PROTERIAL

# News Release

February 13, 2024
Proterial, Ltd.

## Development of Laminated Bonded Amorphous Alloy Ribbon for Motor Cores

Proterial, Ltd. (hereinafter referred to as "Proterial") has developed a laminated bonded amorphous alloy*1 ribbon for motor cores. Amorphous alloys are a low-loss material and are considered to be suitable for high-efficiency motors. However, because of their greater hardness and thinner material compared to electromagnetic steel sheets*2, their application in the mass production of motor cores has been limited to those for axial-gap motors*3. The newly developed laminated bonded amorphous alloy ribbon has a thickness close to that of electromagnetic steel sheets, enabling its application to radial-gap*5 motors, which are a type of motor commonly used as xEV*4 drive motors.

We will continue to provide solutions to the thinness issue through lamination and at the same time provide solutions to the punching issue*6 through the optimization of die materials to help further expand the range of motors that use amorphous alloys.

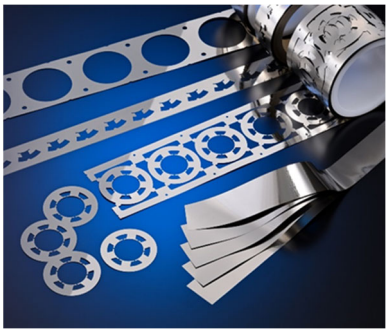
### 1. Background

xEV drive motors, as well as motors used in industrial machinery, home appliances, and other applications account for roughly 60% of Japan's electricity consumption. As such, there is a need for motors with greater efficiency. Since the reduction of iron loss*7 of the core (iron core) is essential for greater motor efficiency, efforts have been ongoing to improve non-oriented electromagnetic steel sheet materials*8. These efforts, however, are said to be approaching their limits.

In recent years, amorphous alloys have been attracting attention as a low iron loss material that exceeds the limitations of electromagnetic steel sheets. It is known that iron loss can be significantly reduced by using amorphous alloys for motor cores compared to using ordinary electromagnetic steel sheets. However, amorphous alloys are about five times harder than electromagnetic steel sheets, resulting in a shorter service life of the punch die. Additionally, the material is only about 1/10th the thickness of electromagnetic steel sheets, resulting in lower productivity in the punching process. Due to these issues, their application in mass produced motors has been limited to axial-gap motors that avoid the use of punching processes.

At Proterial, a leading manufacturer of amorphous alloys for transformer cores, we have been engaged in ongoing research and development, building on our accumulated knowledge of amorphous alloys, to realize the application of cores made of amorphous alloys for radial-gap motors.

### 2. Overview



At Proterial, we have developed a technology for continuously laminating and bonding multiple sheets of amorphous alloy ribbons for radial-gap motor cores. The key points of this technology are selection of the adhesive and control of adhesive layer thickness. With the development of proprietary technology that enables formation of layers of adhesive thinly and uniformly, we are able to achieve a high space factor of 90% or more and laminate the material, with no degradation in the excellent magnetic properties of amorphous alloys. The laminated and bonded material has a thickness comparable to that of electromagnetic steel sheets, which improves material handling and significantly reduces the number of processing

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man-hours required. Another feature is that with this increased thickness, the machining accuracy of the punch die can be relaxed.

We also have a roadmap for improving the service life of the punch die through the selection of die materials and coatings that are suitable for amorphous alloys.

Proterial has begun offering samples of bonded amorphous alloy ribbon to motor manufacturers and core fabricators. We will continue to focus on achieving mass production of radial-gap motors that use amorphous alloys by making use of our knowledge and experience in dies and working together with our customers to further improve them.

End of release

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*1 Amorphous alloys: Metal that does not have a crystalline structure as a result of being formed by cooling molten alloy rapidly

*2 Electromagnetic steel sheet: Magnetic material consisting of iron and silicon

*3 Axial-gap motor: Motor with a stator sandwiched between two disk-shaped rotors

*4 xEV: Collective term for electric vehicles (EVs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs)

*5 Radial-gap motor: A common type of motor with a stator surrounding a cylindrical rotor

*6 Punching: A machining process where material is placed between a die and plate, and the die is pressed against the material to punch out an arbitrary shape

*7 Iron loss: Loss of energy that occurs when an AC magnetic field is applied to an iron core

*8 Non-oriented electromagnetic steel sheet: An electromagnetic steel sheet with nearly uniform magnetic properties in all directions, commonly used as motor cores

## ■About PROTERIAL

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"Proterial" reflects the essence of our corporate philosophy, which consists of three elements: Mission: "Make the best quality available to everyone;" Vision: "Leading sustainability by high performance;" and Values: "Unfaltering integrity" and "United by respect." It combines "pro-" with the word "material."
"Pro-" represents our "three pros":

- Professional — work that exceeds expectations
- Progressive — a spirit that keeps challenging
- Proactive —an enterprising attitude

"Material" refers to the high-performance materials that our original technologies produce and underpinned by the three pros. With our focus on solving customer issues and bringing new levels of value, we promise to contribute to the realization of a sustainable society through the products and services that embody our philosophy.

## ■Proterial, Ltd. — Company Overview

Established: April 1956
Head office: Toyosu Prime Square, 5-6-36 Toyosu, Koto-ku, Tokyo 135-0061, Japan
Capital: 310 million yen (as of March 31, 2023)
Representative: Representative Director, Chairman, President and Chief Executive Officer (CEO)
Sean M. Stack
Sales revenue: 1,118.9 billion yen (Term ended March 2023)
History: 1910: Founded as Tobata Foundry Co.
1937: Merged with Hitachi, Ltd.
1956: Established separately as Hitachi Metals Industries, Ltd.
2023: Company separated from the Hitachi Group, and renamed from Hitachi Metals, Ltd. to Proterial, Ltd.

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