



Doosan Machine Tools

Doosan Machine Tools' VIP Customer Newsletter

OPTIMAL SOLUTION

Why Doosan 5-AXIS?

A Strategy for Successful 5-Axis Machining

**MACHINE
GREATNESS™**

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***COVER
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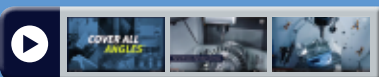
Doosan Machine Tools' New Products



Doosan Machine Tools' powerful and versatile 5-axis machine tool lineup offers a variety of solutions to customers who want to equip themselves with unlimited potential in the production of parts and components.



Meet the Machine Greatness of Doosan Machine Tools 5-axis on a video.



MACHINE GREATNESS™

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Focus

A Strategy for
Successful 5-Axis
Machining

Doosan Machine Tools' 5-Axis Machining Solution

5-axis machining reduces the processing time for hard-to-cut materials while realizing high-speed, high-precision production.

Demand for high-precision, hard-to-cut parts is increasing in line with the lightweight, compactness, and high functionality of finished products.

The machining paradigm has shifted toward the flexible machining of various shapes with 5-axis machining speeding up the trend.

Why is 5-axis machining the answer?

5-axis machining, in which a 2-axis rotation is added to a 3-axis straight line, can freely change the inclination of the tool relative to the workpiece, making it possible to continue cutting complex shapes – which previously had to go through several processes and setups - with one setting, resolving all the issues related to time, cost, and quality involved with frequent setup needs. Most notably, the fact that there is no need to change the settings enables the operator to maintain the dimensional accuracy required in high-precision machining. 5-axis machining also minimizes the protrusion of various tools, eliminating interference when processing complex shapes.

Split 5-Axis Machining and Simultaneous 5-Axis Machining

In 5-axis machining, split 5-axis machining refers to a case in which the 5 axes do not move at the same time to finish machining one side, then turn the rotation axis by the desired angle, and cut the next side. As it can shorten processes or increase tool utilization, split machining is particularly widely used in general machining and automotive parts processing, accounting for over 80% of all 5-axis machining.

By contrast, simultaneous 5-axis machining moves all the axes at the same time to cut any shapes including planes, curved surfaces, and holes most effectively. As such, it is widely used in the processing of aviation parts with structurally complex shapes, such as high-precision turbine blades, impellers, and blisks. A simultaneous 5-axis machining center also support split 5-axis machining operations, whereas a split 5-axis machining center cannot perform simultaneous 5-axis operations. It is therefore necessary to decide which 5-axis vertical machining centers to buy depending on the type of machining operations required.

Improved Cutting Ability and Constant Machining Precision

Recently, the demand for 5-axis machines has continued to grow at machining sites in connection with the reduction of delivery times and the maximization of operational efficiency through one-chucking, high-speed machining, and longer tool life, among other factors.

Recently launched 5-axis vertical machining centers feature not only increased robustness and

precision but also high dimensional accuracy and stable machining quality - capabilities secured on the back of the development of various machining support solutions. Such solutions include tool center point (TCP) correction to control the tool center point, and the 'rotation axis center measurement function' which automatically measures and corrects rotational center position misalignment or tilt. Most notably, Doosan Machine Tools' Intelligent Kinematic Compensation (IKC) solution is regarded as an excellent tool for minimizing shape errors and maintaining accuracy through its function for compensating the center of the rotation axis.

The IKC automatically compensates for the X, Y, and Z axes as well as the A-axis and C-axis, completing all the correction work required to secure precision, including operation and preparation, within 30 minutes. Furthermore, unlike in the past when precision had to be corrected by dispatching technicians from the machine tool manufacturers, the IKC solution makes it easier to compensate for rotational errors at machining sites on a regular basis.

In addition, the IKC enables not only the automation of tool length measurement but also the measurement of workpiece length, step height, and circle diameter with a touch

probe. Doosan Machine Tools offers its IKC as a package option comprising both the calibration software and hardware that includes a touch probe, a datum ball, an automatic tool length measuring device, and a master tool.

5-Axis Machining Is Getting Easier and More Comfortable

Doosan Machine Tools offers application engineering services to buyers of its 5-axis machining center so that they can 'soft land' until they get to the mass production stage. The services include not only mandatory equipment installation, initial calibration and equipment operation, and operation training, but also the setting of the post process (PP), an interface enabling the CAM data created through CAM software to run smoothly on 5-axis vertical machining centers. Also, Doosan Machine Tools even delivers customized processing know-how for a process or two should the customer wish. Such comprehensive customer services make it so much easier for its customers to embark upon 5-axis machining.

In addition to all that, Doosan Machine Tools provides overall system engineering services composed of additional equipment configuration, process design and software based on high-performance machine tools so as to optimize the

production capability of processing equipment through a turn-key solution. The company can also offer a service that provides its customers with an optimized solution in addition to the original function of its machine tools as it has accumulated know-how in processing technology in diverse industries over the years.

In fact, many customers who purchase machine tools from Doosan Machine Tools acquire 5-axis machining technology and various associated functions through a turnkey solution and apply them to their mass production lines.

Doosan Machine Tools' 5-Axis Machining Center Lineup

Starting with the VC 630 5AX, a moving column type of 5-axis machining center first mass produced in 2009, Doosan Machine Tools has secured a full lineup of 5-axis machines. The lineup ranges from the DNM series designed for first-time users of 5-axis vertical machining centers to the FM series, a 5-axis machining center equipped with even higher processing efficiency for complex shapes, as well as an ultra-high-speed, high-precision 5-axis simultaneous control of 42000 r/min.



➤ The result of split 5-axis machining, where one side is machined and then the rotating shaft is rotated for machining of the next side, as described by Jang Dong Sik, a manager of Doosan Machine Tools.



➤ A blocked type of impeller that can only be processed through simultaneous 5-axis operations.



➤ Rotation center axis correction work being carried out by the IKC solution used alongside the calibration software and hardware consisting of a touch probe, a datum ball, an automatic tool length measuring device, and a master tool.



➤ The DVF 5000 in operation. The simultaneous 5-axis equipment can also support split 5-axis operations, whereas the split 5-axis machining center does not support simultaneous operations. Choose the type of equipment according to your specific machining needs.

Focus

A Strategy for Successful 5-Axis Machining



➔ Jang Dong Sik, manager of AE Technology Development Team and an expert of 5-axis processing

Most notably, Doosan Machine Tools' DVF series of new 5-axis vertical machining center, which boasts a uniquely stable frame structure in spite of its compact size, has greatly improved the reliability and productivity of 5-axis machining. The company's VC 630/5AX simultaneous control 5-axis machining center, which has maintained its reputation as the best seller in the 5-axis machine industry for nearly ten years, is equipped with a high-rigidity built-in spindle capable of realizing complex shape processing based on high-speed machining and powerful cutting in one step.

The VCF series of column moving machining center responds flexibly to complex machining from 3 to 5 axes with its top-mounted attachable/detachable C-axis rotary tables and B-axis tilting heads. The DHF, a simultaneous 5-axis horizontal machining center equipped with a multi-faced node head and a powerful 800mm twin-pallet, is equipped with glass scale, spindle, and ball screw shaft cooling as standard features for the optimized machining of large and complex workpieces for the aviation industry.

The HFP series of simultaneous 5-axis horizontal machining center boasts a large tilting table and a high-speed universal head optimized for processing large-sized aerospace components, with high productivity and excellent chip processing capability. The BM series, an accurate and robust 5-axis machining door-type machining center, has a double column structure that is appreciated for its high safety and reliability, making it suitable for the precision machining of large parts such as automobiles, injection molding machines, or press molds.

DVF Series with New Frames

As described above, Doosan Machine Tools' 5-axis machining lineup can cover all areas of 5-axis machining for small to large workpieces with its diverse vertical and horizontal models.

To this already complete lineup, Doosan Machine Tools added a new 5-axis vertical machining center DVF series for more complex and diversely shaped workpieces in 2018, further expanding its offerings of 5-axis vertical machining centers.

The DVF series has greatly improved the reliability and productivity of 5-axis machining. It is the most common yet the most advantageous TT type in machine rigidity. The DVF 6500 and DVF 8000 models, which are designed to machine large and medium-sized workpieces, are equipped with A-axis tilting and C-axis rotation tables.

The DVF 6500 and 8000 feature a symmetrical gantry type of structure, with low a possibility of thermal deformation, making them most suitable for large machine tools requiring high precision. Also, thanks to their rigid frames and outstanding mechanical precision, the models perform superbly in the processing of large and medium-sized workpieces of complex shapes in particular.

The DVF 8000 is also equipped with an additional premium function that rotates the C-axis so that it can perform the turning process. The DVF 8000's turning function even realizes skiving for gear machining. For such advanced features, the DVF 8000 models have received an enthusiastic response from the market. About half of the models are sold with the turning feature as an option.

The DVF 5000, a column moving type of machine tool, is equipped with a tilting B-axis head and a C-axis rotary table, which make it more compact by reducing its width, giving it an edge in chip processing. The Auto Workpiece Changer (AWC) mounted on the DVF 5000, in particular, allows a workpiece to be inserted and removed through the right side of the machine tool, contributing to superior work convenience and compact work automation. Most of the DVF 5000 models are shipped with the AWC feature.

Promotion of Automation and Unmanned Systems

5-axis machining has enabled revolutionary achievements, such as reducing the time required to set up the workpiece and the machine tool by making it possible to perform all machining processes on a single machine through just one chucking of workpieces which previously had to go through several machining processes. Recently, the company has shifted the focus of its technological development of 5-axis machining to 'the minimization of manufacturing downtime.'

Of late, the technology has been evolving toward the development of 'automation and unmanned operations' in order to minimize workers' intervention from the material input stage to the processing completion stage, amid heated discussions at domestic processing sites about reducing working hours and addressing the ageing population phenomenon.

DVF 6500 with LPS



- ⊕ A pallet automation line comprising the DVF 6500 and the LPS that is mainly used for the mass production of medium and large products requiring longer periods of machining operations.

To respond to the rising trends of automation and unmanned operations, many machine tool makers are developing automation solutions that not only exchange work or pallets automatically, but also continue to set up work to be processed and load products that have already been processed. The key elements leading such changes on the part of Doosan Machine Tools are the AWC and the Linear Pallet System (LPS).

The AWC, Doosan Machine Tools' automation solution for changing workpieces, automatically returns the pallet with the workpiece to the machine. Notably, the pneumatic zero point clamp ensures high repeatability when the pallet is mounted, and the gantry robot is used to move pallets, reducing the time taken to replace pallets to less than one minute.

Four to twenty-four pallets are used depending on the size of the workpieces. The AWC can be installed on all types of the company's vertical machining centers, with the DVF 5000 demonstrating the best compatibility thanks to its B-axis tilting function, which is designed for operational automation.

Alongside the AWC, the LPS is another DMT solution that can accelerate the automation of 5-axis machining operations and greatly contribute to improving its customers' productivity. As it is suitable for the prolonged mass production of large and medium-sized products, it is advantageous to use the LPS together with DVF 6500 machining centers.

DVF 5000 with AWC



- ⊕ A combination of the DVF 5000 and AWC, with the DVF 5000 having an absolute advantage for the automation of small workpiece machining because workpieces can be inserted and removed through the right side of the machine tool due to its B-axis tilting and C-axis rotation.

DVF 6500 with APC



- ⊕ A combination of the DVF 6500 and the APC that enables pallets to be changed quickly and accurately, leading to significantly higher productivity.

Focus

—
A Strategy for
Successful 5-Axis
Machining

Solutions for Every Possibility

Doosan Machine Tools' powerful and versatile 5-axis machine tool lineup offers a wide range of solutions to customers who want to secure unlimited capability in the cutting of diverse types of parts.

DNM / 5AX series

A 5-axis machining center suitable for entry-level or mass-production needs; a high-productivity compact machine tool based on the basic DNM structure.



DVF series

A combination of Doosan's unique accumulated know-how and the latest technology, the DVF series takes the customers' 5-axis machining capability to the next level.



VCF 850SR/LSR

Through the combination of a rotating B-axis spindle head and a C-axis table, Doosan Machine Tools' VCF column moving vertical machining center can be used in diverse fields to deliver excellent productivity at all times.



FM / 5AX series

The FM and 5A series, Doosan Machine Tools' ultra-high-speed, ultra-precision linear motors, deliver fast and accurate machining through their powerful 42000 r/min spindle.



DHF series

A powerful twin pallet horizontal 5-axis machining center for the production of large and complex parts, optimized for the handling of large components in particular.



BM U series

A double-column vertical machining center with accuracy and rigidity suitable for processing large parts used in the aviation, construction, oil & gas and other major industries.



HFP series

A high-performance 5-axis machining center boasting a 75kW, 30000 r/min spindle, optimized for processing large aluminum parts for the aviation industry.



INSIDE

—
OMGM Group
(Italy)



👤 Maiardi Maurizio, president of OMGM Group

*Meet the Machine Greatness of Doosan Machine Tools
5-axis on a video.*



Amazing Values Created by Wise Choices: OMGM Group Boosts Its Corporate Competitiveness with Doosan 5-axis Vertical Machining Centers

OMGM Group has used Doosan Machine Tools' 5-axis vertical machining centers for 20 years, helping boost its corporate competitiveness significantly. "Doosan Machine Tools' 5-axis vertical machining centers have helped improve the quality of our parts dramatically," declared Maurizio Maiardi, the company's president. "Most notably, the DVF 5000 enables us to quickly process parts of various sizes from small to medium to large, while the PUMA SMX 3100 has significantly reduced our processing time, so we are extremely satisfied with the company's machine tools."



OMGM Group

“If you are looking for machine tools that can provide outstanding precision, convenient operation, and a quick and accurate customer service at a reasonable price, the answer is Doosan Machine Tools.””



⊕ We cut engineering and aerospace components with the DVF 5000.

Challenge of OMGM Group

Experienced the Impact of Machine Tools on Processing Quality

Based in Bologna in northern Italy, OMGM group started out with just five employees in 1972 but has since grown into a company with 101 employees, and now manufactures parts for the pharmaceutical, automation equipment, crown caps and ceramic press industries.

Having first purchased a piece of DMT equipment back in 2000, the company now runs ten Doosan machine tools. Its president, Maurizio Maiardi, says that he thinks the most important factor in product selection is precision machining, and that Doosan machine tools have not only enabled high-quality, high-precision parts processing but have also improved the company’s production speed significantly.



⊕ DVF 5000

The Ideal Solution Is a High-Performance 5-Axis Machining Center

Amazed by Rapid Chip Processing, Excellent Processing Ability, and Compactness

OMGM Group also produces medical, engineering and aerospace components using Doosan Machine Tools’ DVF 5000 5-axis machining center. President Maiardi said, “As the DVF 5000 is easy to operate, and loading and unloading is extremely fast, our productivity has improved accordingly.”

“Equipped with a 18,000 r/min spindle, the DVF 5000 can even process workpieces at high speeds effectively,” he added. “It comes equipped with a 60-tool magazine as a standard feature, with an option to expand the number to 120. The operators do not have to change tools every time they work, and they can always select the optimal tools for processing machine parts with complex shapes. I am fully satisfied with the model.”

“Though it boasts the same level of processing precision and quality, the DVF 5000 is cheaper than the 5-axis vertical machining centers of other global brands based in Italy and Japan among other countries,” he said. “Most notably, the compact size of the DVF 5000 has enabled us to increase spatial efficiency in our factory.”

Plan is Multi-Tasking Equipment

Secured a Perfect Package through PUMA SMX

OMGM Group has recently purchased an SMX3100, a multitasking machine, to respond to the increasingly diverse cutting process environments and to meet the growing demand for more complex parts. “We are yet to utilize the PUMA SMX 3100S fully because we have never used a multi-tasking machine tool before,” said Maurizio. “Still it is clear that the model has not only enhanced our machining capabilities but also boosted our external competitiveness by enabling us to actively respond to the need to cut parts of ever more complex shapes.”

“If you are looking for machine tools that can provide excellent precision, convenient operation, and a quick and accurate service at a reasonable price, I would recommend Doosan Machine Tools to you,” said Maurizio, “Let me add that Overmach, a dealer we have been working with for the past thirty years, has enabled us to use Doosan machine tools more conveniently and efficiently.”



⊕ PUMA SMX3100ST series

INSIDE

—
Perfect Team
Engineering
(Singapore)



Thorhock Yu, operations manager at Perfect Team Engineering

*Meet the Machine Greatness of Doosan Machine Tools
5-axis on a video.*



Special Parts Processing Solution Found by Perfect Team Engineering: Doosan 5-Axis Machining Center Reduces Processing, Time, and Costs.

Located in Singapore, 'Perfect Team Engineering Pte Ltd' selected Doosan Machine Tools DVF5000 in 2012 as its first 5-axis machining center in order to produce special parts that could not be manufactured with its existing machine tools."

"Doosan Machine Tools' 5-axis machining center maintains high precision while boasting outstanding rigidity and reducing both the number of processes and time taken," said Thorhock Yu. "Most notably, its automatic system enables us to cut down on maintenance and production costs while using a minimal workforce." The company has purchased Doosan Machine Tools' VC 630 5AX. Currently, more than 80% of the company's machine tools have been supplied by Doosan Machine Tools.



Perfect Team Engineering



➔ PUMA 480XL thread test cutting



➔ Perfect Team Engineering is using a 5-axis machining center to machine parts for the oil & gas industry.



➔ With the DVF 5000, Perfect Team Engineering has reduced its lead time, manpower and production costs.

Challenge of Meeting Doosan Machine Tools

The First Purchase of PUMA 480 Turned Out To Be a Great Success!

Founded in 1988, Perfect Team Engineering provides processing services to oil and gas OEM customers, with the focus on downhole products such as safety valves and packer pumps.

"Having previously struggled to secure processing precision and productivity, Perfect Engineering was able to not only secure machining precision and productivity, but also cut down on maintenance costs compared to other machine tools," said Thorhock Yu, the company's operations manager.

Manager Yu recalled that the PUMA 480XL heavy-duty turning center purchased by his company in 2009 proved its excellence in machining stability in a trial cut of $\phi 13 \frac{3}{8}$ threads with a clamping length of 25 mm.



➔ DVF 5000

The Solution Was the DVF 5000, the Company's First 5-Axis Machining Center

Complex Shape Processing, Shortened Lead Time, Reduced Production Costs

"In order to process parts with increasingly complex shapes, we had to increase our machining capacity, but we were unable to do that with the machine tools we had back then," said Thorhock Yu, who personally felt the need for a 5-axis machining center.

In 2012, Perfect Team Engineering decided to buy a 5-axis machining center to meet the increasing demand for its services while addressing its growing cutting needs. Satisfied with the machining performance of the PUMA 480XL, the company chose Doosan Machine Tools' 'DVF 5000' as its first 5-axis machining center. Most notably, the company selected Doosan Machine Tools' 5-axis machining center with confidence, and never even considered buying one of the other brands available. "The DVF5000 not only delivers excellent machining performance but also boasts an inspection function that allows us to check dimensions with a Renishaw probe when parts machining is complete - an especially useful feature," Yu added.



➔ VC 630/5AX

The Plan is Be Ready for a Large Project

Respond Quickly to Difficult-to-Cut Materials While Maintaining Precision

Perfect Team Engineering once again sought a solution from Doosan Machine Tools' equipment when it won a new project to process difficult-to-cut parts of complex shapes.

"We had used 3- and 4-axis machine tools before; but we had to proceed with several processes at the same time, which required a lot of time and manpower, as well as high production costs," said Thorhock Yu. "We decided to purchase an additional 5-axis machine for this large project because the model would require only two more processes while reducing the lead time, manpower and production costs significantly."

In 2015, Perfect Team Engineering chose to buy a VC630 5AX, which would not require multiple setups, while cutting down on machining time and downtime, in a bid to meet increasing demand and cutting needs.

"The VC 630 5AX has increased our machining capability as it can quickly machine difficult-to-cut materials while maintaining precision," he added. "In particular, Doosan Machine Tools not only provides excellent hardware performance but always responds promptly to our requests for support, which makes the firm more reliable."

**NEW
PRODUCT**

—
Doosan Machine
Tools' New Products

New Products equipped with Doosan Machine Tools' Core Technologies

TURNING CENTER

Max Diameter 600mm Quartz, Ceramic Grinding Machine Tool



LYNX XG600

Equipped with a grinding spindle with a maximum speed of 5000r/min, the Lynx XG600 makes it easy to process quartz and ceramic materials required for semiconductor wafer production. It has secured high precision by minimizing vibration and thermal displacement through an integrated high-rigidity bed structure and a feed shaft guide with increased stability. Its durability has also been improved by facilitating the treatment of sludge (quartz dust) through the application of device gap wipers, a close contact structure, and a straight coolant tank structure.

Large Turning Center Capable of Processing from 2- to Y-Axis



PUMA 600 / 700 / 800 II series

The PUMA 600/700/800 II series is an upgraded version of the PUMA 600/700/800 series. It is optimized for large, complex processing as it provides the largest machining area in its class, including a maximum diameter of $\varnothing 900\text{mm}$ for 2-axis/M machine tools and a maximum machining length of 5,050mm for Y-axis machine tools. It is also equipped with an inclined bed structure which makes it easier to process chips. Furthermore, to reduce the setup time, it is equipped with programmable features that enable easy setting of the tailstock location according to the size of the workpieces as a standard feature.

Meet Doosan Machine Tools' new products equipped with the company's core cutting-edge technologies, including its High-speed Spindle Technology, High-rigidity Guideway Technology, Thermal Stability Technology, Easy Operation Technology, and Smart Monitoring Technology.

MACHINING CENTER

Vertical High-Quality, High-Precision Molding Machining Center



MP 6500

The MP 6500, a double-column machining center, is optimized for high-speed traverse and high-precision machining, making high-precision cutting possible with its heat-symmetrical structure and a design that minimizes overhang. The application of a constant pressure spindle has improved the rigidity of the low-speed section and the lifespan of high-speed rotation. Notably, to further enhance the quality of mold processing, this model offers a thermal displacement compensation device, as well as high-speed, high-precision contouring control and a tool measurement device, as standard features.

Highly Productive Compact Vertical Machining Center



DNM 4500L / 5700L

The DNM 4500L and DNM 5700L have seen their X-axis feed distance extended by 910mm and 1300mm, respectively, compared to the existing DNM series. They are also designed to broaden the lower support structure in order to further enhance their structural rigidity and stability. In addition, in order to increase precision when machining various parts, they feature a larger table and allowable load to allow for the largest machining area in their class despite having the same installation area as previous models. What's more, they offer a direct-connect type spindle as a standard feature, as well as reducing the tool change speed (1.2 seconds) and non-cutting time.

5-AXIS. NO LIMITS.

Doosan Machine Tools' lineup of 5-axis machines is the fruit of the company's constant research and development.

Contact the company's nearest branch to experience the excellent machine engineering of its full range of 5-axis vertical machining centers as well as its first rate-service and sales support.



Learn more at [DOOSANMACHINETOOLS.COM](https://www.doosanmachinetools.com)

· The machine tool specifications cited in this article may change without notice due to performance improvements.

· For more detailed product information, please visit Doosan Machine Tools' website or contact your nearest Doosan Machine Tool branch office.

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