FOR IMMEDIATE RELEASE

Development of IE5-class efficiency standard amorphous motor

Material evaluation & design technology to achieving 96% motor efficiency

Tokyo, July 9, 2014 – Hitachi, Ltd. (TSE: 6501, "Hitachi") and Hitachi Industrial Equipment Systems Co., Ltd., (Hitachi Industrial Equipment Systems) today announced the joint development of an amorphous motor(1) which achieves the highest industrial motor efficiency standard of IE5(2). This was realized by the development of high accuracy evaluation technology and design optimization of the amorphous metal(3) used in the core of the motor. The new 11kW amorphous motor prototyped with this technology is more compact than the previous 11kW models, and achieved a further 30% reduction in motor loss compared to the IE4-class(4) motor to realize 96% energy efficiency. The next step will be to develop this technology with a target of product launch in fiscal 2015, for sale as a motor to be used in industrial pumps and fans

A part of this work was supported by The New Energy and Industrial Technology Development Organization (NEDO), Japan, support program for the development of practical technology to substitute or reduce rare metals. In the practical implementation phase, technology was developed to respond to the need for further reduction in power consumption.

The growing social awareness of recent years in environmental issues such as global warming, have raised interest in technology which increases the efficiency of electrical equipment and reduces energy consumption. In relation to motors, the use of IE3-class or above has become mandatory in the US since 2010, and similar regulations will be implemented in Japan from fiscal 2015. Thus, from the viewpoint of energy conservation, there is a growing need worldwide to replace industrial equipment with high-efficiency motors. In response to this need, Hitachi and Hitachi Industrial Equipment Systems employed amorphous magnetic metal in the motor core and developed basic technology for an axial gap motor in 2008, and have been promoting product development for higher capacity, greater efficiency and increased model line-up. In 2012, a prototype 11kW amorphous motor complying with IE4-class standard of 93% energy efficiency was successfully developed.

This time, Hitachi and Hitachi Industrial Equipment Systems have succeeded in developing a medium capacity 11kW amorphous motor which is more compact than the previous model without making major structural changes, and achieves higher energy efficiency than IE4-class, fulfilling the highest standard in the efficiency guideline of IE-5 class. Amorphous metals are characterized by their difficulty to process, and large changes in material magnetism caused by the disturbance which occurs when the motor core is machined. In order to raise the efficiency of the motor, it was necessary to devise a means to effectively employ amorphous metals. Using technical know-how built-up through working with amorphous metals in transformers, design optimization was applied to draw-out the desired characteristics of the amorphous metal to greatly increase the efficiency of the motor.

Features of the technology developed are summarized below.

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(1) **Technology to assess the magnetic characteristics of the amorphous metal core**

Amorphous metals have a significantly lower loss characteristic, approximately 1/10 that of magnetic sheet material used in conventional motors, however, when it is used in the stator core of motors, deterioration due to processing(5) becomes an issue. This refers to the deterioration in magnetic or ferrite-loss characteristics which occurs during processing due to the residual stress on the core or stress state while the core is fixed. With previous techniques used, it was difficult to accurately monitor the magnetic characteristic of the amorphous metal when it was applied to the stator core. In this development, extremely small magnetic sensors(6) were placed on the surface of the core, enabling for the first time, measurement such as the flow of inner magnetic flux. Further, with previous measurements of amorphous metal loss, large error fluctuations of up to 2 to 5 times occurred; with the new technology measurement error was contained within ±5%, significantly raising precision.

(2) **IE5-class motor prototype and evaluation**

By developing a high-speed high-accuracy motor design method based on know-how of various 3-dimensional FEM analyses(7) and permeance analysis(8), characteristic predictions from electrical characteristics to thermal computation can be conducted in 1/10 the time with more than twice the accuracy. Further, by including the magnetic characteristics of amorphous metals to the material property parameter, and using this to conduct a large-scale parameter survey of the core state to optimize design, it is now possible to design the motor even more efficiently. Targeting 11kW-capacity motors, a cooling fan-less short axial length structure was designed, and evaluated. The results confirmed a high-energy efficiency motor fulfilling the highest IEC guideline level of IE5.

Notes

(1) Amorphous motor: April 2002 Hitachi News Release announcing the development of an axial gap motor with an amorphous metal core, achieving IE4-class motor efficiency (95% with 11kW) without using rare-earth metals. http://www.hitachi.com/New/cnews/120411.html
(2) IE5: Currently the highest standard set out in IEC60034-30-2, the IEC guideline for motor energy efficiency
(3) Amorphous metal: Solidified by rapid cooling, the metal has unique characteristics compared to normal crystalline material.
(4) IE4: The standard set out in IEC60034-30/31 guideline for motor energy efficiency
(5) Deterioration due to processing: When the motor core material is subjected processing such as to the press or bending, residual stress is generated and increases loss. In general, it is said that the lower the loss, the greater the deterioration.
(6) Extremely small magnetic sensors: A group of coils to measure the quantity of magnetic flux in a cavity. Precision of the coil conductor position was improved to increase the accuracy in measuring weak magnetic flux.
(7) 3-dimensional finite element (FEM) analysis: A method which creates a 3-dimensional mesh model based on the actual mechanical structure, and calculates the machine's global quantities with the mesh model.
(8) Permeance analysis: A method to calculate magnetic permeance (magnetic resistance) which expresses the difficulty of magnetic flux penetration.

Fig. 1. IE5-class 11kw prototype motor

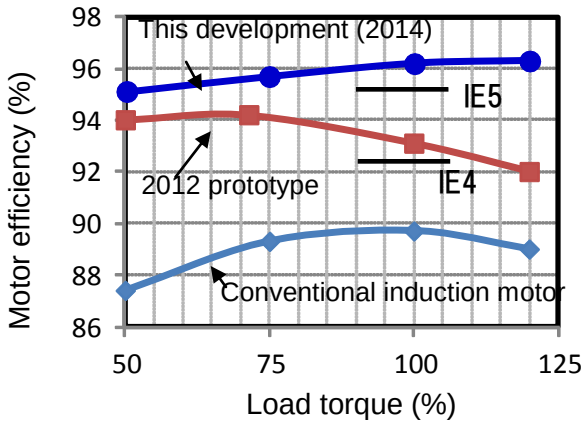

Fig. 2. Comparison of motor efficiency (11kW)

Exhibit at "Techno Frontier 2014"

Hitachi and Hitachi Industrial Equipment Systems will be exhibiting the prototype at the 32nd Precision Electric Products & Technology Exhibition "MotorTech Japan 2014", held in conjunction with Techno Frontier 2014, from 23rd - 25th July 2014 at the Tokyo Big Sight, Tokyo, Japan. The technology will also be presented at the Motor Technology Symposium which is also being held in conjunction.

About Hitachi, Ltd.

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, delivers innovations that answer society's challenges with our talented team and proven experience in global markets. The company's consolidated revenues for fiscal 2013 (ended March 31, 2014) totaled 9,616 billion yen ($93.4 billion). Hitachi is focusing more than ever on the Social Innovation Business, which includes infrastructure systems, information & telecommunication systems, power systems, construction machinery, high functional materials & components, automotive systems, healthcare and others. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

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