

**MITSUBISHI ELECTRIC CORPORATION**  
**PUBLIC RELATIONS DIVISION**  
7-3, Marunouchi 2-chome, Chiyoda-ku, Tokyo, 100-8310 Japan

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**No. 3218**

*Customer Inquiries*

*Media Inquiries*

Advanced Technology R&D Center  
Mitsubishi Electric Corporation  
[www.MitsubishiElectric.com/ssl/contact/company/rd/form.html](http://www.MitsubishiElectric.com/ssl/contact/company/rd/form.html)  
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## **Mitsubishi Electric's New Dot Forming Technology Achieves High-precision Three-dimensional Metal Shaping**

*Raises productivity in wide range of applications, including part manufacturing and build-up repair*

**TOKYO, October 23, 2018** – [Mitsubishi Electric Corporation](http://www.MitsubishiElectric.com) (TOKYO: 6503) announced today that it has developed a unique dot forming technology that realizes high-precision shaping by combining laser, computer numerical control (CNC) and computer aided manufacturing CAM technologies in 3D printers. The technology produces high-quality three-dimensional (3D) parts with few voids at high speed, employing a laser wire directed-energy deposition (DED) method, which is an additive-manufacturing process that uses focused thermal energy to fuse materials as they are deposited. Mitsubishi Electric believes that its new technology will raise productivity in a wide range of applications, such as the “near-net” (near-final) shaping of aircraft and automobile parts and build-up repairs.

A three-dimensional metal shaping machine incorporating the new technology will be exhibited for reference at the 29th Japan International Machine Tool Fair (JIMTOF2018), which will be held at the Tokyo Big Sight exhibition complex beginning November 1. Mitsubishi Electric expects to launch a commercial version within the fiscal year ending in March 2021.

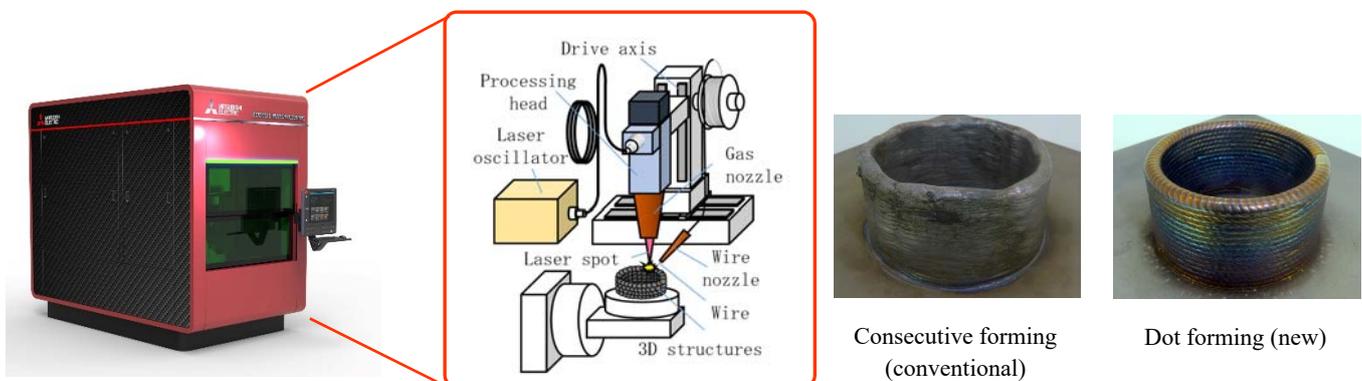


Fig. 1 System components and comparative samples

## **Background of Development**

Amid increasing demands for low-volume production, 3D shaping technology is being used to manufacture metal parts, especially for aircraft and automobiles, because the technology eliminates cost-bearing needs for jigs and assemblies and improves design freedom. The global market for 3D metal shaping equipment is expected to be growing up.

## **Key Features**

### ***1) High-quality 3D parts formed at high speed***

- High-quality 3D parts with few voids can be formed at high speed using the laser wire DED method, which supplies metal wire directly to the laser-irradiated part for build-up shaping.
- A variety of 3D shapes are possible, including hollow or overhanging shapes.
- The technology can be combined with parts produced by other manufacturing methods and is therefore effective in build-up repairs.
- Common, proven and inexpensive laser-welding wire can be used.

Conventional 3D metal modeling equipment employs the powder bed fusion (PBF) method, in which stacked layers of thin metal powders are fused and bonded by a laser. While PBF can form detailed, complicated shapes with high precision, time is required for modeling and voids tend to form inside the shaped objects. The laser wire DED method, however, offers the advantage of forming dense objects at high speed.

### ***2) Improved shape accuracy through unique dot forming technology***

- Unique technique repeats spot forming by synchronously controlling the pulsed laser irradiation, the supply of metal wires and shield gas, and the shaping position. Shape accuracy is 60% more precise compared to conventional consecutive forming technology.
- Oxidation, a problem with the conventional technology, can be reduced by more than 20% compared to the conventional technology because high temperature area are limited to a narrow spot forming area.
- Complex shapes can also be formed by using special CAM processes compatible with dot forming technology.

When shaping 3D objects using the laser wire DED method, the laser is used to melt and deposit the material. Heat generated by the laser and heat from the just-deposited material are transferred to the deposition base. If the laser is continuously irradiated, the temperature of the deposition base rises. If a new molten material is then deposited on this extra-hot base, it can take time to solidify, during which time the shape can collapse under its own weight.

To prevent such heat problems, Mitsubishi Electric has combined unique laser and CNC technologies, specifically, a pulsed laser and minimized heat input, to ensure adequate cooling time. Also, shape collapse is

avoided with a new dot forming technology that synchronously controls the supply of wires and shield gas and the position and moving speed of the laser irradiation point (Fig. 2 and 3). High temperatures are limited to a point-like narrow area, so the antioxidant action of the shield gas spreads over the entire high-heat area to suppress oxidation.

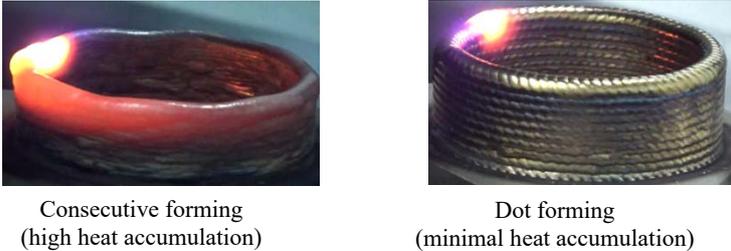


Fig. 2 Comparison of forming processes

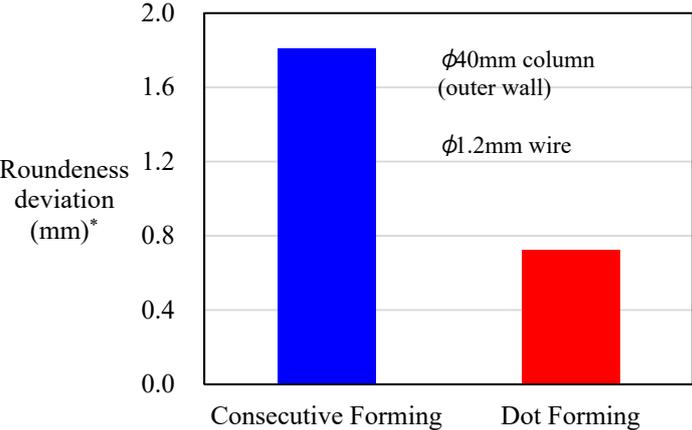


Fig. 3 Forming accuracy (roundness deviation)

\* Difference between radii of two concentric circles sandwiched between two concentric geometric circles, when the distance between the former is minimal

The production of complex shapes is further supported with the use of special-purpose CAM that automatically generate special forming paths corresponding to the dot forming technology (Fig. 4).



Fig. 4 Examples of dot forming technology

### **Contribution to the Environment**

The use of metal wires, which are simpler to manufacture than conventional powders, reduces the energy used to manufacture raw materials, greatly reduces the amount of material scattered during forming, and realizes an environmentally friendly production process.

### **Patents**

The patents for the newly developed technology announced in this new release number five in Japan and one in other countries.

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### **About Mitsubishi Electric Corporation**

With nearly 100 years of experience in providing reliable, high-quality products, Mitsubishi Electric Corporation (TOKYO: 6503) is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. Embracing the spirit of its corporate statement, Changes for the Better, and its environmental statement, Eco Changes, Mitsubishi Electric endeavors to be a global, leading green company, enriching society with technology. The company recorded consolidated group sales of 4,444.4 billion yen (in accordance with IFRS; US\$ 41.9 billion\*) in the fiscal year ended March 31, 2018. For more information visit:

[www.MitsubishiElectric.com](http://www.MitsubishiElectric.com)

\*At an exchange rate of 106 yen to the US dollar, the rate given by the Tokyo Foreign Exchange Market on March 31, 2018