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**Recycling of rare earth elements —  
Methods for the measurement of rare  
earth elements in industrial waste and  
end-of-life products**

*Recyclage des éléments des terres rares — Méthodes pour le  
mesurage des éléments des terres rares dans les déchets industriels et  
les produits en fin de vie*

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## 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 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](http://www.iso.org/directives)).

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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](http://www.iso.org/members.html).

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## Introduction

With technical advancement, rare earth elements (REEs) are increasingly important due to their importance in a number of applications, including green technologies. However, there are high supply risks arising from the dependence on a single source of extraction. Recycling and systemic management of rare earth elements are key issues for solving the waste and supply risks of REEs.

In order to efficiently recycle and systemically manage rare earth elements, a standard measurement method of REEs in industrial wastes and end-of-life cycled products is needed. Industrial wastes and end-of-life products can be found in solid, solid-liquid mixture and liquid forms. For example, machining waste contains chips and flakes with coolant oils, greases and numerous other forms of aqueous and non-aqueous contaminants. Similarly, waste liquid slurries contain REEs, as in LEDs, and batteries contain numerous acids, bases etc. Furthermore, in order to verify the information provided by the producer about REEs in the waste, standardized measurement procedure is necessary.

There are several scientific methods for quantitatively measure REEs in matters, such as X-ray fluorescence (XRF), inductively coupled plasma mass spectroscopy (ICP-MS), inductively coupled plasma optical emission spectroscopy (ICP-OES) and glow discharge mass spectrometry (GD-MS). However, these different characterization techniques often offer dissimilar measurement results depending on the composition and physical state of the sample under observation. This is another reason to establish standard measurement methods.

This document provides a brief overview and several measurement methods for REEs in industrial wastes and end-of-life products. Sample preparation methods are also provided. The accurate measurement of rare earth content (e.g. in ppm range) is still under active research and is not covered by this document. However, this document does provide measurement methods for identifying the presence and approximate content of rare earth elements.

This document is designed to be used with ISO 22450.

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