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TECHNICAL REPORT

Rare earth sintered magnets – Stability of the magnetic properties at elevated temperatures

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms and definitions 7
4 Classification of magnetic flux loss due to temperature 9
4.1 Reversible flux loss 9
4.2 Irreversible flux loss 9
4.3 Permanent flux loss 9
5 Long term ageing of rare earth magnets 10
6 Experimental 11
7 Temperature stability 13
7.1 Flux change due to temperature 13
7.2 Effect of temperature on B_r and H_{cJ} (demagnetization curves at different temperatures) 14
7.3 The time effects at constant temperature (influence of temperature exposure and *L/D*) 16
7.4 The influence of H_{cJ} on the irreversible flux loss for Sm_2Co_{17} magnets 18
7.5 The influence of H_{cJ} on the irreversible flux loss for Nd-Fe-B magnets 20
7.6 Irreversible flux loss per decade 22
7.7 Permanent flux loss 22
8 Summary 24
Annex A (informative) Summary of temperature stability graphs 25
Annex B (informative) Non-linearity of temperature dependence of B_r and H_{cJ} 26
Bibliography 27

Figure 1 – Change of magnetic flux density operating on a load line during elevated temperature ageing after R. Tenzer (schematic) [7, 8] 10
Figure 2 – Long term ageing of rare earth magnets (schematic) [9] 11
Figure 3 – Measuring system of open circuit flux utilizing a fluxgate type digital integrating fluxmeter [13] 12
Figure 4 – Temperature dependence of flux for $SmCo_5$ magnet (*L/D* = 0,7) [16] (See Table 1) 14
Figure 5 – Temperature dependence of flux for Sm_2Co_{17} magnet (*L/D* = 0,7) [16] (See Table 1) 14
Figure 6 – Temperature dependence of flux for Nd-Fe-B magnet (*L/D* = 0,7) [17] (See Table 1) 14
Figure 7 – *J-H* demagnetization curves of Nd-Fe-B magnet measured at different temperatures [18] 14
Figure 8 – *J-H* demagnetization curves of Nd-Fe-B magnet measured at different temperatures [19] 15
Figure 9 – Temperature dependence of normalized B_r and H_{cJ} for $SmCo_5$, Sm_2Co_{17} and Nd-Fe-B magnets [19] 15
Figure 10 – Time dependence of irreversible flux loss for $SmCo_5$ magnet exposed at different temperatures [22] 16
Figure 11 – Time dependence of irreversible flux loss for $SmCo_5$ magnets with various *L/D*s [24] 16

Figure 12 – Time dependence of irreversible flux loss for Sm_2Co_{17} magnet exposed at different temperatures (Material 1) [22] 17

Figure 13 – Time dependence of irreversible flux loss for Sm_2Co_{17} magnets with various *L/D*s (Material 2) [24] 17

Figure 14 – Time dependence of irreversible flux loss for Nd-Fe-B magnet exposed at different temperatures [23] 17

Figure 15 – Temperature dependence of irreversible flux loss after exposure for 100 h for Nd-Fe-B magnets with various *L/D*s [25] 17

Figure 16 – Time dependence of irreversible flux loss for a Sm_2Co_{17} magnet with H_{cJ} = 0,48 MA/m and *L/D* = 0,7 [26] 19

Figure 17 – Time dependence of irreversible flux loss for a Sm_2Co_{17} magnet with H_{cJ} = 1,19 MA/m and *L/D* = 0,7 [27] 19

Figure 18 – Time dependence of irreversible flux loss for a Sm_2Co_{17} magnet with H_{cJ} = 1,97 MA/m and *L/D* = 0,7 [28] 19

Figure 19 – Time dependence of irreversible flux loss for a Nd-Fe-B magnet with H_{cJ} = 1,16 MA/m and *L/D* = 0,7 [30] 20

Figure 20 – Time dependence of irreversible flux loss for a Nd-Fe-B magnet with H_{cJ} = 1,66 MA/m and *L/D* = 0,7 [31] 20

Figure 21 – Time dependence of irreversible flux loss for a Nd-Fe-B magnet with H_{cJ} = 2,17 MA/m and *L/D* = 0,7 [32] 21

Figure 22 – Time dependence of irreversible flux loss for a Nd-Fe-B magnet with H_{cJ} = 2,45 MA/m and *L/D* = 0,7 [33] 21

Figure 23 – Comparison of irreversible flux loss for Sm_2Co_{17} magnets with different H_{cJ} 21

Figure 24 – Comparison of irreversible flux loss for Nd-Fe-B magnets with different H_{cJ} 21

Figure 25 – Relationship between irreversible flux loss per decade and initial flux loss 23

Figure B.1 – Temperature dependence of normalized B_r and H_{cJ} to show the non-linearity (see data for Nd-Fe-B magnets in Figure 9) 26

Table 1 – Magnetic properties of the rare earth magnets employed for the open circuit flux measurements to determine the reversible temperature coefficient of the magnetic flux 13

Table 2 – Reversible temperature coefficient of the magnetic flux determined by temperature cycling 13

Table 3 – Temperature coefficients of B_r and H_{cJ} for $SmCo_5$, Sm_2Co_{17} and Nd-Fe-B magnets (temperature range for the coefficient: 25 °C to 150 °C) 16

Table 4 – Magnetic properties of the specimens for the experiments to evaluate the effects of temperature and *L/D* on irreversible flux loss 18

Table 5 – Magnetic properties of the Sm_2Co_{17} magnets for the experiment to evaluate the influence of H_{cJ} on the irreversible flux loss 20

Table 6 – The magnetic properties of Nd-Fe-B magnets for the evaluation of the influence of H_{cJ} on irreversible flux loss measured by a pulse recording fluxmeter 22

Table 7 – The permanent flux loss of Sm_2Co_{17} magnets after exposure for 1 000 h at different temperatures 23

Table 8 – The permanent flux loss of Nd-Fe-B magnets after exposure for 1 000 h at different temperatures 23

Table 9 – Basic magnetic properties of the three intermetallic compounds 24

Table A.1 – Summary of temperature stability graphs 25

INTERNATIONAL ELECTROTECHNICAL COMMISSION

RARE EARTH SINTERED MAGNETS – STABILITY OF THE MAGNETIC PROPERTIES AT ELEVATED TEMPERATURES

FOREWORD

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IEC 62518, which is a technical report, has been prepared by IEC technical committee 68: Magnetic alloys and steels.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
68/376/DTR	68/383/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

$SmCo_5$ was the first sintered rare earth magnet to be developed (1967) [1][1], followed by Sm_2Co_{17} [2, 3, 4] and Nd-Fe-B [5]. These magnets are used in a wide variety of applications. Recently, these magnets have been used in higher temperature applications such as in heavy duty permanent magnet motors. For these high temperature applications, the temperature stability of the permanent magnet has to be considered along with the design of the magnetic circuit. This is particularly relevant for the relatively inexpensive Nd-Fe-B magnetic material which has a comparatively low Curie temperature. The temperature stability of the rare earth sintered magnets has a critical influence on the reliability of high temperature motors and this will, in turn, contribute to energy savings in the future.

Therefore, the subject of this technical report will be of considerable interest to the manufacturers of this type of motor and to the developers of permanent magnet materials.

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1 The figures in square brackets refer to the Bibliography.

RARE EARTH SINTERED MAGNETS – STABILITY OF THE MAGNETIC PROPERTIES AT ELEVATED TEMPERATURES

1 Scope

The scope of this technical report is to describe the temperature behaviour of rare earth sintered magnets in detail for use in designing magnetic circuits exposed to elevated temperatures. The temperature behaviour of $SmCo_5$, Sm_2Co_{17} and Nd-Fe-B sintered magnets is described.

The various changes of open circuit flux which can occur due to temperature are discussed in Clause 4. The long term stability of the magnets is discussed in Clause 5. The experimental procedures are described in Clause 6. Results of the measurements of the flux loss occurring at the ambient temperature after heating isothermally at 50 °C, 75 °C, 100 °C, 125 °C, 150 °C and 200 °C for up to 1000 h are given in Clause 7. The effect of length to diameter ratio (*L/D*) of the magnet samples and the influence of H_{cJ} on the flux loss were also studied. The results are discussed in Clause 8.

The data in this technical report was provided by the Institute of Electrical Engineers of Japan (IEEJ) and its subcommittees. This data has been gathered from the members of these sub-committees.

The temperature stability correlated with the complex corrosion behaviour and the spin re-orientation phenomena at cryogenic temperatures will not be given in this technical report.

2 Normative references

IEC 60050-121, *International Electrotechnical Vocabulary – Part 121: Electromagnetism*

IEC 60050-151, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050-221:1990, *International Electrotechnical Vocabulary – Chapter 221: Magnetic materials and components*
Amendment 1 (1993)

IEC 60404-8-1, *Magnetic materials – Part 8-1: Specifications for individual materials – Magnetically hard materials*