



**NSAI**  
Standards

Irish Standard  
I.S. EN ISO 9161:2021

# Uranium dioxide powder - Determination of apparent density and tap density (ISO 9161:2019)

**I.S. EN ISO 9161:2021**

*Incorporating amendments/corrigenda/National Annexes issued since publication:*

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## National Foreword

I.S. EN ISO 9161:2021 is the adopted Irish version of the European Document EN ISO 9161:2021, Uranium dioxide powder - Determination of apparent density and tap density (ISO 9161:2019)

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EUROPEAN STANDARD

EN ISO 9161

NORME EUROPÉENNE

EUROPÄISCHE NORM

February 2021

ICS 27.120.30

English Version

## Uranium dioxide powder - Determination of apparent density and tap density (ISO 9161:2019)

Poudre de dioxyde d'uranium - Détermination de la masse volumique apparente et de la masse volumique après tassement (ISO 9161:2019)

This European Standard was approved by CEN on 18 January 2021.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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**EN ISO 9161:2021 (E)**

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## **European foreword**

The text of ISO 9161:2019 has been prepared by Technical Committee ISO/TC 85 "Nuclear energy, nuclear technologies, and radiological protection" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 9161:2021 by Technical Committee CEN/TC 430 "Nuclear energy, nuclear technologies, and radiological protection" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2021, and conflicting national standards shall be withdrawn at the latest by August 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## **Endorsement notice**

The text of ISO 9161:2019 has been approved by CEN as EN ISO 9161:2021 without any modification.

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# INTERNATIONAL STANDARD

**ISO  
9161**

Second edition  
2019-02

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## **Uranium dioxide powder — Determination of apparent density and tap density**

*Poudre de dioxyde d'uranium — Détermination de la masse  
volumique apparente et de la masse volumique après tassement*



Reference number  
ISO 9161:2019(E)

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**ISO 9161:2019(E)**



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## ISO 9161:2019(E)

## 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)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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

This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 5, *Nuclear installations, processes and technologies*.

This second edition cancels and replaces the first edition (ISO 9161:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

- an introduction has been added;
- definitions in [Clause 3](#) have been updated;
- safety precautions have been updated.

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).

## Introduction

Uranium dioxide (UO<sub>2</sub>) powder is the source material for the manufacture of nuclear fuel as pellets, and is produced for use in nuclear reactors by a variety of processes. Specifications for UO<sub>2</sub> powder used in the production of sintered pellets as a nuclear fuel are given in standards such as ASTM C753<sup>[5]</sup> or specifications supplied by the user. These specifications can include requirements for apparent (or bulk) density, tap density, or both.

This document specifies a method for determination of the apparent density and tap density of free-flowing UO<sub>2</sub> powder, and can be used for a variety of powder types. The method can also be applied to other fuel powders, and to powder mixtures, to demonstrate compliance with appropriate specifications for those powders.

It has been assumed in the preparation of this document that the execution of its provisions and the interpretation of the results obtained are entrusted to appropriately qualified and experienced people.



# Uranium dioxide powder — Determination of apparent density and tap density

## 1 Scope

This document specifies a method of determining the apparent density and tap density of free-flowing uranium dioxide ( $\text{UO}_2$ ) powder which will be used for pelleting and sintering of  $\text{UO}_2$  pellets as a nuclear fuel.

This method can be used for different  $\text{UO}_2$  powder types including grains, granules, spheres or other kinds of particles. The method can also be applied to other fuel powders as  $\text{PuO}_2$ ,  $\text{ThO}_2$  and powder mixtures as  $\text{UO}_2\text{-PuO}_2$  and  $\text{UO}_2\text{-Gd}_2\text{O}_3$ .

This document is based on the principle of using a flowmeter funnel (see 4.1). Other measurement apparatus, such as a Scott volumeter, can also be used.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

#### **apparent density**

loose bulk density

dry mass per unit volume of a powder obtained by free pouring under specified conditions

### 3.2

#### **tap density**

dry mass per unit volume of a powder in a container that has been tapped under specified conditions

## 4 Principle

### 4.1 Apparent density

A portion of sample is allowed to fall through a funnel of standard dimensions into a tared density cup filled up to a mark which defines a distinct volume. The cup and contents are weighed to determine the mass of the material in the known volume. The apparent density is calculated from the mass and volume of the powder.

### 4.2 Tap density

A calibrated density cup containing a weighed portion of sample is tapped by means of a special apparatus. The tapping conditions are fixed. The tap density is determined from the mass and volume of the powder after the treatment.

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