INTERNATIONAL STANDARD

ISO 22453

First edition
2021-06

Exchange of information on rare earth elements in industrial wastes and end-of-life cycled products

Échange de données sur les éléments de terres rares dans les déchets industriels et les produits en fin de vie en vue de leur recyclage

Reference number
ISO 22453:2021(E)

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Published in Switzerland

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Foreword

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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 documents 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).

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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) have become essential for a wide range of industrial applications including electric vehicles, batteries, smartphones, displays, transparent lenses, optical fibre and so on. Due to these varied, important applications, REEs are referred to as “vitamins of industry”. In order to ensure the successful use of these vitamins, supply to the industry should be smooth. However, resource scarcity creates an imbalance between supply and demand. Therefore, the importance of REEs is increasingly significant. In order to overcome resource scarcity, the recycling or urban mining of industrial waste and end-of-life (EOL) cycle products is necessary.

For recyclers, it is of utmost importance to know what kind of REEs are present in the waste or scrap material, and how much can be extracted. In order to facilitate recycling, it is important to define what information is required by the recycler, and to establish a standard method of information exchange on REEs in industrial waste and EOL products.

Due to the lack of a standardized system and communication exchange mechanism between waste handlers and recyclers, the ability to recycle currently lags behind what it should be. There are many producers of the same product, but compositions and concentrations are different, which makes it difficult and complicated for recyclers to obtain exact information about the elements being recycled. Furthermore, if the producer and the recycler are located in different countries, information reliability and cross-border transaction of information exchange is problematic. Therefore, a system of information exchange between the waste handler and the recycler is needed.

This document contains a system of information exchange between waste handlers and recyclers about REEs in industrial waste and EOL products. The system of information exchange involves a data exchange mechanism such as quick response (QR) codes and radio frequency identification (RFID).

Exchange of information on rare earth elements in industrial wastes and end-of-life cycled products

1 Scope

This document specifies methods of information exchange between waste handlers and recyclers for rare earth elements (REEs) contained in industrial waste and end-of-life (EOL) products. This document facilitates the efficient recycling of REEs so that dependency on mining can be reduced by promotion of REE recycling.

This document also includes a generic life cycle of the REE recycling process.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 22444-1, *Rare earth — Vocabulary — Part 1: Minerals, oxides and other compounds*

ISO 22444-2, *Rare earth — Vocabulary — Part 2: Metals and their alloys*

ISO 22450, *Recycling of rare earth elements — Requirements for providing information on industrial waste and end-of-life products*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22444-1, ISO 22444-2, ISO 22450 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
industrial waste
waste produced by industrial activity, which includes any material that is rendered useless during a manufacturing process such as that of factories and industries

Note 1 to entry: Industrial waste originates from downstream processing operations of manufacturing industries. In this document, downstream operations refer to processes during the production stages such as machining, milling, chamfering, etc.

SOURCE: ISO 22450:2020, 3.5, modified — “mining and milling operations” has been deleted from the definition and Note 1 to entry has been replaced.]

3.2
life cycle
consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal

[SOURCE: ISO 14040:2006, 3.1, modified — “of a product system” has been added.]

3.3
life cycle stage
element of a *life cycle* (3.2)

EXAMPLE Raw material acquisition and production, manufacturing, collection, dismantling, pre-treatment, identification, sorting, recycling.

[SOURCE: ISO 14009:2020, 3.2.18, modified — the example has been added.]

3.4
quick response code
QR code
machine-readable code consisting of an array of black and white squares, used for storing information for reading by the camera on a smartphone

3.5
radio frequency identification
RFID
use of radio waves to read and capture information stored on a tag attached to an object

4 General principles

There are a variety of processes to convert or use REEs from minerals to final products such as REE magnets, batteries, laser light sources, etc. This document defines methods of communication for the exchange of information on REE-related substances that can be recycled at the product stage as industrial waste by manufacturers and EOL products by recyclers. It suggests ways to facilitate the recycling of REEs by recyclers on the basis of information provided to them by the waste handler. Information can be provided to recyclers efficiently with the use of QR codes, barcodes and RFID depending on the precision of the data. The code containing the information shall be marked on the shipment box in which the REE industrial waste or EOL product is packed. The marking on the shipment simplifies the exchange of information. The recycler can scan the code and receive the useful information provided by the waste producer.

5 Generic life cycle of the REE recycling process

The generic life cycle of recycling industrial scrap and EOL is shown in Figure 1. It gives a general picture of the steps involved in the recycling process and clarifies at which life cycle stage this document applies. The recycling process can vary from industry to industry and this life cycle is one of many potential scenarios. Additional processes may be added, and the steps shown may be excluded or amended.

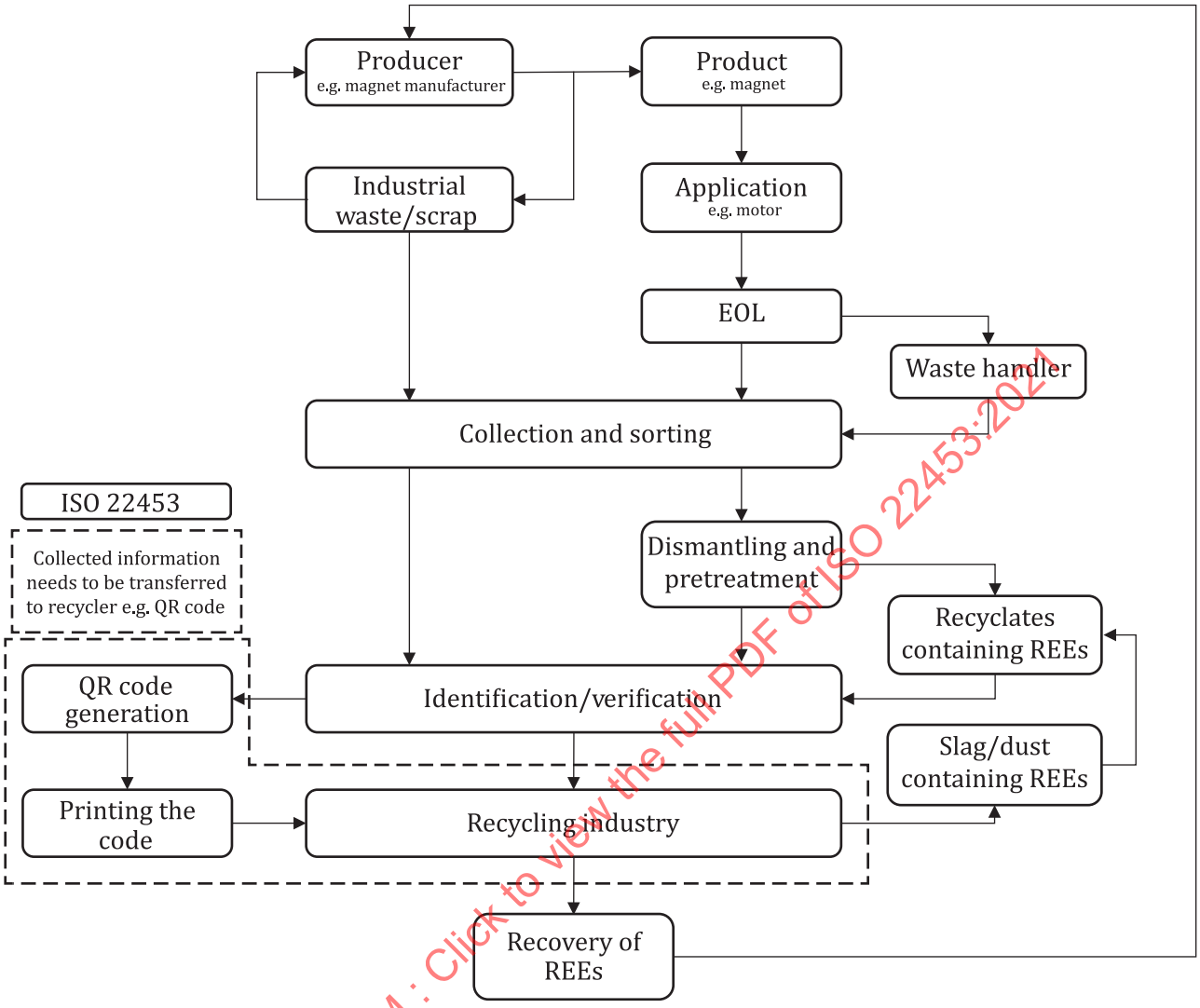

Figure 1 — Generic life cycle of REE recycling

6 Labelling methods

6.1 General

There are many different types of labelling methods, including barcodes and RFID. One-dimensional (1D) barcodes are simple and widely used for providing information for products. However, they can represent only a small amount of data. In comparison, two-dimensional (2D) barcodes and RFID can include lots of data. Therefore, this document specifies the use of 2D barcodes, specifically QR codes and RFID, to record REE information.

6.2 QR codes

2D barcodes are a type of printable label with a low cost and a high storage capacity. There are several kinds of 2D barcodes including QR codes, PDF417, DataMatrix and MaxiCode. The specifications state that up to 2 900 bytes and 4 200 ASCII characters can be encoded in a single symbol.

QR codes are the most suitable and efficient method for storing REE information due to their larger capacity for recording data and error correction function. QR creation and reading tools are commonly available and the cost of creation is very low to negligible. They have readability in different orientations, good processing speed, high durability against damage and a sufficient lifetime. Furthermore, they

have almost no environmental impact and they can direct a user to online content. Their large storage capacity is particularly useful in this context, since there are 17 REEs plus numerous variables such as the name of the supplier, etc. (see Clause 7). All these data can easily be incorporated into a QR code.

6.3 RFID

RFID tags contain an integrated circuit for storing and processing information. The tags contain the information in a non-volatile memory and can be read at a distance of hundreds of metres from the RFID reader, depending on the type of tag. RFID uses electromagnetic fields to identify RFID tags. Thus, unlike 2D barcodes, they do not need to be within the line of sight of the reader. Like QR codes, RFID tags can be read in different orientations and have a good processing speed. Although they are more expensive to create than QR codes, RFID tags have the function of real-time location tracking and are well suited to cylindrical objects.

7 Label contents

The label shall contain REE information in accordance with ISO 22450. This will reduce the time, energy and money spent on confirming the economic efficiency of recycling. The summarized REE information shall be encoded in plain text where a declaration of composition is not mandatory. The label, as illustrated in Annex A, shall contain the following information:

a) 1st row: “Name of the supplier, manufacturer or producer”, which is provided to maintain the reliability of the information;

b) 2nd row: “Name of the product”, which gives information about any possible contamination of the REE product located inside the whole product;

c) 3rd row: “Gross mass of the shipment”; if available, the gross mass of REE should also be provided;

d) 4th row: “Physical form of the product”, since this is an important parameter in deciding the recycling route for REE;

e) 5th row: “Method of storage”;

f) 6th row: “Date of production”, which is provided to improve quality control;

g) 7th row: “Country and region” which is also provided to improve quality control since geological and climate conditions play a key role in deciding the amount of REE left for recycling;

h) 8th row: “Production method”, since compositions and recycling methods can be dependent on the production method;

i) 9th row: “WRE code”, which is the waste rare earth (WRE) product classification code in accordance with ISO 22450:2020, Clause 5, Table 2;

j) 10th row: “Batch number”.

8 Data exchange

Information on REEs in industrial waste and EOL products should be communicated to recyclers and policymakers involved in REEs. This information, except for the composition declaration, shall be recorded in the QR code in accordance with ISO 22450 by the waste handlers of industrial waste and EOL products. Waste handlers may also share the complete information in accordance with ISO 22450, i.e. including a composition declaration; however, this is not mandatory. Recyclers can then access it by scanning the QR code.

Annex A
(informative)

Measurement example

Figure A.1 gives a hypothetical example of a QR code for an EOL sintered magnet to be attached to the shipment box. This QR code contains 262 characters including spaces and represents 284 bytes.

Figure A.1 — Example of a QR code for an EOL sintered magnet

Scanning the QR code in Figure A.1 provides the following example information:

Name of the supplier, manufacturer or producer:	ABC
Name of the product:	Sintered magnet waste
Gross mass of the shipment (in kg):	100
Physical form of the product:	Solid
Method of storage:	Unidentified
Date of production (YYYY-MM-DD):	2020-10-24
Country and region:	South Korea, Incheon
Production method:	Sintered
WRE code:	WRE0101
Batch number:	901018