

“ROBOSPIN”

Robotic Metal Spinning Machine for Non-axisymmetric Products

- Non-axisymmetric shapes (elliptical, polygonal, eccentric, etc.) can be formed using robot control technology.
- This technology is suitable for small production lots with a variety of designs, prototyping and product development because of the low tooling cost and short turnaround.

The National Institute of Advanced Industrial Science and Technology (AIST) and Daitoh Spinning Co., Ltd. have jointly developed a novel metal spinning machine, "RoboSpin," which can form non-axisymmetric shapes.

- (1) A linear motor is adopted to actuate the forming roller and thus control the forming force rapidly.
- (2) The spindle is driven by a servo motor to exactly synchronize with the motion of the forming roller.

RoboSpin can form various non-axisymmetric products with elliptical, eccentric and polygonal shapes, which conventional metal spinning machines cannot handle.

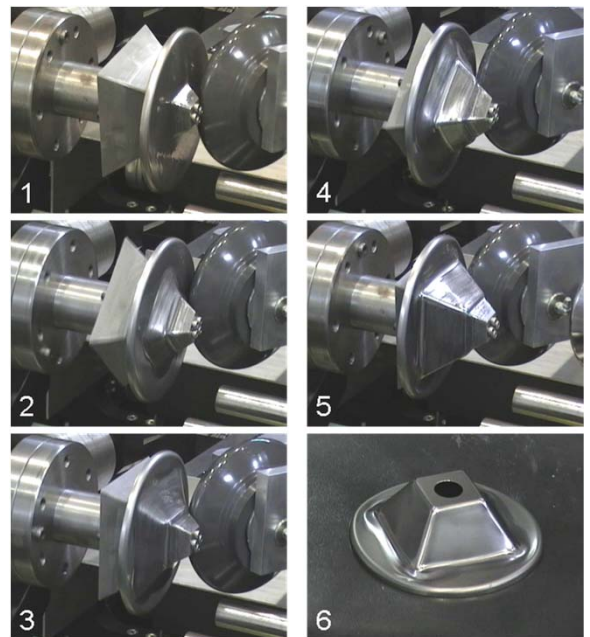
“RoboSpin” Metal Spinning Machine



Examples of Non-axisymmetric Products



Forming a Pyramid Shape



■ Development of RoboSpin ■

Metal spinning is a plastic forming process that shapes a metal sheet or tube by forcing it onto a rotating mandrel using a roller tool. It is widely used for making round hollow metal products in various industries, such as the automotive, aerospace, electronics, medical, lighting, architectural, etc. This forming process is suitable for limited production lots of a wide variety of products and it is particularly effective in prototyping and product development, since it needs only one mandrel, which costs much less than the dies for metal stamping or deep drawing.

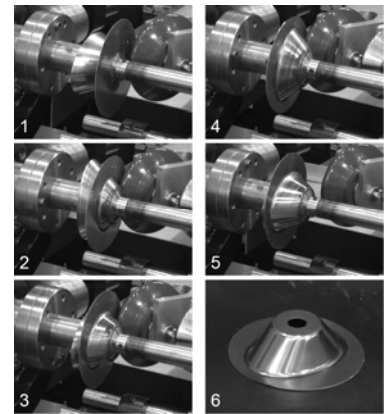
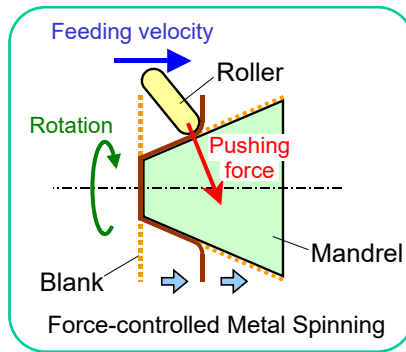
AIST has been studying metal spinning methods in which robot technologies are applied, with the aim of developing versatile and intelligent forming processes. In particular, AIST is conducting R&D on the metal spinning of non-axisymmetric shapes. Metal spinning products have been inherently limited to axisymmetric shapes that have circular cross sections around the rotation axis. However, there is a potential demand for non-axisymmetric products formed by metal spinning which have elliptical, polygonal, eccentric or other non-axisymmetric cross sections. Metal spinning will be used more widely if it can produce a variety of non-axisymmetric products.

AIST and Daitoh Spinning Co., Ltd., a manufacturer specialized in metal spinning machines, have recently developed "RoboSpin" as a functional prototype of a metal spinning machine for forming non-axisymmetric products.

■ Methods of Forming Non-axisymmetric Shapes ■

RoboSpin performs two basic metal spinning actions to form non-axisymmetric products: *force-controlled metal spinning* and *synchronous metal spinning*.

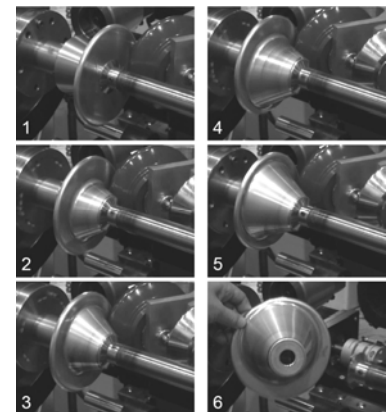
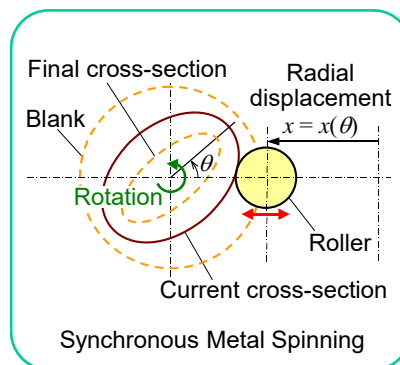
In **Force-controlled Metal Spinning**, a non-axisymmetric mandrel is used. The pushing force of the forming roller is controlled so that the material is forced onto the mandrel. Meanwhile, the forming roller is driven at a constant velocity parallel to the mandrel axis. The roller follows the contour of the mandrel to fit the material to the mandrel. Finally, a non-axisymmetric product of the same shape as the mandrel is fabricated.



Forming process

While a non-axisymmetric product is being spun, the roller must move forward and backward very rapidly. In Robospin, a linear motor directly drives the roller. The roller can quickly track the contour of the mandrel, and the forming time of the non-axisymmetric product is thus reduced.

Another method of forming non-axisymmetric products is **Synchronous Metal Spinning**. The radial displacement, x , of the roller is controlled in synchrony with the rotation angle, θ , of the work piece. The trajectory of the contact point between the roller and the work piece creates the desired cross-section shape. This method is especially effective in forming non-axisymmetric tubes, since no mandrel is necessary. The combination of synchronous metal spinning and force-controlled metal spinning can easily deal with complex shapes and low-formability materials.



Forming process

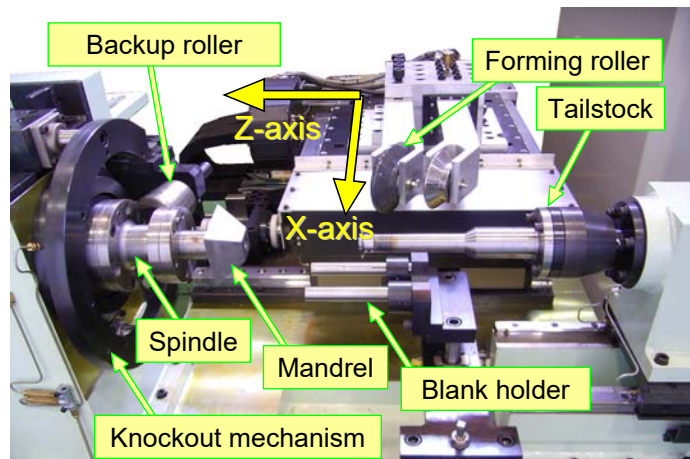
■ Other Functions ■

Various helpful functions, which are implemented in conventional metal spinning machines, are also integrated into RoboSpin.

- A teaching-playback function using a joystick for PNC spinning (circular products only).
- Utility functions for the forming task ... automatic tailstock, blank holder, backup roller, knockout mechanism, etc.

Specifications of RoboSpin

Size	Width 2875mm × Depth 1820mm × Height 1895mm
X-axis (radial)	Linear Servo Motor rated thrust 4000N
Z-axis (axial)	Servo Motor + Ball Screw rated thrust 10000N
Spindle	Servo Motor + Planetary Gear rated power 7.5kW rated speed 375rpm
Work	Max. diameter 400mm length 350mm



Contact

Daitoh Spinning Co. Ltd.
738-5, Nakano, Oura-Cho, Oura-Gun, Gunma
370-0603 JAPAN
phone: +81-276-70-2350 fax: +81-276-88-8656
E-mail: daitoh-spinning@nifty.com
http://www.daitohsp.co.jp/index_e.html

Dr. Hirohiko Arai
Advanced Manufacturing Research Institute
National Institute of Advanced Industrial Science & Technology (AIST)
1-2-1 Namiki, Tsukuba, Ibaraki 305-8564 JAPAN
phone: +81-29-861-7088 fax: +81-29-861-7167
E-mail: h.arai@aist.go.jp <http://staff.aist.go.jp/h.arai/>