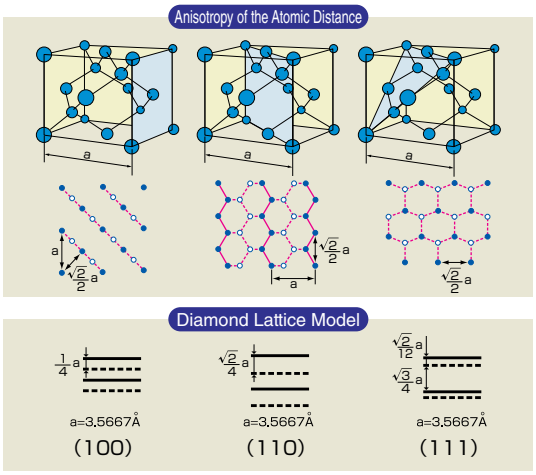
Our state-of-the-art development process yields the highest precision in tool edge measurement. As a result, our diamond cutting tools achieve high-precision microscopic cutting of workpieces in the order of nanometers.

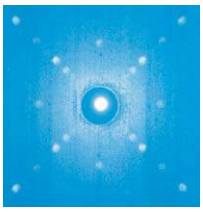
Identification and Measurement Technology

Identify the anisotropy of atoms in single-crystal diamond and pursue the best crystal orientation

Creation of tools pursuing cutting edge sharpness in the order of nanometers starts with the screening and selection of single-crystal diamond.

The lattice constant of diamond is always 3.5667 Å, but the distance between crystal faces varies, causing differences in the ease of cleavage and intrusion of impurities.Therefore, sorting of rough diamonds is important in addition to the identification of crystal orientation according to the machining conditions.





X-Ray Photograph of Single-crystal Diamond

Polishing and Measurement Technologies

Cutting edge polishing technology that produces nanometer-controlled movement

In order to accurately produce nanometer-controlled movement on a workpiece, a cutting tool requires a sharp cutting edge capable of producing nanometer-sized chips and high profile precision.

We have achieved this using our unique polishing and measurement technologies.

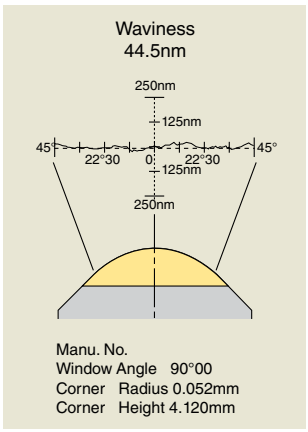
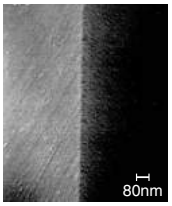
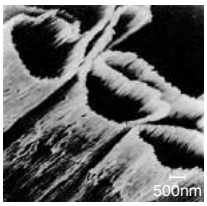


Chart of inspection using our originally-developed profile meter

SEM Photograph of UPC-R



Sharply-polished single-crystal diamond cutting edge



Nanometer-sized chips

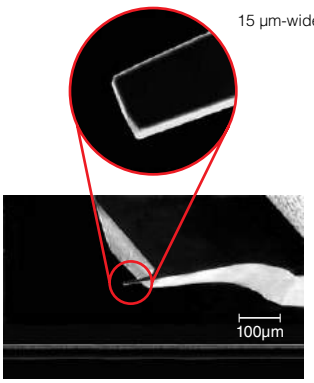
Nano/Micro Processing Technology

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

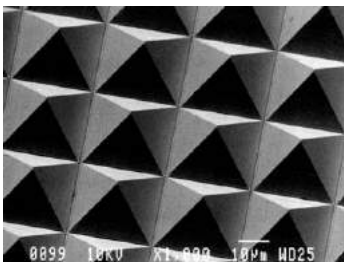
With its cutting edge sharpness in the order of nanometers, A.L.M.T.'s UPC-Nano series achieves a surface roughness and straightness that cannot be obtained by the photolithography or ion-beam method.

This technology is also effective for micrometer-order processing of high aspect ratio.

15 μm-wide Nano endmill tip



Size comparison at the same magnification
Nano endmill (15 μm wide) and a hair (ø50 μm)



Mold surface processed in the order of micrometers

Ultra-fine Grooving Type

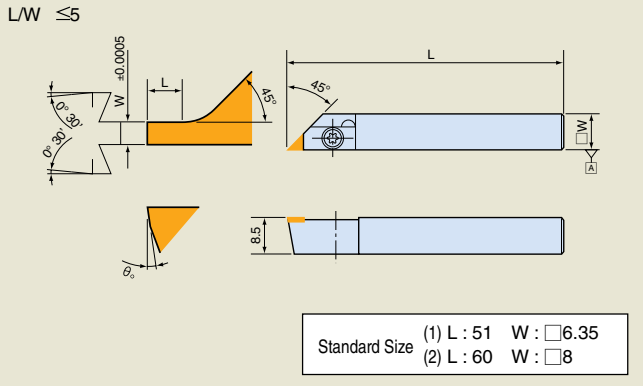
UPC®-Nano groove®

Characteristics

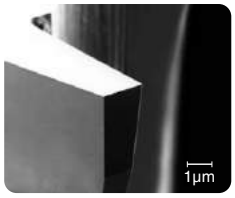
1. The world's smallest grooving tool with a cutting edge width of 0.9 µm
2. Provides the world's highest dimensional accuracy of ±0.5 µm
3. High-precision-polished durable cutting edge
4. Enables high-precision fine grooving that cannot be achieved using the photolithography or ion-beam method

Application

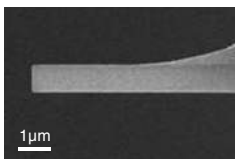
1. Hologram diffraction grating molds
2. Fine linear grooving
3. Molds with fine grooves
4. Optical sheet molds

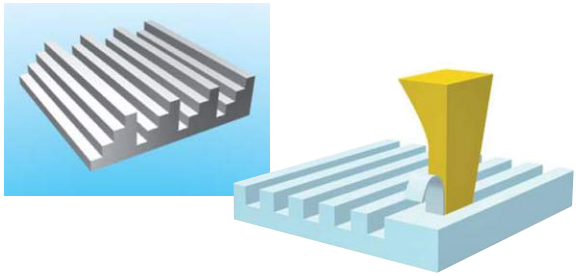


Standard Size		
(1) L : 51	W : □6.35
(2) L : 60	W : □8



900-nm Wide Cutting Edge





Endmill (Square Type)

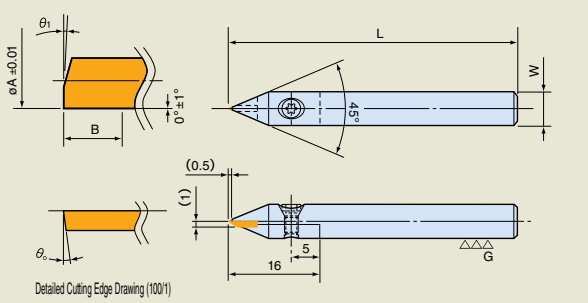
UPC-Nano endmill®

Characteristics

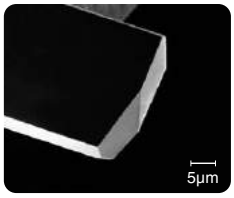
1. Enables the world's thinnest-in-its-class 30-µm wide flexible grooving
2. Enables machining with a high aspect ratio of 2.5 times the rotation diameter
3. High-precision-polished durable cutting edge
4. Enables high-precision fine grooving that cannot be achieved using the photolithography or ion-beam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

Application

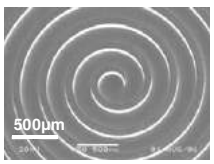
1. Hologram grating
2. Fine free curve grooving
3. LCD light guide plate molds
4. Micro machine parts grooving

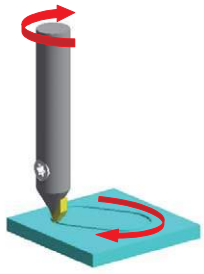


Standard Size		
(1) L : 50	W : ø6
(2) L : 30	W : ø4



Example of Grooving Using a Nano Endmill

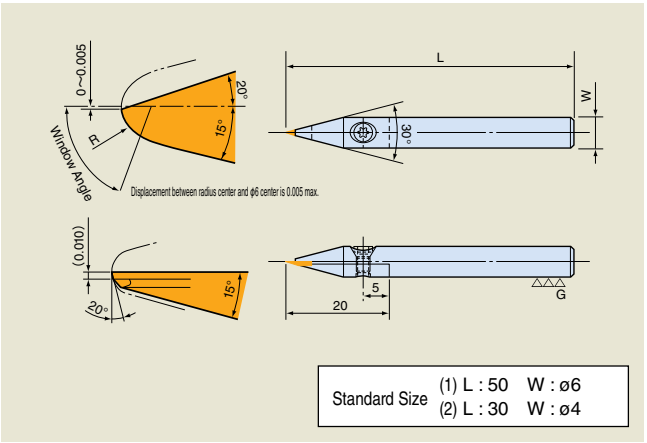


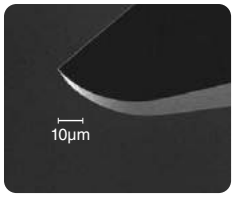


Endmill (Ballnose Type)
UPC-Nano ballendmill®

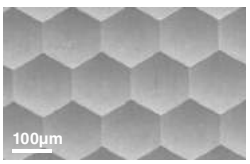
Characteristics
1. The world's smallest-in-its-class ballendmill with R=30 µm
2. Provides the world's highest profile of 50 nm
3. Enables high-precision 3-D machining with its extremely sharp cutting edge

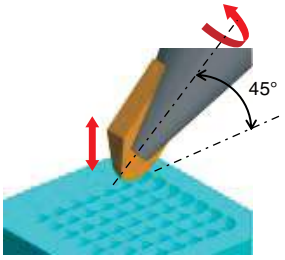
Application
1. Micro lens array
2. Free-form submillimeter lens
3. LCD light guide plate molds
4. Micro machine parts grooving





Example of Grooving Using a Nano Ballnose Endmill

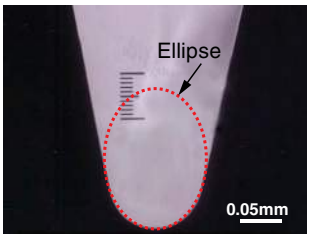




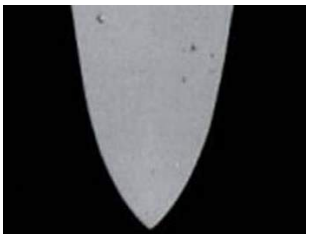
Formed Type
UPC®-Nano Profile®

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

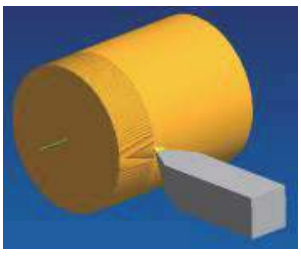
Application
1. Optical sheet molds for LCD panels
2. Micro lens array molds
3. Various optical element molds

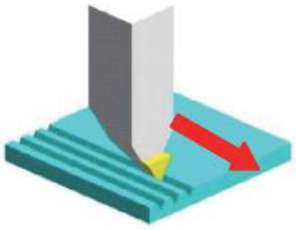


Elliptical Cutting Edge

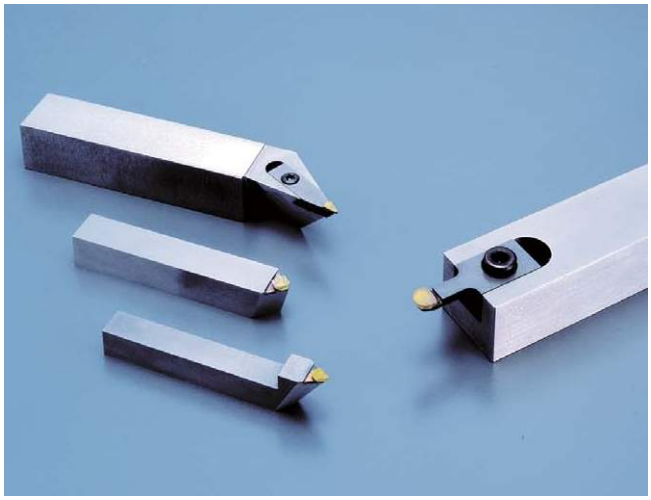


Parabolic Cutting Edge





UPC®-R



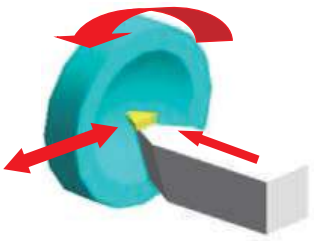
UPC®-R exhibits outstanding performance in ultra-precision spherical and aspherical cutting

Characteristics

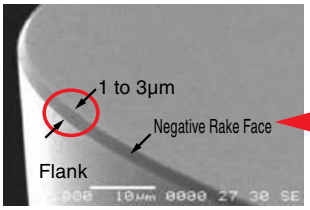
1. Achieves an edge arc profile of 50 nm (0.05 µm) over a wide working angle range of 90°.
2. The cutting edge is uniformly finished in high quality, achieving a surface roughness in the order of nanometers.
3. A record of the edge arc profile measured with our originally-developed measuring instrument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

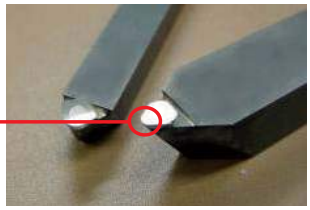
Application

1. Camera lens molds for CD, DVD, and BD players
2. Lens molds for digital cameras
3. Camera lens molds for smartphones, PCs, and tablets
4. Infrared lens
5. Spherical and aspherical mirrors for lasers and X-rays
6. Various spherical and aspherical lenses
7. Profile processing using a ultra-precision processing machine

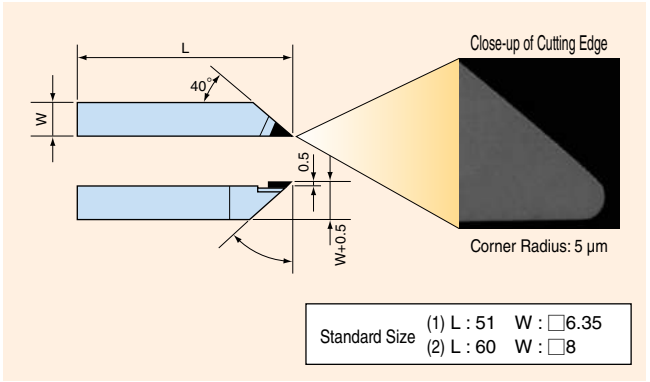


UPC® Cutting Edge for Infrared (IR) Lenses and Carbide Molds

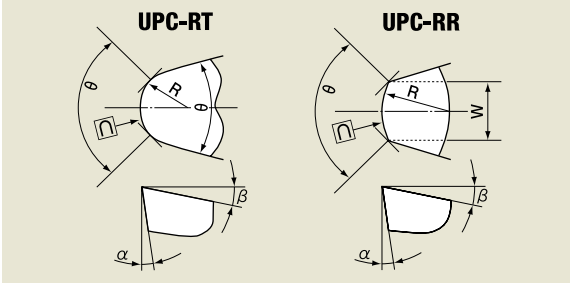




Uniform Negative Rake Face of Cutting Edge (Patented)



□Cutting Edge



□ Dimension and Highest Accuracy

Cat. No.		Profile ∩ θ≤90°	Profile ∩ θ≤120°	Profile ∩ θ≤150°	Corner Radius R	Cutting Edge Angle θ	Grooving Width W (RR)	Relief Angle α	Rake Angle β
UPC-R	Very High Precision SS	0.05µm	0.1µm	-0.20µm	0.002 to 200	15° min.	0.5 to 5	0° to 20°	-30° to 10°
	High Precision S	0.25µm	0.5µm	1µm					

UPC®-F

Exhibits its potential in high-efficiency ultra-precision cutting into plane and cylindrical shapes

Characteristics

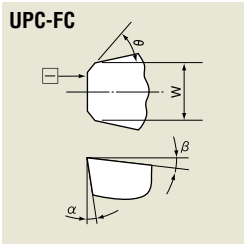
1. Drastically reduces or dispenses with running-in processing time.
2. You can obtain uniform, high-quality worked surfaces by setting the roundness (sharpness) of the cutting edge according to the work material and processing conditions.

Application

1. Laser reflective mirrors
2. Polygon mirrors
3. Photosensitive drums of copying machines
4. Plane and cylindrical mirror finishing

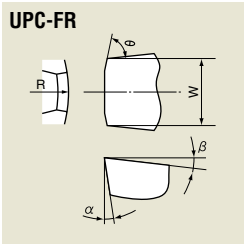
Cutting Edge

UPC-FC



Exclusive Edge for Polygon Mirrors

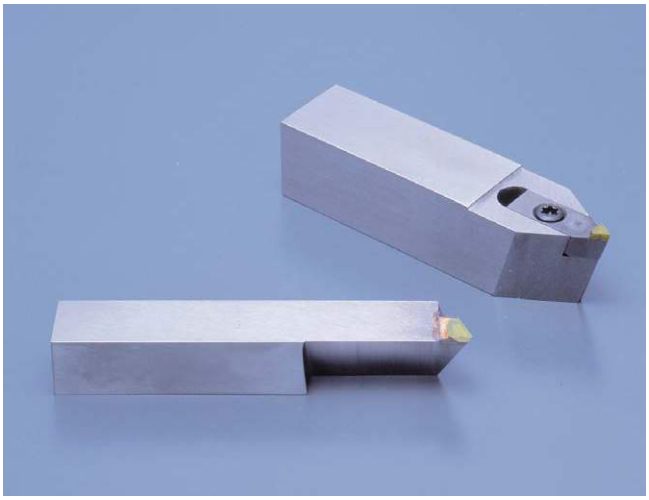
UPC-FR



Dimension and Highest Accuracy

Cat. No.	Cutting Edge Angle β	Grooving Width W	Relief Angle α	Rake Angle β	Lateral Rake Angle γ	Rake Face R
UPC-FC	45° to 80°	1.0 to 4.0	0° to 5°	-5° to 0°	0° to 15°	—
UPC-FR	10° to 45°	2.0 to 4.0	2° to 5°	0°	0°	30 to 40mm

UPC®-T



Ideal for fine grooving such as that for Fresnel lenses

Characteristics

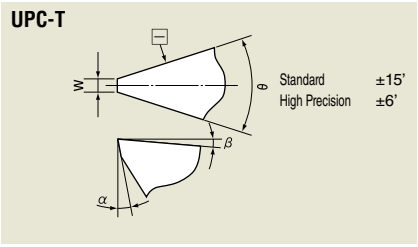
1. The cutting edge is uniform and extremely sharp, free from chipping and undulation.
2. Guarantees the cutting edge shape in the order of submicrons.

Application

1. LCD light guide plate molds
2. Fresnel lens molds
3. Optical sheet molds
4. Various diffraction grating molds
5. Other fine grooving

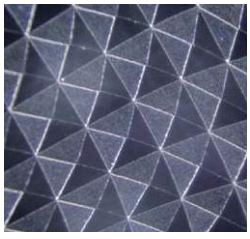
Cutting Edge

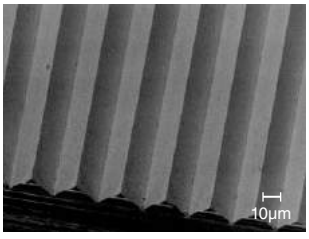
UPC-T



Dimension and Highest Accuracy

Cat. No.		Cutting Edge Angle β	Angular Tolerance	Tip Width W	Relief Angle α	Rake Angle β
UPC-T	Very High Precision SS	Less than 45°	±6'	0.2 μm min.	0° to 15°	-5° to 10°
	High Precision S	45° min.	±15'	Pin Angle		



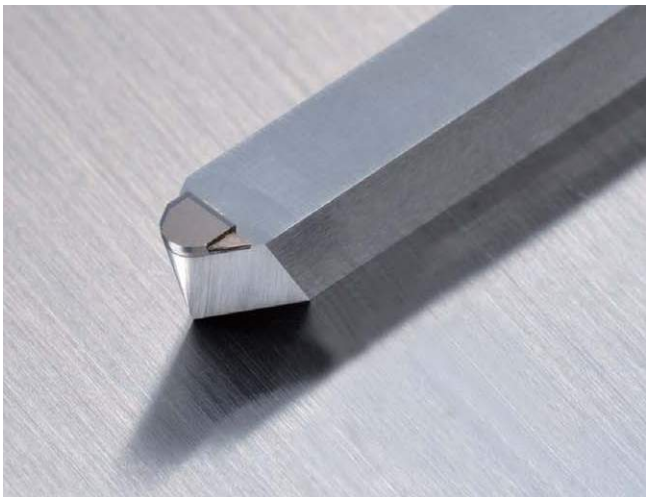


LCD Light Guide Plate Molds

Ultra Precision Cutting Tools
BL-UPC
Binderless Ultra Precision Cutting Tools

SUMIDIA® Binderless (Nano-polycrystalline Diamond)

Ultra-Precision Cutting Tool BL-UPC®



Employs SUMIDIA® Binderless on the edge of UPC®

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

Features of SUMIDIA® Binderless

- Fine grains of several tens of nanometers are firmly and directly bonded together without the use of binder.
- Harder than single-crystal diamond.
- No anisotropy and specific cleavage.

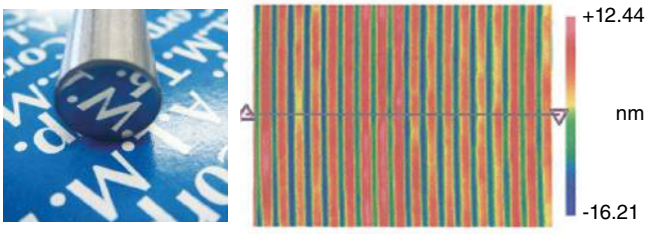
Features of BL-UPC®

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

Application

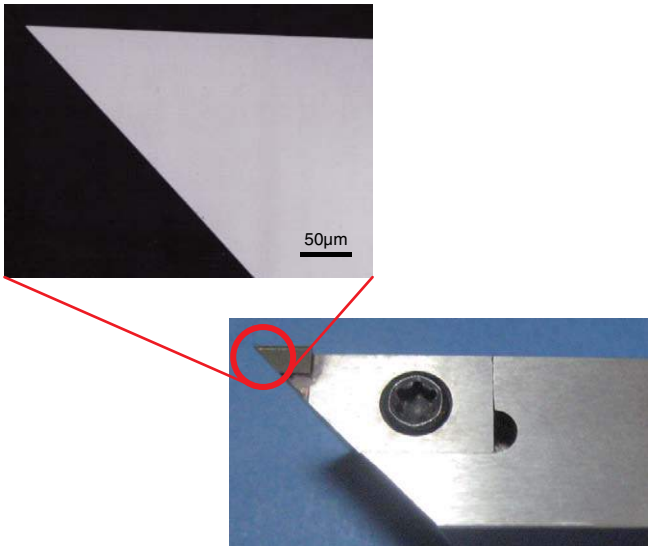
- Molds for carbide glass lenses
- Large molds for prism sheets and light guide plates
- Glass lenses
- Machining of other high-hardness and brittle materials

Surface Roughness of Machined Carbide

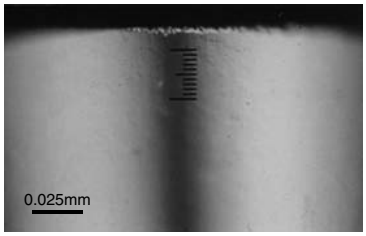


Finished Surface Roughness Ra 5.4 nm

Sharp Cutting Edge Equivalent to Single-Crystal Diamond

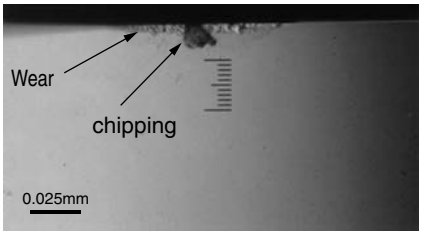


Flank Wear Comparison of Machined Carbide



BL-UPC®

No Large Chipping Found



UPC®(Single-crystal Diamond)

Large Chipping Found

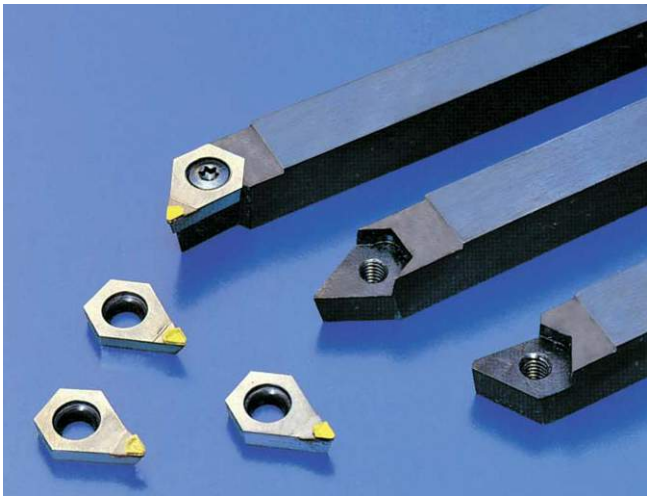
Comparison of Required Characteristics for Cutting Tool Materials

Required Characteristics	Diamond		
	Single Crystal	Polycrystalline	Nano-polycrystalline
(1) High Hardness	◎	◎	◎
(2) High Temperature Hardness	○	○	◎
(3) Suitable Toughness	×	△	○
(4) High Thermal Diffusibility	◎	○	◎
(5) Sharpness of Cutting Edge	◎	×	○

New D Tools

Mono crystal Diamond Cutting Tools

New D Tools® New D



New D Tools® **NewD**

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

Characteristics

(1)Less variation 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.

(2)The combination of our originally-designed inserts and holders enables easy and precise tool setting like indexable inserts.

(3)There are inserts for straight cutting and those for curved-surface copying. The form accuracy of the latter is 5 μm.

(4)The rake face is free from adhesions and accumulation of chips and maintains the high quality of worked surfaces even during continuous use.

(5)The diamond is firmly attached by a unique brazing method.

(6)Exhibits high durability even during interrupted cutting.

(7)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.

Application

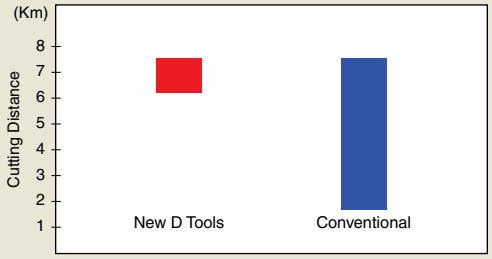
- Automotive components (pistons, aluminum wheels, compressors, commutators, etc.)
- Plastic lenses, resin parts
- HDD parts
- Aluminum die cast alloys, other non-ferrous metals

Performance of New D Tools

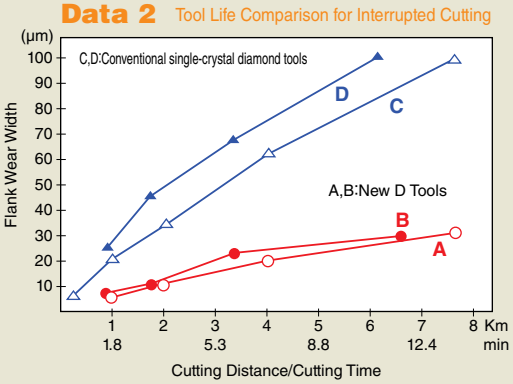
● Conditions (Data 1, 2)

Cutting Speed	565m/min	Feed Rate	0.2mm/rev
Depth of Cut	0.12mm	Coolant	Alcohol oil mist
Work Material	High-silicon aluminum alloy (Si:18%)		

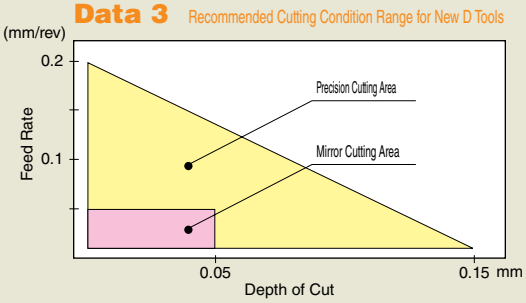
Data 1 Tool Life and Stability Comparisons (Interrupted Cutting)
(Cutting Distance When the Flank Wear Width is 30 μm)



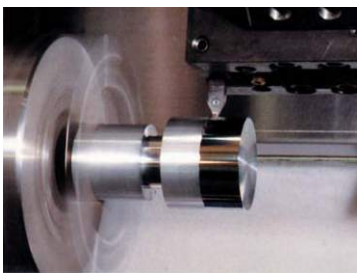
Data 2 Tool Life Comparison for Interrupted Cutting

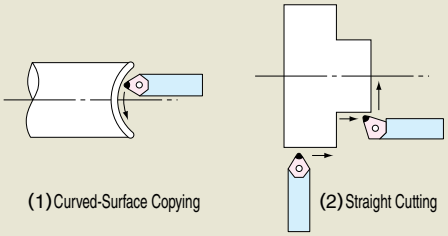


Data 3 Recommended Cutting Condition Range for New D Tools



● Example of Cutting





New D Tools

Mono crystal Diamond Cutting Tools

☐ Insert Cat. No. (Standard stocked item)

Insert Specification	Cat. No. Long-Life Type	Cat. No. *1 High-Precision Type	Corner Radius R	Relief Angle θ	Inscribed Circle ØA (mm)	Hole ØB (mm)	Center Height h (mm)	Applicable Holders
Upon Ordering Insert Cat. No. For NWD-C L 3 02 Corner radius of R0.2 Point angle of 55°(Inscribed circle of ø9.525 Long-life type ("P" for high-precision type) Relief angle of 7°	NWD-CL302	NWD-CP302	R0.2	7°	ø9.525	ø4.4	+0.2 4−0	NDH-R1☐ -L1☐ -N1☐ NDH-QR1☐ -QL1☐
	NWD-CL305	NWD-CP305	R0.5					
	NWD-CL308	NWD-CP308	R0.8					
	NWD-CL310	-	R1.0					
	NWD-CL316	-	R1.6					
	NWD-CL320	-	R2.0					
	NWD-PL302	NWD-PP302	R0.2	11°				
	NWD-PL305	NWD-PP305	R0.5					
	NWD-PL308	NWD-PP308	R0.8					
	NWD-PL202	NWD-PP202	R0.2		ø6.35	ø2.8	+0.2 3−0	NDH-RO☐ -LO☐ -NO☐
	NWD-PL205	NWD-PP205	R0.5					
	NWD-PL208	NWD-PP208	R0.8					
		*2 For Aluminum Wheels						NDH-R20V -L20V -R25V -L25V
	NWD-CL416	NWD-CL416-AW	R1.6	7°	ø9.525	ø4.4	+0.2 5.5−0	
	NWD-CL420	NWD-CL420-AW	R2.0					
	NWD-CL425	NWD-CL425-AW	R2.5					

*1 : High-precision type: cutting edge profile accuracy of 5 μm or less.
*2 : With edge treatment for aluminum wheels

☐ Holder Cat. No. (Standard stocked item)

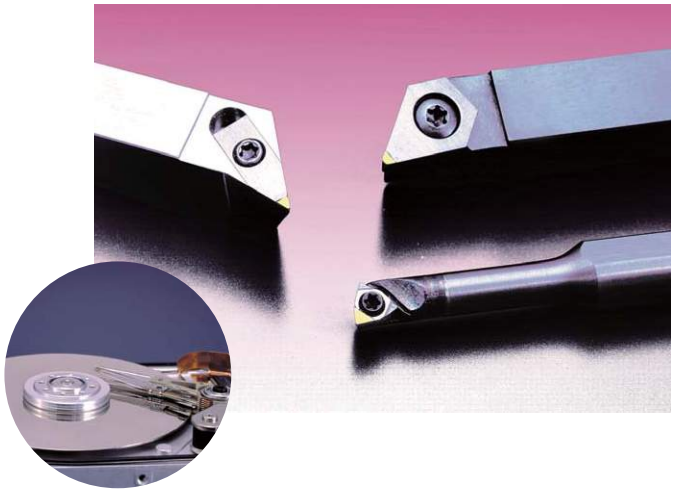
Holder Specification	Right Hand	Left Hand	W	L	S	h	Applicable Holders
	NDH-R06	NDH-L06	6	50	6.5	6	NWD-PP2☐☐
	NDH-R08	NDH-L08	8	60	8.5	8	-PL2☐☐
	NDH-R10	NDH-L10	10	80	10	10	NWD-CL3☐☐
	NDH-R12	NDH-L12	12	100	12	12	-PL3☐☐
	NDH-R16	NDH-L16	16	125	16	16	-CP3☐☐
	NDH-QR10	NDH-QL10	10	80	13	10	-PP3☐☐
	NDH-QR12	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
	Neutral						
	NDH-N06		6	50	-	6	NWD-PP2☐☐
	NDH-N08		8	60	-	8	-PL2☐☐
	NDH-N10		10	80	-	10	NWD-CL3☐☐ -PL3☐☐ -CP3☐☐ -PP3☐☐
	NDH-N12		12	100	-	12	
	NDH-N16		16	125	-	16	

Holder Cat. No. Upon Ordering
For NDH-R 06 ☐6
Right hand ("L" for left hand)

Please contact us for specifications not stated above.

New D e-EDGE

Patent Registered



Environmental protection by dry cutting etc. is an important issue in manufacturing sites as well as the reduction of tool costs.

New D e-EDGE is a cutting tool used for machining of general parts, which is cost-saving and environmentally-friendly and utilizes the features of single-crystal diamond.

■ Characteristics

(1)Significantly lower price.
(2)Insert holders for HDD (hard disk drive) aluminum die castings and boring (minimum boring dia.: 5.5 mm) are included in the standard specification.
(3)Inserts can be replaced according to the holder you are currently using.
(4)Sharp cutting and extremely high cutting heat diffusivity (compared with polycrystalline diamond).

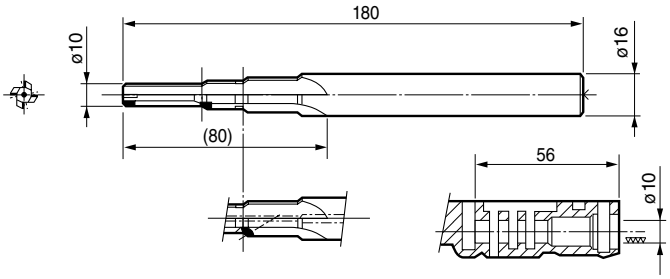
PCD Rotating Tools

Polycrystalline Diamond Round Tools

Characteristics

- Multiple parts can be machined in a single pass by using an integrated formed step tool.
- Adoption of diamond offers significantly-improved tool life (10 times or longer than that of carbide ones).
- Surfaces can be machined without burn at a cutting speed of 300 m/min or higher.
- Stable cutting is possible even when using emulsion-type water-soluble coolant.
  (Semi-dry cutting is also possible according to your environment.)

PCD Reamer Application Example Reaming of automotive fuel pump regulator valve



Work Shape

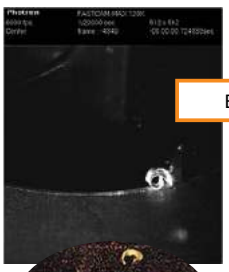
Items	PCD Reamer	Carbide Reamer
Cutting Speed (m/min)	120	120
Feed Rate (mm/rev)	0.2	0.2
Stock Removal (mm/dia.)	0.4	0.4
Coolant	Water soluble	Oil based
Roughness(μmRz)	3	8
Circularity	5	10
Economic Efficiency Ratio	0.5	1

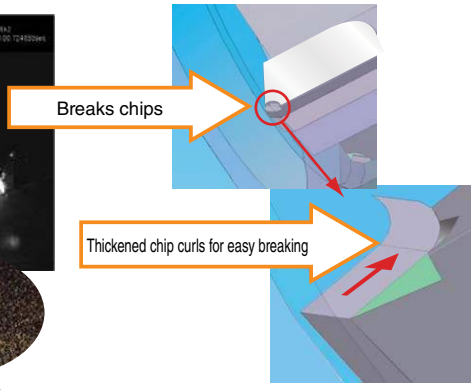
Data 1 Improvement of Productivity by Breaking Chips

Negative Land Specification Cutting Edge

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

Without Chipbreaker

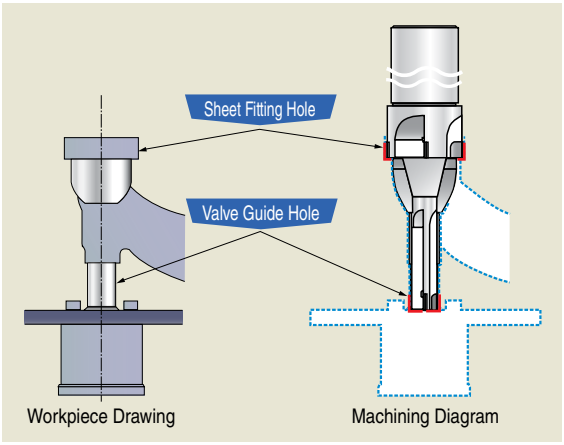




With Chipbreaker

Data 2 Good Balance between High-Efficiency Cutting and High Machining Accuracy

The coaxiality and cylindricity of the cutting edge is dramatically improved by the high rigidity of the shank (made of carbide) and excellent cutting edge polishing technology.The high run-out precision leads to stable machining, and consequently, reduction of the cycle time.



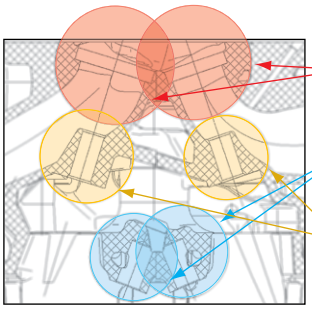
Difference in Performance by Shank Material

Results	1 Flute	4 Flutes(Steel)	4 Flutes(Carbide)
Cutting Time (s)	52	26	13
Circularity (mm)	0.01	0.05	0.03
Coaxiality (mm)	0.01	0.07	0.05

Cutting Conditions

Workpiece	Finishing of cylinder heads and guide-and-sheet fitting holes
Work Material	Aluminum alloy castings AC4B
Machine	Horizontal machining center
Tool Size (mm)	ø11-ø36-L150
S/Speed (min^{-1})	3,500
Cutting Speed (m/min)	395
Feed Rate (mm/rev)	0.3
Stock Removal (mm/dia.)	0.5
Coolant	Emulsion-type water-soluble oil

Machining Process

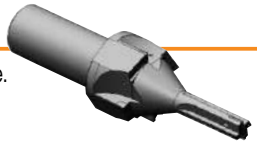


Process 1
Finishing of Valve-and-Sheet Fitting Holes

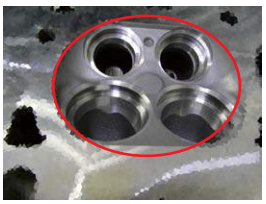
Process 2
Finishing of Hydraulic Lash Adjuster (HLA) Holes

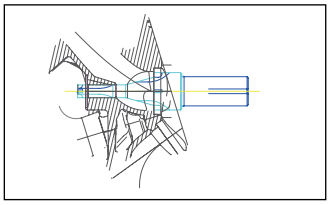
Process 3
Finishing of Intake and Exhaust Valve Guide Holes

Process 1 Finishing of Valve-and-Sheet Fitting Holes



Achieves a good balance between coaxiality and cylindricity from the high rigidity of the shank and the high accuracy of the cutting edge.

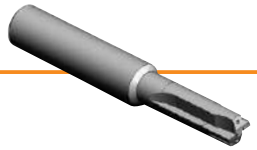




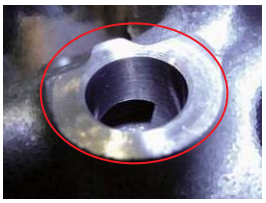
Specifications for Finishing of Valve-and-Sheet Fitting Holes

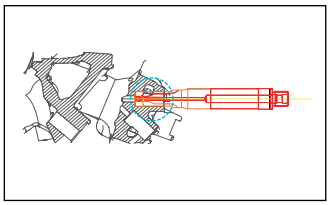
	Processing machine : Horizontal machining center	
Cutting Conditions	Spindle Speed (min^{-1})	6,000
	Feed Rate (mm/rev)	0.48
	Feed Rate (mm/min)	2,880
	Stock Removal (mm/dia.)	0.6
	Coolant	Emulsion-type water-soluble oil

Process 2 Finishing of Hydraulic Lash Adjuster (HLA) Holes



Improves chip evacuation and achieves a high cylindricity using a design ideal for machining thin-wall parts and stop holes.

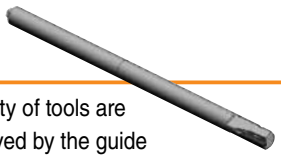




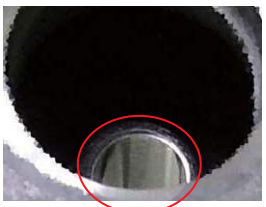
Specifications for Finishing of Hydraulic Lash Adjuster (HLA) Holes

	Processing machine : Horizontal machining center	
Cutting Conditions	Spindle Speed (min^{-1})	5,000
	Feed Rate (mm/rev)	0.34
	Feed Rate (mm/min)	1,540
	Stock Removal (mm/dia.)	0.5
	Coolant	Emulsion-type water-soluble oil

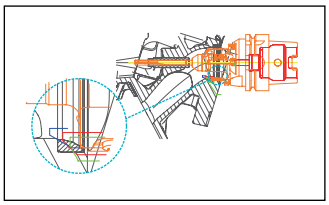
Process 3 Finishing of Intake and Exhaust Valve Guide Holes



Since the overhang (L) is long and the diameter (D) is small, consequently L/D is large, the coaxiality and cylindricity of tools are controlled with high accuracy to improve the self-guide effect during reaming. Additionally, chip evacuation is improved by the guide shape and coolant design. As a result, the tool life is elongated to 10 times that of carbide, improving productivity.



Machined Part



Finishing of Intake and Exhaust Valve Guide Holes

	Processing machine : Horizontal machining center	
Cutting Conditions	Spindle Speed (min^{-1})	3,250
	Feed Rate (mm/rev)	0.1
	Feed Rate (mm/min)	325
	Stock Removal (mm/dia.)	0.1
	Coolant	Emulsion-type water-soluble oil

Results

Material	Tool Life (No. of Holes)	Price Ratio	Cost Ratio	Coaxiality	Inner Diameter Variance
Carbide	1,200	1	1	—	—
A.L.M.T. PCD Tool	12,000	3	0.8	10μm	3 μm/10,000 holes

PCD Rotating Tools

Polycrystalline Diamond Round Tools

Tools for Cylinder Head Machining

Characteristics

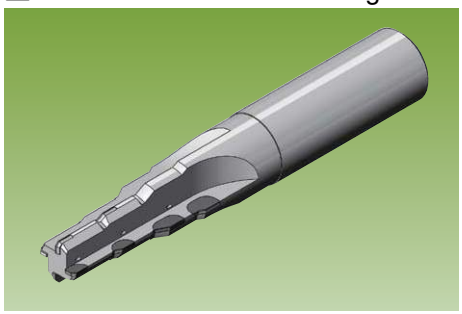
- Design and balance treatment intended for high-feed machining and rigidity.
- Solves problems caused by chips by effectively directing coolant.

Advantages

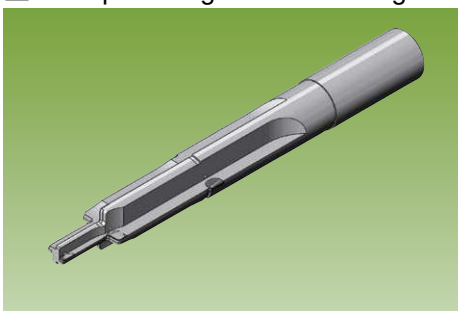
- Improvement of the machining efficiency and quality
- Reduction of tool costs per machine

Achieves high-efficiency machining with formed multi-edge shapes.

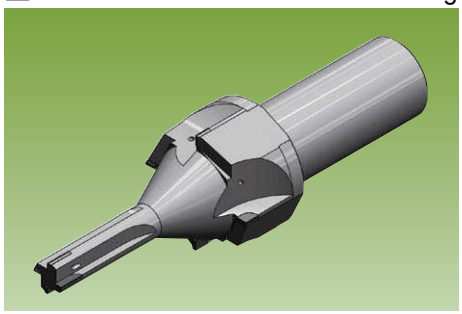
■ For Solenoid Hole Machining



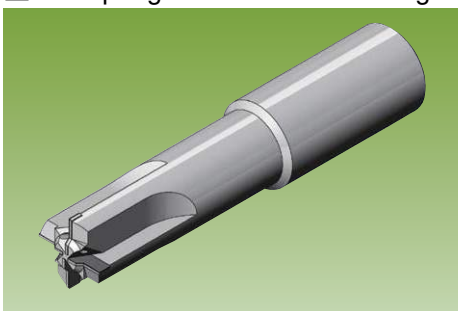
■ For Spark Plug Hole Machining



■ For Guide-and-Sheet Hole Machining

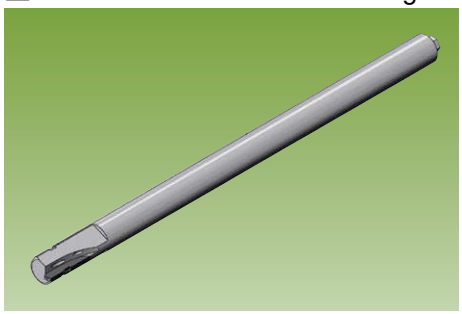


■ For Spring Sheet Hole Machining

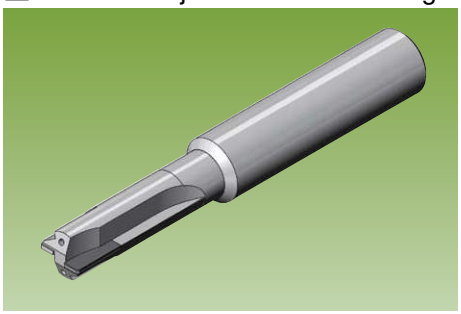


Enables high-efficiency machining using the high rigidity of the shank and the high accuracy of the cutting edge.

■ For Valve Guide Hole Machining

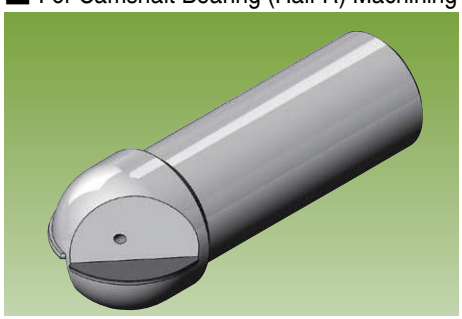


■ For Lash Adjuster Hole Machining



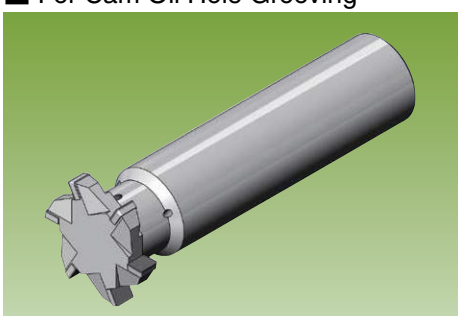
An endmill that enables high-efficiency machining using the high rigidity of the shank

■ For Camshaft Bearing (Half R) Machining



An endmill that enables high-efficiency machining using the multi-edge structure

■ For Cam Oil Hole Grooving



Special Tools for Cylinder Head Machining

Characteristics

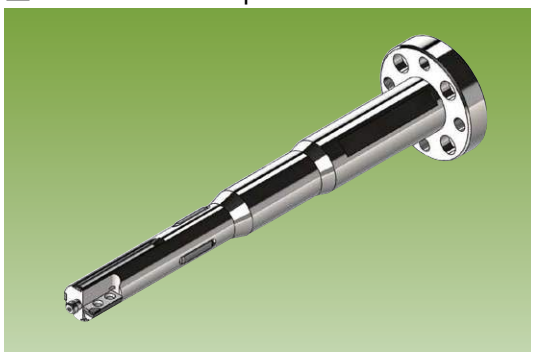
- Design and balance treatment ideal for high rotation speed
- You can reduce the machining time and the tool management cost by using composite tools that integrate machining processes.

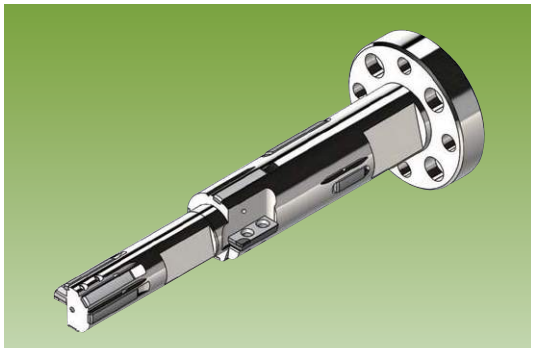
Advantages

- Integration of processes
- Preventing damage to tools
- Elimination of variance in quality due to tool sets

With a run-out adjustment function

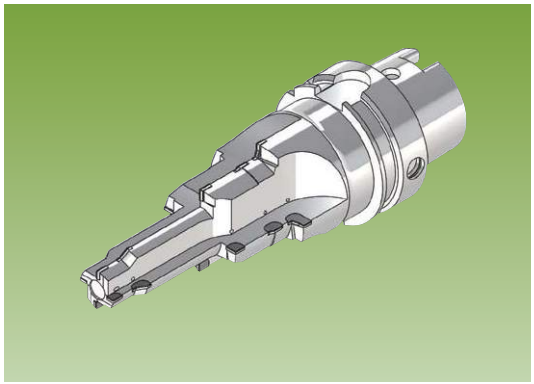
■ Mechanical Clamp Monoblock





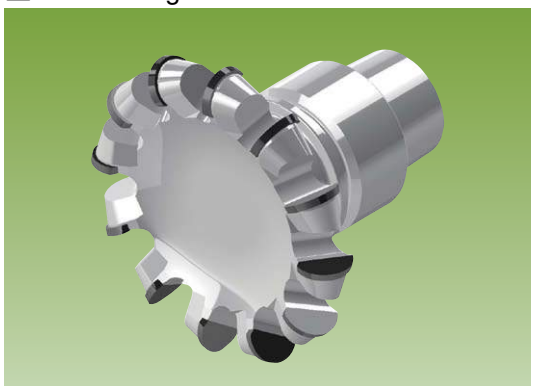
Enables high-efficiency high-precision machining using the high rigidity of the shank

■ Monoblock



Enables high-efficiency machining using the structure

■ Face Milling Cutter



Achieves high-efficiency machining by a structure that integrates several processes

■ Special Process Integrating Tools