ELECTRON ENERGY CORPORATION

Specialists in Rare Earth Magnets and Magnet Systems

Temperature Compensated Magnets

Some magnet applications benefit from having a constant magnetic field strength over a temperature range of interest. This characteristic is referred to as α, the reversible temperature coefficient of residual induction (B_r) and is defined as follows:

$$\alpha = (\Delta B_r/B_r) \times (1/\Delta T) \times 100\%$$

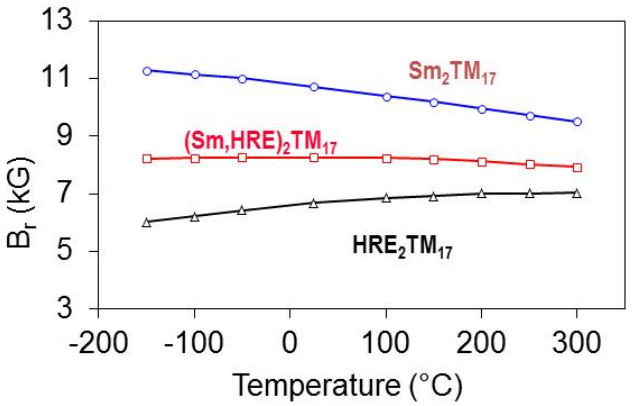
where ΔB_r is the change of residual induction B_r while ΔT is the change of temperature.

For some applications such as traveling wave tubes (TWT), gyroscopes and accelerometers, the reversible temperature coefficient of B_r is required to be as low as possible. To address this requirement, we developed a series of temperature compensated Sm-Co magnets.

Heavy rare earth (HRE) elements, such as Ho, Er, Gd, and Tb, can be substituted for a portion of the Sm in order to improve reversible temperature coefficient of residual induction.

The following figure shows that, for Sm_2TM_{17} (TM = transition metal) magnets, the residual induction, B_r, decreases as temperature increases. As shown, Sm_2TM_{17} magnets have a negative reversible temperature coefficient of residual induction. Conversely, the HRE_2Co_{17} alloys have a positive reversible temperature coefficient of B_r. By carefully adjusting the compositions, substituting HRE elements for a portion of the Sm, EEC has developed a series of temperature compensated Sm-Co 2:17 magnets with reversible temperature coefficient of B_r very close to zero, as shown by the $(Sm,HRE)_2TM_{17}$ data points.

924 Links Avenue, Landisville, PA 17538 • 717.898.2294 • Fax: 717.898.0660
www.electronenergy.com



Temperature dependence of residual induction Br for Sm_2TM_{17}, $(Sm,HRE)_2TM_{17}$ and HRE_2TM_{17} magnets (TM=transition metals, HRE=heavy rare earth)

The following table shows the comparison of reversible temperature coefficient for some RE_2TM_{17} magnets.

Grades	$(BH)_{max}$	Typical RTC of B_r	Comment
EEC 2:17-24	24 MGOe	-0.035 %/°C	no compensation
EEC2:17TC-18	18 MGOe	-0.02 %/°C	some compensation
EEC2:17TC-16	16 MGOe	-0.001 %/°C	Full compensation

The typical reversible temperature coefficient (RTC) of B_r is calculated between -50 and 150°C. The fully compensated EEC2:17TC-16 magnets have a typical RTC of -0.001%/°C. Of course the RTC of B_r will be more meaningful if it is determined in the actual device in the temperature range of interest for specific applications.

Typical applications which benefit from using temperature compensated Sm-Co magnets include gyroscopes, accelerometers, traveling wave tubes (TWT) and high precision weighing scales. Please contact EEC engineering department if the RTC of B_r is critical for your application. We can work with you to determine the best possible composition for your specific application.