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Verification of samples of uranyl or plutonium nitrate solutions by density measurements

*Qualification d'échantillons de solutions de nitrate d'uranyle ou de
plutonium par mesure de la masse volumique*



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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.

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.

International Standard ISO 11597 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 5, *Nuclear fuel technology*.

Annex A forms an integral part of this International Standard. Annex B is for information only.

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Verification of samples of uranyl or plutonium nitrate solutions by density measurements

1 Scope

This International Standard establishes the use of density measurements for verifying the homogeneity of an industrial solution of uranyl or plutonium nitrate of nuclear grade, and the representativity of samples drawn from such a solution.

It is applicable to solutions of densities greater than 1,25 g/cm³, containing 100 g/l to 400 g/l of uranium or 50 g/l to 300 g/l of plutonium, in 0,2 mol/l to 8 mol/l nitric acid. The procedure assumes that the only cause of heterogeneity of the industrial solution can be an incomplete mixing with aqueous diluents containing 0 to 7 mol/l nitric acid.

The procedure is intended to provide a quick test which can be used directly at the sampling station to accept or reject the samples taken for fissile material accountability analysis.

It requires a dip tube system for measuring the density and the volume of the solution in the tank in accordance with future International Standards.

NOTE 1 The statistical concepts used in this International Standard are described in ISO 10980.

2 Principle

2.1 The procedure is based on experimental correlations between the density, the free nitric acid concentration and the concentration of uranium (table 1) or plutonium (table 2).

2.2 The homogeneity of the solution is verified first by checking that the densities of successive samples lie within preset limits.

2.3 The representativity of the last sample is then checked by comparing its density with the average density of the bulk solution measured with a dip tube device installed in the tank.

2.4 The major steps of the procedure are as follows:

- a) The relative difference in uranium or plutonium concentration D , which should not be exceeded between the concentration of the fissile element in a sample and its average concentration in the industrial solution, is selected.
- b) Derive from table 1 or 2 the density difference Δ_0 which is not to be exceeded to ensure that a) is met.
- c) Replicate samples are taken and the volume of solution in the tank after successive mixings of the industrial solution is measured.
- d) Mixing is repeated until the densities of three successive samples agree within the selected limit Δ_0 , after correction of potential evaporation losses and for given risks of non-detection, β , and false alarm, α .
- e) The density of the last sample is compared with the density measured by a dip tube immersed in the industrial solution.
- f) The last sample is accepted if its density agrees with the dip tube measurement within the selected limit Δ_0 and the experimental errors of measurements, for the selected risks β and α .