

FINAL
DRAFT

INTERNATIONAL
STANDARD

ISO/FDIS
24544

ISO/TC 298

Secretariat: SAC

Voting begins on:
2023-11-09

Voting terminates on:
2024-01-04

**Rare earth — Recyclable Neodymium
iron boron (NdFeB) resources —
Classification, general requirements
and acceptance conditions**

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ISO/FDIS 24544](#)

<https://standards.iteh.ai/catalog/standards/sist/6bba766d-ca9f-459f-8c5d-be6a8b07ab84/iso-fdis-24544>

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.



Reference number
ISO/FDIS 24544:2023(E)

© ISO 2023

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ISO/FDIS 24544](#)

<https://standards.iteh.ai/catalog/standards/sist/6bba766d-ca9f-459f-8c5d-be6a8b07ab84/iso-fdis-24544>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2023

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Classification and codes	3
4.1 General.....	3
4.2 Classification of recyclable S-NdFeB resources.....	3
4.2.1 Recyclable S-NdFeB resources from EOL products.....	3
4.2.2 Recyclable S-NdFeB resources from industrial products.....	4
4.3 Classification of recyclable B-NdFeB resources.....	5
4.4 Classification of recyclable D-NdFeB resources.....	6
4.5 Codes of recyclable NdFeB resources.....	6
5 General requirements	8
5.1 Sampling.....	8
5.1.1 General.....	8
5.1.2 Recyclable S-NdFeB resources from EOL products.....	8
5.1.3 Recyclable S-NdFeB resources from industrial products.....	8
5.2 Testing and analysis.....	8
5.3 Packaging.....	9
5.4 Transportation and storage.....	9
5.5 Labelling.....	9
6 Acceptance conditions	9
Bibliography	11

[ISO/FDIS 24544](https://standards.iteh.ai/catalog/standards/sist/6bba766d-ca9f-459f-8c5d-be6a8b07ab84/iso-fdis-24544)

<https://standards.iteh.ai/catalog/standards/sist/6bba766d-ca9f-459f-8c5d-be6a8b07ab84/iso-fdis-24544>

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 298, *Rare earth*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Rare earth elements (REEs) are an important ingredient in products such as magnets, luminous devices and catalysts. Among these, magnets, especially neodymium iron boron ($\text{Nd}_2\text{Fe}_{14}\text{B}$ or NdFeB in shortened form), consume more than a mass fraction of 30 % of rare earths. The process of exploring and producing rare earths is causing pressure on the environment due to the use of different kinds of chemical agents as well as the resulting emissions of waste water, slag, dust and gas. In addition, there are limited primary rare earth resources available for economically viable production across the world. The recovery of rare earth from industrial products (including scraps and sludge) and end-of-life (EOL) products will help address these problems, particularly from a long-term perspective.

The NdFeB magnet is the permanent magnet of choice in many products, including in the motors of electronic vehicles and hard discs in computers, and is a key component of air conditioners. The use of both sintered and bonded NdFeB products has grown steadily during the last several decades at an average annual growth rate of around 9 % and 6,2 %, respectively.^[1] The steady growth of NdFeB production has led to an increase in recyclable resources, especially sintered NdFeB scrap. These recyclable NdFeB resources contain not only about 30 % of REEs, but also other valuable elements such as Co, Ni, Ga, etc., which shows there is significant potential in recycling these resources to effectively supplement rare earth resources.

In addition, when the products containing NdFeB magnets come to the end of their lives, there will be an increase in EOL products. Therefore, recycling rare earth from recyclable NdFeB resources can meet a substantial part of the demand for global light (Nd and Pr) REEs and heavy (Dy and Tb) REEs.

However, a challenge for recycling rare earth is that the recyclable NdFeB resources from different sources and processes can vary significantly in form, shape, chemical composition, phase structure, etc., leading to quite complex and diverse recycling methods. [Figure 1](#) provides an example of sintered NdFeB (S-NdFeB), which accounts for about 90 % of the total market,^[2] to illustrate some of the typical recyclable resources from EOL products and industrial processes, and the recycled products that can be created using a highly efficient and low polluting recovery method as follows:

- For some large sintered NdFeB magnets from EOL products, after removing the coating, the cleaned magnet can be used as raw materials and can be further manufactured into sintered NdFeB magnets.
- NdFeB sludge from industrial products in the machining stage is usually recycled into NdFeB powders or magnets by using a combination of calcium thermal reduction and sintering, or into REE compounds by using hydrometallurgy or thermometallurgy, depending on the oxidation and main phase structure of the sludge.
- Scraps including unqualified bulk, residual powder and other recyclable resources from different processing stages can be applied in different steps of the sintering process and regenerated into recycled NdFeB magnets according to the phase, and the degree of contamination and oxidation.

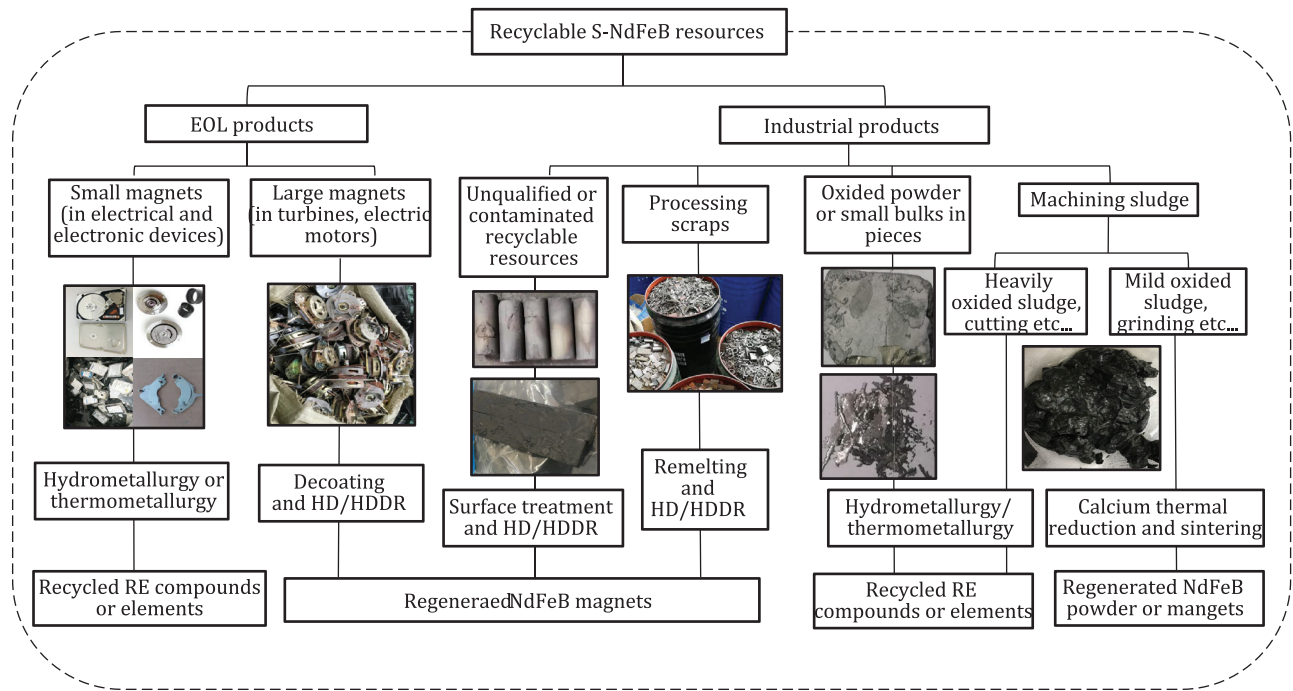


Figure 1 — Typical examples of recyclable NdFeB resources from different sources, and possible methods to recycle to different products

Therefore, it is important to determine the characteristics of different recyclable NdFeB resources. This document provides the classification, general requirements and acceptance conditions for recyclable NdFeB resources, considering the unique characteristics of the different resources and the industrial recycling methods that can be used.

This document promotes the efficient recycling of valuable REE elements across countries that produce and consume magnets.

<https://standards.iteh.ai/catalog/standards/sist/6bba766d-ca9f-459f-8c5d-be6a8b07ab84/iso-fdis-24544>