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**Nuclear fuel technology — Guidelines  
on the measurement of the specific  
surface area of uranium oxide  
powders by the BET method**

*Technologie du combustible nucléaire — Lignes directrices pour le  
mesurage de l'aire massique (surface spécifique) des poudres d'oxyde  
d'uranium par la méthode BET*



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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)).

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 on 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 the following URL: [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 12800:2003), which has been technically revised.

# Nuclear fuel technology — Guidelines on the measurement of the specific surface area of uranium oxide powders by the BET method

## 1 Scope

This document gives guidelines on the determination of the specific surface area of as-fabricated uranium dioxide powder by volumetric or gravimetric determination of the amount of nitrogen adsorbed on the powder, and can be applied to other similar materials, e.g.  $\text{U}_3\text{O}_8$ ,  $\text{UO}_2\text{-PuO}_2$  powders, and other bodies with similar surface areas, e.g. powder granules or green pellets, provided that the conditions described are fulfilled. Modifications using other adsorbing gases are included.

The method is relevant as long as the expected value is in the range between  $1 \text{ m}^2/\text{g}$  and  $10 \text{ m}^2/\text{g}$ .

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

No terms and definitions are listed in this document.

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

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

## 4 Principle

### 4.1 Summary of the BET method

The BET method is based on the determination of the amount of gas necessary to cover the surface by a monomolecular layer. This amount is determined from the isothermal adsorption curve of nitrogen ( $\text{N}_2$ ) at the temperature of liquid nitrogen (77,4 K) according to Reference [2]. The amount of  $\text{N}_2$  adsorbed at a given pressure is determined by volumetric or gravimetric measurement[6]. In order to remove surface contamination of the adsorbent, the sample has to be evacuated and heated under appropriate conditions before the measurement is performed.

### 4.2 Isothermal adsorption curves

The isothermal adsorption curve describes the relationship between the mass of the adsorbate,  $m_A$  ( $\text{N}_2$ ), adsorbed per gram of adsorbent (e.g.  $\text{UO}_2$  powder) at an equilibrium pressure of  $p$  at constant temperature  $T$ , as shown in [Formula \(1\)](#):

$$m_A = f(p, T) \quad (1)$$

Generally, the relative pressure  $p/p_0$  is introduced instead of the absolute pressure  $p$ , where  $p_0$  is the saturation vapour pressure which is  $1,013 \times 10^5 \text{ Pa}$  for nitrogen at 77,4 K.