Vertical Machining Center YMC430

YASDA PRECISION TOOLS K.K.

1. Product outline

In the always improving micro machining fields including "medical equipment components," "IT-related components" and "miniature precision dies," demand for ultrahigh accuracy and high quality surface finish machining has rapidly increased. The YMC430 Machining Center was developed to meet such demand.

Fig. 1 Machine appearance

The YMC430 offers stable high accuracy and high quality surface finish machining for long hours of operation in general factory environments. For this reason, not only superior kinematic performance but also providing stability in response to vibration and thermal disturbance are required, and the YMC430 was devised with a new basic structure and put into production for micro machining markets.

The YMC430 is equipped with a DD motor-driven two-axis control table, which enables 5-axis controlled machining for complicated profiles. It also offers a solution for mounting compact work changers for automatization and unmanned operation, providing a greater level of expandability.

2. Basic structure

The basic axes are composed of an X-Y stage that allows the table to move back and forth and from side to side, and a Z axis along which the spindle moves up and down. An ATC unit is located at the rear side of the machine. Adoption of an X-Y stage provides a structure with a low center gravity, and light-weight designed movable elements are assembled in a unified arrangement near the center of gravity. The bed has been designed to secure a sufficient level of thickness, and the X-Y stage unit is mounted around the bed center. The low height of the table top surface improves workability in loading/unloading workpieces, and the reduced weight of the movable elements improves stability in response to vibrations created during table movement.

3. Characteristics

1) Symmetrically-structured H-shaped column

For an X-Y table, a single-type column of a C-framed structure is generally adopted. With this column, an overhang from the column front surface to the spindle is large, and the force line from the spindle to the table is lengthened. In addition, as the column structure is asymmetrical at the front and rear sides, displacement in the Y-axis direction as a result of changes in temperature becomes a problem. In order to solve these problems, Yasda has developed an H-shaped cross-section column and incorporated it into the YMC430. The cross-section shape of a new column resembles the profile of a double-type column and secures higher bending and torsion rigidities. Compared to a conventional single-type column (C frame), the overhang from the column to the spindle is short, and the force line between the tool and workpiece is also short. In addition, there are two force lines, which offer remarkably high rigidity.

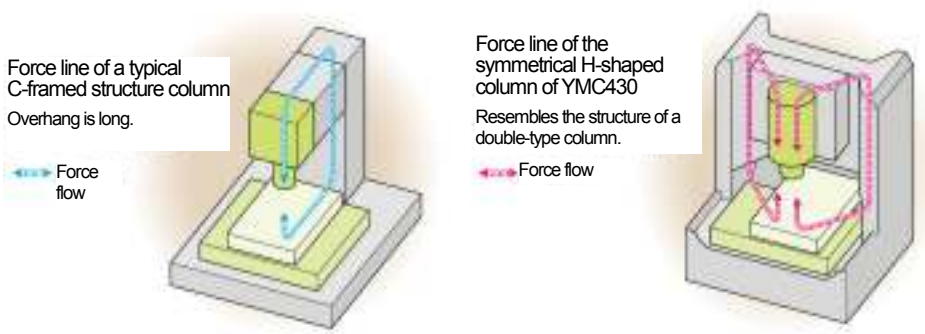


Fig. 2 Comparison of column shape

As a result, the Z-axis acceleration/deceleration performance and vibration damping characteristics have improved, and higher speed and higher accuracy during reverse travel in micro machining have been realized. For the H-shaped column, its shape has been made symmetrical not only in side to side direction but also in the back and forth direction, which offers greater control of deformation due to changes in temperature as well as greater stability in accuracy.

2) Linear motor driven X-Y stage

For the table, an X-Y stage that allows the table to move back and forth and from side to side has been adopted. This X-Y stage is mounted at the lowest possible position, reducing rolling of the entire machine. As the machining point is always inside the guide, the influence on the positioning accuracy of a posture change of each axis (which has been reduced to the minimum) is extremely small. In order to realize a non-contact, highly-accurate table drive, a linear motor has been adopted in place of ball screws that are used for conventional machines. As there is no mechanical backlash or lost motion, the movement of the table when axis movement travel reverses the direction is seamless, and contouring is also excellent.

3) Measures in response to thermal displacement and vibration

A thermal distortion stabilization system, which circulates temperature-controlled heat exchange liquid, uniformly controls the thermal distribution **of** the entire machine and ensures geometric accuracy (straightness, squareness, etc) of the machine.

Devices that generate vibration and heat, such as pumps and control units, have been configured in a unified arrangement at the rear side of the machine. As these devices are installed separately from the main unit of the machine, the direct propagation of vibration and heat is eliminated.

4. Accuracy

1) Positioning accuracy of each axis (ISO 230-2)

Accuracy A (2σ): X axis: 0.356 µm, Y axis: 0.508 µm, Z axis: 0.316 µm

2) Circularity of X and Y axes

Configuration accuracy of X-Y axis circular interpolation during actual machining

Circularity: 0.60 µm

Material: A5052

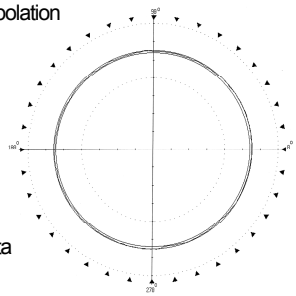
Machining diameter: φ105 mm

Spindle revolution: 12,000^{-1}

Feedrate: 2,000 mm/min

Tool: φ6 mm square end mill

Measuring device: TAYLOR-HOBSON Talycenta



5. Machining example

End milling of φ3-32, φ18-4 and φ20-4 holes on a plastic lens die base plate

Workpiece material: HPM38 (HRc52)

Workpiece size: 200 x 200 x 25 h (mm)

Tool: Coated carbide end mill

Machining liquid: Oil mist

Hole position accuracy: ±1 µm

6. Conclusion

From the steady number of orders received since its launch, it is estimated that the YMC430 has approximately a 20% share of the micro machining center market.

As increasingly stricter demands will be made for higher component accuracy, Yasda continues to position itself to meet the development challenges of such market demands.

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