

## RECENT DEVELOPMENTS OF NON-ORIENTED ELECTRICAL STEEL SHEET FOR AUTOMOBILE ELECTRICAL DEVICES

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In recent years, there has been a strong demand for improving the fuel economy of automobiles in an effort to protect the global environment. To improve the fuel economy, hydraulic drive parts in automobiles have begun to be replaced with electrical drive devices, such as electric power steering (EPS) and electric brake systems. Moreover, a hybrid electric vehicle (HEV) has been developed, and the market is being expanded. In an HEV, some high-frequency electrical devices such as traction motors, generators, air conditioner motors and reactors are used. Therefore, the amount of both motor and actuator use increases, and they are playing an important role in automobiles. Non-oriented electrical steel sheets are used as the core material for such electrical devices, and they are contributing to the improvement in the efficiency of the apparatus.

In this paper, recent developments of non-oriented electrical steel sheet for automobile electrical devices, such as HEV traction motors, EPS motors and high-frequency reactors, are reviewed and discussed.

In HEV traction motors, high torque, high efficiency and small size are demanded. In order to satisfy such demands, the internal permanent magnet (IPM) type motor is mainly used in Japan. Non-oriented electrical steel sheets for HEV traction motors should have high magnetic flux density for high torque, low iron loss for high efficiency and high strength for reliability. JFE Steel has developed electrical steel sheets for energy efficient motors<sup>1)</sup>, and it is suitable for HEV traction motors. The developed material achieved low iron loss and high magnetic flux density by high purification and texture control. Moreover, JFE Steel has developed thin-gauge electrical steel sheets for high frequency motors. This material shows lower iron loss than that of conventional products in high-frequency range (Fig.1).

Some of the HEVs are equipped with a converter/inverter for power conversion. The properties of low iron loss in the high frequency range for compactness, together with low noise for quietness are required in the core material for this application. JFE Steel developed a 6.5% Si steel sheet, which shows low iron loss and low noise in the 400Hz to 10kHz so it is the optimum material for high frequency reactors (Table 1).

### References

- 1) Y. Oda, M. Kohno, A. Honda, Journal of Magn. Magn Mater. 2430-2435 (2008) 320

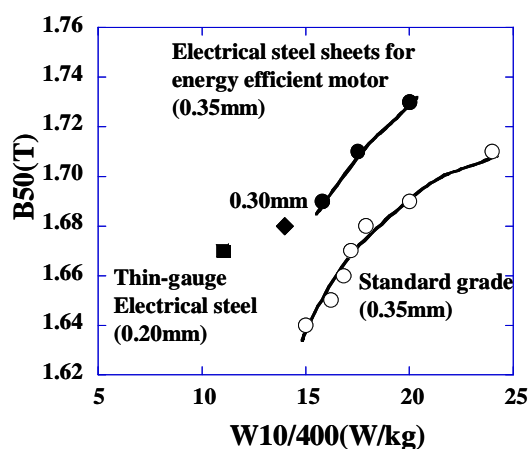


Fig.1 Magnetic properties of thin-gauge electrical steel sheet

Table 1 Magnetic properties of 6.5% Si steel sheet

Materials	Thickness (mm)	Saturation magnetization (T)	Iron loss W <sub>10/400</sub> (W/kg)	Magnetostriction $\lambda_{10/400}$ ( $\times 10^{-6}$ )
6.5%Si steel	0.10	1.80	5.7	0.1
Grain oriented electrical steel sheet (Si:3wt%)	0.10	2.00	7.2	-0.8
	0.23	2.00	7.8	
Non-oriented electrical steel sheet (Si:3wt%)	0.20	2.00	10.4	7.8
	0.35	2.00	14.4	
Fe-based amorphous	0.025	1.50	1.5	27