
**Nuclear energy — Uranium dioxide
pellets — Determination of density and
volume fraction of open and closed
porosity**

*Énergie nucléaire — Pastilles de dioxyde d'uranium — Détermination
de la masse volumique et de la fraction volumique de pores ouverts et
fermés*



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Foreword

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ISO 9278 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 5, *Nuclear fuel technology*.

This second edition cancels and replaces the first edition (ISO 9278:1992), which has been technically revised.

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Nuclear energy — Uranium dioxide pellets — Determination of density and volume fraction of open and closed porosity

1 Scope

This International Standard specifies a method for determining the bulk density and the amount of open and closed porosity of sintered UO_2 pellets. The method can be applied to other materials, for example green pellets, and $\text{UO}_2\text{-PuO}_2$ or $\text{UO}_2\text{-Gd}_2\text{O}_3$ pellets.

2 Principle

The method is based on the determination of the pellet volume and the volume of open and closed pores by measurement of the dry mass, the saturated mass and the immersed mass of the samples. Alternative penetration immersion liquids and saturation conditions can be used, provided the samples can be completely impregnated during the procedure.

3 Apparatus

3.1 Balance, of adequate capacity, with an accuracy of 0,1 mg.

3.2 Oven, capable of maintaining a temperature of $(200 \pm 5)^\circ\text{C}$. A vacuum drying oven is recommended for samples with a large amount of open pores.

3.3 Weighing device, to allow the test piece to be weighed in air and in the penetration immersion liquid, in order to make saturated mass and immersed mass measurements (see Table 1, step 1).

3.4 Container, a glass beaker or similar container of size and shape such that the sample, when suspended from the balance by the device, is completely immersed in the penetration immersion liquid, with the sample and the device for suspension being completely free from contact with any part of the container.

3.5 Vacuum impregnation apparatus, which may consist of glass components (see Table 1, step 2).

3.6 Test ball, made of any hard alloy or metal, e.g. carbide metal.

The radius, r , shall be between 5 mm and 10 mm, known with an accuracy of $\pm 0,5 \mu\text{m}$, for the determination of the density of the penetration immersion liquid (see 4.1.4).

4 Procedure

SAFETY PRECAUTIONS — Standard precautions shall be observed when handling uranium dioxide and plutonium dioxide samples.

4.1 Ethanol impregnation method

Use ethanol of analytical grade (for possible modifications, see 4.2) for the impregnation method.