CITIZEN

Miyano

VC03

LFV technology

Opening Up New Possibilities in Machining Technology with Low Frequency Vibration-cutting

Having realized the innovative machining technology of “low frequency vibration cutting”, which is completely different from conventional ultrasonic vibration cutting, the VC03[*1] can handle a diverse range of machining geometries and materials with its special control technology, and alleviates[*2] various problems including entanglement of chips and built-up edges.
In combination with the “machine construction for high accuracy” inherited from the GN series, this opens up new possibilities in machining technology.

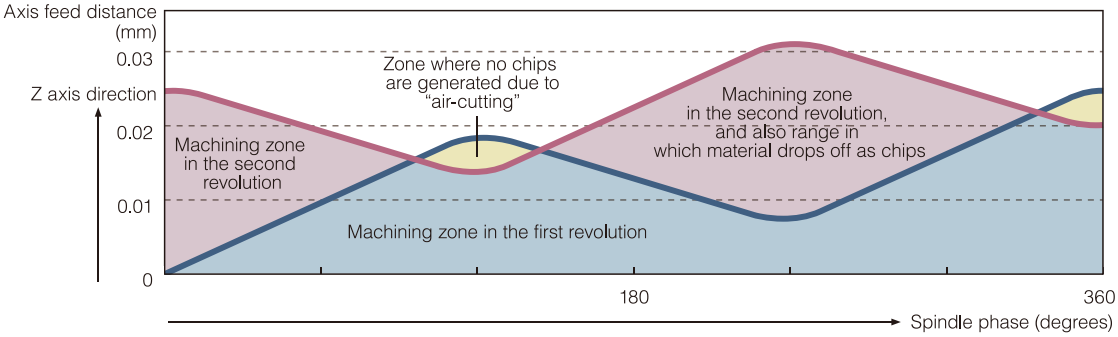
*1, *2 Patented


VC03

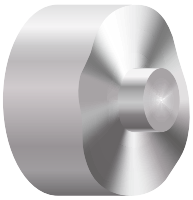
What is Low Frequency Vibration-cutting (LFV) ?

The servo axes are vibrated in the axial direction using a unique control technology whereby cutting is performed while synchronizing this vibration with the rotation of the spindle. Because “air-cutting” times are provided during cutting, this technique is also characterized by intermittent expulsion of fine chips.
This has made it possible to resolve problems such as chip entanglement and built-up edges at a stroke, even in machining that has proved difficult up until now, such as the machining of deep holes and micromachining.
Low frequency vibration cutting is a brand new cutting technology with excellent general applicability, able to handle a wide range of machining geometries and materials.

Z axis feed distance per spindle revolution and the low frequency vibration waveform

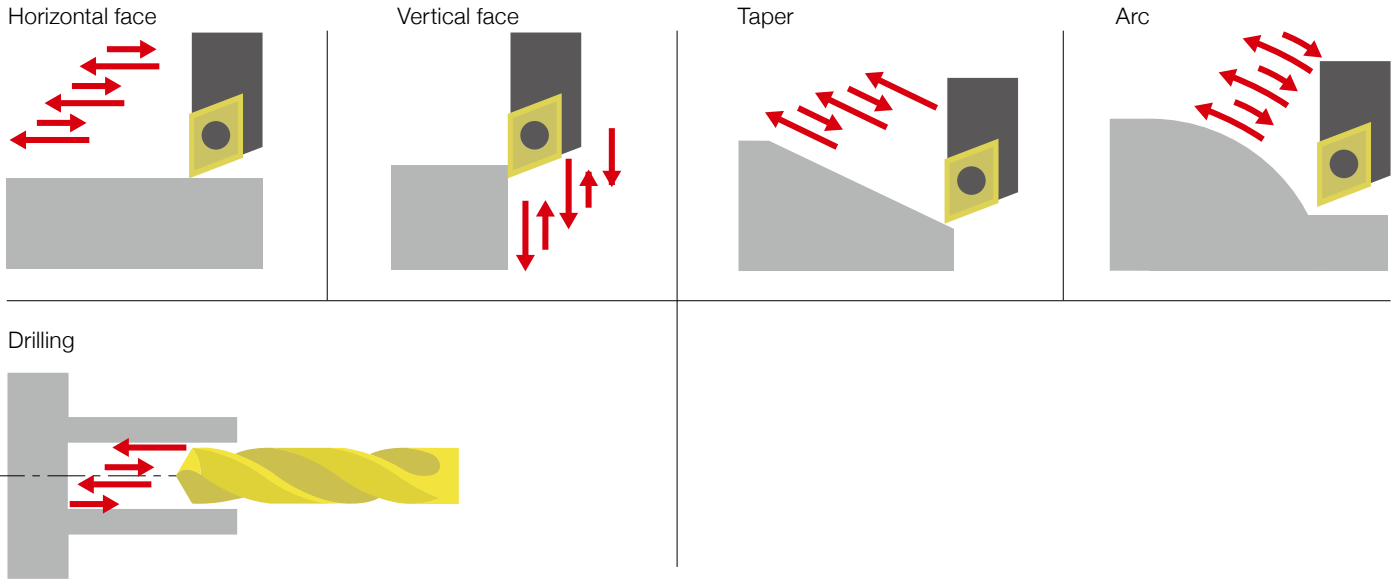


Representation of the cutting



Variety of Machinable Geometries

Vibration cutting can handle a variety of types of machining in addition to linear machining on faces, including tapers, arcs, and drilling. Vibration cutting can be turned ON and OFF just by inserting G codes into a program, giving relief from chip entanglement and problems with the tool nose, depending on the material being machined.



Micromachining leaving 0.2 mm dia. pin

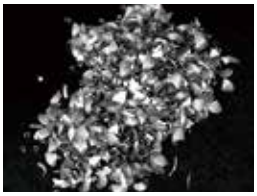
Comparison with the lead (0.5 mm dia.) of a mechanical pencil

Chip Shapes

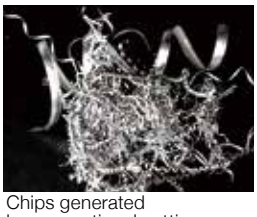
Depending on the material being cut, a variety of problems can be caused by chips getting entangled with each other, including increased cutting resistance, scarring, changes in the texture of the machined surface, tool nose damage, and built-up edges due to cutting heat.
In low frequency vibration cutting, “air cutting” time provided during cutting serves to break chips up finely and expel them. This “air cutting” time also prevents the machining temperature rising, which both prolongs tool lives and gives relief from various problems caused by chips.

*There are differences in effects depending on materials and cutting conditions

Deep hole drilling with an oil hole drill
Since the broken-up chips are expelled along the grooves in the drill, there is no concern about entanglement of chips.



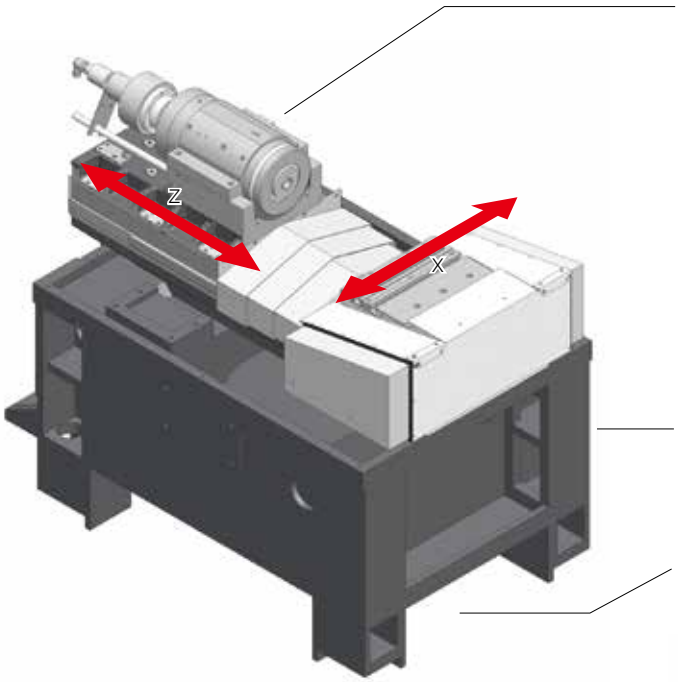
Chips generated by low frequency



Chips generated
by conventional cutting

Machine Construction for High Precision

The basic concept in designing the machine is preventing thermal displacement over time and the heat of machining being transferred to the body of the machine. This is achieved by a frame and bed with a thermally symmetric design, backed up by a wing-type headstock and a separately-installed coolant tank.
built-in motor with a forced cooling function gives smooth rotation with low vibration thanks to beltless drive, and this construction ensures outstanding shape accuracy.
The incorporation of a high-speed gantry loader with a service time of 3.5 seconds and peripheral devices such as an IN/OUT stocker allows a whole range of automation needs to be accommodated.



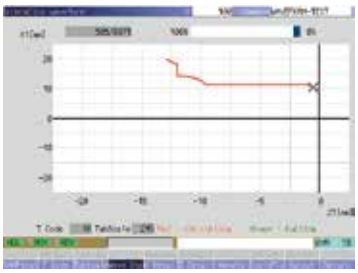
Wing Type Headstock
The spindle section is constructed such that only the “wing” parts make contact with the slides and the central part of the sleeve is suspended, so spindle heat generation is uniform and heat is not easily transmitted to the headstock.

Base with Thermally Symmetric Design
A base that is a monobloc casting with a left/right symmetrical construction has the advantage that heat transfer is also symmetrical at left and right, which cancels out the effects that the machine’s heat generation has on machining.

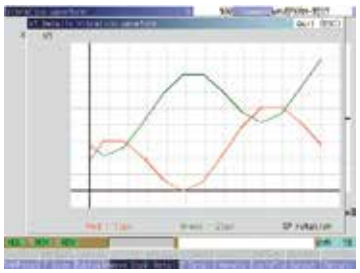
Separately installed tank
The coolant tank has been made a separable type to restrict the thermal effects of chips and coolant that have absorbed cutting heat and installed between the machine legs separately from the machine.

Waveform Display Screen

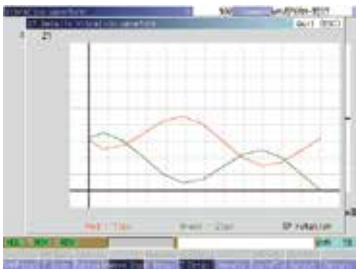
The waveform display screen allows you to display the cutting path in the first rotation, and the cutting path for the second rotation, in relation to the spindle angle, in order to check the extent to which chips have been broken up in accordance with the way the amplitude changes.
Since the signals fed back from the servo motors are displayed, the display on the screen is useful for checking differences between the programmed and actual cutting paths.



Vibration cutting path display
"x" indicates the cutting position, which can be changed either with the tab key or with the manual pulse handle.



Cutting path (X axis)
This displays the cutting paths for the first and second rotations. The sections where the lines intertwine are where the chips are broken up.

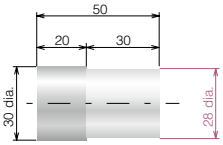


Cutting path (Z axis)

Accuracy

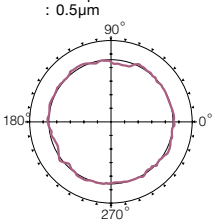
Test piece (LFV)

Material : SUS304
Spindle speed : 1,250 min-1
Feed : 0.01 mm/rev
Nose R : 0.4 mm
Frequency : 1.5 times per spindle rotation

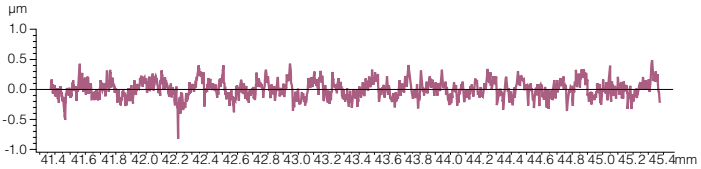


Roundness (LFV)

Roundness : 0.80μm
Scale : 0.5μm

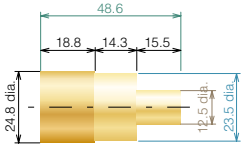


Surface roughness (LFV)



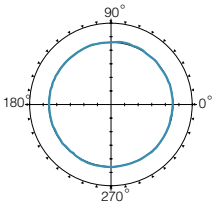
Test piece (regular cutting)

Material : BsBM
Spindle speed : 3,000 min-1
Feed : 0.04 mm/rev
Nose R : 0.2 mm

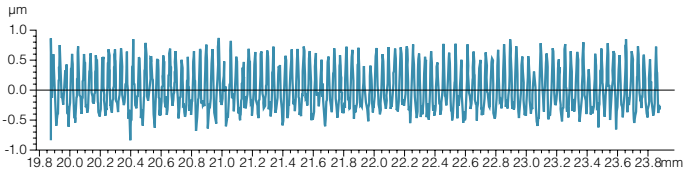


Roundness (regular cutting)

Roundness : 0.18μm
Scale : 0.5μm

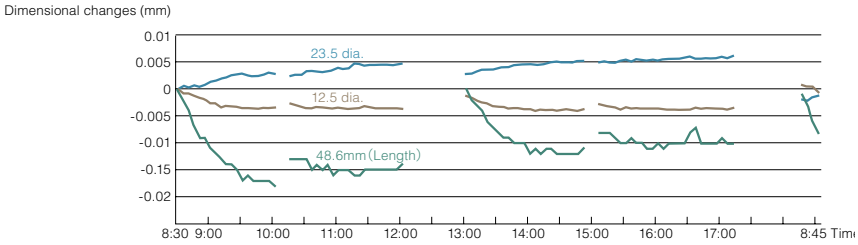


Surface roughness (regular cutting)



* Although the values stated here are the results of actual measurement, please note that they are not guaranteed.

Thermal displacement (when using an oil-based coolant)



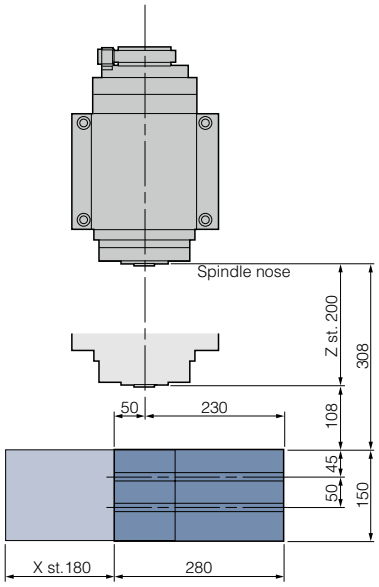
Options

Gantry Loader
New-design, high-speed gantry loaders featuring excellent cost performance support high-efficiency production in combination with part feeders, conveyors and stockers.

Pallet Conveyor
This is a conveyor suited to the feed/conveyance of irregularly shaped products, and precision parts that must not be scratched.

Rotary stocker
This is a space-saving 8-station stocker ideal for plate-shaped products with a short workpiece length.
The guide bar and plate are designed to suit the product shape.

Tooling Area



Chuck system

Collet chuck (pull type)

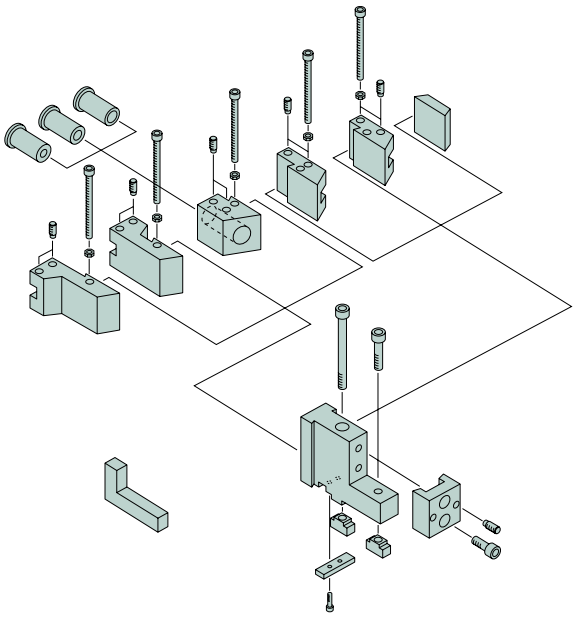
Collet chuck (fixed type)

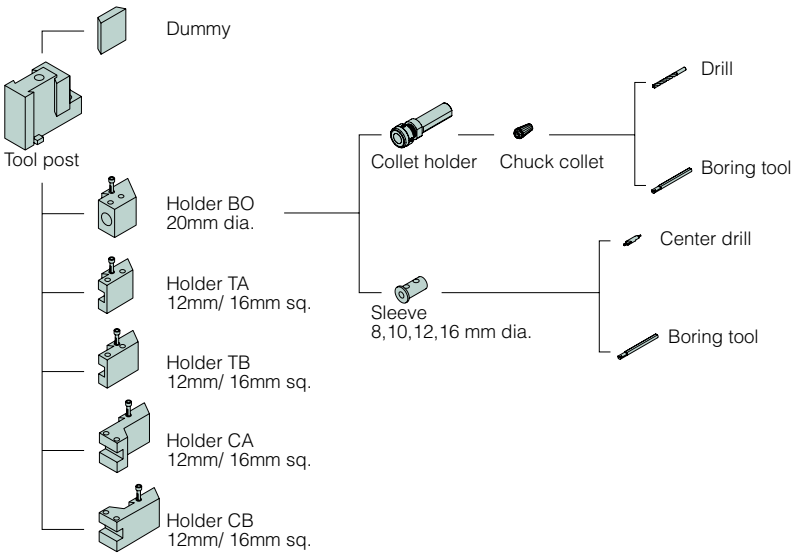
Fine precision chuck

Power chuck

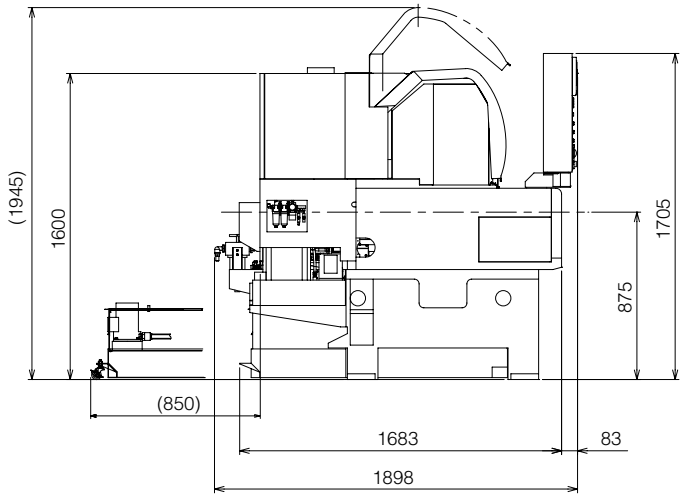
Diaphragm chuck

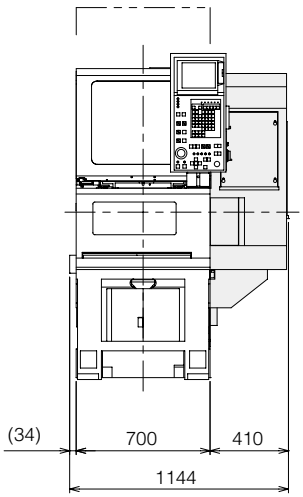
Tooling system





External view





*Loader(opt.)

Machine specifications

		VC03
Machining capacity		
Max. Work diameter	Pull type collet chuck	40 mm dia.
	Fixed type collet chuck	35 mm dia.
	Fine precision air chuck	45 mm dia.
	Power chuck	45 mm dia.
	Diaphragm chuck	45 mm dia.
Max. Machining length		50 mm
Max. work length with loader		40 mm
Spindle		
Number of spindles		1
Spindle nose		Special flat
Through hole diameter		17 mm dia.
Inner diameter of draw tube		11 mm dia.
Spindle speed range		8,000 min^{-1}
Slide		
Number of Tool Platens		1
Type		Horizontal linear tool platen
Control axis		2-Axis (Simultaneously X, Z)
Slide travel	X-axis	180 mm
	Z-axis	200 mm
Rapid feed rate	X-axis	20 m/min
	Z-axis	30 m/min
Tools		
Shank size of square turning tool	10, 12, (16) mm sq.	
Number of tools	Standard	5
Diameter of drill shank		20mm dia.
Motor		
Spindle drive	15 min./ Cont.	3.7/2.2kw
Coolant pump		0.18kw
Coolant		
Tank type		Separate type
Tank capacity		90L
Spindle Cooling device		
Tank capacity	Oil Viscosity VG10	7L
Air supply		
Air pressure supply		0.5 Mpa (5 kgf/ cm^2)
Lubricating system		
Tank capacity	Oil Viscosity VG32	1L
Equipment power supply		
Capacity		11 KVA
Machine dimensions		
Spindle center height		875 mm
Machine hight		1,705 mm
Floor space	Width	700 mm
	Depth	1,683
Machine weight		1,500 kg
Others		
Spalsh guard interlock		
Optional accessories		
Gantry loader, Chuck Systems, Air Blow, High pressure coolant No.1,		
High pressure & inner coolant, Spindle inner coolant, Automatic fire-extinguisher,		
Automatic power off, Chip conveyor, Chip box, Coolant mist collector,		
Coolant mist collector duct, Damper & duct, warning light, Specification color, etc.		

Loader specifications (Optional)		
Type		2-Axis NC
		1 saddle 2 hands
Conveyance capability		
Max. work piece size		40×40 mm dia.
Max. weight capacity		250 g
Feed rate	Right and left operation	108 m/ min
	Upper and lower sides	90 m/ min
Control		
Control system		PMC axis control
Control soft		Flexible loader control
Drive system	Right and left operation	Rack & pinion
	Upper and lower sides	Rack & pinion

NC Specification	
	MITSUBISHI M70V
Controlled axis	X, Z
Min. input increment	0.0001 mm, 0.00001 inch, 0.0001 deg
Min. output increment	X axis: 0.00005 mm (Radius value) Z axis: 0.0001 mm
Interpolation	G01, G02, G03
Threading	G32, G76, G92
Rapid feed override	0-100%
Cutting feed override	0-200%
Parts program storage capacity	16 Kbyte (40 m)
No of registered programs	64
Spindle function	Spindle speed S4-digits, directly specified (G97),
	Constant Cutting speed control (G96)
Tool function	T AABB(AA=Tool number & geometry,
	BB=Wear offset number)
Tool compensation	40pieces
Data input/output	RS-232C, Memory card interface
Others	8.4" color LCD,Chamferring/Corner R, Drilling canned cycle,
	Custom macro, Multiple repetitive canned cycle,
	Spindle orientation, Tool nose R compensation(G40, G41, G42),
	Operating time/Parts No. display.
Options	Cs outline control.

CITIZEN MACHINERY CO., LTD.

CITIZEN

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