INTERNATIONAL STANDARD

ISO 13463

First edition
1999-09-15

Nuclear-grade plutonium dioxide powder for fabrication of light water reactor MOX fuel — Guidelines to help in the definition of a product specification

Poudre de dioxyde de plutonium de qualité nucléaire en vue de la fabrication de combustible MOX pour réacteur à eau légère — Guide d'aide à la définition d'une spécification de produit

Reference number
ISO 13463:1999(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

International Standard ISO 13463 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 5, *Nuclear fuel technology*.

Introduction

Plutonium recycling in the form of mixed uranium and plutonium oxide based fuel (MOX fuel) has become an industrial reality.

This plutonium cannot be considered as a standard product because the possibility of recycling the oxide powder produced by the reprocessing of spent fuels (plutonium dioxide mixed or not with uranium) depends on numerous factors:

— its fabrication process;

— the MOX fuel fabrication process;

— the safety constraints applied to these processes;

— the characteristics of the reprocessed spent fuel (initial enrichment, burn-up rate, etc.).

As it cannot be considered a standard product, the plutonium consequently cannot form the subject of general supply specifications, as is the case for uranium.

The development of the use of this type of fuel nevertheless makes it worthwhile to draw-up a standard which defines certain minimum properties to be complied with by the oxide powder and which recommends both the seller and purchaser to reach agreement concerning a certain number of parameters which it will be advisable to specify.

This International Standard meets this need for the plutonium dioxide power.

Nuclear-grade plutonium dioxide powder for fabrication of light water reactor MOX fuel — Guidelines to help in the definition of a product specification

1 Scope

This International Standard applies to nuclear-grade plutonium dioxide powder (PuO_2), for fabrication of light water reactor MOX fuel.

It defines minimal requirements for the product, quality assurance and quality control. It can be modified or amended once the powder supplier and the MOX fuel fabricator agree. This International Standard sets, in that respect, guidelines for the definition of a product specification.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 9002:1994, *Quality systems — Model for quality assurance in production, installation and servicing.*

ASTM C1233, *Practice for determining equivalent boron contents of nuclear materials.*

3 General requirements

3.1 Quality assurance

The supplier shall establish a quality assurance system in accordance with ISO 9002, or equivalent.

In that respect, the following principles shall be respected.

— Plutonium dioxide shall be produced with a qualified process, that is to say, in accordance with ISO 9002. Qualification shall encompass the powder fabrication process itself (homogenization, conditioning, etc.) but also the powder sampling process and characterization methods.

— A product quality plan shall be established, it shall contain at least the following information:

  — a fabrication description including the list and values of the important parameters regarding the quality of the finished product;

  — a description for on-line inspection methods and for analytical determination (equipment, measurement principle and related statistical characteristics).

3.2 Sampling

3.2.1 PuO_2 powder lot

A lot is defined as a quantity of material that is uniform in isotopic, chemical and physical characteristics and free from foreign material.

3.2.2 Sample size

Each powder lot shall be represented by a test sample.

Traceability between the PuO_2 powder lot and the sample shall be maintained.

The recommended sample size shall be 10 g.

3.3 Packaging

Each PuO_2 powder lot shall be packaged in containers ensuring material confinement.

Each container shall have a unique reference number.

Traceability between the different containers of each lot and the sample on which analytical determination are performed shall be maintained.

3.4 Documentation

For each lot, the following documents shall be provided:

— a conditioning certificate identifying the different containers of the lot;

— a record of all data from tests and analytical determination;

— a declaration of conformity of the PuO_2 powder lot.

4 Material characteristics

The limits given in Table 1 refer to the reference date (date of sampling if not agreed otherwise). This date is mentioned on the analysis record.

Determinations are performed on raw powder.

Table 1 — Material characteristics

Material characteristics	Unit	Limit
Mass fraction of plutonium	mass percentage	$\geqslant$ 86,0
Pu isotopic composition	mass percentage reported on a Pu basis	
^{238}Pu		value to be reported
^{239}Pu		value to be reported
^{240}Pu		$\geqslant$ 5,1
^{241}Pu		value to be reported
^{242}Pu		value to be reported
Mass fraction of americium 241	$\mu g \cdot g^{-1}$ Pu	value to be reported
Mass fraction of uranium	$\mu g \cdot g^{-1}$ Pu	value to be reported (give isotopic composition if U $\geqslant$ 0,5 %)
Total activity of fission products isotopes to be taken into account: ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{106}Ru, ^{137}Cs, ^{144}Ce	$Bq \cdot g^{-1}$ Pu	$\leqslant$ 296 000
Thermal power	$W \cdot kg^{-1}$ Pu	value to be reported
Residual moisture	mass percentage	value to be reported
Surface area	$m^2 \cdot g^{-1}$	$\leqslant$ 30 $\geqslant$ 2

5 Impurities

5.1 Total impurities

The limits given in Tables 2 and 3 refer to the reference date (date of sampling if not agreed otherwise).

Determinations are performed on raw powder.

Table 2 — Impurities (requirements)

Values in micrograms per gram of plutonium

Impurities	Limit
Ag	$\leqslant$ 100
Al	$\leqslant$ 150
B	value to be reported
C	$\leqslant$ 500
Ca	$\leqslant$ 250
Cd	value to be reported
Cl + F	$\leqslant$ 250
Co	$\leqslant$ 100
Cr	$\leqslant$ 200
Cu	$\leqslant$ 100
Dy	value to be reported
Eu	value to be reported
Fe	$\leqslant$ 500
Gd	value to be reported
Li	value to be reported
Mg	$\leqslant$ 200
Ni	$\leqslant$ 200
Si	$\leqslant$ 200
Sm	value to be reported
Sn	$\leqslant$ 100
V	$\leqslant$ 300

Table 3 — Impurities (options)

Values in micrograms per gram of plutonium

Impurities	Limit
Bi	value to be reported
In	value to be reported
Mn	value to be reported
Mo	value to be reported
N	value to be reported
Na	value to be reported
Pb	value to be reported
Th	value to be reported
Ti	value to be reported
Zn	value to be reported
W	value to be reported

The total of the impurities mentioned in Tables 2 and 3 shall not exceed 5 000 $\mu g \cdot g^{-1}$ Pu.

5.2 Neutron-absorbing impurities

The equivalent-boron mass fraction (w_{EB}) of each lot shall be calculated taking into account the following elements: B, Gd, Sm, Eu, Cd, Li, Dy.

The equivalent-boron factors of the above-mentioned elements are those of ASTM C 1233.

Determine w_{EB}, expressed in micrograms per gram, from the following formula:

$$w_{EB} = \sum_{x} F_{EB,x} \times w_x$$

where

w_{EB} is the equivalent-boron mass fraction, expressed in micrograms per gram;

$F_{EB,x}$ is the equivalent-boron factor, for element x;

w_x is the mass fraction of element x, expressed in micrograms per gram of plutonium.

Protocol to be implemented if elements are measured at their detection limit should be established upon agreement between the powder supplier and the MOX fuel fabricator.

w_{EB} shall not exceed 10 $\mu g \cdot g^{-1}$.

Bibliography

EN 10204:1991 (amended in 1995), *Metallic products — Types of inspection documents.*

ICS 27.120.30
Price based on 6 pages