APPLICATION NOTES

Permeability measurement of non-magnetic steel materials crucial in reducing heat loss in high-power magnetic force generators

Improving energy efficiency is critical for reducing carbon dioxide emissions, which are a major contributor to global warming. One way to achieve this is to use energy sources without converting them into heat, especially when generating electricity. Unfortunately, facilities and equipments that employ electromagnetic induction principles generate eddy currents and resistance caused by anti-magnetic fields. Consequently, a considerable amount of energy is lost as heat energy, which lowers the overall energy efficiency.

A Maglev, or a linear motor car, uses superconducting magnets on the car and electromagnetic coils on the track for levitation and propulsion. However, the technology has significant issues due to electromagnetic induction. As the vehicle moves, the electromagnetic induction generates eddy currents in the steel framework, causing energy loss. In addition, the anti-magnetic field generated by this process creates resistance to the movement of the vehicle. Ordinary track steel utilized in the track has a high magnetic permeability, making it susceptible to these effects.

To address these issues, non-magnetic steels with a specific permeability of 1.1 or less, like austenitic stainless steels and high manganese steels, are used to suppress energy loss from eddy currents and anti-magnetic fields. Therefore, non-magnetic steels are commonly utilized for steel bars, bolts, and other metal fittings within the range of magnetic influence.

Strict control of these steel materials is critical during manufacturing, storage, outgoing inspection, delivery to the construction site, and secondary processing. Maintaining precise magnetic permeability control for non-magnetic steels is necessary at all stages to prevent undesired influence from other steel materials.

Effective management of non-magnetic steel is vital for multiple applications, including synchrotron radiation facilities, medical facilities utilizing MRI technology, and electric power facilities.

*Figure 1: Maglev, linear motor car**

Figure 2: MAGNETSCOP 1.070 and permeability measurement probe

The MAGNETSCOP 1.070 is a lightweight and highly portable device that measures specific permeability (μr: 1.00000 to 2.00000) quickly and accurately. It can be taken into the field, it operates on battery power, and allows for easy recording of measurement results.

Compliant with IEC60404-15 and ASTM A432/A432M.

**Source: https://scmaglev.jr-central-global.com/about/design/*