Nuclear fuel technology - Chemical separation and purification of uranium and plutonium in nitric acid solutions for isotopic and isotopic dilution analysis by solvent extraction chromatography - Part 1: Samples containing plutonium in the microgram range and uranium in the milligram range (ISO 15366-1:2014)

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NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 15366-1:2016 sisaldab Euroopa standardi EN ISO 15366-1:2016 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 15366-1:2016 consists of the English text of the European standard EN ISO 15366-1:2016.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 20.04.2016.	Date of Availability of the European standard is 20.04.2016.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

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Nuclear fuel technology - Chemical separation and purification of uranium and plutonium in nitric acid solutions for isotopic and isotopic dilution analysis by solvent extraction chromatography - Part 1: Samples containing plutonium in the microgram range and uranium in the milligram range (ISO 15366-1:2014)

Technologie du combustible nucléaire - Séparation et purification chimiques de l'uranium et du plutonium dans les solutions d'acide nitrique par extraction chromatographique par solvant pour les mesures isotopiques et les analyses par dilution isotopique - Partie 1: Échantillons ayant des teneurs en plutonium de l'ordre du microgramme et en uranium de l'ordre du milligramme (ISO 15366-1:2014)

Kernbrennstofftechnologie - Chemische Trennung und Reinigung von Uran und Plutonium in Salpetersäure-Lösungen für Isotopen- und Isotopenverdünnungsanalysen mittels Lösemittelextraktions-Chromatographie - Teil 1: Proben mit Plutonium im Mikrogrammbereich und Uranium im Milligrammbereich (ISO 15366-1:2014)

This European Standard was approved by CEN on 21 February 2016.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

The text of ISO 15366-1:2014 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 15366-1:2016 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 October 2016, and conflicting national standards shall be withdrawn at the latest by October 2016.

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Endorsement notice

The text of ISO 15366-1:2014 has been approved by CEN as EN ISO 15366-1:2016 without any modification.

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1 Scope

This part of ISO 15366 describes procedures to chemically separate and purify uranium and plutonium in dissolved solutions of irradiated light water reactor fuels and in samples of high active liquid waste of spent fuel reprocessing plants, prior to their isotopic analysis by e.g. mass spectrometric method (see ISO 8299[1]) or alpha spectrometry (see ISO 11483[2]).

This part of ISO 15366, describes a technique for the separation of uranium and plutonium in spent fuel type samples based on chromatographic method. The procedure applies to samples containing 1 µg to 150 µg Pu (IV) and (VI) and 0,1 mg to 2 mg U (IV) and (VI) in up to 2 ml of 3 mol·l^{-1} nitric acid solution. It is applicable to mixtures of uranium and plutonium in which the U/Pu-ratio can range from 0 up to 200.

2 Principle of the method

The chemical separation is based on a column extraction chromatography using tri-*n*-octylphosphine-oxide (TOPO) as extractant.[3][4] The necessary valency adjustment prior to the separation is done with iron(II) sulfate and sodium nitrite. The extraction process is performed in disposable columns loaded with a silica gel powder coated with the TOPO.[5] Plutonium(IV) and uranium(VI) in 3 mol·l^{-1} nitric acid medium are selectively extracted into the TOPO while americium, the fission products and other interfering elements are not retained. Plutonium is eluted after reduction to the trivalent state with ascorbic acid[6]; uranium is eluted by an ammonium carbamate solution. Besides the measurement by mass spectrometry, the plutonium fractions are also measured by alpha spectrometry for the determination of the isotopic abundance of ^{238}Pu (mass spectrometry might be biased by residual amounts of uranium in the plutonium fraction) and for checking the recovery of plutonium.

In order to ensure favourable kinetics of the chemical reactions, the (gravity) column flow rates should not exceed 0,1 ml·min^{-1}.

Parallel measurement of blank and/or control sample is recommended to verify the analysis.

Blanks are run in parallel with the samples to verify the absence of significant external cross-contamination and cross-contamination between samples.

Control samples prepared from certified or analysed materials are also prepared and separated along with the sample to verify that suitable valency adjustment, isotopic equilibration and separation efficiency are achieved.

3 Apparatus

3.1 Biological shielding, e.g. shielded glove box or fume cupboard.

