

AS 24181.1:2025



Rare earth — Determination of non-rare earth impurities in individual rare earth metals and their oxides — ICP-AES

Part 1: Analysis of Al, Ca, Mg, Fe and Si (ISO 24181-1:2024, MOD)



AS 24181.1:2025

This Australian Standard® was prepared by MN-011, Rare Earth. It was approved on behalf of Standards Australia's Standards Development and Accreditation Committee on 11 September 2025.

This Standard was published on 26 September 2025.

The following are represented on Committee MN-011:

- Association of Accredited Certification Bodies
- Association of Mining and Exploration Companies
- Australian Nuclear Science and Technology Organisation
- CSIRO
- Curtin University
- Department of Industry, Science and Resources
- Department of Resources (QLD) - Geological Survey of Queensland
- Minerals Council of Australia
- National Association of Testing Authorities Australia
- The Australasian Institute of Mining & Metallurgy
- The Chamber of Minerals and Energy of Western Australia

This Standard was issued for comment as DR AS 24181.1:2025

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals and new products by visiting:

www.standards.org.au

ISBN: 978 1 76175 382 4

Australian Standard®

Rare earth — Determination of non-rare earth impurities in individual rare earth metals and their oxides — ICP-AES

**Part 1: Analysis of Al, Ca, Mg, Fe and Si (ISO
24181-1:2024, MOD)**

First published as AS 24181.1:2025.

How to read this Standard

This page explains the meaning of the language and structure of this Standard.

Refer to Standards Australia's [Standardisation Guide 006](#) for more details about drafting rules.

Australian and Australian/New Zealand Standards are voluntary unless they are referenced in legislation or called up in contracts.

Requirements

To conform to a Standard, all requirements in the Standard need to be met.

A requirement is any statement in the Standard which uses the word "shall".

Recommendations, permissions and possibilities

The following words are commonly used in Standards, but statements using them do not have to be followed to conform to the Standard:

- (a) "should" means that something is recommended.
- (b) "may" means that something is permitted.
- (c) "can" means that something is possible.

Structure of Standards

A Standard always has the following parts:

- (i) The Preface states who developed the Standard, what the Standard is aiming to do, and how it relates to other documents.
- (ii) The Scope states what the Standard is about, what it covers and what it does not cover.
- (iii) The Normative references clause lists other documents that are referenced in the Standard as part of requirements.
- (iv) The Terms and definitions clause defines important terms to help with understanding the Standard.

A Standard may also include other parts, such as the following:

- (1) A normative appendix sets additional requirements that need to be conformed to.
- (2) An informative appendix provides additional information or guidance. They usually do not contain requirements. If an informative appendix does contain requirements, the Standard will explain when those requirements apply.
- (3) A Bibliography lists documents referenced in the Standard but not as part of requirements.

Many Standards include notes. Notes provide recommendations and/or guidance only. They never contain requirements.

Preface

This Standard was prepared by the Standards Australia Committee MN-011, Rare Earth.

The objective of this document is to describe procedures for the determination of non-rare earth impurities in individual rare earth metals and their oxides through the use of inductively coupled plasma atomic emission spectroscopy (ICP-AES). Magnesium (Mg), aluminium (Al), silicon (Si), calcium (Ca) and iron (Fe) are included as non-rare earth impurity elements, and the measurement ranges for each impurity element are specified. The applicable measurement range (mass fraction %) of magnesium, aluminium, silicon and calcium is from 0,001 to 0,2, and that of iron is from 0,001 to 0,5. The verified measurement ranges in the interlaboratory tests are described later in this document.

This document is an adoption with national modifications, and has been reproduced from, ISO 24181-1:2024, *Rare earth — Determination of non-rare earth impurities in individual rare earth metals and their oxides — ICP-AES — Part 1: Analysis of Al, Ca, Mg, Fe and Si*.

As this document has been reproduced from an international document, a comma is to be read as a full point when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

Contents	Page
Preface	v
Foreword	vii
Introduction	viii
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Principle	3
5 Reagent	4
6 Apparatus	4
6.1 Volumetric glassware	4
6.2 Inductively coupled plasma atomic emission spectrometer	4
6.2.1 General	4
6.2.2 Line spectra selection	5
7 Procedure	6
7.1 Weighing the test portion	6
7.2 Sample preparation	6
7.3 Preparation of calibration solutions	6
7.4 Measurements	7
7.4.1 Instrument set-up	7
7.4.2 Measurement of the calibration solution and calibration curve construction	7
7.4.3 Measurement of the test solution	7
8 Calculation and expression of results	8
8.1 Method of calculation	8
8.2 Precision	8
8.2.1 Interlaboratory test	8
8.2.2 Statistical analysis	8
9 Test report	8
Annex A (informative) Interlaboratory test results	9
Annex B (informative) Regression formulae of precision	10
Bibliography	11

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*.

A list of all parts in the ISO 24181 series can be found on the ISO website.

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

Atomic spectroscopy has been recognised as the most common technique for trace elemental determinations. Although atomic absorption spectroscopy is limited to determination of one element at a time, many elements are analysed routinely at the same time by inductively coupled plasma atomic emission spectroscopy (ICP-AES), which utilises the inductively coupled plasma (ICP) as an excitation source for atomic emission spectrometry (AES). Several thousands of these instruments are in routine use throughout the world.

ICP-AES is the most common technique for trace elemental determinations, particularly for the analysis of impurities. This method has been demonstrated to feature a linear response over a wide dynamic range, a low chemical interference/matrix effect, good stability and good reproducibility. It demonstrates a low detection limit and various sample introduction techniques are available for different sample analysis demands.

In rare earth metals and oxides, during processing ores of rare earth elements, Aluminium(Al), calcium(Ca), magnesium(Mg), iron(Fe) and silicon(Si) are contained as impurities. ICP-AES is well-suited for the quantification of non-rare earth impurities in a matrix containing rare earth elements. Additionally, the ICP-AES technique also offers high resolution for rare earth elements as rare earth elements exhibits line-rich emission spectra.

This document provides a guide for chemical analysis of materials for producers, consumers, and traders in the field of rare-earth metals and their oxides. This document is anticipated to reduce discrepancies caused by inconsistencies in the analytical procedures used when working with rare earth metals and their oxides.

Australian Standard®

Rare earth — Determination of non-rare earth impurities in individual rare earth metals and their oxides — ICP-AES

Part 1: Analysis of Al, Ca, Mg, Fe and Si (ISO 24181-1:2024, MOD)

WARNING The use of this document can involve hazardous chemicals, materials, operations and equipment. This document does not purport to address any safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and to determine the applicability of regulatory limitations before use (e.g. according to ISO 15202-2 and ISO 15202-3).

1 Scope

This document describes procedures for the determination of non-rare earth impurities in individual rare earth metals and their oxides through the use of inductively coupled plasma atomic emission spectroscopy (ICP-AES). Magnesium (Mg), Aluminium (Al), silicon (Si), calcium (Ca) and iron (Fe) are included as non-rare earth impurity elements, and the measurement ranges for each impurity element are specified. The applicable measurement range (mass fraction %) of magnesium, Aluminium, silicon and calcium is from 0,001 to 0,2, and that of iron is from 0,001 to 0,5. The verified measurement ranges in the interlaboratory tests are described later in this document.

2 Normative references

NATIONAL VARIATIONS

1. After first paragraph, *add* the following:

The Australian Standard listed below is a modified adoption of, or not equivalent to, the ISO normative references and is required for the application of this document. All references in the source text to that ISO normative reference shall be replaced by referenced to the corresponding Australian Standards.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably.

2. *Delete* "ISO 22444-1, Rare earth — Vocabulary — Part 1: Minerals, oxides and other compounds" and *replace* with the following:

AS 22444.1:2025, Rare earth — Vocabulary, Part 1: Minerals, oxides and other compounds (ISO 22444-1:2020, MOD)

The following documents are referred to in the text in such a way that some or all of their content dictates requirements or specifications 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 648, *Laboratory glassware — Single-volume pipettes*

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 11885, *Water quality — Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES)*