ISO Standardization for Active Magnetic Bearing Technologies

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Magnetic levitation is one of our industrial dream technologies from ancient time. In fact, many ideas were offered to levitate an objector without any mechanical contact by using various layouts of permanent magnets. All these ideas looked magic in simple ways. Instead of these passive means, the active feedback means combining the electromagnets with the displacement sensors have recently been introduced to industrial machines, i.e., railway cars, TMPs (turbo molecular pump), centrifugal pumps and so on. In this AMB (active magnetic bearings) system, the objector / rotor position is measured by displacement sensors and the measured offset from the center is compensated by electromagnet forces on the basis of feedback control theory. The AMB is then capable to of maintaining the rotor at the neutral position with no mechanical contact and no loss.

The AMB technology is quite new compared to conventional bearings including ball bearings, oil-film bearings, etc. It requires the knowledge of a typical mechatronics, because it consists of mechanical electromagnetic bearing and electrical sensing and computer controlling. We found that vendors wanted more simpler and more reliable design for cheaper AMB products. And, customers were confused and could not understand the benefit of the introduction to their own machines and how it operates. In some of the cases, we encountered misunderstanding and conflicts between the vendor and the customers. Therefore, we recommended both parties with the ISO standardization as they wanted immediate resolutions for unanticipated / unexpected situations.

Since the ISO TC108/SC2/WG7 AMB project was established in 1996, the standardization of AMB technology has continued to expand with AMB applications. In the past 12 years, we discussed the standardization at 24 meetings held at numerous worldwide places. The following parts have been developed:

ISO 14839-1 Vocabulary; published in May, 2002
ISO 14839-2 Evaluation of vibration; published in July, 2004
ISO 14839-3 Evaluation of stability margin; published in May, 2006
ISO WD14839-4 Technical guidelines; still being developed, 2010

These four standards play an important role for AMB businesses for the smooth operation of each process for planning, designing, trading, commissioning, etc.

Meanwhile, our project, which is supported by the NEDO grant, works from FY2002 to FY2004 as the main members of WG7. In Part 3, particularly, the stability margin of AMB control systems is a new subject not seen in conventional standards. A consensus has been missing for a long time due to each company's internal knowledge. To resolve this deadlock, international collaborative tests were successfully achieved in a three-year program. This collaboration finally created a consensus and accelerated the standardization process toward a publication. Our activity was recognized by the JSME "Standards Board Contribution Awards" in 2005 and gained positive appraisal and approval from the ISO TC108/SC2 organizations.

In my talk, the following topics are presented at this workshop:

(1) Principle of Magnetic Levitation by Passive or Active Control
(2) AMB system descriptions and Applications
(3) ISO Standardization of AMB Rotating Machinery