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SOLUBILITY DATA SERIES

Volume 55

ACTINIDE NITRATES

SOLUBILITY DATA SERIES

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ACTINIDE NITRATES

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INTRODUCTION TO THE SOLUBILITY DATA SERIES

SOLUBILITY OF SOLIDS IN LIQUIDS

NATURE OF THE PROJECT

The Solubility Data project (SDP) has as its aim a comprehensive review of published data for solubilities of gases, liquids and solids in liquids or solids. Data of suitable precision are compiled for each publication on data sheets in a uniform format. The data for each system are evaluated and, where data from independent sources agree sufficiently, recommended values are proposed. The evaluation sheets, recommended values, and compiled data sheets are published on consecutive pages.

COMPILATIONS AND EVALUATIONS

The formats for the compilations and critical evaluations have been standardized for all volumes. A description of these formats follows.

Compilations

The format used for the compilations is, for the most part, self-explanatory. Normally, a compilation sheet is divided into boxes, with detailed contents described below.

Components: Each component is listed according to IUPAC name, formula, and Chemical Abstracts (CA) Registry Number. The Chemical Abstracts name is also included if this differs from the IUPAC name, as are trivial names if appropriate. IUPAC and common names are cross-referenced to Chemical Abstracts names in the System Index.

The formula is given either in terms of the IUPAC or Hill (1) system and the choice of formula is governed by what is usual for most current users: i.e., IUPAC for inorganic compounds, and Hill system for organic compounds. Components are ordered on a given compilation sheet according to:

- (a) saturating components;
- (b) non-saturating components;
- (c) solvents.

In each of (a), (b) or (c), the components are arranged in order according to the IUPAC 18-column periodic table with two additional rows:

Columns 1 and 2: H, alkali elements, ammonium, alkaline earth elements

Columns 3 to 12: transition elements

Columns 13 to 17: boron, carbon, nitrogen groups; chalcogenides, halogens

Column 18: noble gases

Row 1: Ce to Lu

Row 2: Th to the end of the known elements, in order of atomic number.

The same order is followed in arranging the compilation sheets within a given volume.

Original Measurements: References are abbreviated in the forms given by Chemical Abstracts Service Source Index (CASSI). Names originally in other than Roman alphabets are given as transliterated by Chemical Abstracts. In the case of multiple entries (for example, translations) an asterisk indicates the publication used for compilation of the data.

Variables: Ranges of temperature, pressure, etc. are indicated here.

Prepared by: The names of all compilers are given here.

Experimental Values: Components are described as (1), (2), etc., as defined in the "Components" box. Data are reported in the units used in the original publication, with the exception that modern names for units and quantities are used; e.g., mass per cent for weight per cent; mol dm⁻³ for molar; etc. Usually, only one type of value (e.g., mass per cent) is found in the original paper, and the compiler has added the other type of value (e.g., mole per cent) from computer calculations based on 1989 atomic weights (2). Temperatures are expressed as *t*/°C, *t*/°F or *T*/K as in the original; if necessary, conversions to *T*/K are made, sometimes in the compilations and always in the critical evaluation. However, the author's units are expressed according to IUPAC recommendations (3) as far as possible.

Errors in calculations, fitting equations, etc. are noted, and where possible corrected. Material inserted by the compiler is identified by the word "compiler" or by the compiler's name in parentheses or in a footnote. In addition, compiler-calculated values of mole or mass fractions are included if the original data do not use these units. If densities are reported in the original paper,

conversions from concentrations to mole fractions are included, but otherwise this is done in the evaluation, with the values and sources of the densities being quoted and referenced.

Details of smoothing equations (with limits) are included if they are present in the original publication and if the temperature or pressure ranges are wide enough to justify this procedure and if the compiler finds that the equations are consistent with the data.

The precision of the original data is preserved when derived quantities are calculated, if necessary by the inclusion of one additional significant figure. In some cases, compilers note that numerical data have been obtained from published graphs using digitizing techniques. In these cases, the precision of the data can be determined by the quality of the original graph and the limitations of the digitizing technique. In some cases graphs have been included, either to illustrate data more clearly, or if this is the only information in the original. Full grids are not usually inserted as it is not intended that users should read data from the graphs.

Method: The apparatus and procedure are mentioned briefly. Abbreviations used in Chemical Abstracts are often used here to save space, reference being made to sources of further detail if these are cited in the original paper.

Source and Purity of Materials: For each component, referred to as (1), (2), etc., the following information (in this order and in abbreviated form) is provided if available in the original paper: source and specified method of preparation; properties; degree of purity.

Estimated Error: If estimated errors were omitted by the original authors, and if relevant information is available, the compilers have attempted to estimate errors (identified by "compiler" or the compiler's name in parentheses or in a footnote) from the internal consistency of data and type of apparatus used. Methods used by the compilers for estimating and reporting errors are based on Ku and Eisenhart (4).

Comments and/or Additional Data: Many compilations include this section which provides short comments relevant to the general nature of the work or additional experimental and thermodynamic data which are judged by the compiler to be of value to the reader.

References: The format for these follows the format for the Original Measurements box, except that final page numbers are omitted. References (usually cited in the original paper) are given where relevant to interpretation of the compiled data, or where cross-reference can be made to other compilations.

Evaluations

The evaluator's task is to assess the reliability and quality of the data, to estimate errors where necessary, and to recommend "best" values. The evaluation takes the form of a summary in which all the data supplied by the compiler have been critically reviewed. There are only three boxes on a typical evaluation sheet, and these are described below.

Components: The format is the same as on the Compilation sheets.

Evaluator: The name and affiliation of the evaluator(s) and date up to which the literature was checked.

Critical Evaluation:

(a) Critical text. The evaluator checks that the compiled data are correct, assesses their reliability and quality, estimates errors where necessary, and recommends numerical values based on all the published data (including theses, patents and reports) for each given system. Thus, the evaluator reviews the merits or shortcomings of the various data. Only published data are considered. Documented rejection of some published data may occur at this stage, and the corresponding compilations may be removed.

The solubility of comparatively few systems is known with sufficient accuracy to enable a set of recommended values to be presented. Although many systems have been studied by at least two workers, the range of temperatures is often sufficiently different to make meaningful comparison impossible.

Occasionally, it is not clear why two groups of workers obtained very different but internally consistent sets of results at the same temperature, although both sets of results were obtained by reliable methods. In such cases, a definitive assessment may not be possible. In some cases, two or more sets of data have been classified as tentative even though the sets are mutually inconsistent.

(b) Fitting equations. If the use of a smoothing equation is justifiable the evaluator may provide an equation representing the solubility as a function of the variables reported on all the compilation sheets, stating the limits within which it should be used.

(c) Graphical summary. In addition to (b) above, graphical summaries are often given.

(d) Recommended values. Data are recommended if the results of at least two independent

groups are available and they are in good agreement, and if the evaluator has no doubt as to the adequacy and reliability of the applied experimental and computational procedures. Data are reported as tentative if only one set of measurements is available, or if the evaluator considers some aspect of the computational or experimental method as mildly undesirable but estimates that it should cause only minor errors. Data are considered as doubtful if the evaluator considers some aspect of the computational or experimental method as undesirable but still considers the data to have some value where the order of magnitude of the solubility is needed. Data determined by an inadequate method or under ill-defined conditions are rejected. However, references to these data are included in the evaluation together with a comment by the evaluator as to the reason for their rejection.

(e) References. All pertinent references are given here, including all those publications appearing in the accompanying compilation sheets and those which, by virtue of their poor precision, have been rejected and not compiled.

(f) Units. While the original data may be reported in the units used by the investigators, the final recommended values are reported in SI units (3) when the data can be accurately converted.

QUANTITIES AND UNITS USED IN COMPILATION AND EVALUATION OF SOLUBILITY DATA

Mixtures, Solutions and Solubilities

A *mixture* (5) describes a gaseous, liquid or solid phase containing more than one substance, where the substances are all treated in the same way.

A *solution* (5) describes a liquid or solid phase containing more than one substance, when for convenience one of the substances, which is called the *solvent*, and may itself be a mixture, is treated differently than the other substances, which are called *solutes*. If the sum of the mole fractions of the solutes is small compared to unity, the solution is called a *dilute solution*.

The *solubility* of a solute 1 (solid, liquid or gas) is the analytical composition of a saturated solution, expressed in terms of the proportion of the designated solute in a designated solvent (6).

"Saturated" implies equilibrium with respect to the processes of dissolution and precipitation; the equilibrium may be stable or metastable. The solubility of a substance in metastable equilibrium is usually greater than that of the same substance in stable equilibrium. (Strictly speaking, it is the activity of the substance in metastable equilibrium that is greater.) Care must be taken to distinguish true metastability from supersaturation, where equilibrium does not exist.

Either point of view, mixture or solution, may be taken in describing solubility. The two points of view find their expression in the reference states used for definition of activities, activity coefficients and osmotic coefficients.

Note that the composition of a saturated mixture (or solution) can be described in terms of any suitable set of thermodynamic components. Thus, the solubility of a salt hydrate in water is usually given as the relative proportions of anhydrous salt in solution, rather than the relative proportions of hydrated salt and water.

Physicochemical Quantities and Units

Solubilities of solids have been the subject of research for a long time, and have been expressed in a great many ways, as described below. In each case, specification of the temperature and either partial or total pressure of the saturating gaseous component is necessary. The nomenclature and units follow, where possible, ref. (3)

A note on nomenclature. The nomenclature of the IUPAC Green Book (3) calls the solute component B and the solvent component A. In compilations and evaluations, the first-named component (component 1) is the solute, and the second (component 2 for a two-component system) is the solvent. The reader should bear these distinctions in nomenclature in mind when comparing equations given here with those in the Green Book.

1. *Mole fraction* of substance 1, x_1 or $x(1)$:

$$x_1 = n_1 / \sum_{s=1}^c n_s \quad [1]$$

where n_s is the amount of substance of s , and c is the number of distinct substances present (often

the number of thermodynamic components in the system). *Mole per cent* of substance 1 is $100 x_1$.

2. *Ionic mole fractions* of salt i , x_{i+} , x_{i-} :

For a mixture of s binary salts i , each of which ionizes completely into v_{i+} cations and v_{i-} anions, with $v_i = v_{i+} + v_{i-}$, and a mixture of p non-electrolytes k , of which some may be considered as solvent components, a generalization of the definition in (7) gives:

$$x_{i+} = \frac{v_{i+} x_i}{1 + \sum_{j=1}^s (v_j - 1) x_j}, \quad x_{i-} = \frac{v_{i-} x_i}{v_{i+}} \quad i = 1 \dots s \quad [2]$$

$$x_{ok} = \frac{x_k}{1 + \sum_{j=1}^s (v_j - 1) x_j}, \quad k = (s+1) \dots c \quad [3]$$

The sum of these mole fractions is unity, so that, with $c = s + p$,

$$\sum_{i=1}^s (x_{i+} + x_{i-}) + \sum_{i=s+1}^c x_{oi} = 1 \quad [4]$$

General conversions to other units in multicomponent systems are complicated. For a three-component system containing non-electrolyte 1, electrolyte 2 and solvent 3,

$$x_1 = \frac{v_{+2} x_{o1}}{v_{+2} - (v_2 - 1) x_{+2}}, \quad x_2 = \frac{x_{+2}}{v_{+2} - (v_2 - 1) x_{+2}} \quad [5]$$

These relations are used in solubility equations for salts, and for tabulation of salt effects on solubilities of gases.

3. *Mass fraction* of substance 1, w_1 or $w(1)$:

$$w_1 = g_1 / \sum_{s=1}^c g_s \quad [6]$$

where g_s is the mass of substance s . *Mass per cent* of substance 1 is $100 w_1$. The equivalent terms *weight fraction*, *weight per cent* and *g (1)/100 g solution* are no longer used.

4. *Solute mole fraction* of substance 1, $x_{s,1}$:

$$x_{s,1} = m_1 / \sum_{s=1}^{c'} m_s = x_1 / \sum_{s=1}^{c'} x_s \quad [7]$$

where c' is the number of solutes in the mixture. These quantities are sometimes called Jänecke mole (mass) fractions (8, 9). *Solute mass fraction* of substance 1, $w_{s,1}$, is defined analogously.

5. *Solvent mole fraction* of substance 1, $x_{v,1}$:

$$x_{v,1} = x_1 / \sum_{s=1}^p x_s \quad [8]$$

Here, p is the number of solvent components in the mixture. *Solvent mass fraction* of substance 1, $w_{v,1}$, is defined analogously.

6. *Molality* of solute 1 in a solvent 2, m_1 :

$$m_1 = n_1/n_2 M_2 \quad [9]$$

SI base units: mol kg⁻¹. Here, M_2 is the molar mass of the solvent.

7. *Aquamolality*, *Solvomolality* of substance 1 in a mixed solvent with components 2, 3 (10), $m_1^{(3)}$:

$$m_1^{(3)} = m_1 \bar{M}/M_3 \quad [10]$$

SI base units: mol kg⁻¹. Here, the average molar mass of the solvent is

$$\bar{M} = x_{v,2}M_2 + (1-x_{v,2})M_3 \quad [11]$$

and $x_{v,2}$ is the solvent mole fraction of component 2. This term is used most frequently in discussing comparative solubilities in water (component 2) and heavy water (component 3) and in their mixtures.

8. *Amount concentration* of solute 1 in a solution of volume V , c_1 :

$$c_1 = [\text{formula of solute}] = n_1/V \quad [12]$$

SI base units: mol m⁻³. The symbol c_1 is preferred to [formula of solute], but both are used. The old terms *molarity*, *molar* and *moles per unit volume* are no longer used.

9. *Mass concentration* of solute 1 in a solution of volume V , ρ_1 :

$$\rho_1 = g_1/V = c_1 M_1/V \quad [13]$$

SI base units: kg m⁻³.

10. *Mole ratio*, $r_{n,12}$ (dimensionless):

$$r_{n,12} = n_1/n_2 \quad [14]$$

Mass ratio, symbol $r_{m,12}$, may be defined analogously.

11. *Ionic strength*, I_m (molality basis), or I_c (concentration basis):

$$I_m = \frac{1}{2} \sum_i m_i z_i^2, \quad I_c = \frac{1}{2} \sum_i c_i z_i^2 \quad [15]$$

where z_i is the charge number of ion i . While these quantities are not used generally to express solubilities, they are used to express the compositions of non-saturating components. For a single salt i with ions of charge numbers z_+ , z_- ,

$$I_m = |z_+ z_-| \nu m_i, \quad I_c = |z_+ z_-| \nu c_i \quad [16]$$

Mole and mass fractions and mole ratios are appropriate to either the mixture or the solution point of view. The other quantities are appropriate to the solution point of view only. Conversions between pairs of these quantities can be carried out using the equations given in Table 1 at the end of this Introduction. Other useful quantities will be defined in the prefaces to individual volumes or on specific data sheets.

Salt hydrates are generally not considered to be saturating components since most solubilities are expressed in terms of the anhydrous salt. The existence of hydrates or solvates is noted carefully the critical evaluation.

Mineralogical names are also quoted, along with their CA Registry Numbers, again usually in the text, and CA Registry Numbers (where available) are given usually in the critical evaluation.

In addition to the quantities defined above, the following are useful in conversions between concentrations and other quantities.

12. *Density*, ρ :

$$\rho = g/V = \sum_{s=1}^c \rho_s \quad [17]$$

SI base units: kg m^{-3} . Here g is the total mass of the system.

13. *Relative density*, $d = \rho/\rho^0$: the ratio of the density of a mixture at temperature t , pressure p to the density of a reference substance at temperature t' , pressure p' . For liquid solutions, the reference substance is often water at 4°C , 1 bar. (In some cases 1 atm is used instead of 1 bar.) The term *specific gravity* is no longer used.

Thermodynamics of Solubility

Thermodynamic analysis of solubility phenomena provides a rational basis for the construction of functions to represent solubility data, and thus aids in evaluation, and sometimes enables thermodynamic quantities to be extracted. Both these aims are often difficult to achieve because of a lack of experimental or theoretical activity coefficients. Where thermodynamic quantities can be found, they are not evaluated critically, since this task would involve examination of a large body of data that is not directly relevant to solubility. Where possible, procedures for evaluation are based on established thermodynamic methods. Specific procedures used in a particular volume will be described in the Preface to that volume.

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Table 1. Interconversions between Quantities Used as Measures of Solubility
c-component Systems Containing c - 1 Solutes i and Single Solvent c

	x_i	w_i	m_i	c_i
$x_i =$	x_i	$\frac{1}{1 + \frac{M_i}{M_c} \left(\frac{1}{w_i} - 1 + \sum_{j \neq i}^{c-1} \left(\frac{M_c}{M_j} - 1 \right) \frac{w_j}{w_i} \right)}$	$\frac{1}{1 + \frac{1}{m_i M_c} + \sum_{j \neq i}^{c-1} \frac{m_j}{m_i}}$	$\frac{1}{1 + \frac{1}{M_c} \left(\frac{\rho}{c_i} - M_i \right) + \sum_{j \neq i}^{c-1} \frac{c_j}{c_i} \left(1 - \frac{M_j}{M_c} \right)}$
$w_i =$	$\frac{1}{1 + \frac{M_c}{M_i} \left(\frac{1}{x_i} - 1 + \sum_{j \neq i}^{c-1} \left(\frac{M_j}{M_c} - 1 \right) \frac{x_j}{x_i} \right)}$	w_i	$\frac{1}{1 + \frac{1}{m_i M_i} \left(1 + \sum_{j \neq i}^{c-1} m_j M_j \right)}$	$\frac{c_i M_i}{\rho}$
$m_i =$	$\frac{1}{M_c \left(\frac{1}{x_i} - 1 - \sum_{j \neq i}^{c-1} \frac{x_j}{x_i} \right)}$	$\frac{1}{M_i \left(\frac{1}{w_i} - 1 - \sum_{j \neq i}^{c-1} \frac{w_j}{w_i} \right)}$	m_i	$\frac{1}{\frac{1}{c_i} \left(\rho - \sum_{j \neq i}^{c-1} c_j M_j \right) - M_i}$
$c_i =$	$\frac{\rho}{M_i + M_c \left(\frac{1}{x_i} - 1 + \sum_{j \neq i}^{c-1} \left(\frac{M_j}{M_c} - 1 \right) \frac{x_j}{x_i} \right)}$	$\frac{\rho w_i}{M_i}$	$\frac{\rho}{\frac{1}{m_i} \left(1 + \sum_{j \neq i}^{c-1} M_j m_j \right) + M_i}$	c_i

ρ - density of solution; M_i - molar masses of i. For relations for 2-component systems, set summations to 0.

PREFACE

This volume contains critically evaluated data on the solubility of actinide nitrates as a function of temperature in aqueous and organic solvents. The data are presented in two forms: tables of the original experimental values which were obtained from research publications; and, recommended values. A discussion describing the rationale for selecting and rejecting data fitted to the solubility equation is included. Where there are sufficient data, recommended values were computed from this equation. Recommended solubilities as a function of temperature are given for uranyl nitrate where the equilibrium solids are the hexahydrate, trihydrate and dihydrate; and for thorium nitrate, where the equilibrium solids are the pentahydrate and the tetrahydrate.

Equilibrium solid phases for nonactinide solids such as aluminum nitrate and other nitrates, ice and uranyl nitrate etherates are identified. Phase diagrams for the uranyl nitrate-water, uranyl nitrate-water-nitric acid, uranyl nitrate-water-ether, and thorium nitrate-water systems are included. The uranyl nitrate and thorium nitrate binary systems with water cover the temperature range 220K to 450K. The ternary system uranyl nitrate-water-diethyl ether was constructed over the temperature range 248K to 323K.

The tabulation of original measurements also includes densities when these data have been published with the solubility measurements.

The literature was searched from 1900 to June 1992. By far, the largest number of publications contain data for uranyl nitrate, followed by thorium nitrate with much less for plutonium and neptunium nitrates. No references were found to data for the solubility of americium nitrate in Chemical Abstracts.

The uranyl nitrate section is organized into aqueous and organic systems. The aqueous systems consist of the binary uranyl nitrate-water; ternary systems with added nitric acid or a salt such as potassium nitrate; and, a multicomponent system. The organic system consists of a uranyl nitrate solid, water, organic solvents and a diluent. The organic solvents are organized into sections with esters, alcohols, ketones/aldehydes, ethers, other organics and phosphates. The thorium, plutonium and neptunium nitrates sections are also organized into aqueous and organic systems. Because there is much less data than for uranium, the organic systems for these three actinides are organized according to the year of publication.

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COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
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CRITICAL EVALUATION:
THE BINARY SYSTEM
INTRODUCTION

Measurements of the solubility of $\text{UO}_2(\text{NO}_3)_2$ in water used for this evaluation were obtained from 26 publications (1,3,5,7-12,14,16-25,28-30,34,35,37). The data are mainly from systematic studies of the solubility of uranyl nitrate as a function of temperature. Some of these data were included in studies involving ternary systems such as uranyl nitrate, nitric acid and water. Other data were obtained in investigations of mixed solvent systems, e.g. aqueous and organic solutions. This work considered over 100 values of the solubility of uranyl nitrate in water covering a temperature range from the eutectic point with ice, about 254 K, to the congruent melting point of the salt dihydrate, about 456 K. The most commonly used laboratory method in measuring solubility as a function of temperature is the isothermal analytical method at several different temperatures. Most publications do not include the experimental errors. Selected data are given in Tables 1, 6, 9 and 13.

The following solid phases of uranium nitrate are known:

Formula	Hydrate	CA Registry
$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	Uranium nitrate hexahydrate	[13520-83-7]
$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$	Uranium nitrate trihydrate	[20651-50-7]
$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$	Uranium nitrate dihydrate	[16071-05-9]
$\text{UO}_2(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$	Uranium nitrate monohydrate	
$\text{UO}_2(\text{NO}_3)_2$	Anhydrous uranium nitrate	[10102-06-4]

In addition to these, Germann (4) claimed the existence of a salt with 24 hydrated waters which forms spontaneously at about -35°C (238 K), and which decomposes at -20°C (253 K). In the binary system $\text{UO}_2(\text{NO}_3)_2 - \text{H}_2\text{O}$, the hexa-, tri- and dihydrates have been identified as the solids present at equilibrium in the temperature range 253 - 460 K. The invariant points reported for the binary system are given in Table 2. There is conflicting evidence in the literature concerning the eutectic temperature for the hexahydrate and ice. According to Vasil'ev (3), the eutectic temperature

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CRITICAL EVALUATION: (Continued)

Table 1. Summary of the solubility of $\text{UO}_2(\text{NO}_3)_2$ in the binary system $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} - \text{H}_2\text{O}$ in the temperature range 253 K to 334 K, considered for fitting to Eq 1.

T/K	Solubility mol/kg	Ref.	T/K	Solubility mol/kg	Ref.
253.15	2.105	12	*298.15	3.213	25
255.05	1.921	3	*298.15	3.217	8
261.05	2.119	3	*298.15	3.219	25
261.65	2.182	8	*298.15	3.22	21
*267.65	2.387	8	*298.15	3.22	30
268.95	2.099	8	*298.15	3.223	28, 29, 35
*270.95	2.414	3	298.15	3.04	18
273.15	5.756	9	*298.15	3.23	34
*273.15	2.482	3	*298.15	3.240	5, 7
*273.15	2.49	28, 29, 30, 34	*298.15	3.246	25
*273.15	2.52	21	*298.15	3.26	23
*273.15	2.477	25	298.15	3.3	20
*273.15	2.488	25	298.75	3.385	3
*278.15	2.67	21	305.05	3.728	24
*278.65	2.594	8	305.65	4.00	12
*278.85	2.671	12	*308.15	3.825	35
*280.75	2.702	8	*309.25	3.851	8
*283.15	2.75	21	*309.85	4.011	3
*285.45	2.846	3	*316.75	4.551	8
287	1.25	1	*318.35	4.734	3
287.15	2.94	24	*323.15	5.218	25
*288.15	2.839	8	*323.15 ^b	5.27	22
*288.15	2.84	21	*324.95 ^b	5.329	3
*288.15	2.85	30	*327.65	5.993	8
289.45	2.98	12	*329.25	6.510	8
*291.45	2.98	12	330.15	7.900	24
*293.15	2.98	19	*330.55	6.779	8
*293.15	2.990	16	*331.35	7.272	8
*293.15	3.028	8	*331.8	7.884	8
*293.15	3.028	9	332.15 ^c	8.50	24
*293.15 ^a	3.03	21	333.15 ^c	9.27	24
*293.55 ^a	3.08	24	333.4 ^d	9.250	3
294.25	3.175	8	334.15 ^c	8.64	24
296.35	3.31	24			

^aMean temperature.

^bTemperature according to Ref. (8). There must be a typographical error in *Chem. Zentr.* 1910, 11, 1527.

^cMetastable equilibrium.

^dTemperature of the congruent melting point of the hexahydrate (3). The corresponding molality was calculated by the evaluators.

*Used in fitting to Eq 1.

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<p>CRITICAL EVALUATION: (Continued)</p> <p>is 255.1 K, whereas Harmon (12) finds 253.2 K. Perova (21) reports that the lowest eutonic point, the invariant point where two solid phases and one liquid phase are in equilibrium, is 253.8 K for the ternary system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$. This means that the eutectic temperature for the hexahydrate and ice must exceed 253.8 K.</p> <p><u>EVALUATION PROCEDURE</u></p> <p>Certain data were rejected because of obvious errors, e.g. inconsistency with other other data. Experimental values and congruent melting point calculated molalities were used. In addition, data points obtained by an extrapolation to zero HNO_3 concentration for values in the ternary system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ were also used in the analysis. These data were fitted initially to the general solubility equation, Eq 1, with $d = 0$.</p> $Y = \ln (m/m_0) - (m/m_0 - 1) = a + b/T + c \ln (T) + d (T) \quad (1)$ <p>In Eq 1, m is the solubility of the solute in units of mol/kg, at the temperature T/K; m_0 is the molality at the congruent melting point; and the values of a, b, c and d are obtained from the fitting of the solubility data to Eq 1.</p> <p>Statistical analysis utilized the criterion that a data point would be rejected when the absolute value of the residual exceeded the product of the standard error of the estimate, σ_Y, and the value of Grubbs parameter k (15) at the 0.05 significance level exceeded $k_{0.05}\sigma_Y$. A data point in this category was defined as an outlier, and rejected. The value of $k_{0.05}$ changes from 2.29 for $n = 10$, to 2.71 when $n = 25$, where n is defined as the number of data points. When there was more than one outlier, only the data point with the highest absolute value of the residual was rejected. Iterative data fitting continued until absolute values of the residuals were less than the value of $k_{0.05}\sigma_Y$.</p> <p><u>SOLUBILITY IN THE SYSTEM $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} - \text{H}_2\text{O}$</u></p> <p>Some publications reporting solubility values do not specifically identify the hexahydrate as the solid phase present under equilibrium conditions. However, the presence of the hexahydrate can only be</p>	

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CRITICAL EVALUATION: (Continued) <p>questioned at temperatures near the hexahydrate - trihydrate phase transition, or when the temperature is below 270 K. The incongruent melting point for the hexahydrate occurs about 332 - 333 K, whereas the congruent melting point is at 333.4 K. See the summary in Table 2. From an inspection of the preliminary solubility curve in Figure 1, it can be concluded that the molality at the hexahydrate incongruent melting point is about 8.2 mol/kg. For this reason, all data points with temperatures below 333 K and with molalities less than 8.2 mol/kg were assigned to the stable hexahydrate, whereas those values which are below 334 K but which exceed 8.2 mol/kg in concentration have been assigned to the metastable hexahydrate. Those data points assigned to temperatures above 334 K are lower hydrates. With these assumptions, only the point for $T = 334$ K and $m = 8.64$ mol/kg is somewhat arbitrary for the hexahydrate. Two data points can be rejected immediately. De Conninck (1) reports that the solubility of uranyl nitrate for a temperature of about 287 K is one part in two parts of water, or 1.25 mol/kg. However, this value is lower than those reported by other researchers near this temperature by about 1.6 mol/kg, and is therefore rejected. The solubility of 69.40 mass %, 5.756 mol/kg, reported by Misciattelli (9) is far too high, and is also rejected. There appears to be a typographical error in the tabulation of Ref. 9, because the phase diagram shows the solubility at 273.2 K as 50 mass %, or 2.54 mol/kg. Twelve solubility values at 298.2 K have been reported. Of these twelve, the two values of 3.04 mol/kg (18) and of 3.3 mol/kg (20) are outliers according to the Grubbs test (15) and these were therefore rejected. Statistical analysis of the remaining data gave the mean values, standard deviations from the mean, and confidence limits of solubilities at the standard temperature 298.2 K, and three other temperatures shown in Table 3. As can be seen in Table 3, the confidence intervals of mean solubilities are narrow so that the agreement among various authors is quite good. It is interesting to note that the solubility of $\text{UO}_2(\text{NO}_3)_2$ at 298.2 K in the $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{D}_2\text{O} - \text{D}_2\text{O}$ system is 2.720 mol/kg (37). This value is considerably lower than in ordinary</p>	

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CRITICAL EVALUATION: (Continued) <p>water. Other data points were rejected because the solubilities lay outside the initial solubility - temperature plot in Figure 1. This plot was drawn through points representing average solubilities at given temperatures, using data from Table 3 with high weighting factors. On the basis of this plot, the two values published by Guempel (8), 2.099 mol/kg at 269 K and 3.175 mol/kg at 294.3 K were rejected because the first is lower than expected by about 0.3 mol/kg, while the second value is higher than expected by about 0.1 mol/kg. Nethaway and Lang (24) published data which appear to have low precision, and generally exhibit a positive systematic error. Of the eight solubility determinations, those at 287 K, ($m = 2.93$ mol/kg), 296.4 K ($m = 3.31$ mol/kg), 305.1 K ($m = 3.79$ mol/kg), and 330 K ($m = 7.90$ mol/kg) were rejected because they are higher than expected from the preliminary plot by 0.1, 0.15, 0.20 and 1.0 mol/kg, respectively. Harmon's (12) results were rejected because identical solubility values ($m = 2.98$ mol/kg) were found at the two differing temperatures, 289.5 K and 291.5 K, and the initial solubility plot in Figure 1 indicates that the value at 289.5 K is about 0.1 mol/kg too high. A solubility of 4.00 mol/kg at 305.7 K published by Guempel (8) was also rejected because this value is about 0.4 mol/kg higher than would be expected. Similarly, the value of 3.385 mol/kg obtained from Vasil'ev (3) is about 0.15 mol/kg higher than the more accurate solubility at almost the identical temperature of 298.2 K. Thus, this value was also rejected.</p> <p>In all, 14 of the data points in Table 1 were rejected during the initial critical evaluation. Note that values for temperatures less than 270 K appear lower than expected, based on the extrapolated portion of the solubility - temperature curve which has been drawn smoothly through data points at temperatures above 270 K. Data points below 270 K may represent differing statistical parent populations, as compared to those above 270 K. This possibility was checked in the fitting procedure described in the next paragraphs.</p> <p>The remaining data were fitted to Eq 1, and the values from Vasil'ev (3)</p>	

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CRITICAL EVALUATION: (Continued)

Table 2. Invariant points in the $\text{UO}_2(\text{NO}_3)_2 - \text{H}_2\text{O}$ binary system.

Invariant point	T/K	molality	Ref.
		mol/kg	
eutectic	<253.2	---	12
	>253.8	---	21
	255.1	1.921	3
hexahydrate to trihydrate transition	331.8	---	8,10
	333	---	17
hexahydrate congruent	333.4	9.251 ^a	3
trihydrate to dihydrate transition	386.2	14.02	14,17
trihydrate congruent	394.7	18.50 ^a	3
dihydrate congruent	452.5	27.75	3
	457.2	27.78	14,17
	460	27.7	10

^aTheoretical value.

Table 3. Mean solubilities of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in water from repeat measurements.

T/K	Number of data points	m mol/kg	σ_m mol/kg	$t_{0.05}\sigma_m$ mol/kg	Ref.
273.2	5 ^a	2.491	0.0075	0.021	3,21,25,28
288.2	3	2.843	0.0035	0.015	8,21,30
293.2	5	3.011	0.0010	0.028	8,9,16,19,21
298.2	10	3.229	0.0048	0.011	5,8,21,23,25,28,30,34

m denotes the mean value of solubility; σ_m is the standard deviation of the mean; $t_{0.05}$ is the Student's t statistic at the 0.05 significance level.

^aThree data points at 273.2 K, and two at 273.3 K.

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CRITICAL EVALUATION: (Continued)

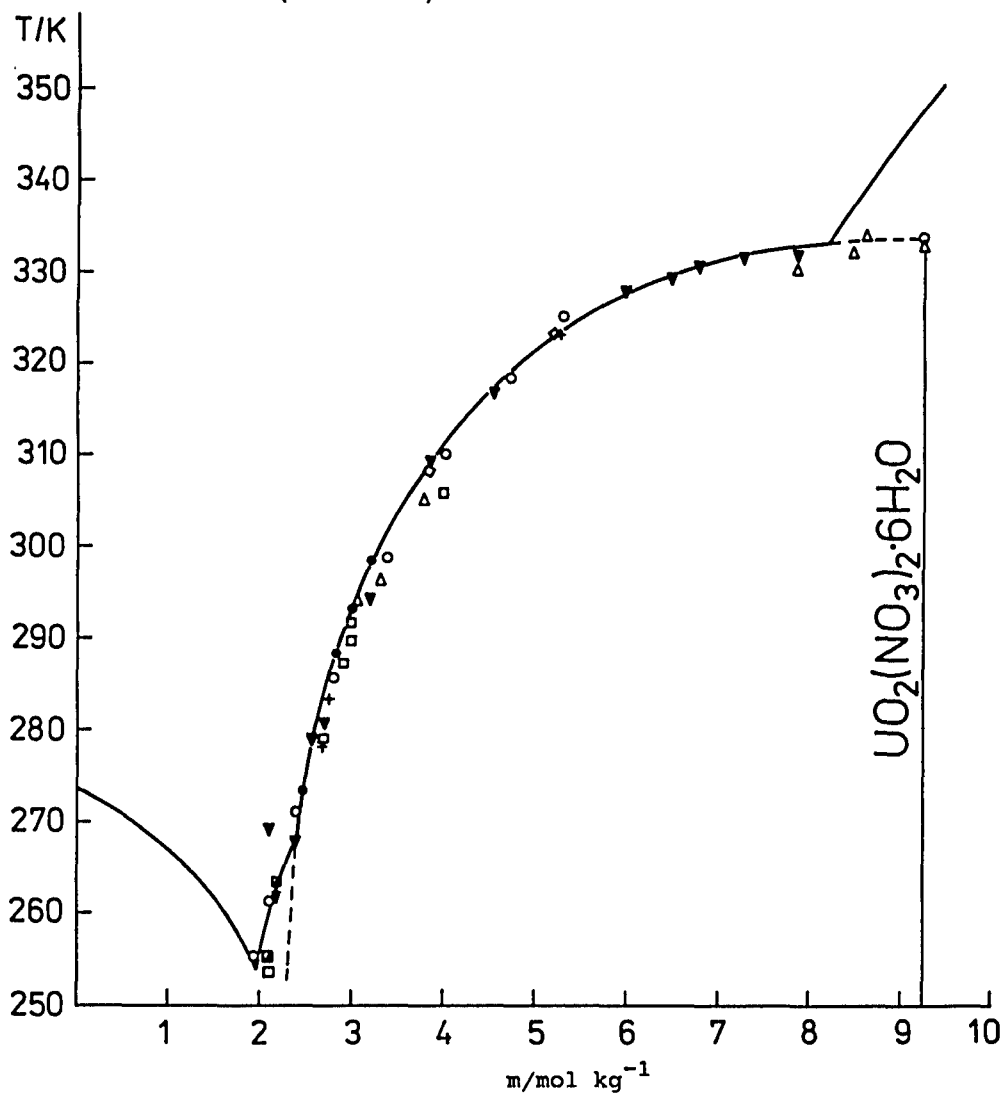


Figure 1. Phase diagram for the $\text{UO}_2(\text{NO}_3)_2 - \text{H}_2\text{O}$ system. The solid line for the stable hexahydrate phase and the dashed lines for the metastable hexahydrate phase were calculated from the smoothing equation. The solid line for solubility below 268 K and the solid line for the ice system were obtained by graphic smoothing. Experimental data: o, from Ref.3; ▼, from Ref.8; □, from Ref. 12; + from Ref. 21 and Ref.22; △, from Ref.24; ◇, from Ref. 25, 28 and 35; ■, from Ref.32 and Ref.39; ●, from mean solubility values in Table 2.

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CRITICAL EVALUATION: (Continued) <p>at 255.1 K ($m = 1.921$ mol/kg) and 261.1 K ($m = 2.119$ mol/kg) were found to be outliers according to the Grubbs test. These were therefore rejected. The residuals for both data points were negative, i.e. the experimental solubilities were lower than those resulting from the fit. Of the remaining points, the solubility at 253.2 K ($m = 2.105$ mol/kg) reported by Harmon (12) and that at 261.7 K ($m = 2.182$ mol/kg) given by Guempel (8) are very near to the rejection region. The absolute values were 2.5 times greater than the standard error of the estimate. Fitting of these 52 points resulted in the solubility values 2.457, 2.861, 3.047 and 3.267 mol/kg at temperatures of 273.2, 288.2, 293.2 and 298.2 K, respectively. The standard deviations in the values obtained from the fit varied from about 0.006 mol/kg at 273.2 K, to about 0.009 mol/kg at 298.2 K. A statistical comparison at the 0.05 significance level showed that the mean solubilities for replicate measurements at the given temperatures are not equal to those from the fit. This result suggests that not all of the data points belong to a single parent population, with $n = 6$ for Eq 1. The same conclusion can be drawn from the test of series which show that positive and negative residuals are organized separately into broad temperature intervals, rather than following a random distribution. Therefore, in a third fitting procedure, solubility values at 253.2 K ($m = 2.105$ mol/kg) from (12) and at 261.7 K ($m = 2.182$ mol/kg) were excluded. Rejection of these data points resulted in a decrease of the standard error of the estimate, σ_y, from 0.012 to 0.008, and in a considerable improvement in the distribution pattern of the residuals. However, the most important result was a decrease in the difference between mean solubility values calculated from replicate measurements, and solubility values obtained as a result of the fitting to Eq 1. The latter values then became: 2.498 mol/kg at 273.2 K, 2.858 mol/kg at 288.2 K, 3.022 mol/kg at 293.2 K, 3.242 mol/kg at 298.2 K. Standard deviations in the solubility values obtained from this fit, σ_m, vary from 0.004 mol/kg at 273.2 K to 0.006 mol/kg at 298.2 K. The solubility values from the two sets, replicate measurements and the</p>	

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CRITICAL EVALUATION: (Continued) <p>fit, are still not equal from a statistical viewpoint at the 0.05 significance level. However, the differences are not of any practical importance. Therefore, no additional fittings were made with the idea to improve the agreement by rejection of any additional data points.</p> <p>Results for the analyses with Eq 1 on the solubility of $\text{UO}_2(\text{NO}_3)_2$ in the $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} - \text{H}_2\text{O}$ system are given in Table 4 and Table 5, and depicted in Figure 1 and Figure 2. The data reported for the ice - branch (3,8,21) are also shown in these figures. The imprecision in solubility values calculated according to the fitting is given by $\pm t_{0.05} \sigma_m$, where σ_m is the standard deviation in solubility and can be calculated from the standard error of the estimate. Because solubility data in the hexahydrate system were published by different researchers, most of the inaccuracy is included in σ_m, so that the overall uncertainty in the recommended values is equal to the imprecision from the fit. This was found to increase from ± 0.008 mol/kg at 273.2 K, through ± 0.012 mol/kg at 298.2 K to ± 0.05 mol/kg at 328.2 K.</p> <p>Two explanations can be offered for the apparent lack of compatibility between data points below 270 K, and those above this temperature. First, difficulties in obtaining equilibrium at low temperatures may result in solubilities lower than equilibrium values, the differences increasing with decreasing temperature. A more plausible explanation is the existence at equilibrium of a hydrate with more water molecules than that of the hexahydrate for temperatures below 270 K. This is in accord with the general tendency toward an increasing number of hydrated waters with decreasing temperature. In this context, Germann claimed that a solid phase with 24 water molecules in the solid hydrate was stable at low temperatures (4). It should also be noted that thorium nitrate, which forms a stable penta- or hexahydrate at 298.2 K, crystallizes with about ten waters in the solid hydrate at 277 K. See the evaluation of the $\text{Th}(\text{NO}_3)_4 - \text{H}_2\text{O}$ system in this work. Additional experimental data are needed on the solubility of $\text{UO}_2(\text{NO}_3)_2$ below 270K, to confirm the</p>	

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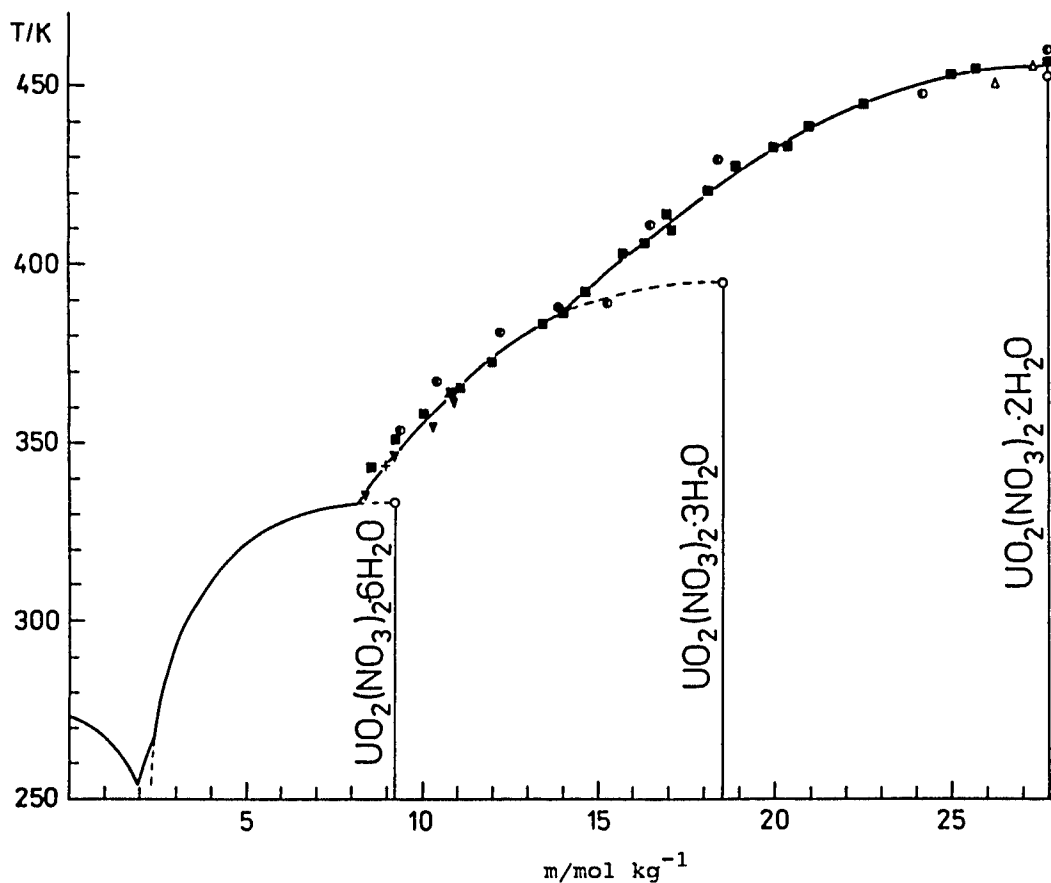
CRITICAL EVALUATION: (Continued)

Figure 2. Phase diagram for the $\text{UO}_2(\text{NO}_3)_2 - \text{H}_2\text{O}$ system. The solid lines represent stable phases and dashed lines are for metastable phases. These were calculated from smoothing equation. Solid line for solubility below 268 K and the solid line for the ice system were obtained by graphical smoothing. Experimental data: o, Ref. 3; ∇ , Ref. 8; \bullet , Ref. 10; \blacksquare , Ref. 14, 17; +, Ref. 21, 22; \triangle , Ref. 24.

COMMENTS:

The molality corresponding to the congruent melting point of the 24-hydrate is 2.1 mol/kg, a value very close to the intersection point of the solubility curves at about 266 K. Therefore, if a 24-hydrate exists, its congruent melting point and the peritectic transition between the 24-hydrate and hexahydrate must almost coincide.

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CRITICAL EVALUATION: (Continued)

Table 4. Values of the parameters and the standard deviations for the smoothing equation, Eq 1.

Parameter	Parameter Value	Standard Deviation
a	964.618 mol/kg	0.0149
b	-23711.09 mol/(kg K)	4.57
c	-172.094 mol/kg	0.00261
d	0.3187	0.0000489
m_o	9.25 mol/kg	0.0149 ^a

^aStandard error of the estimate.

Table 5. Recommended and tentative solubilities in the system $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, obtained with Eq 1^a.

Solubility		Solubility	
T/K	mol/kg	T/K	mol/kg
258.15	2.17	298.15	3.21
263.15	2.28	303.15	3.44
268.15	2.39	308.15	3.71
273.15	2.49	313.15	4.07
278.15	2.61	318.15	4.53
283.15	2.73	323.15	5.17
288.15	2.87	328.15	6.17 ^b
293.15	3.03	332.15	9.25

^aThe equilibrated solid may be a hydrate with more than 6 waters in the temperature interval 258.15 - 268.15 K.

^bCongruent melting point.

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<p>CRITICAL EVALUATION: (Continued) existence and exact composition of a high hydrate phase.</p> <p>Assuming that the reported data for temperatures below 270 K represent true equilibrium with respect to a hydrate of unknown composition, then solubility values in the temperature interval $258.2 < T/\text{K} < 268.2$ can be obtained by graphically smoothing the five reported data points at temperatures below 270 K. We have added two additional data points which were obtained from extrapolation of solubilities in the system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ to zero nitric acid concentration. These two values are 2.1 mol/kg at 258.2 K, and 2.2 mol/kg at 263.2 K (32,39). Tentative solubility values in the temperature range 258.2 - 268.2 K obtained in this manner are given in Table 5, and in Figure 1 and Figure 2. The uncertainty in the tentative solubility values are estimated at about ± 0.05 mol/kg. The corresponding solubility values obtained from the smoothing Eq 1 with $n = 6$ are 2.17 mol/kg at 258.2 K, and 2.28 mol/kg at 263.2 K.</p> <p><u>SOLUBILITIES IN THE SYSTEM $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} - \text{H}_2\text{O}$</u></p> <p>Since the hexahydrate to trihydrate phase transition temperature is about 333 K and 8.2 mol/kg, and that between the trihydrate and the dihydrate 386 K and 14.0 mol/kg, all data points in the temperature interval 333 K to 386 K and molalities in the interval 8.2 mol/kg to 14.0 mol/kg have been assigned to the stable trihydrate branch. Because the congruent melting point of the trihydrate is 394.7 K and 18.50 mol/kg (Table 2), data points in the temperature interval 386 K to 395 K and concentrations between 14.0 mol/kg to 18.5 mol/kg may belong to the metastable trihydrate branch. The latter appears to be the case for the value at 389 K and 15.3 mol/kg (10).</p> <p>Four solubility values in the plot of the temperature versus the amount solubility from (20) have been rejected in this evaluation, because of the incompatible composition scale used. The value of 11 mol/kg at 346 K was not considered because it exceeded data obtained by others for similar temperatures by as much as 2 mol/kg. All the results of Lane (11) and those in the phase diagram (17) are much higher than the data of</p>	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U. S. A.
<p>CRITICAL EVALUATION: (Continued)</p> <p>other investigators at similar temperatures, and have therefore been rejected. It should be noted that in the phase diagram (17), the data points given by Lane and by Guempel (8) were apparently interchanged. From an inspection of the preliminary plot of T/K versus m, the results of Marshall et al. (14,17) appear to be the most precise. Solubility values at 363.2 K and 363.2 K published by Perova (22) and Marshall et al., respectively, agree very well. However, the solubility at 343.2 K given by Perova is about 0.4 mol/kg greater than that of Marshall et al. (14,17), and appears to belong to the set of four solubility values reported by Guempel (8). On the other hand, the five solubilities found in Benrath (10) are lower than expected from the solubility curve drawn through the data points of Marshall et al. The reported solubilities taken into account in the first fitting procedure are given in Table 6. No outliers were found, although the data point at 367 K, with $m = 10.5$ mol/kg (10), was very close to the rejection region.</p> <p>The results of the analyses for the solubility of $\text{UO}_2(\text{NO}_3)_2$ in the system $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} - \text{H}_2\text{O}$ are given in Table 7 and Table 8, and shown in Figure 2. The invariant points with the trihydrate are in Table 2. Since solubility values in the trihydrate system were reported by four different groups of researchers, it can be assumed that most of the inaccuracy is included in the imprecision calculated from the standard deviation of the estimate. Therefore, the overall uncertainty is simply equal to $\pm t_{0.05} \sigma_m$, where σ_m is the standard deviation in the solubility. The overall uncertainty calculated in this manner was found to be about ± 0.1 mol/kg at 338.2 K, ± 0.15 mol/kg at 363.2 K, and ± 0.3 mol/kg at 383.2 K.</p> <p><u>SOLUBILITIES IN THE SYSTEM $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} - \text{H}_2\text{O}$</u></p> <p>The solubility value of 21.2 mol/kg at 417.35 K reported by Lane (11) is about 3.5 mol/kg higher than expected, based on the initial plot of T/K versus m, and was therefore rejected. Data points used for the fit are given in Table 9. Following the first fitting procedure, the point at 429.15 K, $m = 18.4$ mol/kg, reported by Benrath (10) was found to be an</p>	

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Water; H_2O ; [7732-18-5]

EVALUATOR:

S. Siekierski

Warsaw, Poland

and

S. L. Phillips

Orinda, California U. S. A.

CRITICAL EVALUATION: (Continued)

Table 6. Solubility data for $\text{UO}_2(\text{NO}_3)_2$ in the system $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} - \text{H}_2\text{O}$.

Solubility			Solubility		
T/K	mol/kg	Ref.	T/K	mol/kg	Ref.
335.2	8.415	8	363.7	10.81	14,17
343.2	8.617	14,17	365.2	11.08	14,17
343.2	8.998	22	367	10.5	10
345.6	9.266	8	373.2	12.02	14,17
350.4	9.260	14,17	381	12.3	10
353	9.5	10	383.2	13.46	14,17
354.1	10.28	8	386.2 ^a	14.02	14,17
358.2	10.10	14,17	*388	13.9	10
361.7	10.91	8	*389 ^b	15.3	10
363.2	10.82	22	*394.7 ^c	18.50	3

^aThe trihydrate --> dihydrate transition point (14,17).

^bMetastable equilibrium.

^cCongruent melting point of the trihydrate (3). The corresponding molality was calculated by the evaluators.

*Not used in fitting.

Table 7. Parameters and standard deviations for Eq 1, for the system $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} - \text{H}_2\text{O}$.

Parameter	Parameter Value	Standard Deviation
a	384.618 mol/kg	0.0124
b	-12148.7 mol/(kg K)	4.49
c	-65.227 mol/kg	0.00212
d	0.09145	0.0000346
m_o	18.50 mol/kg	0.0124 ^a

^aStandard error of the estimate.

Table 8. Recommended solubilities in the $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} - \text{H}_2\text{O}$ system, obtained with Eq 1.

Solubility		Solubility	
T/K	mol/kg	T/K	mol/kg
338.15	8.54	368.15	11.2
343.15	8.93	373.15	11.8
348.15	9.33	378.15	12.5
353.15	9.74	383.15	13.3
358.15	10.2	388.15	14.4 ^a
363.15	10.7	393.15	16.2 ^a

^aMetastable branch, tentative values.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p>outlier and was rejected. No outlier was found in the second fitting. The results of the analyses for the solubility of $\text{UO}_2(\text{NO}_3)_2$ in the system $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} - \text{H}_2\text{O}$ are tabulated in Table 10 and Table 11, and are shown in Figure 2. The invariant points with the dihydrate are given in Table 12. The imprecision in solubilities, $\pm t_{0.05} \sigma_m$, where σ_m denotes the standard deviation in solubility calculated from the standard error of the estimate, and 0.06 mol/kg at 388.2 K, 0.12 mol/kg at 423.2 K, and 0.31 mol/kg at 448.2 K. When considering high solubilities and higher temperatures, the imprecision appears to be low, particularly in comparison with the trihydrate system. The reason is mainly that solubilities in the dihydrate system which are calculated from the smoothing equation are based for the most part on the results reported by only one group of researchers (14,17). These results appear to be precise, though not necessarily accurate. However, solubilities in the trihydrate system reported by Marshall et al. have proven to be both precise and accurate. Because the same experimental procedure was used in both cases, it is reasonable to assume that solubilities in the dihydrate system (14,17) are also accurate. Moreover, except for the value of 18.4 mol/kg at 429 K, the other four solubilities in Benrath (10), and the two given in Nethaway (24) are in fairly good agreement with those of Marshall et al. Therefore solubilities given in Table 11 are the recommended values. However, in contrast to the hexa- and trihydrate systems, the overall uncertainty in the dihydrate system cannot be solely based on the imprecision calculated from data fitting, and is estimated to be about ± 0.15 mol/kg at 388.2 K, ± 0.25 at 423.2 K, and ± 0.5 mol/kg at 448.2 K.</p>	
THE SYSTEM ICE - $\text{UO}_2(\text{NO}_3)_2$ <p>Data on temperature for water freezing as a function of uranyl nitrate concentration are in good agreement (3,8,21). The ice branch of the liquidus curve obtained by graphical smoothing of data points is shown in Figure 1 and Figure 2. Experimental data are given in Table 13.</p>	

COMPONENTS:	EVALUATOR:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	S. Siekierski Warsaw, Poland and
(2) Water; H_2O ; [7732-18-5]	S. L. Phillips Orinda, California U.S.A.

CRITICAL EVALUATION: (Continued)Table 9. Solubility data for $\text{UO}_2(\text{NO}_3)_2$ in the system $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} - \text{H}_2\text{O}$

Solubility			Solubility		
T/K	mol/kg	Ref.	T/K	mol/kg	Ref.
386.15 ^a	14.02	14,17	433.15	20.41	14,17
393.15	14.67	14,17	439.65	21.00	14,17
403.15	15.76	14,17	445.15	22.64	14,17
406.15	16.32	14,17	448.15	24.2	10
410.15	17.09	14,17	451	26.3	24
411.15	16.5	10	*452.5 ^b	27.75	14,17
414.35	17.01	14,17	*453.15	24.99	14,17
420.15	18.18	14,17	*454.15	25.98	14,17
427.65	19.02	14,17	*455.5 ^c	27.3	24
*429.15	18.4	10	*457.15 ^d	27.78	14,17
432.15	20.00	14,17	*460.15	27.7	10

^aThe trihydrate --> dihydrate transition point (14,17).^bCongruent melting point of the dihydrate (3). Molality was calculated by the evaluator.^cThe reported solubility corresponds to the temperature interval 454 - 457 K (24).^dCongruent melting point of the dihydrate (14,17).

*Not used in fitting to Eq 1.

Table 10. Parameters and standard deviations for Eq 1, for the system $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} - \text{H}_2\text{O}$.

Parameter	Parameter Value	Standard Deviation
a	576.981 mol/kg	0.00606
b	-20478.6 mol/(kg K)	2.56
c	-95.3630 mol/kg	0.00100
d	0.11359	0.0000144
m_0	27.75 mol/kg	0.00606 ^a

^aStandard error of the estimate.Table 11. Recommended solubilities in the $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} - \text{H}_2\text{O}$ system, obtained with Eq 1.

Solubility		Solubility	
T/K	mol/kg	T/K	mol/kg
388.15	14.2	423.15	18.3
393.15	14.7	428.15	19.1
398.15	15.3	433.15	19.9
403.15	15.9	438.15	20.9
408.15	16.4	443.15	22.2
413.15	17.0	448.15	24.1
418.15	17.7		

COMPONENTS:	EVALUATOR:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	S. Siekierski Warsaw, Poland and
(2) Water; H_2O ; [7732-18-5]	S. L. Phillips Orinda, California U.S.A.

CRITICAL EVALUATION: (Continued)

Table 12. Invariant points in the system $\text{UO}_2(\text{NO}_3)_2 - \text{H}_2\text{O}$ computed from data fitting.

Invariant Point	T/K	mol/kg
Eutectic between ice and $\text{UO}_2(\text{NO}_3)_2 \cdot n\text{H}_2\text{O}^a(?)$	254	1.95
n hydrate ---> hexahydrate transition (?)	268	2.45
hexahydrate ---> trihydrate transition	333.0	8.19
hexahydrate congruent	332.9	9.251 ^b
trihydrate ---> dihydrate transition	386	13.9
trihydrate congruent	398	18.50 ^b
dihydrate congruent	455	27.75 ^b

^a_n > 6, see the evaluation of solubilities in the hexahydrate system.

^bTheoretical value at the congruent melting point:

6 mole H_2O = (6)(18.0154) = 108.09 g, 0.10809 kg
molality: 1 mole/0.10809 = 9.25 mol/kg

3 mole H_2O = (3)(18.0154) = 54.046 g, 0.054046 kg
molality: 1 mole/0.054046 = 18.50 mol/kg

COMMENT AND/OR ADDITIONAL DATA:

The heat of solution of anhydrous uranyl nitrate, $\text{UO}_2(\text{NO}_3)_2$, in water at 25°C is -81.6 kJ/mol (45).

COMPONENTS:	EVALUATOR:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	S. Siekierski Warsaw, Poland and
(2) Water; H_2O ; [7732-18-5]	S. L. Phillips Orinda, California U.S.A.

CRITICAL EVALUATION: (Continued)

Table 13. Temperature for water freezing as a function of uranyl nitrate. The solid phase is ice.

$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$ mol/kg	Ref.
-0.2	0.0402	3
-0.3	0.217	8
-1	0.218	12 ^a
-1.0	0.22	21
-1.6	0.3082	3
-2.1	0.3536	3
-2.9	0.5264	3
-2.9	0.5320	8
-4.4	0.7800	3
-5	0.7780	12 ^a
-5.4	0.846	21
-5.4	0.8392	8
-6.0	0.9005	3
-7.3	1.067	8
-7.9	1.223	3
-11.2	1.505	3
-14.4	1.692	21
-18.0	1.918	8
-20	2.105	12 ^a

^aSolid phase is not specified in source publication, evaluator assumes ice is the solid phase.

Recommended values for water freezing as a function of uranyl nitrate, based on fitting above data to Eq 1.

T/K	mol/kg ^b
251.02	9.251
253.15	2.436
258.15	1.436
263.15	1.511
266.15	1.221
268.15	0.8396
270.15	0.4556
272.65	0.1429

^bStandard deviation, 0.157

COMPONENTS:

- (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]
 (2) Nitric acid; HNO_3 ; [7697-37-2]
 (3) Water; H_2O ; [7732-18-5]

EVALUATOR:

S. Siekierski
 Warsaw, Poland
 and
 S. L. Phillips
 Orinda, California U.S.A.

CRITICAL EVALUATION: (Continued)

THE TERNARY AND QUATERNARY SYSTEMS

SYSTEMS WITH NITRIC ACID

The system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ has been investigated over a broad range of temperatures and nitric acid concentrations by a number of researchers (5,12,13,20,26,32,33,36,37,40-43). Besides these data, other data points were estimated from an enlarged phase diagram (13), and then recalculated by the evaluators for this ternary system.

Depending on the temperature and nitric acid concentrations, the uranyl nitrate solid phases under equilibrium conditions have been reported as:

Formula	Name
$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	Uranium nitrate hexahydrate
$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$	Uranium nitrate trihydrate
$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$	Uranium nitrate dihydrate
$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{HNO}_3$	Uranium nitrate trinitric acid
$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{HNO}_3$	Uranium nitrate dinitric acid
$\text{UO}_2(\text{NO}_3)_2 \cdot \text{N}_2\text{O}_4 \cdot \text{H}_2\text{O}$	Uranium nitrate dinitrogen tetroxide monohydrate

At concentrations of HNO_3 exceeding 77 mass % (depending on temperature) and at low concentrations of $\text{UO}_2(\text{NO}_3)_2$, the solid phase at equilibrium is the adduct containing three HNO_3 molecules (32). When the HNO_3 concentration exceeds 55 mass % (depending on temperature) and at medium nitrate concentrations, the solid phase at equilibrium consists of the adduct with two HNO_3 molecules (35). According to Lacher, et al. (31), nitric acid decomposes in the acid-rich region, and the solid phase under equilibrium conditions is $\text{UO}_2(\text{NO}_3)_2 \cdot \text{N}_2\text{O}_4 \cdot \text{H}_2\text{O}$. According to Deigele (42), when $T/\text{K} = 278.2$ and the nitric acid concentration is above 70 mass %, the solid phase at equilibrium may be a monohydrate. In another study, no evidence was found for the existence of solids in which water is replaced by nitric acid (42). The composition at the transition points, points of minimum solvent activity, between various uranyl nitrate solids, reported in the referenced publications, or estimated by the evaluators, is given in Tables 14 - 16.

COMPONENTS:	EVALUATOR:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	S. Siekierski Warsaw, Poland
(2) Nitric acid; HNO_3 ; [7697-37-2]	and
(3) Water; H_2O ; [7732-18-5]	S. L. Phillips Orinda, California U.S.A.

CRITICAL EVALUATION: (Continued)

Table 14. Transition points between the hexahydrate and the trihydrate in the system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$.

T/K	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		Ref.
	mass %	mol/kg	mass %	mol/kg	
263.15	15 ^a	1.1	52 ^a	25	32, 39
273.15	19 ^a	1.4	47 ^a	22	32, 39
278.15	21 ^a	1.5	44 ^a	20	42
298.15	37.99	3.026	30.15	15.02	5
298.15	38.2	3.04	29.9	13.83	35
298.15	39 ^a	3.2	30 ^a	15	31
303.15	43 ^a	3.6	27 ^a	14	31
303.35	43.1	3.56	26.2	13.5	32
308.15	48.8	4.11	21.1	11.1	35
313.15	55 ^a	5.2	18 ^a	10	31
323.15	65.7	6.44	8.4	5.1	35

^aEvaluator estimates from phase diagram in source paper.

Table 15. Transition points between the trihydrate and dihydrate in the system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$.

T/K	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		Ref.
	mass %	mol/kg	mass %	mol/kg	
263.15	15 ^a	---	64.5 ^a	48	32
273.15	18.1	2.27	61.7	48.5	32
278.15	19.5 ^a	2.54	61 ^a	50	42
298.15	27.49	3.711	53.71	45.34	5
298.15	28.7	3.87	52.5	44.3	35
298.15	28 ^a	3.7	53 ^a	44	31
303.15	30 ^a	4.0	51 ^a	43	31
303.35	31 ^a	4.5	50 ^a	42	32
308.15	34.7	5.00	47.7	43.0	35
313.15	36 ^a	5.1	46 ^a	41	31
322.25	45.7	6.44	36.3	32.0	32
323.15	45.5	6.08	35.5	29.7	35
332.15	52 ^a	8.2	32 ^a	32	31

^aEvaluator estimates from phase diagram in source papers.

Table 16. Transition points between $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ and $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{HNO}_3$ in the system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$.

T/K	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		Ref.
	mass %	mol/kg	mass %	mol/kg	
298.15	37.6	119	61.6	1220	35
308.15	40.5	203	58.5	928	35
323.15	45.5	88.8	53.2	649	35

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p>The only reported isotherms at 248.2 K and 255.2 K (39) cover a limited portion of the hexahydrate branch, and as expected are some distance from the 263.2 K isotherms. The hexahydrate branch and both the hexa- and trihydrate branches of the 263.2 K and 273.2 K isotherms were reported in (39) and in (32), respectively. At 263.2 K, the agreement between the two sets of data is very satisfactory. However, both the 263.2 K and 278.2 K isotherms of the hexahydrate (32) seem slightly too low. Accordingly, the hexahydrate branch of the 273.2 K isotherm shown in Figure 3 was drawn mainly through data points reported by Christensen and Holmberg (39).</p> <p>The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ system at 278.2 K has been studied extensively by Deigele (42): about 119 data points are available covering the hexa-, tri- and dihydrate branches of the isotherm. The hexa-, tri- and left portion of the dihydrate branch seem to be both precise and accurate. However, the right portion of the dihydrate branch has a very improbable shape and was therefore rejected. When nitric acid levels exceed 70 mass %, the scattered data points obtained from Deigele probably correspond to the monohydrate. However, data points at 265.2 K, 273.2 K, 303.2 K and 323.2 K, which lie in approximately the same region, were assigned by Gaunt et al. (32) to the $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{HNO}_3$ branch. In view of the very low water content in the region under consideration, the latter assignment seems to be more plausible.</p> <p>Data points belonging to the hexahydrate branch of the 293.2 K isotherm have been reported by Christensen and Holmberg (39). A comparison with the adjacent 298.2 K isotherm suggests that the results are rather accurate. The ternary system with nitric acid at 298.2 K has been examined thoroughly (5,23,31,35,36). In general, there is a satisfactory agreement among the various values. The right portion of the dihydrate and the branch corresponding to $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{HNO}_3$, depicted in Figure 3, are based solely on the data in Yakimov and Mishin (35).</p> <p>Lacher et al. (31) and Gaunt et al. (32) give solubilities at 303.2 K and 303.4 K, respectively. Because of the small difference between these</p>	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitric acid; HNO_3 ; [7697-86-9] (3) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
<p>CRITICAL EVALUATION: (Continued)</p> <p>two temperatures, the two sets of data were pooled into a single 303.2 K isotherm. From a comparison with the 298.2 K isotherm, it appears that the data from Gaunt et al. (32) which correspond to the hexahydrate branch are too high, and were therefore rejected. The agreement in the data of references (31,32) is consistent with the tri- and dihydrate as the solid phases, under equilibrium conditions.</p> <p>Only one set of data points exists for each 308.2 K (35) and 313.2 K (31) isotherm. The data in Yakimov and Mishin (35) cover four branches of the isotherm, whereas those of Lacher (31) are only for the hexa- and the trihydrate branches. A comparison with the 303.2 K isotherm suggests that within the hexahydrate branch, the solubility values at 308.2 K are too low. Both the position and shape of the 313.2 K isotherm are correct.</p> <p>Studies of the $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ system made at 323.2 K (31,35) were merged with the measurements at 322.3 K (32). The agreement is satisfactory for the tri- and dihydrate branches, with the exception of some data points in Gaunt et al. (32). The right portion of the dihydrate branch of the isotherm is based solely on the data from Yakimov and Mishin (35). Based on a comparison with the 313.2 K isotherm, the evaluators conclude that results reported by Gaunt et al. (32) were too low, and those by Lacher et al. (31) were too high. Both were therefore rejected. For this reason, the hexahydrate branch of the 323.2 K isotherm in Figure 3 is based only on the data from Yakimov and Mishin (35). Lacher et al. (31) have data for the ternary system at 332.2 K, which is only 1.4 K below the hexahydrate incongruent solubility points. Figure 3 shows that the hexahydrate branch has disappeared almost completely. It follows from a comparison with preceding isotherms that both the position and shape of the 322.2 K isotherm follow expectations.</p>	
<p><u>SYSTEMS WITH ALKALI METALS, AMMONIUM AND THALLIUM NITRATES</u></p> <p>Ternary systems with MeNO_3, $\text{Me} = \text{Li}, \text{Na}, \text{K}, \text{Rb}, \text{Cs}, \text{NH}_4$ and Tl, have been investigated extensively (2,6,7,13,21,22,29,34). The solid phases of uranyl nitrate which are present at equilibrium are the hexahydrate and</p>	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Alkali Metal and Other Cations (3) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p>the trihydrate, with the latter stable for temperatures above the hexahydrate ---> trihydrate transition point. For the Rb, Cs and NH_4 nitrate double salts with uranyl nitrate, these are also the stable phases. Rimbach (2) notes a double salt exists also for potassium nitrate as the second component, but his findings have not been verified by Perova (21,22). Solubility isotherms at 298.2 K for the system with KNO_3 (2,5,21) are in very good agreement. Similarly, there is good agreement for the NH_4NO_3 system at 298.1 - 298.2 K (2,6).</p> <p><u>SYSTEMS WITH ALKALINE EARTH METALS AND TRANSITION METAL NITRATES</u></p> <p>Solubility data for the ternary systems $\text{UO}_2(\text{NO}_3)_2 - \text{Me}(\text{NO}_3)_2 - \text{H}_2\text{O}$, where $\text{Me} = \text{Cu}, \text{Be}, \text{Mg}, \text{Ca}, \text{Sr}, \text{Zn}, \text{Cd}$ and Hg are found in five publications (25,27,28,29,30). In all of these systems, the solid at equilibrium was uranyl nitrate hexahydrate, $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. There has been no report of a double salt as the solid phase at equilibrium.</p> <p><u>QUATERNARY SYSTEMS WITH TWO SATURATING COMPONENTS</u></p> <p>Systems with two saturating components and nitric acid have been studied (13,14,28,38,39). In the majority of these systems, the solid phase at equilibrium is uranyl nitrate hexahydrate. In the system with $\text{Al}(\text{NO}_3)_3$, a trihydrate has also been reported as the equilibrium solid (33,44). Nikolaev et al. (38) mention that when high concentrations of $\text{Th}(\text{NO}_3)_4$ are present, the solid at equilibrium is uranyl nitrate tetrahydrate, $\text{UO}_2(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$. However, this assignment is most improbable, because the formation of uranyl nitrate tetrahydrate has not been otherwise observed, either in the binary system or in all other systems which were investigated, regardless of the temperature and the concentration of the other components.</p>	

COMPONENTS:

- (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]
 (2) Water; H_2O ; [7732-18-5]

EVALUATOR:

S. Siekierski
 Warsaw, Poland
 and
 S. L. Phillips
 Orinda, California U.S.A.

CRITICAL EVALUATION: (Continued)

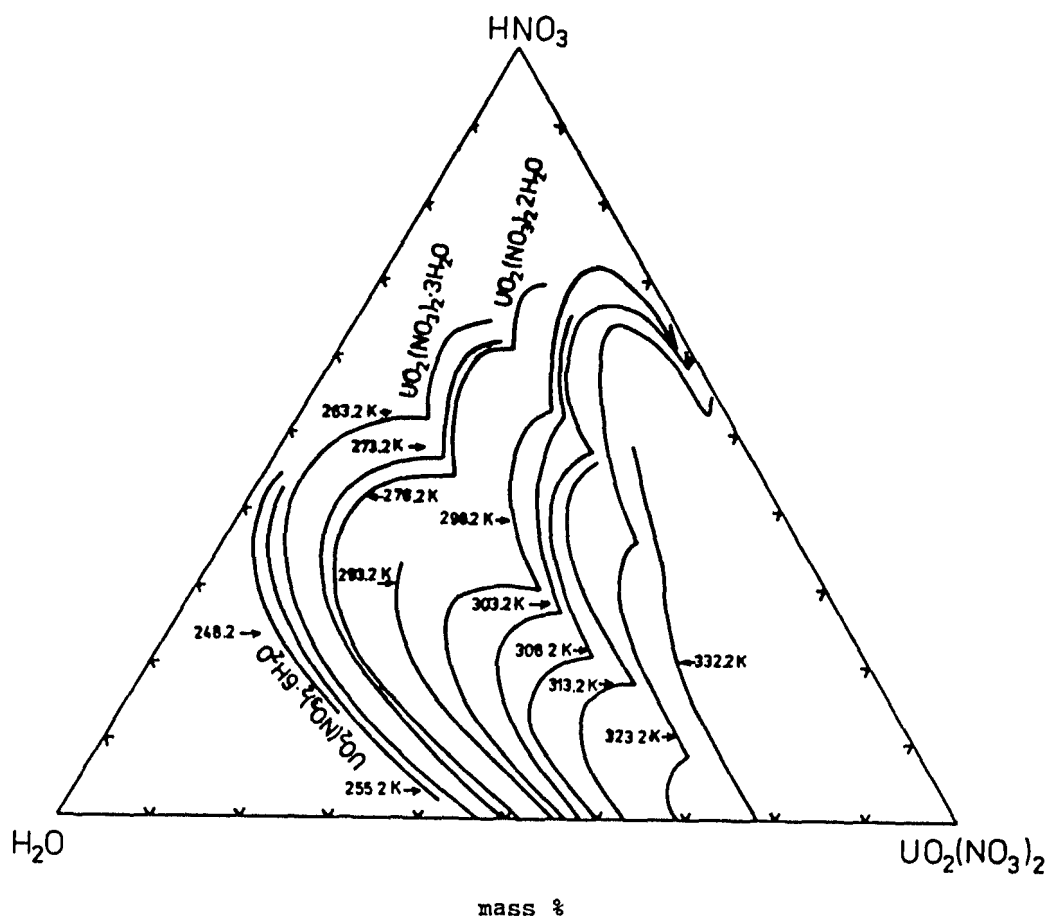


Figure 3. Phase diagram for the $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ system.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p style="text-align: center;">REFERENCES</p> <ol style="list-style-type: none"> 1. De Conninck, Oe. <i>Compt. Rend.</i>, <u>1900</u>, 131, 1219. 2. Rimbach, E. <i>Ber.</i>, <u>1904</u>, 37, 461. 3. Vasil'ev, A. M. <i>Zh. Russ. Fiz. Khim. Obshchestva</i>, <u>1910</u>, 42, 570. <i>Chem. Zentr.</i>, <u>1910</u>, 81, 1527. 4. Germann, F. E. E. <i>J. Am. Chem. Soc.</i>, <u>1922</u>, 44, 1466. 5. Colani, A. <i>Bull. Soc. Chim. Fr.</i>, <u>1926</u>, 39, 1243. 6. Colani, A. <i>Compt. Rend.</i>, <u>1927</u>, 185, 1475. 7. Colani, A. <i>Bull. Soc. Chim. Fr.</i>, <u>1928</u>, 43, 194. 8. Guempel, O. <i>Bull. Soc. Chim. Belg.</i>, <u>1929</u>, 38, 443. 9. Misciattelli, P. <i>Gazz. Chim. Ital.</i>, <u>1930</u>, 60, 839. 10. Benrath, A. <i>Z. Anorg. Allg. Chem.</i>, <u>1942</u>, 249, 245. 11. Lane, J. A. <i>Plutonium Project Handbook</i>, Rev. Ed., CL-697, Chapt. 2, "Physical and Chemical Properties," May <u>1945</u>. 12. Harmon, M. K. "Freezing Point Data for UNH - H_2O - HNO_3," Hanford Works, General Electric Co., HW-8309, December <u>1947</u>. 13. Harmon, M. K.; Cooper, V. R. Report HW-10137, <u>1948</u>. 14. Marshall, W. L.; Gill, J. S. Oak Ridge National Laboratory Report ORNL-607, <u>1949</u>, 38. 15. Grubbs, F. E. <i>Ann. Math. Stat.</i>, <u>1950</u>, 21, 27. 16. De Keyser, W. L.; Cypres, R.; Herrmann, M. <i>Bull. Centre Phys. Nucl. Univ. Libre de Bruxelles</i>, <u>1950</u>, No. 17. 17. Marshall, W. L.; Gill, J. S.; Secoy, C. H. <i>J. Am. Chem. Soc.</i>, <u>1951</u>, 73, 1867. 18. Katzin, L. I.; Sullivan, J. C. <i>J. Phys. Colloid Chem.</i>, <u>1951</u>, 55, 346. 19. Warner, R. K. <i>Australian J. Appl. Sci.</i>, <u>1953</u>, 4, 581. 20. Report HW-31000, <u>1955</u>. 21. Perova, A. P. <i>Zh. Neorg. Khim.</i>, <u>1956</u>, 1, 323. <i>Russ. J. Inorg. Chem.</i>, <u>1956</u>, 1, 140. (Eng. trans.) 22. Perova, A. P. <i>Zh. Neorg. Khim.</i>, <u>1956</u>, 1, 330. <i>Russ. J. Inorg. Chem.</i>, <u>1956</u>, 1, 148. (Eng. trans.) 23. Bol'shakov, K. A.; Korovin, S. S. <i>Zh. Neorg. Khim.</i>, <u>1957</u>, 2, 1940. <i>Russ. J. Inorg. Chem.</i>, <u>1957</u>, 2, 365. (Eng. trans.) 24. Nethaway, M. O.; Lang, G. P. Report MCW-1412, <u>1958</u>. 25. Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. <i>Zh. Neorg. Khim.</i>, <u>1958</u>, 3, 504. <i>Russ. J. Inorg. Chem.</i>, <u>1958</u>, 3, 358. (Eng. trans.) 26. Hart, R. G.; Morris, G. O. <i>Progr. Nucl. Energy, Series III</i>, Vol. 2, 544. (Bruce, F. R.; Fletcher, J. M.; Hyman, H. H., eds.) London, <u>1958</u>. 	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: 27. Kurnakova, A. G.; Nikolaev, A. V. <i>Zh. Neorg. Khim.</i> , <u>1958</u> , 3, 1028. <i>Russ. J. Inorg. Chem.</i> , <u>1958</u> , 3, 298. (Eng. trans.) 28. Yakimov, M. A.; Nosova, N. F. <i>Zh. Neorg. Khim.</i> , <u>1960</u> , 5, 720. <i>Russ. J. Inorg. Chem.</i> , <u>1960</u> , 5, 346. (Eng. trans.) 29. Yakimov, M. A.; Nosova, N. F. <i>Zh. Neorg. Khim.</i> , <u>1961</u> , 6, 208. <i>Russ. J. Inorg. Chem.</i> , <u>1961</u> , 6, 103. (Eng. trans.) 30. Yakimov, M. A.; Nosova, N. F. <i>Vestn. Leningr. Univ.</i> , <u>1962</u> , 4, 106. 31. Lacher, J. R.; Ensley, K.; Park, J. D. <i>Inorg. Chem.</i> , <u>1962</u> , 1, 944. 32. Gaunt, J.; Bastien, I. J.; Adelman, M. <i>Can. J. Chem.</i> , <u>1963</u> , 41, 527. 33. Thibodeau, R. D.; Adelman, M. <i>Can. J. Chem.</i> , <u>1963</u> , 41, 531. 34. Yakimov, M. A.; Nosova, N. F.; Degtyarev, A. Ya.; Tsyun-Tsi, Yui <i>Radiokhim.</i> , <u>1963</u> , 5, 73. <i>Sov. Radiochem.</i> , <u>1963</u> , 60. (Eng. trans.) 35. Yakimov, M. A.; Mishin, V. Ya. <i>Radiokhim.</i> , <u>1964</u> , 6, 454. <i>Sov. Radiochem.</i> , <u>1964</u> , 437. (Eng. trans.) 36. Davis, W.; Lawson, P. S.; De Bruin, H. J.; Mrochek, J. J. <i>Phys.</i> <i>Chem.</i> , <u>1965</u> , 69, 1904. 37. Vdovenko, V. M.; Legin, E. K. <i>Radiokhim.</i> , <u>1966</u> , 8, 317. (Eng. trans.) 38. Nikolaev, A. V.; Ryabinin A. I.; Afanasiev, Iu. A. <i>Izv. Sib. Otdel.</i> <i>Akad. Nauk SSSR</i> , <u>1966</u> , 129. 39. Christensen, H. Th.; Holmberg, K. E. <i>Nukleonik</i> , <u>1968</u> , 11, 165. 40. Cordfunke, E. H. P. <i>J. Inorg. Nucl. Chem.</i> , <u>1972</u> , 34, 531. 41. Efimova, V. S.; Gromov, B. V. <i>At. Energ.</i> , <u>1973</u> , 35, 57. 42. Deigele, E. <i>Thesis</i> , Munich <u>1983</u> , INIS-mf-9277. 43. Vogler, S.; Grosvenor, D. E.; Lewitz, N. M. Report ANL-7917, <u>1972</u> . 44. Medkov, B. K.; Petrov, M. R.; Roslyakova, O. N. <i>Radiokhim.</i> , <u>1988</u> , 30, 272. <i>Sov. Radiochem.</i> , <u>1988</u> , 30, 253. (Eng. trans.) 45. Kanevskii, E. A.; Zarubin, A. I.; Rengevich, V. B.; Pavlovskaya, G.R. <i>Radiokhim.</i> , <u>1974</u> , 16, 410. <i>Sov. Radiochem.</i> , <u>1975</u> , 16, 407. (Eng. trans.)	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Conninck, Oe. Compt. Rend., <u>1900</u> , 131, 1219 - 1220.
VARIABLES: Temperature: About 287 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in water is reported to be about one part of the salt per two parts of water. It is an average of determinations at 12.9°C, 13.2°C, 13.7°C, 14°C, and 14.2°C.</p> <p>The compilers have calculated this solubility as 1.25 mol/kg.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate, presumably the hexahydrate, $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ (compilers) was exposed for several days to a stream of dry air, and then dried for four hours at 85°C to 90°C. Distilled water was used as the solvent.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS:		ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Vasil'ev, A. M.		
(2) Water; H_2O ; [7732-18-5]		<i>Zh. Russ. Fiz. Khim. Obied.</i> , 1910, 42, 570 - 581.		
VARIABLES:		PREPARED BY:		
Temperature: 271 to 345 K		L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES:				
Solubility of $\text{UO}_2(\text{NO}_3)_2$ in H_2O as a function of temperature ^{a,b}				
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	$\text{UO}_2(\text{NO}_3)_2$		Solid Phase ^c
	mass %	mass %	mol/kg	
-1.6	13.80	10.83	0.3082	A
-2.1	15.59	12.23	0.3536	A
-2.9	21.90	17.18	0.5264	A
-4.4	29.96	23.51	0.7800	A
-6.0	33.38	26.19	0.9005	A
-7.9	41.44	32.52	1.223	A
-11.2	47.45	37.23	1.505	A
-18.1	54.90	43.08	1.921	B
-12.1	58.00	45.51	2.119	B
-2.2	62.13	48.75	2.414	B
0	63.01	49.44	2.482	B
12.3	67.36	52.86	2.846	B
25.6	72.83	57.15	3.385	B
36.7	78.05	61.25	4.011	B
45.2 ^d	82.96	65.10	4.734	B
71.8	86.32	67.74	5.329	B
^a Temperature and solubility values were taken by the compilers from Ref. (1).				
^b Mass % of $\text{UO}_2(\text{NO}_3)_2$ and molalities calculated by the compilers.				
^c Solid phases: A = ice; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.				
^d Probably a typographical error in Ref. (1). According to Ref. (2), the temperature is 51.8 ^o C.				
The eutectic temperature is -18.1 ^o C and the congruent melting points of the hexa-, tri- and dihydrate are 60.2, 121.5, and 179.3 ^o C, respectively.				
AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:		
Nothing specified in Ref. (1).		$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ with a m.p. of 60.2 ^o C was used.		
		ESTIMATED ERROR:		
		Nothing specified.		
		REFERENCES:		
		1. Vasil'ev, A. <i>Chem. Zentr.</i> 1910, 81, 1527.		
		2. Guempel, O. <i>Bull. Soc. Chim. Belg.</i> 1929, 38, 443.		

COMPONENTS:			ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Guempel, O.	
(2) Water; H_2O ; [7732-18-5]			Bull. Soc. Chim. Belg. <u>1929</u> , 38, 443 - 477.	
VARIABLES:			PREPARED BY:	
Temperature: 273 to 362 K			L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:				
Solubility of $\text{UO}_2(\text{NO}_3)_2$ in H_2O as a function of temperature ^a				
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		Method	Solid Phase ^c
	mass %	mol/kg		
-0.3	7.87	0.217	Cryoscopic	A
-2.9	17.33	0.5320	"	A
-5.4	24.85	0.8392	"	A
-7.3	29.60	1.067	"	A
-18.0	43.04	1.918	"	A
-11.5	46.25	2.182	Synthetic	B
-5.5	48.47	2.387	"	B
-4.2	45.27 ^b	2.099	"	B
5.5	50.55 ^b	2.594	"	B
7.6	51.27	2.702	"	B
15.0	52.80	2.839	"	B
20.0	54.40 ^b	3.028	Analytical	B
21.1	55.58 ^b	3.175	"	B
25.0	55.90	3.217	"	B
36.1	60.28	3.851	"	B
43.6	64.20	4.551	"	B
54.5	70.25	5.993	"	B
56.1	71.95	6.510	"	B
57.4	72.76	6.779	"	B
58.2	74.13	7.272	"	B
58.6	75.65	7.884	"	B+C
62.0	76.83	8.415	"	C
72.4	78.50	9.266	"	C
80.9	80.20	10.28	"	C
88.5	81.13	10.91	"	C
^a Molalities calculated by compilers.				
^b Data points erroneously ascribed to Vasil'ev (1).				
^c Solid phases: A = ice, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, C = $\text{UO}_2(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$, $x < 6$.				
AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE: The uranyl nitrate concentrations were determined gravimetrically as U_3O_8 .			SOURCE AND PURITY OF MATERIALS:	
			Nothing specified.	
			ESTIMATED ERROR:	
			Nothing specified.	
			REFERENCES:	
			1. Vasil'ev, A. Chem. Zentr. <u>1910</u> , 81, 1527.	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Benrath, A. <i>Z. Anorg. Allg. Chem.</i> , <u>1942</u> , 249, 245 - 250.																																
VARIABLES: Temperature: 353 to 460 K	PREPARED BY: A. Sozanski; S. Siekierski																																
EXPERIMENTAL VALUES: Solubility of $\text{UO}_2(\text{NO}_3)_2$ in H_2O as a function of temperature ^a <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th></tr><tr><th>mass %</th><th>mol/kg</th></tr><tr><td>80</td><td>79</td><td>9.5</td></tr><tr><td>94</td><td>80.6</td><td>10.5</td></tr><tr><td>108</td><td>82.9</td><td>12.3</td></tr><tr><td>115</td><td>84.6</td><td>13.9</td></tr><tr><td>116</td><td>85.8</td><td>15.3</td></tr><tr><td>138</td><td>86.7</td><td>16.5</td></tr><tr><td>156</td><td>87.9</td><td>18.4</td></tr><tr><td>175</td><td>90.5</td><td>24.2</td></tr><tr><td>187</td><td>91.6</td><td>27.7</td></tr></table>		$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		mass %	mol/kg	80	79	9.5	94	80.6	10.5	108	82.9	12.3	115	84.6	13.9	116	85.8	15.3	138	86.7	16.5	156	87.9	18.4	175	90.5	24.2	187	91.6	27.7
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$																																
	mass %	mol/kg																															
80	79	9.5																															
94	80.6	10.5																															
108	82.9	12.3																															
115	84.6	13.9																															
116	85.8	15.3																															
138	86.7	16.5																															
156	87.9	18.4																															
175	90.5	24.2																															
187	91.6	27.7																															
^a Molalities calculated by the compilers.																																	
COMMENTS AND/OR ADDITIONAL DATA: The hexa ---> trihydrate transition point is at 58.6 $^{\circ}\text{C}$. Decomposition of uranyl nitrate was observed at 180 $^{\circ}\text{C}$. In the source paper, the solubility vs. temperature diagram is given.																																	
AUXILIARY INFORMATION																																	
METHOD/APPARATUS/PROCEDURE: The synthetic method was used. The temperature of crystallization was determined visually. Details were given in Ref. (1).	SOURCE AND PURITY OF CHEMICALS: Nothing specified.																																
	ESTIMATED ERROR: Nothing specified.																																
	REFERENCES: 1. Benrath, A.; Gjedebo, F.; Schiffers, B.; Wunderlich, H. <i>Z. Anorg. Allg. Chem.</i> <u>1937</u> , 231, 285.																																

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Lane, J. A. Plutonium Project Handbook, Rev. Ed., CL-697, Chapt. 2, "Physical and Chemical Properties", May 1945.																																										
VARIABLES: Temperature: 333 to 417 K	PREPARED BY: L. Fuks; S. Siekierski																																										
EXPERIMENTAL VALUES: Solubility of $\text{UO}_2(\text{NO}_3)_2$ in H_2O as a function of temperature ^a <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th rowspan="2">Solid_b Phase</th></tr><tr><th>mass %</th><th>mol/kg</th></tr><tr><td>60</td><td>79.0</td><td>9.57</td><td>A</td></tr><tr><td>64.5</td><td>79.5</td><td>9.87</td><td>A</td></tr><tr><td>71.9</td><td>79.2</td><td>9.68</td><td>A</td></tr><tr><td>78.9</td><td>80.6</td><td>10.5</td><td>A</td></tr><tr><td>80.5</td><td>82.0</td><td>11.6</td><td>A</td></tr><tr><td>92.2</td><td>82.8</td><td>12.2</td><td>A</td></tr><tr><td>101.1</td><td>85.6</td><td>15.1</td><td>A</td></tr><tr><td>105.5</td><td>86.0</td><td>15.6</td><td>A</td></tr><tr><td>144.2</td><td>89.3</td><td>21.2</td><td>B</td></tr></table>		$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		Solid _b Phase	mass %	mol/kg	60	79.0	9.57	A	64.5	79.5	9.87	A	71.9	79.2	9.68	A	78.9	80.6	10.5	A	80.5	82.0	11.6	A	92.2	82.8	12.2	A	101.1	85.6	15.1	A	105.5	86.0	15.6	A	144.2	89.3	21.2	B
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		Solid _b Phase																																								
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144.2	89.3	21.2	B																																								
^a Numerical data were taken by the compilers from Ref. (1) which contained the phase diagram. In the phase diagram, some of the data points reported by Lane and by Guempel (2) have been interchanged (compilers). ^b Solid phase: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$.																																											
AUXILIARY INFORMATION																																											
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.																																										
	ESTIMATED ERROR: Nothing specified.																																										
	REFERENCES: 1. Marshall, W. L.; Gill, J. S.; Secoy, C. H. <i>J. Am. Chem. Soc.</i> <u>1951</u> , 73, 1867. 2. Guempel, O. <i>Bull. Soc. Chim. Belg.</i> <u>1929</u> , 30, 443.																																										

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Marshall, W. L.; Gill, J. S. Report 1949, ORNL-607, Oak Ridge National Laboratory, 38 - 44.	
VARIABLES: Temperature: 343 to 457 K		PREPARED BY: A. Sozanski; S. Siekierski	
EXPERIMENTAL VALUES: Solubility of $\text{UO}_2(\text{NO}_3)_2$ in H_2O as a function of temperature ^a			
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		Solid ^b Phase
	mass %	mol/kg	
70	77.25	8.617	A ^c
77.2	78.49	9.260	A ^c
85	79.92	10.10	A
90.5	80.98	10.81	A ^d
92	81.37	11.08	A
100	82.57	12.02	A
110	84.14	13.46	A
113	84.67	14.02	A+B
120	85.25	14.67	B
130	86.16	15.80	B
133	86.54	16.32	B
137	87.07	17.09	B
141.2	87.02	17.01	B ^e
147	87.75	18.18	B
154.5	88.23	19.02	B
159	88.74	20.00	B
160	88.94	20.41	B
166.5	89.22	21.00	B
172	89.92	22.64	B
180	90.78	24.99	B
181	91.01	25.69	B ^f
184	91.63	27.78	B ^f
^a Molalities calculated by the compilers.			
^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$.			
^c 87.08% $\text{UO}_2(\text{NO}_3)_2$ (theor. 87.95%). ^d 87.05% $\text{UO}_2(\text{NO}_3)_2$ (theor. 87.95%).			
^e 90.58% $\text{UO}_2(\text{NO}_3)_2$ (theor. 91.63%). ^f True dihydrate melting point.			
AUXILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE: Isothermal method used. Solubility ³ runs made in a long-necked 200 cm flask complete with a side arm. The flask was connected to a standard taper joint unit having gas analysis and vacuum line takeoff. Sample was withdrawn with pipets through the side arm. A partial vacuum was placed on molten uranyl nitrate hydrate at the working temperature to remove water, and the liquid was vigorously stirred until crystals formed. After 40 to 45 min. of further stirring, samples of clear solution were taken. Analysis of uranium was made by straight oxidation at 900°C to U_3O_8 , or by precipitation of ammonium diuranate followed by oxidation to U_3O_8 . Values have been obtained both going up and down the temperature scale. The system appears thermally stable up to 184°C, above the dihydrate decomposition to UO_3 and NO_2 .		SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, chemically pure. 2. $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ obtained by dehydration of hexahydrate.	
		ESTIMATED ERROR: Solubility: less than 0.2%. Temperature: Precision $\pm 0.1\text{K}$.	
		REFERENCES:	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Keyser, W. L.; Cypres, R.; Herrmann, M. Bull. Centre Phys. Nucl. Univ. Libre de Bruxelles No. 17, 1950.
VARIABLES: Temperature: 293 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in water is reported to be 54.09 g of anhydrous salt per 100 g of solution, at 20°C. The corresponding molality value calculated by the compilers is 2.990 mol/kg.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm ³ of water and mixed for 30 minutes at 30 to 40°C. The liquid with crystals was then transferred to a thermostat where it was stirred for another 30 min. After the solution had settled (15 min), a 10 cm ³ aliquot was pipetted for weighing. The sample was dried at 120°C and calcined at 900°C in a platinum crucible to constant weight as the oxide, U_3O_8 .	SOURCE AND PURITY OF MATERIALS: Nothing specified for the solid uranyl nitrate hexahydrate. The amount of crystallization water was 21.30% (theor. 21.52%). ESTIMATED ERROR: Soly: the reported solubility is mean of two values which differ by 0.003 mol/kg Temp: nothing specified REFERENCES:

COMPONENTS:		ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Marshall, W. L.; Gill, J. S.; Secoy, C. H.	
(2) Water; H_2O ; [7732-18-5]		<i>J. Am. Chem. Soc.</i> , <u>1951</u> , 73, 1867 - 1869.	
VARIABLES:		PREPARED BY:	
Temperature: 343 to 457 K		L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:			
Solubility of $\text{UO}_2(\text{NO}_3)_2$ in H_2O as a function of temperature ^a			
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		Solid _d Phase
	mass %	mol/kg (compilers)	
70	77.25	8.617	A
77.2	78.49	9.260	A
85	79.92	10.10	A
90.5	80.98	10.80	A
92	81.37	11.08	A
100	82.57	12.02	A
110	84.14	13.46	A
113 ^b	84.67	14.02	A+B
120	85.25	14.67	B
130	86.13	15.76	B
133	86.54	16.32	B
137	87.07	17.09	B
141.2	87.02	17.10	B
147	87.75	18.18	B
154.5	88.23	19.02	B
159	88.74	20.00	B
160	88.94	20.41	B
165.5	89.22	21.00	B
172	89.92	22.64	B
180	90.78	24.99	B
181 ^c	91.10	25.98	B
184 ^c	91.63	27.78	B
^a The initial solid phase is $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.			
^b Intersecting point for incongruent melting point of trihydrate.			
^c True melting point of the dihydrate.			
^d Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$.			
AUXILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:	
Uranyl nitrate hexahydrate was placed in the thermostated vacuum-connected flask at the desired temperature, and was stirred until crystallization began. Then dried air was admitted to the system, followed by stirring for an additional 40 to 50 min. Duplicate samples of the clear solution as well as of the solid phase were removed, and the uranium content determined by ignition at 900°C to form the oxide, U_3O_8 .		1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, Mallinckrodt C.P.	
		2. Dihydrate prepared by the dehydration of the hexahydrate.	
		ESTIMATED ERROR:	
		Soly: Results of 5 separate runs.	
		Temp: Precision $\pm 0.1^{\circ}\text{C}$.	
		REFERENCES:	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Warner, R. K. <i>Australian J. Appl. Sci.</i> , <u>1953</u> , 4, 581-589.
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in water at 20°C was reported to be 0.540 g of the anhydrous salt per g of the solution.</p> <p>The corresponding molality was calculated by the compilers as 2.98 mol/kg.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: <p>The isothermal method was used. Excess uranyl nitrate hexahydrate was placed with the appropriate amount of pure solvent into a small flask, warmed to between 30°C and 50°C, and agitated for 15 min. Then the flask was placed in a thermostated bath at 20°C, and shaken for 6 to 8 hours. When equilibrium was reached, the solution was decanted, filtered, and sampled for analysis. The analysis consisted of the total uranium concentration determined by evaporation of the weighed aliquots, followed by ignition to U_3O_8.</p>	SOURCE AND PURITY OF MATERIALS: "AR" grade $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. ESTIMATED ERROR: Soly: Repeat determinations of the solubility were made until agreement within 0.2 mass %. Temp: Precision ± 0.05 K. REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Nethaway, M. O.; Lang, G. P. Report 1958, MCW-1412 (Elliot, B., ed.)																																							
VARIABLES: Temperature: 287 to 457 K	PREPARED BY: A. Sozanski; S. Siekierski																																							
EXPERIMENTAL VALUES: Solubility of $\text{UO}_2(\text{NO}_3)_2$ in H_2O as a function of temperature ^{a,b} <table><tr><th>$t/^{\circ}\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th></tr><tr><th></th><th>mass %</th><th>mol/kg</th></tr><tr><td>14</td><td>32.4</td><td>2.94</td></tr><tr><td>20.2-20.6</td><td>33.1</td><td>3.08</td></tr><tr><td>23.2</td><td>34.2</td><td>3.31</td></tr><tr><td>31.9</td><td>35.94</td><td>3.728</td></tr><tr><td>57</td><td>45.72</td><td>7.900</td></tr><tr><td>59</td><td>46.5</td><td>8.50</td></tr><tr><td>61</td><td>46.7</td><td>8.64</td></tr><tr><td>60</td><td>47.4</td><td>9.27</td></tr><tr><td>73</td><td>49.1</td><td>11.0</td></tr><tr><td>175-180</td><td>55.1</td><td>26.3</td></tr><tr><td>181-184</td><td>55.3</td><td>27.3</td></tr></table>		$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$			mass %	mol/kg	14	32.4	2.94	20.2-20.6	33.1	3.08	23.2	34.2	3.31	31.9	35.94	3.728	57	45.72	7.900	59	46.5	8.50	61	46.7	8.64	60	47.4	9.27	73	49.1	11.0	175-180	55.1	26.3	181-184	55.3	27.3
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$																																							
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175-180	55.1	26.3																																						
181-184	55.3	27.3																																						
^a Molalities calculated by the compilers. ^b Nature of solid phase not specified. COMMENTS AND/OR ADDITIONAL DATA: Uranyl nitrate solutions exhibit a very marked ability to supercool. For this reason, it is somewhat difficult to accurately determine a precise temperature of physical change. The best freezing point values were obtained by repeated determinations at close to equilibrium conditions. The results are presented also in the form of a temperature vs. composition (mass % or uranium) plot.																																								
AUXILIARY INFORMATION																																								
METHOD/APPARATUS/PROCEDURE: The synthetic method was used. An oil bath was used as a heat transfer medium to provide slow and uniform temperature change. No other information is given.	SOURCE AND PURITY OF CHEMICALS: Mallinckrodt $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ was (purified). Uraynlyl nitrate dihydrate obtained by drying hexahydrate and storing under vacuum. Analysis of these materials showed a ratio to within 0.5 to 1% of the stoichiometry.																																							
	ESTIMATED ERROR: Nothing specified.																																							
	REFERENCES:																																							

COMPONENTS:		ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Colani, A.		
(2) Nitric acid; HNO_3 ; [7697-37-2]		Bull. Soc. Chim. Fr., 1926, 39, 1243 - 1245.		
(3) Water; H_2O ; [7732-18-5]				
VARIABLES:		PREPARED BY:		
Composition at 298 K		A. Sozanski; S. Siekierski		
EXPERIMENTAL VALUES:				
The system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ at 25°C				
Composition of Saturated Solutions ^a				
HNO_3		$\text{UO}_2(\text{NO}_3)_2$		Solid _b Phase
mass %	mol/kg	mass %	mol/kg	
0	0	56.08	3.240	A
12.35	4.144	40.36	2.166	A
25.14	8.951	30.29	1.725	A
28.67	10.92	29.65	1.805	A
29.84	12.18	31.27	2.041	A
30.43	14.70	36.72	2.837	A
30.15	15.02	37.99	3.026	A+B
32.31	16.32	36.28	2.931	B
46.12	27.41	27.18	2.583	B
50.43	33.66	25.79	2.752	B
53.20	42.15	26.77	3.392	B
53.71	45.34	27.49	3.711	B+C
55.24	50.04	27.24	3.946	C
60.38	60.00	23.65	3.758	C
66.71	96.24	22.29	5.143	C
68.83	125.8	22.49	6.576	C
^a Molalities calculated by the compilers.				
^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$; C = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$.				
AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. The mixture of water and nitric acid was saturated with uranyl nitrate. Uranyl nitrate hexahydrate was used at low nitric acid concentrations, whereas at high concentrations of the nitric acid, the initial solid phase was uranium nitrate dehydrated in a vacuum. Solid phase was determined by Schreinemakers method (1). No additional information is given.		Nothing specified.		
		ESTIMATED ERROR:		
		Nothing specified.		
		REFERENCES:		
		1. Schreinemakers, F. A. H. Z. physik. Chem., 1893, 11, 81.		

COMPONENTS:			ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Harmon, M. K.		
(2) Nitric acid; HNO_3 ; [7697-37-2]			"Freezing Point Data for $\text{UNH}_3\text{-H}_2\text{O-HNO}_3$," Hanford Works, General Electric Co., HW-8309, Dec. 17, 1947.		
(3) Water; H_2O ; [7732-18-5]					
VARIABLES:			PREPARED BY:		
Temperature: 253 to 318 K			A. Sozanski; S. Siekierski		
EXPERIMENTAL VALUES:					
The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ system					
Composition of saturated solutions ^{a,b}					
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$		$\text{UO}_2(\text{NO}_3)_2$	HNO_3	
	mass %	g/dm^3		g/dm^3	mol/kg
-20	57.78	912.26	2.105	0	0
- 5	29.90	369.48	0.7780	0	0
- 1	10.1	107.85	0.218	0	0
5.7	65.35	1110.1	2.671	0	0
16.3	68.8	1217.1	2.98	0	0
18.3	68.8	1215.4	2.98	0	0
32.5	78.0	1461.2	4.00	0	0
-20.7	54.91	849.84	1.955	15.13	0.2774
- 6.5	32.2	370.5	0.876	17.72	0.3339
- 2.2	10.0	107.52	0.220	18.18	0.2966
11	64.8	1107.7	2.68	17.66	0.3407
23.5	69.8	1249.7	3.14	18.34	0.3688
-21.1	46.88	699.04	1.578	60.62	1.091
-13.3	51.5	806.2	1.85	66.54	1.219
-11.3	29.07	367.97	0.7971	57.72	0.9964
- 5.2	9.75	107.2	0.224	62.52	1.041
19.8	64.61	1130.1	2.765	48.20	0.9396
32.5	69.6	1285.0	3.25	50.48	1.017
33.8	70.4	1317.4	3.39	63.0	1.29
-26.1	29.6	393.6	0.931	178.5	3.363
-22.5	33.3	461.09	1.10	188.67	3.5895
-16.5	8.6	107.54	0.22	177.3	2.846
1.6	45.29	693.69	1.736	191.39	3.8162
33.5	62.6	1101.8	3.04	172.63	3.7902
44.5	71.3	1351.6	3.88	140.40	3.2078
^a Nature of the equilibrium solid phase not specified.					
^b Molalities calculated by the compilers.					
AUXILIARY INFORMATION					
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:		
The synthetic method was used. The test solutions were prepared to an approximately given predetermined composition, then the freezing points were measured. In all cases, cooling curves were obtained and the setting point wherever possible was measured as the true freezing temperature. Crystal formation was observed closely with the aid of a strong light source and the temperature at which crystals were first noted was taken as the freezing point for those solutions whose cooling curves exhibited no setting point.			Nothing specified.		
			ESTIMATED ERROR:		
			Nothing specified.		
			REFERENCES:		

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Report <u>1955</u> , HW-31000.
VARIABLES: Composition and temperature	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate hexahydrate in water was determined as a function of temperature from about -25°C to about 45°C at varying nitric acid concentrations of the range 1 to 10 M. The data are presented in the form of $t/^\circ\text{C}$ vs. M, molarity. The diagram is based on data reported in Refs. (1-3). A solution of 60 mass %, about 13M, HNO_3 saturated with respect to uranyl nitrate at 25°C is reported to contain 23.5 mass % of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, which is equivalent to 2.17 mol/kg of the anhydrous salt (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES: 1. Report HW-8309. 2. Report CL-51-II-66. 3. Report PDB-116.

COMPONENTS:				ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]				Hart, R. G.; Morris, G. O.			
(2) Nitric acid; HNO_3 ; [7697-37-2]				Prog. Nucl. Energ., Series III, Vol. 2, (Bruce, F. R.; Fletcher, J. M.; Hyman, H. H., eds.) London, 1958, 544 - 545.			
(3) Water; H_2O ; [7732-18-5]							
VARIABLES:				PREPARED BY:			
Composition and temperature				A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:							
The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System							
HNO_3 mol/dm ³	$t/^\circ\text{C}$	U g/cm ³	Solid _a Phase ^a	HNO_3 mol/dm ³	$t/^\circ\text{C}$	U g/cm ³	Solid _a Phase ^a
0	-16	400	A	3	-26	200	A
0	-11	350	A	3	-20	150	A
0	-8	300	A	3	-16	100	A
0	-6	250	A	3	-8	250	B
0	-4	200	A	3	5	300	B
0	-2	150	A	3	14	350	B
0	-1	100	A	3	21	400	B
0	3	500	B	3	31	500	B
1	-19	350	A	4	-32	150	A
1	-17	300	A	4	-27	100	A
1	-13	250	A	4	-5	200	B
1	-10	200	A	4	6	250	B
1	-7	150	A	4	15	300	B
1	-6	100	A	4	21	350	B
1	-2	400	B	4	27	400	B
1	18	500	B	4	34	500	B
2	-22	250	A	5	-39	100	B
2	-18	200	A	5	-5	150	B
2	-14	150	A	5	7	200	B
2	-12	100	A	5	15	250	B
2	-9	300	B	5	21	300	B
2	5	350	B	5	26	350	B
2	14	400	B	5	30	400	B
2	27	500	B	5	35	500	B
(Continued on the next page)							
AUXILIARY INFORMATION							
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:			
The synthetic method was used. Equilibrium was approached from both higher and lower temperatures.				Nothing specified.			
				ESTIMATED ERROR:			
				Soly: The results represent the mean of two temperatures observed for the first formation and the final disappearance of crystals.			
				Temp.: Precision $\pm 2\text{K}$.			
				REFERENCES:			

COMPONENTS:			ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Gaunt, J.; Bastien, I. J.; Adelman, M.		
(2) Nitric acid; HNO_3 ; [7697-37-2]			Can. J. Chem., <u>1963</u> , 41, 527 - 530.		
(3) Water; H_2O ; [7732-18-5]					
VARIABLES:			PREPARED BY:		
Composition and temperature			A. Sozanski; S. Siekierski		
EXPERIMENTAL VALUES:					
The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System					
Composition of Saturated Solutions ^a					
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	
49.1	62.0	4.78	5.1	2.5	A
	63.1	4.75	3.2	1.5	A
	62.5	4.94	5.4	2.7	A
	59.0	5.04	11.3	6.04	A
	61.4	5.59	10.7	6.09	A
	56.8	4.46	10.9	5.36	A
	60.9	5.79	12.4	7.37	B
	60.8	5.91	13.1	3.97	B
	54.6	5.39	19.7	12.2	B
	55.4	5.65	19.7	12.6	B
	49.5	5.02	25.5	16.2	B
	48.2	4.97	27.2	17.5	B
	47.8	5.05	28.2	18.6	B
	46.3	5.13	30.8	21.3	B
	46.4	4.99	30.0	20.2	B
	45.9	5.63	33.4	25.6	B
45.6	5.70	34.1	26.7	B	
44.4	5.69	35.8	28.7	B	
(Continued on the next page)					
AUXILIARY INFORMATION					
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. The uranyl nitrate solutions were prepared by dissolving uranyl nitrate hexahydrate in nitric acid. At high acid concentrations, the hexahydrate was dissolved in more concentrated acid, and the crystals obtained were redissolved in increasing concentrations of nitric acid and red fuming nitric acid. Each sample was saturated at a temperature above that at which the determinations were made and transferred to glass-stoppered bottles. The samples were then placed in a constant temperature bath. A minimum period of 48 hours was allowed to attain equilibrium. Samples of liquid phases and residues were taken for analyses. Uranium was determined by titrating the reduced form with ceric sulfate; nitric acid by direct titration (1).			Nothing specified.		
			ESTIMATED ERROR:		
			Solubility: Nothing specified. Temperature: Precision $\pm 0.2\text{K}$.		
			REFERENCES:		
			1. Brothers, J. A.; Olmstead, W. J. Report <u>1955</u> , CLE-112.		

COMPONENTS:			ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Gaunt, J.; Bastien, I. J.; Adelman, M.		
(2) Nitric acid; HNO_3 ; [7697-37-2]			Can. J. Chem., <u>1963</u> , 41, 527 - 530.		
(3) Water; H_2O ; [7732-18-5]					

EXPERIMENTAL VALUES: (Continued)					
The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System					
Composition of Saturated Solutions ^a					
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		Solid _b Phase
	mass %	mol/kg	mass %	mol/kg	
49.1	45.7	6.44	36.3	32.0	B+C
	41.4	5.08	37.9	29.1	C
	40.7	5.52	40.6	34.5	C
	36.5	6.22	48.6	51.8	C
	35.9	6.24	49.5	53.8	C
	35.0	6.99	52.3	65.4	C
	26.0	6.28	63.5	96.0	-
	12.2	4.07	80.2	167	D
	12.7	4.88	80.7	194	D
	10.3	3.90	83.0	197	D
	8.83	3.95	85.5	239	D
30.2	55.6	3.39	2.82	1.08	A
	49.6	2.91	7.12	2.61	A
	46.7	2.85	11.7	4.46	A
	40.3	2.47	18.3	7.01	A
	38.8	2.63	23.8	10.1	A
	42.5	3.24	24.2	11.5	A
	42.6	3.38	25.4	12.6	A
	40.1	2.98	25.7	11.9	A
	43.1	3.56	26.2	13.5	A+B
	39.7	3.37	30.4	16.1	B
	39.0	3.28	30.8	16.2	B
	39.2	3.37	31.3	16.8	B
	37.8	3.37	33.7	18.8	B
	37.2	3.29	34.1	18.9	B
	35.8	3.03	34.2	18.1	B
	33.4	3.12	39.4	23.0	B
	32.6	3.42	43.2	28.3	B
	32.0	3.40	44.1	29.3	B
	30.3	3.26	46.1	31.0	B
	30.0	3.64	49.1	37.3	B
	29.4	4.41	53.7	50.4	C
	28.5	4.95	56.9	61.8	C
	22.9	4.61	64.5	81.2	C
	13.0	3.37	77.2	125	D
	10.9	2.85	79.4	130	D
0.0	45.2	2.20	2.72	0.829	A
	34.8	1.64	11.3	3.33	A
	22.9	1.04	21.3	6.06	A
	14.3	0.662	30.9	8.95	A
	11.1	0.610	42.7	14.7	A
	11.5	0.637	42.7	14.8	A
	13.4	0.812	44.7	16.9	A
	13.3	0.796	44.3	16.6	A
	19.9	1.49	46.1	21.5	A

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COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Nitric acid; HNO_3 ; [7697-37-2]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gaunt, J.; Bastien, I. J.; Adelman, M.

Can. J. Chem., 1963, 41, 527 - 530.

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System

Composition of Saturated Solutions^a

$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	
0.0	18.6	1.34	46.2	20.8	A
	22.2	1.78	46.1	23.1	A
	20.0	1.52	46.5	22.0	A
	18.6	1.36	46.8	21.5	A
	20.5	1.59	46.8	22.7	B
	18.5	1.41	48.2	23.0	B
	17.4	1.33	49.5	23.7	B
	17.5	1.35	49.6	23.9	B
	17.1	1.41	52.1	26.8	B
	15.7	1.29	53.5	27.6	B
	15.1	1.43	58.1	34.4	B
	14.8	1.44	59.1	35.9	B
	14.9	1.46	59.2	36.3	B
	15.0	1.52	59.9	37.9	B
	15.2	1.60	60.7	40.0	B
	15.6	1.78	62.1	44.2	B
	17.0	2.06	62.1	47.2	B
	18.1	2.27	61.7	48.5	B+C
	18.4	2.38	62.0	50.2	C
	19.5	3.28	65.4	68.7	C _c
	5.81	1.51	84.4	137	- ^c
-10.0	30.0	1.31	12.0	3.28	A
	8.46	0.371	33.6	9.20	A
	4.65	0.240	46.2	14.9	A
	10.0	0.668	52.0	21.7	A
	13.7	1.02	52.2	24.3	B
	12.1	1.19	62.1	38.2	B
	11.4	1.05	61.1	35.3	B
	11.7	1.20	63.5	40.6	B
	11.8	1.22	63.7	41.3	B
	14.4	1.85	65.8	52.7	B
	15.6	1.91	63.7	48.8	B
	18.2	3.06	66.7	70.1	C
	6.8	1.7	82.9	128	D

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$;
C = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$; D = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{HNO}_3$.

^cAnalysis of solid phase after filtration gave 83.5% $\text{UO}_2(\text{NO}_3)_2$ and 11.5% HNO_3 .

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Yakimov, M. A.; Mishin, V. Ya.			
(2) Nitric acid; HNO_3 ; [7697-37-2]			Radiokhim., 1964, 6, 454 - 459.			
(3) Water; H_2O ; [7732-18-5]			Sov. Radiochem., 1964, 437. (Eng.)			
VARIABLES:			PREPARED BY:			
Composition and temperature			A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2$ - HNO_3 - H_2O System at 25°C, 35°C, 50°C						
Composition of Saturated Solutions ^a						
t/°C	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		H_2O	Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
25	55.95	3.223	0	0	44.05	A _C
	50.0	2.75	3.8	1.3	45.3	A _C
	46.4	2.54	7.2	2.5	48.4	A _C
	44.4	2.42	9.1	3.1	46.5	A
	38.4	2.10	15.2	5.20	46.4	A
	32.8	1.86	22.4	7.93	44.8	A
	34.4	2.45	29.9	13.3	35.7	A
	38.2	3.04	29.9	14.9	31.9	A+B
	31.9	2.73	38.4	20.5	29.7	B
	31.5	2.66	38.4	20.2	30.1	B
35	29.7	2.46	39.6	20.5	30.7	B
	26.7	2.68	48.0	30.1	25.3	B
	27.6	3.23	50.7	37.1	21.7	B
	28.4	3.73	52.3	43.0	19.3	B
	28.7	3.87	52.5	44.3	18.8	B+C
	27.3	3.81	54.5	47.5	18.2	C _C
	26.7	3.85	55.7	50.2	15.6	C _C
	24.8	3.91	59.1	58.3	16.1	C
	23.3	4.45	63.4	75.7	13.3	C
	22.1	4.71	66.0	88.0	11.9	C
50	22.0	6.14	68.9	120	9.1	C
	22.4	8.01	70.5	158	7.1	C
	22.3	8.57	71.1	171	6.6	C
	24.4	15.5	71.6	284	4.0	C
	29.5	32.6	68.2	471	2.3	C
	29.9	39.9	68.2	570	1.9	C
	33.7	53.5	64.7	642	1.6	C
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. Experiments were performed as before (1). Nitrate solutions were prepared by dissolving uranyl nitrate hexahydrate in nitric acid solutions. At acid concentrations above 65 mass %, 50°C, or above 70 mass %, 25°C, anhydrous uranyl nitrate was used. Equilibrium was established after 4 to 5 hours. Nitric acid was determined by titration; uranium by precipitation of ammonium diuranate, then calcined to U_3O_8 . Water found as difference.			1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, not specified.			
			2. $\text{UO}_2(\text{NO}_3)_2$, Ref. (1).			
			ESTIMATED ERROR:			
			Nothing specified.			
			REFERENCES:			
			1. Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. Zh. Neorg. Khim., 1958, 3, 504.			
			2. Marketos, P. Compt. Rend., 1912, 155, 210.			

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Yakimov, M. A.; Mishin, V. Ya.			
(2) Nitric acid; HNO_3 ; [7697-37-2]			Radiokhim., 1964, 6, 454 - 459.			
(3) Water; H_2O ; [7732-18-5]			Sov. Radiochem., 1964, 437. (Eng.)			
EXPERIMENTAL VALUES: (Continued)						
The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C, 35°C, 50°C						
Composition of Saturated Solutions ^a						
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		H_2O	Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
25	37.6	119	61.6	1220	0.8	C+D
	36.7	155	62.7	1660	0.6	D
	36.1	183	63.4	2010	0.5	D
35	60.10	3.823	0	0	39.90	A _C
	58.8	3.68	0.6	0.2	50.6	A _C
	57.7	3.60	1.6	0.62	40.7	A
	53.1	3.26	5.5	2.1	41.4	A
	47.9	2.89	10.1	3.82	42.0	A
	45.7	2.82	13.2	5.10	41.1	A
	44.7	2.98	17.2	7.16	38.1	A
	44.5	3.12	19.3	8.46	36.2	A
	48.6	3.99	20.5	10.5	30.9	A
	48.8	4.11	21.1	11.1	30.1	A+B
	43.6	3.71	26.6	14.2	29.8	B _C
	37.6	3.44	34.7	19.9	28.0	B _C
	35.5	3.51	38.8	24.0	25.7	B
	34.5	3.50	40.5	25.7	25.0	B
	33.6	3.40	41.3	26.1	25.1	B
	34.0	3.85	43.6	30.9	22.4	B _C
	34.3	4.27	45.3	35.2	21.4	B _C
	34.6	4.50	45.9	37.4	19.5	B
	34.4	4.50	46.2	37.8	19.4	B
	34.4	4.62	46.7	39.2	18.9	B
	34.7	5.00	47.7	43.0	17.6	B+C
	30.5	4.61	52.7	49.8	16.8	C
	28.9	4.31	54.1	50.5	17.0	C
	26.4	4.85	59.8	68.8	13.8	C
	25.4	5.42	62.7	83.6	11.9	C
	25.5	7.27	65.6	117	8.9	C
	31.0	23.1	65.6	306	3.4	C
	31.0	22.5	65.5	297	3.5	C
	40.5	103	58.5	928	1.0	C+D
	39.5	501	60.3	4780	0.2	D
50	69.15	5.72	0.15	0.078	30.7	A _C
	68.1	5.52	0.6	0.3	30.6	A _C
	66.0	5.84	5.3	2.9	28.7	A
	65.6	5.70	5.2	2.8	29.2	A
	65.1	6.16	8.1	4.8	26.8	A
	65.7	6.44	8.4	5.1	25.9	A+B
	63.7	6.24	10.4	6.37	25.9	B
	63.5	6.22	10.6	6.49	25.9	B
	61.3	6.08	13.1	8.12	25.6	B

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COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitric acid; HNO_3 ; [7697-37-2] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yakimov, M. A.; Mishin, V. Ya. <i>Radiokhim.</i> , 1964, 6, 454 - 459. <i>Sov. Radiochem.</i> , 1964, 437. (Eng.)
EXPERIMENTAL VALUES: (Continued) <p style="text-align: center;">The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C, 35°C, 50°C</p> <p>The solubility isotherms have four branches corresponding to the solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$, and $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{HNO}_3$.</p> <p>The phase diagram for this system is given as:</p> <div style="text-align: center;"> </div> <p>Solubility isotherms in the system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ at 25°C and 50°C (compositions in weight %).</p> <ol style="list-style-type: none"> 1. This work. 2. Data from Gaunt, J.; Bastien, I. J.; Adelman, M. <i>Can. J. Chem.</i>, 1963, 41, 527. 3. Data from Colani, A. <i>Bull. Soc. Chim. Fr.</i>, 1926, 39, 1243. 	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Davis, W.; Lawson, P. S.; De Bruin, H. J.; Mrochek, J. <i>J. Phys. Chem.</i> , <u>1965</u> , <i>69</i> , 1904 - 1914.																																																										
VARIABLES: Temperature: 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																										
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Solutions ^a <table><tr><th rowspan="2">Density g/cm³</th><th colspan="2">HNO_3</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th rowspan="2">Solid^b Phase^b</th></tr><tr><th>mol/dm³</th><th>mol/kg</th><th>mol/dm³</th><th>mol/kg</th></tr><tr><td>1.7793</td><td>0.005</td><td>0.006</td><td>2.440</td><td>2.985</td><td>A</td></tr><tr><td>1.7267</td><td>1.320</td><td>1.653</td><td>2.144</td><td>2.684</td><td>A</td></tr><tr><td>1.6587</td><td>2.478</td><td>3.130</td><td>1.804</td><td>2.279</td><td>A</td></tr><tr><td>1.5957</td><td>4.368</td><td>5.813</td><td>1.444</td><td>1.922</td><td>A</td></tr><tr><td>1.5837</td><td>5.932</td><td>8.224</td><td>1.240</td><td>1.719</td><td>A</td></tr><tr><td>1.6507</td><td>7.687</td><td>12.19</td><td>1.360</td><td>2.157</td><td>A</td></tr><tr><td>1.7341</td><td>8.282</td><td>14.24</td><td>1.600</td><td>2.750</td><td>A</td></tr><tr><td>1.6909</td><td>11.304</td><td>22.651</td><td>1.217</td><td>2.439</td><td>B</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$.		Density g/cm ³	HNO_3		$\text{UO}_2(\text{NO}_3)_2$		Solid ^b Phase ^b	mol/dm ³	mol/kg	mol/dm ³	mol/kg	1.7793	0.005	0.006	2.440	2.985	A	1.7267	1.320	1.653	2.144	2.684	A	1.6587	2.478	3.130	1.804	2.279	A	1.5957	4.368	5.813	1.444	1.922	A	1.5837	5.932	8.224	1.240	1.719	A	1.6507	7.687	12.19	1.360	2.157	A	1.7341	8.282	14.24	1.600	2.750	A	1.6909	11.304	22.651	1.217	2.439	B
Density g/cm ³	HNO_3		$\text{UO}_2(\text{NO}_3)_2$		Solid ^b Phase ^b																																																						
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AUXILIARY INFORMATION																																																											
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Uranyl nitrate hexahydrate was agitated in sealed vessels with aqueous nitric acid of a known concentration. The vessels were agitated for 1 to 2 days in a thermostat. The liquid phase was sampled some time after agitation had been stopped. The samples were analyzed for uranium by conventional methods. The solution densities were measured in duplicate using 10 mL pycnometers.			SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ of high quality was recrystallized from water. 2. HNO_3 , reagent grade, N_2 sparged. 3. Water, distilled and deionized.																																																								
			ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Precision probably $\pm 0.01\text{K}$ (compilers).																																																								
			REFERENCES:																																																								

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Christensen, H. Th.; Holmberg, K. E.			
(2) Nitric acid; HNO_3 ; [7697-37-2]			Nukleonik, 1968, 11, 165 - 170.			
(3) Water; H_2O ; [7732-18-5]						
VARIABLES:			PREPARED BY:			
Composition and temperature			A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System						
Composition of Saturated Solutions ^a						
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		HNO_3		H_2O	Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
-44.7	2.9	0.12	33.9	8.51	63.2	A+B+C
-36.7	6.6	0.25	27.5	6.62	65.9	A+C
-34.3	8.1	0.31	26.0	6.26	65.9	A+C
-31.3	11.8	0.453	22.1	5.31	66.1	A+C
-29.3	13.9	0.535	20.2	4.86	65.9	A+C
-27.0	18.5	0.729	17.1	4.21	64.4	A+C
-25.0	25.0	1.03	13.5	3.48	61.5	A
-25.0	20.1	0.814	17.2	4.35	62.7	A
-25.0	11.7	0.464	24.3	6.03	64.0	A
-25.0	3.63	0.151	35.4	9.21	61.0	A
-25.0	2.50	0.110	39.6	10.9	57.9	A
-25.0	2.09	0.0999	44.8	13.4	53.1	A
-23.4	28.2	1.16	10.0	2.57	61.8	A+C
-22.0	33.6	1.43	6.8	1.8	59.6	A+C
-21.3	36.5	1.58	4.7	1.3	58.8	A+C
-20.1	40.7	1.82	2.4	0.37	56.9	A+C
-19.4	42.9	1.94	1.0	0.28	56.1	A+C
-18.0	41.7	1.89	2.30	0.652	56.0	A
-18.0	35.1	1.53	6.71	1.83	58.2	A
-18.0	21.1	0.869	17.3	4.46	61.6	A
-18.0	6.29	0.260	32.3	8.35	61.4	A
-18.0	3.32	0.156	42.7	12.5	54.0	A
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. A 20 mL portion of the solution was placed in an ultra-cryostat, and stirred while cooling. The plot of temperature vs time was made, and an inflection in the curve indicated the beginning of crystallization. The temperature was lowered by about 3°C, and after 2 to 3 hours, crystals and liquid were separated by centrifuging (4 minutes, 2000 g). Nitric acid and uranium concentrations were measured by potentiometric titration (1,2).			1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, HNO_3 , A.R. grade.			
			2. H_2O , purified by ion exchange and distilled twice from quartz.			
			ESTIMATED ERROR:			
			Soly: nothing specified.			
			Temp.: Precision ± 0.002 to 0.04K.			
			REFERENCES:			
			1. Ahrlund, S. <i>Acta Chem. Scand.</i> , 1960, 14, 2035.			
			2. Motojima, K.; Izawa, K. <i>Anal. Chem.</i> , 1964, 36, 733.			

COMPONENTS:		ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Deigele, E.		
(2) Nitric acid; HNO_3 ; [7697-37-2]		Thesis, Munich 1983, INIS-mf-9277.		
(3) Water; H_2O ; [7732-18-5]				
VARIABLES:		PREPARED BY:		
Composition at 278 K		L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES:				
The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 5°C				
Composition of Saturated Solutions ^a				
HNO_3		$\text{UO}_2(\text{NO}_3)_2$		H_2O
mass %	mol/kg	mass %	mol/kg	mass %
2.26	0.851	42.68	1.967	55.05
1.17	0.364	47.81	2.378	51.02
0.94	0.296	48.71	2.455	50.35
1.88	0.577	46.94	2.280	51.67
1.61	0.527	49.93	2.615	48.46
2.75	0.828	44.52	2.143	52.73
2.35	0.739	47.19	2.373	50.46
2.86	0.833	45.17	2.206	51.97
5.40	1.59	40.76	1.921	53.84
4.67	1.43	43.68	2.146	51.76
4.06	1.24	43.91	2.142	52.02
5.37	1.63	42.33	2.054	52.30
4.89	1.52	44.03	2.188	51.08
5.56	1.76	44.26	2.238	50.18
5.73	1.76	42.69	2.096	51.63
6.48	1.93	40.29	1.921	53.23
7.36	2.19	39.32	1.871	53.32
6.95	1.98	41.81	2.051	51.74
6.57	2.00	41.39	2.018	52.04
6.10	1.86	41.77	2.033	52.14
9.37	2.81	37.66	1.804	52.97
9.72	2.90	37.11	1.771	53.17
11.18	3.269	34.55	1.616	54.27
11.87	3.488	34.12	1.603	54.02
12.61	3.759	34.15	1.628	53.24
12.01	3.526	33.94	1.594	54.05
15.45	4.361	28.32	1.278	56.24
16.70	4.843	28.57	1.325	54.73
(Continued on the next page)				
AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF CHEMICALS:		
The isothermal method was used. Uranium nitrate hexahydrate or U_3O_8 (when nitric acid exceeded 16 mol/dm ³) was dissolved in nitric acid at room temperature, and then cooled to 5°C . The precipitated solid and the cooled solution were stirred for 24 hours at 5°C . The uranium content was determined by evaporation of the solution and ignition to U_3O_8 . The total content of nitrate ions was measured by titration with NaOH after removal of uranium using Dowex 50 W-X8 ion exchanger. The HNO_3 content was determined as the difference.		Nothing specified.		
		ESTIMATED ERROR:		
		Solubility: Nothing specified.		
		Temperature: Precision $\pm 0.3^\circ\text{C}$.		
		REFERENCES:		

COMPONENTS:		ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Deigele, E.		
(2) Nitric acid; HNO_3 ; [7697-37-2]		Thesis, Munich 1983, INIS-mf-9277.		
(3) Water; H_2O ; [7732-18-5]				

EXPERIMENTAL VALUES: (Continued)				
The system $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ at 5°C				
Composition of saturated solutions ^a				
HNO_3		$\text{UO}_2(\text{NO}_3)_2$		H_2O
mass %	mol/kg	mass %	mol/kg	mass %
18.08	5.152	26.23	1.195	55.69
17.04	4.851	27.21	1.239	55.75
17.17	4.838	26.51	1.195	56.32
21.67	6.103	21.98	0.9899	56.35
20.85	5.841	22.50	1.008	56.65
25.88	7.301	17.86	0.8056	56.25
22.67	6.392	21.04	0.9486	56.27
19.58	5.487	23.79	1.066	56.63
21.57	6.049	21.84	0.9794	56.59
24.79	6.988	18.91	0.8524	56.30
29.97	7.974	16.36	0.7458	55.67
28.60	8.248	16.37	0.7549	55.03
30.39	8.780	14.68	0.6782	54.93
29.88	8.633	15.19	0.7018	54.94
30.61	8.862	14.57	0.6741	54.82
29.51	8.951	15.07	0.6901	55.42
30.06	8.664	14.88	0.6858	55.06
31.93	9.331	13.76	0.6430	54.31
36.23	11.19	12.37	0.6108	51.40
32.70	9.591	13.19	0.6186	54.11
34.43	10.38	12.94	0.6240	52.63
35.76	10.94	12.36	0.6046	51.89
37.85	11.99	12.06	0.6110	50.09
38.05	12.10	12.05	0.6128	49.90
40.34	13.45	12.07	0.6437	47.59
44.83	19.11	17.93	1.222	37.24
44.22	17.09	14.72	0.9098	41.07
44.04	16.68	14.05	0.8508	41.91
44.07	18.35	16.64	1.092	38.67
44.92	19.45	18.42	1.275	36.67
44.72	19.69	19.23	1.354	36.05
53.75	29.01	16.84	1.453	29.42
52.23	27.51	17.64	1.486	30.13
55.59	31.92	16.17	1.474	27.83
62.02	47.53	17.27	2.116	20.70
62.12	51.18	18.62	2.953	19.26
61.81	52.15	19.38	2.615	18.81
61.93	50.61	18.65	2.437	19.42
61.71	56.51	20.96	3.069	17.32
62.27	49.17	17.63	2.226	20.11
65.68	61.03	17.24	2.562	17.08
69.90	83.60	16.83	3.219	13.26
67.72	71.08	17.16	2.880	15.12
60.07	39.54	15.82	1.665	24.10
60.34	40.44	15.98	1.722	23.68
61.00	43.65	16.82	1.925	22.17
67.91	72.82	17.29	2.965	14.81
66.80	66.63	17.29	2.758	15.91
65.09	60.48	17.83	2.649	17.09
54.22	29.41	16.52	1.433	29.26
57.37	33.72	15.63	1.469	27.00
60.92	41.71	15.90	1.741	23.18
63.79	57.59	18.60	2.680	17.61

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COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Nitric acid; HNO_3 ; [7697-37-2]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Deigele, E.

Thesis, Munich 1983, INIS-mf-9277.

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ system at 5°C

Composition of saturated solutions^a

HNO_3		$\text{UO}_2(\text{NO}_3)_2$		H_2O
mass %	mol/kg	mass %	mol/kg	mass %
61.59	51.91	19.58	2.639	18.83
63.74	56.93	18.49	2.641	17.77
50.54	25.55	18.07	1.461	31.38
55.56	31.19	16.17	1.452	28.26
57.36	39.06	15.91	1.511	26.73
63.65	57.43	18.76	2.707	17.59
80.32	238.3	14.33	6.798	5.35
63.30	55.84	18.71	2.639	17.99
76.91	173.1	16.04	5.774	7.05
51.23	26.25	17.80	1.459	30.97
62.35	53.81	19.26	2.658	18.39
75.58	134.9	15.51	4.418	9.918
61.83	52.33	19.42	2.628	18.75
69.30	94.89	19.11	4.184	11.59
46.23	21.86	20.20	1.527	33.57
49.81	24.74	18.24	1.449	31.95
79.65	219.8	14.60	6.444	5.75
73.18	108.9	16.16	3.847	10.67
61.01	50.35	19.76	2.608	19.22
79.41	197.5	14.21	5.652	6.37
48.45	23.41	18.70	1.445	32.84
79.38	209.3	14.60	6.155	6.02
67.78	85.31	19.61	3.947	12.61
69.12	93.92	19.20	4.172	11.68
73.58	116.0	16.35	4.140	10.07
48.37	23.77	19.33	1.159	32.30
75.55	125.7	14.91	3.966	9.54
66.57	77.46	19.79	3.682	13.64
83.05	282.2	12.28	6.673	4.67
67.54	84.40	19.76	3.949	12.70
69.36	92.81	18.78	4.019	11.86
45.03	21.06	21.04	1.574	33.92
66.86	71.41	18.28	3.122	14.86
66.41	78.65	20.19	3.824	13.40
70.46	90.11	17.13	3.503	12.41
68.92	81.81	17.71	3.362	13.37
69.31	85.54	17.83	3.519	12.86
44.33	20.51	21.37	1.581	34.29

^aMolalities calculated by the compilers.

COMMENTS AND/OR ADDITIONAL DATA:

At 11 mol/dm^3 HNO_3 , equilibrium solid changes from hexa- to trihydrate; at 16 mol/dm^3 , from the tri- to the dihydrate. At these nitric acid concentrations, an appreciable scatter of results was observed. It is possible at 19 mol/dm^3 HNO_3 , the equilibrium solid is the monohydrate. No evidence found for the existence of a solid in which hydrated water is replaced by HNO_3 . In the source paper, the triangular diagram is also given.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Ammonium nitrate; NH_4NO_3 ; [6484-52-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Colani, A. <i>Bull. Soc. Chim. Fr.</i> , <u>1928</u> , 43, 194 - 199.																																																																																									
VARIABLES: Temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski																																																																																									
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{NH}_4\text{NO}_3 - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Solutions ^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{NH}_4\text{NO}_3$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th></tr><tr><td>56.08</td><td>3.240</td><td>0</td><td>0</td><td>A</td></tr><tr><td>54.53</td><td>3.221</td><td>2.50</td><td>0.727</td><td>A</td></tr><tr><td>53.23</td><td>3.343</td><td>6.36</td><td>1.97</td><td>A</td></tr><tr><td>51.79</td><td>3.474</td><td>10.38</td><td>3.428</td><td>A</td></tr><tr><td>53.06</td><td>4.534</td><td>17.24</td><td>7.252</td><td>A</td></tr><tr><td>54.35</td><td>5.593</td><td>20.99</td><td>10.63</td><td>A</td></tr><tr><td>52.00</td><td>5.101</td><td>22.13</td><td>10.69</td><td>B</td></tr><tr><td>49.33</td><td>4.862</td><td>24.92</td><td>12.09</td><td>B</td></tr><tr><td>46.31</td><td>4.692</td><td>28.64</td><td>14.28</td><td>B</td></tr><tr><td>40.81</td><td>4.227</td><td>34.69</td><td>17.69</td><td>B</td></tr><tr><td>40.23</td><td>4.154</td><td>35.19</td><td>17.89</td><td>C</td></tr><tr><td>30.54</td><td>2.958</td><td>43.26</td><td>20.63</td><td>C</td></tr><tr><td>23.12</td><td>2.046</td><td>48.21</td><td>21.01</td><td>C</td></tr><tr><td>18.10</td><td>1.528</td><td>51.84</td><td>21.55</td><td>C</td></tr><tr><td>6.90</td><td>0.543</td><td>60.84</td><td>23.56</td><td>C</td></tr><tr><td>0</td><td>0</td><td>65.72</td><td>23.95</td><td>C</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{NH}_4\text{NO}_3 \cdot 2\text{H}_2\text{O}$. C = NH_4NO_3 .		$\text{UO}_2(\text{NO}_3)_2$		NH_4NO_3		Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	56.08	3.240	0	0	A	54.53	3.221	2.50	0.727	A	53.23	3.343	6.36	1.97	A	51.79	3.474	10.38	3.428	A	53.06	4.534	17.24	7.252	A	54.35	5.593	20.99	10.63	A	52.00	5.101	22.13	10.69	B	49.33	4.862	24.92	12.09	B	46.31	4.692	28.64	14.28	B	40.81	4.227	34.69	17.69	B	40.23	4.154	35.19	17.89	C	30.54	2.958	43.26	20.63	C	23.12	2.046	48.21	21.01	C	18.10	1.528	51.84	21.55	C	6.90	0.543	60.84	23.56	C	0	0	65.72	23.95	C
$\text{UO}_2(\text{NO}_3)_2$		NH_4NO_3		Solid Phase ^b																																																																																						
mass %	mol/kg	mass %	mol/kg																																																																																							
56.08	3.240	0	0	A																																																																																						
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54.35	5.593	20.99	10.63	A																																																																																						
52.00	5.101	22.13	10.69	B																																																																																						
49.33	4.862	24.92	12.09	B																																																																																						
46.31	4.692	28.64	14.28	B																																																																																						
40.81	4.227	34.69	17.69	B																																																																																						
40.23	4.154	35.19	17.89	C																																																																																						
30.54	2.958	43.26	20.63	C																																																																																						
23.12	2.046	48.21	21.01	C																																																																																						
18.10	1.528	51.84	21.55	C																																																																																						
6.90	0.543	60.84	23.56	C																																																																																						
0	0	65.72	23.95	C																																																																																						
AUXILIARY INFORMATION																																																																																										
METHOD/APPARATUS/PROCEDURE: Nothing specified, but probably the isothermal procedure as given in (1). No numerical data are given in (1), but a small phase diagram was presented.	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Colani, A. <i>Compt. Rend.</i> <u>1927</u> , 185, 1475.																																																																																									

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Ammonium nitrate; NH_4NO_3 ; [6484-52-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Colani, A. <i>Compt. Rend.</i> , <u>1927</u> , 185, 1475 - 1476.
VARIABLES: Temperature: 298 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>The results are given only in the form of a small diagram in which the concentration of $\text{UO}_2(\text{NO}_3)_2$ is plotted against the concentration of NH_4NO_3. The following solid phases were found: $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $(\text{NH}_4)_2\text{UO}_2(\text{NO}_3)_4 \cdot 2\text{H}_2\text{O}$ and NH_4NO_3.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal analytical method was used. No additional information is given.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Ammonium nitrate; NH_4NO_3 ; [6484-52-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Rimbach, E. Ber., 1904, 37, 461 - 488.																																														
VARIABLES: Composition and temperature	PREPARED BY: L. Fuks; S. Siekierski																																														
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{NH}_4\text{NO}_3 - \text{H}_2\text{O}$ System Composition of Saturated Solutions ^a <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{NH}_4\text{NO}_3$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th></tr><tr><td>0.5</td><td>43.35</td><td>2.519</td><td>12.97</td><td>3.710</td><td>A</td></tr><tr><td>13.5</td><td>47.20</td><td>3.186</td><td>15.20</td><td>5.051</td><td>A</td></tr><tr><td>24.9</td><td>53.21</td><td>4.348</td><td>15.73</td><td>6.327</td><td>A</td></tr><tr><td>35.0</td><td>61.39</td><td>6.678</td><td>15.28</td><td>8.183</td><td>A</td></tr><tr><td>59.0</td><td>64.74</td><td>7.341</td><td>12.88</td><td>7.190</td><td>B</td></tr><tr><td>80.7</td><td>65.60</td><td>7.868</td><td>13.24</td><td>7.817</td><td>B</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{NH}_4\text{NO}_3 \cdot n\text{H}_2\text{O}$.		$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		NH_4NO_3		Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	0.5	43.35	2.519	12.97	3.710	A	13.5	47.20	3.186	15.20	5.051	A	24.9	53.21	4.348	15.73	6.327	A	35.0	61.39	6.678	15.28	8.183	A	59.0	64.74	7.341	12.88	7.190	B	80.7	65.60	7.868	13.24	7.817	B
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		NH_4NO_3		Solid Phase ^b																																										
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80.7	65.60	7.868	13.24	7.817	B																																										
AUXILIARY INFORMATION																																															
METHOD/APPARATUS/PROCEDURE: The isothermal analytical method was used. Weighed amounts of the double salt and water were mixed at the investigated temperature. The solution was analyzed either after water evaporation, or after the uranium precipitation using $(\text{NH}_4)_2\text{S}$. The uranium concentration was measured after its calcination to the oxide, U_3O_8 .	SOURCE AND PURITY OF MATERIALS: Pure uranium-ammonium salt was used. ESTIMATED ERROR: Nothing specified. REFERENCES:																																														

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Lithium nitrate; LiNO_3 ; [7790-69-4] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yakimov, M. A.; Nosova, N. F. <i>Zh. Neorg. Khim.</i> , <u>1961</u> , 6, 208 - 211. <i>Russ. J. Inorg. Chem.</i> , <u>1961</u> , 6, 103. (Eng. trans.)																																																																																																																												
VARIABLES: Composition at 273 and 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																																																																																												
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{LiNO}_3 - \text{H}_2\text{O}$ System at 0°C and 25°C Composition of Saturated Solutions ^a <table><tr><th rowspan="2">$t/^\circ\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{LiNO}_3$</th><th>$\text{H}_2\text{O}$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th><th>mass %</th></tr><tr><td>0</td><td>0</td><td>0</td><td>34.7</td><td>7.71</td><td>65.3</td><td>A</td></tr><tr><td></td><td>2.6</td><td>0.10</td><td>31.6</td><td>6.97</td><td>65.8</td><td>A</td></tr><tr><td></td><td>4.2</td><td>0.16</td><td>30.6</td><td>6.81</td><td>65.2</td><td>A</td></tr><tr><td></td><td>8.6</td><td>0.35</td><td>29.1</td><td>6.77</td><td>62.3</td><td>A</td></tr><tr><td></td><td>11.1</td><td>0.458</td><td>27.4</td><td>6.46</td><td>61.5</td><td>A</td></tr><tr><td></td><td>13.4</td><td>0.563</td><td>26.2</td><td>6.29</td><td>60.4</td><td>A</td></tr><tr><td></td><td>17.0</td><td>0.734</td><td>24.2</td><td>5.97</td><td>58.8</td><td>A</td></tr><tr><td></td><td>17.6</td><td>0.760</td><td>23.6</td><td>5.82</td><td>58.8</td><td>A+B</td></tr><tr><td></td><td>18.0</td><td>0.780</td><td>23.4</td><td>5.79</td><td>58.6</td><td>B</td></tr><tr><td></td><td>23.2</td><td>1.02</td><td>19.2</td><td>4.83</td><td>57.6</td><td>B</td></tr><tr><td></td><td>24.8</td><td>1.09</td><td>17.6</td><td>4.43</td><td>57.6</td><td>B</td></tr><tr><td></td><td>29.4</td><td>1.32</td><td>14.2</td><td>3.65</td><td>56.4</td><td>B</td></tr><tr><td></td><td>34.0</td><td>1.59</td><td>11.6</td><td>3.09</td><td>54.4</td><td>B</td></tr><tr><td></td><td>38.6</td><td>1.81</td><td>7.2</td><td>1.9</td><td>54.2</td><td>B</td></tr><tr><td></td><td>44.0</td><td>2.14</td><td>3.8</td><td>1.1</td><td>52.2</td><td>B</td></tr><tr><td></td><td>49.5</td><td>2.49</td><td>0</td><td>0</td><td>50.5</td><td>B</td></tr></table>		$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		LiNO_3		H_2O	Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	mass %	0	0	0	34.7	7.71	65.3	A		2.6	0.10	31.6	6.97	65.8	A		4.2	0.16	30.6	6.81	65.2	A		8.6	0.35	29.1	6.77	62.3	A		11.1	0.458	27.4	6.46	61.5	A		13.4	0.563	26.2	6.29	60.4	A		17.0	0.734	24.2	5.97	58.8	A		17.6	0.760	23.6	5.82	58.8	A+B		18.0	0.780	23.4	5.79	58.6	B		23.2	1.02	19.2	4.83	57.6	B		24.8	1.09	17.6	4.43	57.6	B		29.4	1.32	14.2	3.65	56.4	B		34.0	1.59	11.6	3.09	54.4	B		38.6	1.81	7.2	1.9	54.2	B		44.0	2.14	3.8	1.1	52.2	B		49.5	2.49	0	0	50.5	B
$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		LiNO_3		H_2O	Solid Phase ^b																																																																																																																							
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(Continued on the next page)																																																																																																																													
AUXILIARY INFORMATION																																																																																																																													
METHOD/APPARATUS/PROCEDURE: The procedure has been described in Ref. (1). Uranium was determined in both phases by precipitation as the ammonium diuranate followed by calcination to the oxide, U_3O_8 . The lithium content in filtrate was determined by evaporation with H_2SO_4 as Li_2SO_4 .	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Nothing specified. REFERENCES: 1. Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. <i>Zh. Neorg. Khim.</i> , <u>1958</u> , 3, 504.																																																																																																																												

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Lithium nitrate; LiNO_3 ; [7790-69-4]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yakimov, M. A.; Nosova, N. F.

Zh. Neorg. Khim., 1961, 6, 208 - 211.

Russ. J. Inorg. Chem., 1961, 6, 103. (Eng. trans.)

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - LiNO_3 - H_2O System at 0°C and 25°C

Composition of Saturated Solutions^a

$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		LiNO_3		H_2O	Solid _b Phase
	mass %	mol/kg	mass %	mol/kg	mass %	
25	0	0	46.4	12.6	53.6	A
	2.9	0.14	45.0	12.5	52.1	A
	4.8	0.24	44.2	12.6	51.0	A
	7.2	0.37	43.0	12.5	49.8	A
	9.4	0.49	41.8	12.4	48.8	A
	10.6	0.560	41.4	12.5	48.0	A
	12.8	0.687	39.9	12.2	47.3	A
	14.6	0.795	38.8	12.1	46.6	A
	15.0	0.820	38.6	12.1	46.4	A
	18.4	1.04	36.7	11.9	44.9	A
	20.6	1.19	35.6	11.8	43.8	A
	22.2	1.31	34.9	11.8	42.9	A+B
	22.4	1.29	33.4	11.0	44.2	B
	22.8	1.29	32.4	10.5	44.8	B
	23.2	1.30	31.4	10.0	45.4	B
	23.8	1.31	30.0	9.42	46.2	B
	24.2	1.32	29.2	9.09	46.6	B
	24.8	1.33	27.8	8.51	47.4	B
	26.4	1.38	25.0	7.46	48.6	B
	26.8	1.41	24.8	7.43	48.4	B
	30.0	1.56	21.2	6.30	48.4	B
	32.2	1.68	19.2	5.73	48.6	B
	34.2	1.79	17.4	5.21	48.4	B
	36.6	1.93	15.2	4.57	48.2	B
	41.0	2.20	11.6	3.55	47.4	B
	44.6	2.44	9.0	2.8	46.4	B
	48.0	2.67	6.4	2.0	45.6	B
	51.4	2.90	3.6	1.2	45.0	B
	55.95	3.223	0	0	44.05	B

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{LiNO}_3 \cdot 3\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Sodium nitrate; NaNO_3 ; [7631-99-4] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Colani, A. <i>Compt. Rend.</i> , <u>1927</u> , 185, 1475 - 1476.
VARIABLES: One temperature: 298 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in water at 25°C was reported as 44.2 g/100 g of solution, and the solubility of sodium nitrate at 25°C in water was reported as 16.2 g/100 g of solution. The equilibrium solids are $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ and NaNO_3. The molality of uranyl nitrate in a saturated solution at the eutonic point at 25°C is 2.83 mol/kg (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal analytical method was used. No additional information was given.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Sodium nitrate; NaNO_3 ; [7631-99-4] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Colani, A. <i>Bull. Soc. Chim. Fr.</i> , 1928, 43, 194 - 195.																																																																
VARIABLES: One temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski																																																																
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{NaNO}_3 - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Solutions ^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{NaNO}_3$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th></tr><tr><td>56.08</td><td>3.240</td><td>0</td><td>0</td><td>A</td></tr><tr><td>53.06</td><td>3.096</td><td>3.45</td><td>0.933</td><td>A</td></tr><tr><td>51.59</td><td>3.092</td><td>6.06</td><td>1.68</td><td>A</td></tr><tr><td>48.62</td><td>2.941</td><td>9.43</td><td>2.64</td><td>A</td></tr><tr><td>45.37</td><td>2.861</td><td>14.39</td><td>4.207</td><td>A^c</td></tr><tr><td>44.20</td><td>2.833</td><td>16.20</td><td>4.812</td><td>A^c</td></tr><tr><td>40.76</td><td>2.483</td><td>17.58</td><td>4.964</td><td>B</td></tr><tr><td>34.35</td><td>2.009</td><td>22.26</td><td>6.035</td><td>B</td></tr><tr><td>20.83</td><td>1.114</td><td>31.71</td><td>7.860</td><td>B</td></tr><tr><td>9.12</td><td>0.455</td><td>40.06</td><td>9.273</td><td>B</td></tr><tr><td>0</td><td>0</td><td>47.78</td><td>10.76</td><td>B</td></tr></table>		$\text{UO}_2(\text{NO}_3)_2$		NaNO_3		Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	56.08	3.240	0	0	A	53.06	3.096	3.45	0.933	A	51.59	3.092	6.06	1.68	A	48.62	2.941	9.43	2.64	A	45.37	2.861	14.39	4.207	A ^c	44.20	2.833	16.20	4.812	A ^c	40.76	2.483	17.58	4.964	B	34.35	2.009	22.26	6.035	B	20.83	1.114	31.71	7.860	B	9.12	0.455	40.06	9.273	B	0	0	47.78	10.76	B
$\text{UO}_2(\text{NO}_3)_2$		NaNO_3		Solid Phase ^b																																																													
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^a Molalities calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; B = NaNO_3 . ^c In Reference (1), this data point is given as the eutonic point, i.e., with solid phases A + B.																																																																	
AUXILIARY INFORMATION																																																																	
METHOD/APPARATUS/PROCEDURE: Nothing specified, but probably the isothermal method was used as in Ref. (1).	SOURCE AND PURITY OF MATERIALS: Nothing specified.																																																																
	ESTIMATED ERROR: Nothing specified.																																																																
	REFERENCES: 1. Colani, A. <i>Comp. Rend.</i> , 1927, 185, 1475.																																																																

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Potassium nitrate; KNO_3 ; [7757-79-1] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Rimbach, E. Ber., 1904, 37, 461 - 488.																																														
VARIABLES: Composition and temperature	PREPARED BY: L. Fuks; S. Siekierski																																														
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$ System Composition of Saturated Solutions ^a <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{KNO}_3$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th></tr><tr><td>0.5</td><td>46.66</td><td>2.422</td><td>4.45</td><td>0.900</td><td>A</td></tr><tr><td>13.0</td><td>48.74</td><td>2.800</td><td>7.08</td><td>1.58</td><td>A</td></tr><tr><td>25.0</td><td>54.09</td><td>3.864</td><td>10.39</td><td>2.893</td><td>A</td></tr><tr><td>45.0</td><td>61.55</td><td>6.221</td><td>13.34</td><td>5.254</td><td>A</td></tr><tr><td>59.0</td><td>60.78</td><td>6.528</td><td>15.59</td><td>6.525</td><td>B</td></tr><tr><td>80.6</td><td>63.78</td><td>8.204</td><td>16.49</td><td>8.266</td><td>B</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phases: A = KNO_3 ; B = $\text{UO}_2(\text{NO}_3)_2 \cdot \text{KNO}_3$.		$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		KNO_3		Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	0.5	46.66	2.422	4.45	0.900	A	13.0	48.74	2.800	7.08	1.58	A	25.0	54.09	3.864	10.39	2.893	A	45.0	61.55	6.221	13.34	5.254	A	59.0	60.78	6.528	15.59	6.525	B	80.6	63.78	8.204	16.49	8.266	B
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		KNO_3		Solid Phase ^b																																										
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AUXILIARY INFORMATION																																															
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Weighed quantities of the double salt and water were mixed at the desired temperature. The solution was analyzed either after evaporation of the water, or following the uranium precipitation by using $(\text{NH}_4)_2\text{S}$. The uranium content was determined after calcination of the precipitate to the oxide, U_3O_8 .	SOURCE AND PURITY OF MATERIALS: Pure uranium - potassium double salt was used. ESTIMATED ERROR: Nothing specified. REFERENCES:																																														

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Potassium nitrate; KNO_3 ; [7757-79-1] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Colani, A. <i>Compt. Rend.</i> , <u>1927</u> , 185, 1475 - 1476.
VARIABLES: One temperature: 298 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate hexahydrate in water at 25°C is reported as 53.8 g/100 g of the solution, and the solubility of potassium nitrate at 25°C in water is reported as 10.4 g/100 g of the solution (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. No additional information was given.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Potassium nitrate; KNO_3 ; [7757-79-1] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Colani, A. <i>Bull. Soc. Chim. Fr.</i> , <u>1928</u> , 43, 194 - 199.																																																																					
VARIABLES: Temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski																																																																					
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Solutions ^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{KNO}_3$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th></tr><tr><td>56.08</td><td>3.240</td><td>0</td><td>0</td><td>A</td></tr><tr><td>54.68</td><td>3.307</td><td>3.36</td><td>0.792</td><td>A</td></tr><tr><td>54.21</td><td>3.398</td><td>5.30</td><td>1.30</td><td>A</td></tr><tr><td>53.90</td><td>3.738</td><td>9.51</td><td>2.57</td><td>A^c</td></tr><tr><td>53.88</td><td>3.828</td><td>10.40</td><td>2.880</td><td>A^c</td></tr><tr><td>48.65</td><td>3.012</td><td>10.36</td><td>2.500</td><td>B</td></tr><tr><td>40.60</td><td>2.314</td><td>11.11</td><td>2.275</td><td>B</td></tr><tr><td>25.80</td><td>1.065</td><td>12.74</td><td>2.050</td><td>B</td></tr><tr><td>9.71</td><td>0.350</td><td>19.94</td><td>2.803</td><td>B</td></tr><tr><td>6.46</td><td>0.225</td><td>21.23</td><td>2.902</td><td>B</td></tr><tr><td>3.16</td><td>0.109</td><td>23.15</td><td>3.107</td><td>B</td></tr><tr><td>0</td><td>0</td><td>27.44</td><td>3.740</td><td>B</td></tr></table>		$\text{UO}_2(\text{NO}_3)_2$		KNO_3		Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	56.08	3.240	0	0	A	54.68	3.307	3.36	0.792	A	54.21	3.398	5.30	1.30	A	53.90	3.738	9.51	2.57	A ^c	53.88	3.828	10.40	2.880	A ^c	48.65	3.012	10.36	2.500	B	40.60	2.314	11.11	2.275	B	25.80	1.065	12.74	2.050	B	9.71	0.350	19.94	2.803	B	6.46	0.225	21.23	2.902	B	3.16	0.109	23.15	3.107	B	0	0	27.44	3.740	B
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^a Molalities calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = KNO_3 . ^c In Reference (1), this is given as the eutonic point, i.e., the solid phase is A + B.																																																																						
AUXILIARY INFORMATION																																																																						
METHOD/APPARATUS/PROCEDURE: Nothing specified, but the isothermal method was probably used, as discussed in Ref. (1).	SOURCE AND PURITY OF MATERIALS: Nothing specified.																																																																					
	ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Nothing specified.																																																																					
	REFERENCES: 1. Colani, <i>Compt. Rend.</i> , <u>1927</u> , 185, 1475.																																																																					

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Perova, A. P.			
(2) Potassium nitrate; KNO_3 ; [7757-79-1]			<i>Zh. Neorg. Khim.</i> , 1956, 1, 323-329.			
(3) Water; H_2O ; [7732-18-5]			<i>Russ. J. Inorg. Chem.</i> , 1956, 1, 140. (Eng. trans.)			
VARIABLES: Composition and temperature			PREPARED BY: A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$ System						
Composition of Saturated Solutions ^a						
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		KNO_3		H_2O	Solid ^b Phase
	mass %	mol/kg	mass %	mol/kg	mass %	
0	---	---	12.24	1.379	87.76	A
	1.00	0.0289	11.3	1.27	87.7	A
	7.4	0.23	0	1.1	83.4 ^{c,d}	A
	24.0	0.870	6.0	0.85	70.0	A
	38.7	1.72	4.1	0.71	57.2	A
	48.3	2.50	2.69	0.543	40.0 ^{c,d}	A+B
	49.8	2.52	---	---	50.2	B
5	---	---	14.4	1.66	85.6	A
	0.9	0.03	14.3	1.67	84.8	A
	7.1	0.22	11.4	1.38	81.5	A
	23.6	0.870	7.6	1.1	68.8	A
	38.0	1.69	5.1	0.89	56.9	A
	48.0	2.56	4.5	0.94	47.5	A
	49.8	2.78	4.8	1.0	45.4 ^c	A+B
10	51.3	2.67	---	---	48.7	B
	---	---	17.7	2.13	82.3	A
	0.8	0.02	16.7	2.00	82.5	A
	7.0	0.22	14.0	1.75	79.0	A
	23.0	0.866	9.6	1.4	67.4	A
	37.3	1.68	6.4	1.1	56.3	A
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
Solubility in three-component systems was determined by the polythermal, visual technique. A glass test tube with a given solution was dipped in liquid air, and then slowly warmed. Temperature of appearance of the first crystals during cooling and of dissolution of the last crystals at warming was noted. To verify results, and to determine the eutonic point, isothermal methods at 0°C and 25°C were also used. Investigations were carried out in a thermostat with a stirrer. Solutions with a composition near the investigated points were prepared, then 10 to 15% excess solid salt was added. Equilibrium was established at 0°C after 3 hours, and at 25°C after 1 hour. Potassium and uranium measured gravimetrically.			1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ and KNO_3 both of unknown purity, recrystallized from water.			
			ESTIMATED ERROR:			
			Solubility: Nothing specified. Temperature: Precision ± 0.1 K.			
			REFERENCES:			

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$;
[15905-86-9]

(2) Potassium nitrate; KNO_3 ;
[7757-79-1]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Perova, A. P.

Zh. Neorg. Khim., 1956, 1, 323 -
329.

Russ. J. Inorg. Chem., 1956, 1,
140. (Eng. trans.)

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$ System

Composition of Saturated Solutions^a

$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		KNO_3		H_2O	Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
Initial Solution I: $\text{UO}_2(\text{NO}_3)_2 = 1.56$ mass %, $\text{H}_2\text{O} = 98.44$ mass % (KNO_3 was added) (continued)						
10.0	1.32	0.0402	15.25	1.808	83.43	A
12.8	1.30	0.0402	16.66	2.009	82.04	A
14.8	1.27	0.0399	18.03	2.210	80.70	A
19.6	1.23	0.0399	20.63	2.611	78.14	A
24.2	1.20	0.0402	23.07	3.013	75.73	A
Initial Solution II: $\text{UO}_2(\text{NO}_3)_2 = 8$ mass %, $\text{H}_2\text{O} = 92.0$ mass % (KNO_3 was added)						
- 1.0	8.0	0.22	---	---	92.0	ice
- 2.2	7.68	0.220	3.84	0.429	88.48	ice
- 3.0	7.40	0.220	7.40	0.859	85.20	ice
- 3.2	7.38	0.220	7.5	0.871	85.12 ^c	ice+A
3.6	7.14	0.221	10.71	1.289	82.15	A
9.8	6.89	0.220	13.79	1.720	79.32	A
14.6	6.66	0.220	16.66	2.149	76.68	A
18.6	6.45	0.221	19.35	2.579	74.20	A
22.4	6.25	0.221	21.87	3.009	71.88	A
25.6	6.06	0.221	24.25	3.442	69.69	A
Initial Solution III: $\text{UO}_2(\text{NO}_3)_2 = 25$ mass %, $\text{H}_2\text{O} = 75$ mass % (KNO_3 was added)						
- 5.4	25.0	0.846	---	---	75.	ice
- 6.0	23.8	0.845	4.76	0.659	71.44	ice
- 6.4	23.8	0.830	3.40	0.462	72.80 ^c	ice+A
- 2.4	23.8	0.845	4.76	0.659	71.44	A
10.4	22.72	0.856	9.90	1.45	67.38	A
19.2	21.73	0.845	13.04	1.977	65.23	A
31.5	20.83	0.846	16.66	2.636	62.51	A
Initial Solution IV: $\text{UO}_2(\text{NO}_3)_2 = 40$ mass %, $\text{H}_2\text{O} = 60$ mass % (KNO_3 was added)						
-14.4	40.00	1.692	---	---	60.0	ice
-14.8	39.0	1.675	1.92	0.321	59.08 ^c	ice+A
-13.6	39.16	1.688	1.96	0.329	58.88	A
- 0.4	38.46	1.692	3.84	0.658	57.70	A
6.8	37.73	1.691	5.66	0.989	56.61	A
13.2	37.03	1.691	7.40	1.32	55.57	A
19.0	36.36	1.717	9.90	1.82	53.74	A
24.4	35.71	1.691	10.71	1.977	53.58	A

(Continued on the next page)

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COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Potassium nitrate; KNO_3 ; [7757-79-1] (3) Water; H_2O ; [7732-18-5]			ORIGINAL MEASUREMENTS: Perova, A. P. <i>Zh. Neorg. Khim.</i> , 1956, 1, 330 - 336. <i>Russ.J.Inorg.Chem.</i> , 1956, 1, 140.				
VARIABLES: Composition and temperature			PREPARED BY: A. Sozanski; S. Siekierski				
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2$ - KNO_3 - H_2O System Composition of Saturated Solutions ^a							
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		KNO_3		H_2O	Solid Phase ^b	
	mass %	mol/kg	mass %	mol/kg	mass %		
50	---	---	46.09	8.456	53.91	A ^c	
	0.88	0.040	43.50	7.736	55.62	A	
	4.82	0.222	40.12	7.207	55.06	A	
	17.20	0.8593	32.00	6.230	50.80	A	
	30.53	1.691	23.66	5.108	45.81	A	
	40.00	2.538	20.00	4.945	40.00	A	
	52.6	4.82	19.70	7.034	27.70	A	
	58.73	6.878	19.60	8.946	21.67	A+B ^e	
	65.5	5.11	2.0	0.61	32.50	B	
	67.5	5.27	---	---	32.5	B ^c	
	70	---	---	57.9	13.6	42.10	A ^c
		0.98	0.058	55.8	12.8	43.22	A
4.20		0.244	52.2	11.8	43.60	A	
14.35		0.8702	43.8	10.4	41.85	A	
26.00		1.732	35.9	9.32	38.10	A	
35.22		2.624	30.72	8.921	34.06	A	
48.34		4.746	25.81	9.876	25.85	A	
56.80		7.101	22.90	11.16	20.30	A	
61.30		9.205	21.80	12.76	16.90	A	
63.00		9.993	21.00	12.98	16.00	A+C ^d	
76.20		8.871	2.00	0.907	21.80	C	
78.00		8.998	---	---	22.00	C ^c	
90	---	---	66.8	19.9	33.2	A ^c	
	0.75	0.053	63.5	17.6	35.75	A	
	4.25	0.310	61.0	17.4	34.75	A	
(continued on the next page)							
AUXILIARY INFORMATION							
METHOD/APPARATUS/PROCEDURE: Solubility in three-component systems was determined by the polythermal, visual method (1,2). Hermetisation was partially ensured and solutions were frequently changed in order to avoid evaporation. The isothermal method was also used at 50 ^o C and 90 ^o C to check data and establish eutonic points. Equilibrium at this temperature was established after 30 to 40 minutes. Potassium and uranium were measured by gravimetric methods, water by desiccation.			SOURCE AND PURITY OF MATERIALS: $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ and KNO_3 , unknown purity, recrystallized ³ twice.				
			ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Probably $\pm 0.1\text{K}$ (compilers)				
			REFERENCES: 1. Alekseev, V. F. <i>Zh. R. Kh. O.</i> , 1877, 9, 208. 2. Bergman, A. G. <i>Trudy sessii AN SSSR</i> , 1932, II, 167, ed. AN SSSR, Leningrad, 1933.				

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Perova, A. P.
(2) Potassium nitrate; KNO_3 ; [7757-79-1]	<i>Zh. Neorg. Khim.</i> , 1956, 1, 330 - 336. <i>Russ. J. Inorg. Chem.</i> , 1956, 1, 140. (Eng. trans.)
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$ SystemComposition of Saturated Solutions^a

$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		KNO_3		H_2O	Solid _b Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
46.3	4.93	0.220	38.27	6.664	56.80	A
49.6	4.82	0.222	40.12	7.207	55.06	A
52.4	4.65	0.221	41.86	7.740	53.49	A
54.3	4.52	0.221	43.50	8.277	51.98	A
57.0	4.39	0.220	44.93	8.769	50.68	A
60.4	4.29	0.221	46.52	9.354	49.19	A
64.0	4.06	0.221	49.24	10.43	46.70	A
69.5	3.86	0.220	51.69	11.50	44.45	A
74.5	3.68	0.220	53.91	12.57	42.41	A
77.3	3.52	0.220	55.94	13.65	40.54	A
83.7	3.37	0.220	57.80	14.72	38.83 _f	A
86.2	3.23	0.220	59.51	15.80	37.28 _f	A
91.0	3.11	0.220	61.08	16.87	35.81	A

Initial Solution III: $\text{UO}_2(\text{NO}_3)_2 = 25$ mass %, $\text{H}_2\text{O} = 75$ mass %
(KNO_3 added)

27.0	20.83	0.8457	16.66	2.636	62.51	A
35.8	19.23	0.8458	23.07	3.955	57.70	A
41.5	18.51	0.8453	25.92	4.613	55.57	A
44.0	17.86	0.8461	28.57	5.275	53.57	A
49.5	17.23	0.8451	31.03	5.932	51.74	A
51.9	16.66	0.8454	33.33	6.592	50.01	A
54.7	16.12	0.8452	35.48	7.251	48.40	A
58.3	15.62	0.8456	37.50	7.912	46.88	A
61.5	15.15	0.8458	39.39	8.570	45.46	A
67.0	14.28	0.8454	42.85	9.886	42.87 _f	A
72.6	13.51	0.8455	42.94	9.752	40.55 _f	A
77.8	12.82	0.8457	48.71	12.52	38.47	A
82.4	12.19	0.8452	51.21	13.84	36.60	A
89.5	11.62	0.8450	53.48	15.16	34.90	A

Initial Solution IV: $\text{UO}_2(\text{NO}_3)_2 = 40$ mass %, $\text{H}_2\text{O} = 60$ mass %
(KNO_3 added)

24.6	35.71	1.691	10.71	1.977	53.58	A
31.5	34.93	1.691	12.66	2.389	52.41	A
34.0	34.48	1.692	13.80	2.639	51.72	A
35.9	33.75	1.686	15.44	3.006	50.81	A
39.1	33.05	1.691	17.35	3.460	49.60	A
40.5	32.39	1.692	19.02	3.872	48.59	A
43.7	31.74	1.691	20.63	4.284	47.63	A
45.6	31.12	1.691	22.18	4.698	46.70	A
50.1	30.53	1.691	23.66	5.108	45.81	A
52.0	29.96	1.692	25.09	5.521	44.95	A
54.5	29.41	1.692	26.49	5.941	44.10	A
58.0	28.36	1.691	29.08	6.758	42.56	A

(Continued on the next page)

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Potassium nitrate; KNO_3 ; [7757-79-1]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Perova, A. P.

Zh. Neorg. Khim., 1956, 1, 330 - 336.

Russ. J. Inorg. Chem., 1956, 1, 140. (Eng. trans.)

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - KNO_3 - H_2O System

Composition of Saturated Solutions^a

$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		KNO_3		H_2O	Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
Initial Solution VII: $\text{UO}_2(\text{NO}_3)_2 = 73.3$ mass %, $\text{H}_2\text{O} = 26.7$ mass % (KNO_3 added)						
57.6	73.3	6.967	---	---	26.7	C
56.6	70.0	6.939	4.4	1.7	25.6	C
55.0	67.0	6.940	8.5	3.4	24.5	C
54.2	64.2	6.933	12.3	5.18	23.5	C
53.1	61.7	6.959	15.8	6.95	22.5	C
52.5	59.1	7.176	20.0	9.46	20.9	A+C
80.3	54.7	7.156	25.9	13.2	19.4	A
89.1	52.6	7.063	28.5	14.9	18.9	A
Initial Solution VIII: $\text{UO}_2(\text{NO}_3)_2 = 78$ mass %, $\text{H}_2\text{O} = 22$ mass % (KNO_3 added)						
81.8	78.00	8.998	---	---	22.0	A
73.6	76.9	9.24	1.97	0.922	21.13	A
68.7	73.5	8.93	5.62	2.66	20.88	A
63.1	70.73	9.038	9.41	4.69	19.86	A
58.5	66.10	9.117	15.5	8.33	18.40	A
56.4	62.0	9.15	20.8	12.0	17.20	A
68.7	62.2	9.31	20.85	12.17	16.95	A
81.1	59.7	9.13	23.70	14.12	16.60 ^f	A
89.2	58.3	9.25	25.72	15.91	15.18 ^f	A
Initial Solution IX: $\text{KNO}_3 = 5$ mass %, $\text{H}_2\text{O} = 95$ mass % ($\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ was added)						
- 1.2	---	---	5.00	0.521	95.00	ice
- 1.5	8.9	0.26	4.44	0.507	86.66	ice
- 3.0	15.1	0.475	4.16	0.510	80.74	ice
- 4.5	21.7	0.740	3.84	0.510	74.46	ice
- 5.8	26.5	0.962	3.57	0.505	69.93	ice
- 6.0	30.5	1.17	3.33	0.498	66.17 ^f	ice
- 8.5	34.0	1.37	3.12	0.491	72.88 ^f	ice
-11.2	37.0	1.56	2.94	0.484	60.06	ice
11.5	50.2	2.67	2.08	0.431	47.72	B
16.2	51.5	2.81	2.00	0.425	46.50	B
24.0	53.7	3.07	1.85	0.412	44.45	B
29.0	55.5	3.29	1.72	0.398	42.78	B
33.0	57.1	3.51	1.61	0.386	41.29	B
35.8	58.5	3.71	1.51	0.373	39.99	B
41.2	60.8	4.08	1.35	0.353	37.85	B
45.6	62.6	4.39	1.21	0.331	36.19	B
47.2	64.1	4.68	1.11	0.316	34.79	B
49.1	65.3	4.92	1.02	0.300	33.68	B
51.4	66.4	5.16	0.94	0.28	32.66	B

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COMPONENTS:

- (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$;
[15905-86-9]
- (2) Potassium nitrate; KNO_3 ;
[7757-79-1]
- (3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Perova, A. P.

Zh. Neorg. Khim., 1956, 1, 330 -
336.
Russ. J. Inorg. Chem., 1956, 1,
140. (Eng. trans.)

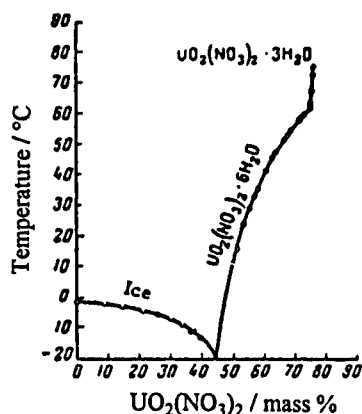
EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$ System

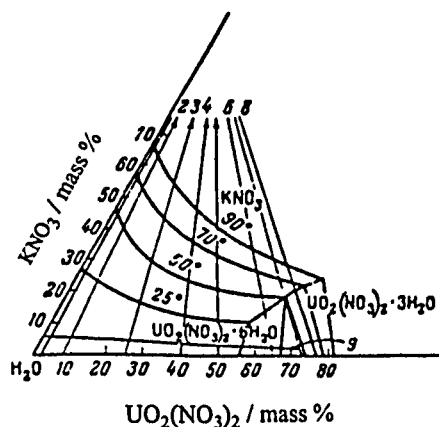
Solubility isotherms at 50°C, 70°C and 90°C were obtained from polythermal data by the graphic method.

There are three areas of crystallization. The largest is that of KNO_3 . Uranyl nitrate decreases the solubility of potassium nitrate, but the solubility of $\text{UO}_2(\text{NO}_3)_2$ increases slightly in the presence of KNO_3 .

The phase diagrams are:



Crystallization curve of a cross section of the system $\text{UO}_2(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$.



Isothermal triangle of the system $\text{UO}_2(\text{NO}_3)_2 - \text{KNO}_3 - \text{H}_2\text{O}$, 25-90°C.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Rubidium nitrate; RbNO_3 ; [13126-12-0] (3) Cesium nitrate; CsNO_3 ; [7789-18-6] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Rimbach, E. Ber., 1904, 37, 461 - 488.																						
VARIABLES: Composition at: 289, 298, 353 K	PREPARED BY: L. Fuks; S. Siekierski																						
EXPERIMENTAL VALUES: <div>Composition of Saturated Solutions^a</div> <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{RbNO}_3$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th></tr><tr><td>25.0</td><td>51.67</td><td>3.253</td><td>8.02</td><td>1.35</td><td>A</td></tr><tr><td>80.0</td><td>50.68</td><td>4.241</td><td>18.99</td><td>4.246</td><td>B</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phases: A = RbNO_3 , B = $\text{UO}_2(\text{NO}_3)_2 \cdot \text{RbNO}_3$. CsNO_3 , 16.1 ^o C In the uranyl nitrate - cesium nitrate system, the composition of saturated solutions is reported to be 45.80 mass % of $\text{UO}_2(\text{NO}_3)_2$ i.e., 2.610 mol/kg (compilers), and 9.66 mass % CsNO_3 , i.e., 1.11 mol/kg (compilers), at 16.1 ^o C.		$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		RbNO_3		Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	25.0	51.67	3.253	8.02	1.35	A	80.0	50.68	4.241	18.99	4.246	B
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		RbNO_3		Solid Phase ^b																		
	mass %	mol/kg	mass %	mol/kg																			
25.0	51.67	3.253	8.02	1.35	A																		
80.0	50.68	4.241	18.99	4.246	B																		
AUXILIARY INFORMATION																							
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Weighed amounts of the double salt and water were mixed at the desired temperature. The solution was analyzed either after evaporation of water, or after the uranium was precipitated with ammonium sulfide. Uranium was measured after the precipitate was calcined to U_3O_8 .	SOURCE AND PURITY OF MATERIALS: Pure uranium - rubidium and pure uranium - cesium double salts were used. ESTIMATED ERROR: Nothing specified. REFERENCES:																						

COMPONENTS:			ORIGINAL MEASUREMENTS:					
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Yakimov, M. A.; Nosova, N.F.; Degtyarev, A. Ya.; Tsyhan-Tsi, Yui					
(2) Cesium nitrate; CsNO_3 ; [7789-18-6]			Radiokhim., 1963, 5, 73 - 80.					
(3) Water; H_2O ; [7732-18-5]			Sov. Radiochem., 1963, 60. (Eng. trans.)					
VARIABLES:			PREPARED BY:					
Composition at 273 and 298 K			A. Sozanski; S. Siekierski					
EXPERIMENTAL VALUES:								
The $\text{UO}_2(\text{NO}_3)_2 - \text{CsNO}_3 - \text{H}_2\text{O}$ System at 0°C								
Composition of Saturated Solutions ^a								
$\text{UO}_2(\text{NO}_3)_2$			CsNO_3			H_2O		Solid Phase ^c
mol %	mass %	mol/kg	mol %	mass %	mol/kg	mol %	mass %	
0	0	0	0.86	8.6	0.48	99.14	91.42	
0.06	1	0.03	0.81	8.0	0.45	99.13	90.77	
0.10	2.0	0.056	0.78	7.7	0.44	99.12	90.32	A
0.41	7.8	0.23	0.64	6.0	0.36	98.95	86.16	A
0.82	15	0.46	0.56	4.9	0.32	98.62	80.43	A
0.99	17	0.56	0.54	4.6	0.30	98.47	78.17	A
1.00	17.4	0.564	0.53	4.6	0.30	98.47	78.10	A
1.10	18.8	0.621	0.54	4.6	0.30	98.36	76.69	A
1.56	24.7	0.885	0.55	4.3	0.31	97.89	70.95	A
2.21	31.7	1.26	0.63	4.5	0.36	97.16	63.79	A
2.82	37.2	1.62	0.71	4.6	0.41	96.47	58.17	A
2.84	37.2	1.64	0.79	5.1	0.46	96.37	57.69	A
3.32	40.7	1.93	0.94	5.7	0.55	95.74	53.63	A
3.45	41.6	2.00	0.97	5.8	0.56	95.58	52.65	A
3.69	43.2	2.15	1.02	5.9	0.594	95.29	50.95	A
3.71	43.2	2.16	1.06	6.11	0.618	95.23	50.70	A
4.04	45.2	2.36	1.13	6.26	0.661	94.83	48.53	A+B
4.00	45.2	2.34	1.02	5.70	0.596	94.98	49.08	B
4.01	45.4	2.34	0.97	5.4	0.57	95.02	49.18	B
4.07	45.9	2.38	0.90	5.0	0.53	95.03	49.04	B
4.11	46.2	2.40	0.89	5.0	0.52	95.00	48.84	B+C
4.11	46.4	2.40	0.80	4.5	0.47	95.09	49.11	C
4.13	46.8	2.41	0.68	3.8	0.40	95.19	49.35	C
4.20	48.1	2.44	0.33	1.9	0.19	95.47	50.01	C
4.29	49.5	2.49	0	0	0	95.71	50.50	C
(Continued on the next page)								
AUXILIARY INFORMATION								
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:					
The method was described by Yakimov et al. in Ref. (1). Uranium was measured as U_3O_8 . In order to avoid cesium contamination, two pptns of ammonium diruanate were made before calcination to the oxide. Cesium determined radiometrically as Cs^{134} . Counter STS-5 with 1 mm lead shield was used. Solid phase compositions determined by Schreinemakers method. Details on the experimental method are given in Ref. (1) for the $\text{Ca}(\text{NO}_3)_2 - \text{UO}_2(\text{NO}_3)_2 - \text{H}_2\text{O}$ system.			Nothing specified.					
			ESTIMATED ERROR:					
			Nothing specified.					
			REFERENCES:					
			1. Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. Zh. Neorg.Khim., 1958, 3, 504.					

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Cesium nitrate; CsNO_3 ; [7789-18-6] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yakimov, M. A.; Nosova, N. F.; Degtyarev, A. Ya.; Tsyann-Tsi, Yui <i>Radiokhim.</i> , 1963, 5, 73 - 80. <i>Sov. Radiochem.</i> , 1963, 60. (Eng. trans.)
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EXPERIMENTAL VALUES: (Continued)The $\text{UO}_2(\text{NO}_3)_2 - \text{CsNO}_3 - \text{H}_2\text{O}$ System at 25°CComposition of Saturated Solutions^a

$\text{UO}_2(\text{NO}_3)_2$			CsNO_3			H_2O		Solid Phase ^c
mol %	mass %	mol/kg	mol %	mass %	mol/kg	mol %	mass %	
0	0	0	2.46	21.4	1.40	97.54	78.56	A
0.09	2	0.05	2.34	20.3	1.33	97.57	78.15	A
0.12	2.1	0.068	2.27	19.7	1.29	97.61 ^b	78.22	A
0.20	3.5	0.11	2.24	19.2	1.27	97.56 ^b	77.32	A
0.24	4.2	0.14	2.13	18.3	1.21	97.63 ^b	77.53	A
0.26	4.5	0.15	2.14	18.3	1.22	97.60 ^b	77.19	A
0.30	5.2	0.17	2.12	18.1	1.21	97.58	76.79	A
0.40	6.8	0.23	2.07	17.4	1.18	97.53	75.80	A
0.85	14	0.49	1.80	14.4	1.03	97.35 ^b	71.89	A
1.11	17.3	0.634	1.78	13.7	1.02	97.11 ^b	69.05	A
1.21	18.4	0.693	1.92	14.4	1.10	96.87	67.22	A
1.52	22.0	0.874	1.96	14.1	1.13	96.52 ^b	63.93	A
1.88	25.6	1.09	2.19	14.7	1.27	95.93 ^b	59.68	A
2.25	29.3	1.31	2.12	13.7	1.23	95.63	57.00	A
2.83	34.2	1.65	2.22	13.3	1.30	94.95	52.50	A
3.26	37	1.92	2.52	14.1	1.48	94.22	48.87	A
3.65	39.6	2.16	2.60	14.0	1.54	93.75	46.48	A
3.69	39.6	2.19	2.72	14.4	1.61	93.59	45.94	A
3.99	41.6	2.37	2.71	14.0	1.61	93.30	44.45	A+B
4.04	42.1	2.40	2.61	13.5	1.55	93.35 ^b	44.46	B
4.05	41.4	2.42	2.99	15.1	1.79	92.96 ^b	43.46	B
4.06	42.8	2.41	2.32	12.1	1.38	93.62 ^b	45.11	B
4.39	45.3	2.61	2.09	10.7	1.24	93.52 ^b	44.08	B
4.34	45.2	2.57	2.00	10.3	1.19	93.66	44.55	B
4.40	45.6	2.61	1.97	10.1	1.17	93.63	44.34	B
4.38	45.7	2.59	1.86	9.60	1.10	93.76	44.71	B
4.52	46.4	2.68	1.92	9.74	1.14	93.56	43.88	B
4.71	47.7	2.80	1.79	8.97	1.06	93.50	43.31	B
4.77	48.1	2.83	1.75	8.74	1.04	93.48	43.13	B
4.81	48.5	2.86	1.70	8.47	1.01	93.49	43.07	B
5.00	49.3	2.98	1.76	8.59	1.05	93.24	42.07	B+D
4.96	49.8	2.94	1.46	7.25	0.866	93.58	42.95	D
5.00	50.7	2.96	1.14	5.72	0.674	93.86	43.54	D
5.03	51.3	2.97	0.95	4.8	0.56	94.02	43.87	D
5.12	51.9	3.03	0.91	4.6	0.54	93.97	43.54	D+C
5.18	53.0	3.05	0.57	2.9	0.34	94.25	44.10	C
5.30	54.3	3.12	0.30	1.5	0.18	94.40	44.20	C
5.49	56.0	3.23	0	0	0	94.51	44.04	C

^aMolalities and mass % calculated by compilers. ^bCalculated by compilers.
^cSolid phases: A = CsNO_3 , B = $\text{Cs}_2\text{UO}_2(\text{NO}_3)_4$, C = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$,
D = $\text{CsUO}_2(\text{NO}_3)_3$.

COMMENTS AND/OR ADDITIONAL DATA: Solubility isotherms are given in the source paper. Isotherm at 25°C has four branches corresponding to soly of cesium nitrate, uranyl and cesium tetranitrate, uranyl and cesium trihydrate, and uranyl hexahydrate. Isotherm at 0°C has three branches only, corresponding to soly of cesium nitrate, cesium and uranyl tetranitrate, and uranyl nitrate hexahydrate.

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$;
[15905-86-9]

(2) Thallium nitrate; TlNO_3 ;
[10102-45-1]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yakimov, M. A.; Nosova, N. F.;
Degtyarev, A. Ya.; Tsyhan-Tsi, Yui

Radiokhim., 1963, 5, 73 - 80.

Sov. Radiochem., 1963, 60.
(Eng. trans.)

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - TlNO_3 - H_2O System at 25°C

Composition of Saturated Solutions^a

$\text{UO}_2(\text{NO}_3)_2$			TlNO_3			H_2O		Solid Phase ^c
mol %	mass %	mol/kg	mol %	mass %	mol/kg	mol %	mass %	
0	0	0	0.79	11	0.44	99.21	89.47	A
0.06	1	0.03	0.74	9.8	0.41	99.20	89.00	A
0.12	2.3	0.067	0.71	9.3	0.40	99.17	88.31	A
0.13	2.5	0.073	0.71	9.3	0.40	99.16	88.14	A
0.18	3.5	0.10	0.65	8.5	0.36	99.17	87.98	A
0.24	4.6	0.13	0.61	7.9	0.34	99.15	87.42	A
0.36	6.8	0.20	0.56	7.2	0.31	99.08	85.98	A
0.39	7.4	0.22	0.56	7.1	0.31	99.05	85.49	A
0.060	11	0.34	0.48	6.0	0.27	98.92	83.03	A
0.66	12	0.37	0.46	5.7	0.26	98.88	82.32	A
0.85	15	0.48	0.43	5.1	0.24	98.72	79.83	A
0.95	17	0.53	0.42	4.9	0.24	98.63 ^b	78.51	A
1.12	19.0	0.631	0.40	4.6	0.23	98.48	76.41	A
1.34	22.0	0.757	0.38	4.2	0.21	98.28	73.78	A
1.54	24.5	0.872	0.38	4.1	0.22	98.08 ^b	71.39	A
1.58	25.0	0.895	0.38	4.1	0.22	98.04 ^b	70.93	A
1.62	25.5	0.918	0.38	4.0	0.22	98.00	70.48	A
1.67	26.1	0.946	0.37	3.9	0.21	97.96	69.99	A
1.99	29.7	1.13	0.37	3.7	0.21	97.64	66.59	A
2.23	32.2	1.27	0.37	3.6	0.21	97.40	64.23	A
2.76	37.0	1.58	0.40	3.6	0.23	96.84	59.37	A
3.02	39.2	1.74	0.39	3.4	0.22	96.59	57.35	A
3.12	40.0	1.80	0.40	3.5	0.23	96.48	56.54	A
3.27	41.1	1.88	0.41	3.5	0.24	96.32	55.39	A
3.42	42.2	1.97	0.42	3.5	0.24	96.16	54.27	A
4.06	46.4	2.36	0.47	3.6	0.27	95.47	49.93	A
4.25	47.6	2.48	0.49	3.7	0.29	95.26	48.74	A
4.84	50.7	2.84	0.56	4.0	0.33	94.60	45.32	A
5.39	53.4	3.18	0.60	4.0	0.35	94.01	42.58	A
5.65	54.4	3.35	0.67	4.4	0.40	93.68	41.24	A+B
5.60	54.8	3.31	0.47	3.1	0.28	93.93	42.05	B
5.49	56.0	3.22	0	0	0	94.51	44.04	B

^aMolalities and mass % calculated by the compilers.

^bCalculated by the compilers.

^cSolid phases: A = TlNO_3 , B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

COMMENTS AND/OR ADDITIONAL DATA:

Solubility isotherms are also given in graphical form in the source publication.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Beryllium nitrate; $\text{Be}(\text{NO}_3)_2$; [13597-99-4] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yakimov, M. A.; Nosova, N. F. <i>Zh. Neorg. Khim.</i> , <u>1961</u> , <i>6</i> , 208 - 211. <i>Russ. J. Inorg. Chem.</i> , <u>1961</u> , <i>6</i> , 103. (Eng. trans.)																																																																																																																																																																										
VARIABLES: Composition at 273 and 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																																																																																																																																										
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{Be}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System at 0°C Composition of Saturated Solutions ^a <table><tr><th rowspan="2">$t/^\circ\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{Be}(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th><th>mass %</th></tr><tr><td rowspan="4">0</td><td>0</td><td>0</td><td>50.1</td><td>7.55</td><td>49.9</td><td>A</td></tr><tr><td>0.80</td><td>0.04</td><td>50.0</td><td>7.64</td><td>49.2</td><td>A</td></tr><tr><td>2.1</td><td>0.11</td><td>49.5</td><td>7.69</td><td>48.4</td><td>A</td></tr><tr><td>7.3</td><td>0.42</td><td>48.5</td><td>8.25</td><td>44.2</td><td>A</td></tr><tr><td></td><td>7.4</td><td>0.42</td><td>48.2</td><td>8.16</td><td>44.4</td><td>A+B</td></tr><tr><td></td><td>5.4</td><td>0.29</td><td>46.8</td><td>7.36</td><td>47.8</td><td>B</td></tr><tr><td></td><td>4.6</td><td>0.23</td><td>44.9</td><td>6.68</td><td>50.5</td><td>B</td></tr><tr><td></td><td>4.5</td><td>0.22</td><td>43.8</td><td>6.37</td><td>51.7</td><td>B</td></tr><tr><td></td><td>4.2</td><td>0.20</td><td>42.6</td><td>6.02</td><td>53.2</td><td>B</td></tr><tr><td></td><td>4.0</td><td>0.19</td><td>42.2</td><td>5.90</td><td>53.8</td><td>B</td></tr><tr><td></td><td>4.4</td><td>0.21</td><td>41.9</td><td>5.87</td><td>53.7</td><td>B</td></tr><tr><td></td><td>4.6</td><td>0.21</td><td>39.2</td><td>5.24</td><td>56.2</td><td>B</td></tr><tr><td></td><td>4.8</td><td>0.21</td><td>37.6</td><td>4.91</td><td>57.6</td><td>B</td></tr><tr><td></td><td>5.4</td><td>0.23</td><td>36.0</td><td>4.62</td><td>58.6</td><td>B</td></tr><tr><td></td><td>5.7</td><td>0.25</td><td>35.7</td><td>4.58</td><td>58.6</td><td>B</td></tr><tr><td></td><td>6.0</td><td>0.26</td><td>35.2</td><td>4.50</td><td>58.8</td><td>B</td></tr><tr><td></td><td>8.2</td><td>0.34</td><td>31.4</td><td>3.91</td><td>60.4</td><td>B</td></tr><tr><td></td><td>8.6</td><td>0.36</td><td>30.2</td><td>3.71</td><td>61.2</td><td>B</td></tr><tr><td></td><td>9.6</td><td>0.40</td><td>29.4</td><td>3.62</td><td>61.0</td><td>B</td></tr><tr><td></td><td>13.2</td><td>0.537</td><td>24.4</td><td>2.94</td><td>62.4</td><td>B</td></tr><tr><td></td><td>15.0</td><td>0.616</td><td>23.2</td><td>2.82</td><td>61.8</td><td>B</td></tr><tr><td></td><td>18.8</td><td>0.762</td><td>18.6</td><td>2.23</td><td>62.6</td><td>B</td></tr><tr><td></td><td>21.0</td><td>0.871</td><td>17.8</td><td>2.19</td><td>61.2</td><td>B</td></tr></table> (Continued on the next page)		$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Be}(\text{NO}_3)_2$		H_2O	Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	mass %	0	0	0	50.1	7.55	49.9	A	0.80	0.04	50.0	7.64	49.2	A	2.1	0.11	49.5	7.69	48.4	A	7.3	0.42	48.5	8.25	44.2	A		7.4	0.42	48.2	8.16	44.4	A+B		5.4	0.29	46.8	7.36	47.8	B		4.6	0.23	44.9	6.68	50.5	B		4.5	0.22	43.8	6.37	51.7	B		4.2	0.20	42.6	6.02	53.2	B		4.0	0.19	42.2	5.90	53.8	B		4.4	0.21	41.9	5.87	53.7	B		4.6	0.21	39.2	5.24	56.2	B		4.8	0.21	37.6	4.91	57.6	B		5.4	0.23	36.0	4.62	58.6	B		5.7	0.25	35.7	4.58	58.6	B		6.0	0.26	35.2	4.50	58.8	B		8.2	0.34	31.4	3.91	60.4	B		8.6	0.36	30.2	3.71	61.2	B		9.6	0.40	29.4	3.62	61.0	B		13.2	0.537	24.4	2.94	62.4	B		15.0	0.616	23.2	2.82	61.8	B		18.8	0.762	18.6	2.23	62.6	B		21.0	0.871	17.8	2.19	61.2	B
$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Be}(\text{NO}_3)_2$		H_2O	Solid Phase ^b																																																																																																																																																																					
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AUXILIARY INFORMATION																																																																																																																																																																											
METHOD/APPARATUS/PROCEDURE: The procedure has been described in Ref. (1). Beryllium was measured in solution and in solid phase by the precipitation of beryllium hydroxide from oxalic acid solution. Uranium was precipitated from the filtrate by oxine, and ignited to U_3O_8 .			SOURCE AND PURITY OF MATERIALS: $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, nothing specified. $\text{Be}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ was obtained from a concentrated solution of beryllium nitrate, after adding concentrated nitric acid. Product contained 4.37 % Be and 60.40 % NO_3 (theor. 4.39 % and 60.48 %, respectively).																																																																																																																																																																								
REFERENCES: 1. Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. <i>Zh. Neorg. Khim.</i> , <u>1958</u> , <i>3</i> , 504.			ESTIMATED ERROR: Nothing specified.																																																																																																																																																																								

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Beryllium nitrate; $\text{Be}(\text{NO}_3)_2$; [13597-99-4]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yakimov, M. A.; Nosova, N. F.;

Zh. Neorg. Khim., 1961, 6, 208 - 211.

Russ. J. Inorg. Chem., 1961, 6, 103. (Eng. trans.)

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Be}(\text{NO}_3)_2$ - H_2O System at 0°C

Composition of Saturated Solutions^a

$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Be}(\text{NO}_3)_2$		H_2O	Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
0	24.5	1.02	14.8	1.83	60.7	B
	25.6	1.08	14.4	1.80	60.0	B
	26.8	1.12	12.6	1.56	60.6	B
	28.7	1.23	12.0	1.52	59.3	B
	30.6	1.33	10.9	1.40	58.5	B
	33.1	1.47	9.6	1.3	57.3	B
	34.1	1.52	9.2	1.2	56.8 ^c	B
	37.6	1.72	6.9	0.93	55.5	B
	42.6	2.02	3.8	0.53	53.6	B
	46.6	2.26	1.1	0.16	52.3	B
	49.5	2.49	0	0	50.5	B
25	0	0	54.57	9.030	45.43	A
	2.0	0.12	53.9	9.19	44.1	A
	6.6	0.40	51.0	9.04	42.4	A
	8.4	0.51	50.0	9.04	41.6	A
	10.2	0.638	49.2	9.11	40.6	A
	12.7	0.812	47.6	9.01	39.7	A
	17.6	1.19	44.9	9.00	37.5	A
	18.5	1.27	44.6	9.09	36.9	A+B
	18.3	1.22	43.7	8.65	38.0	B
	18.4	1.19	42.2	8.05	39.4	B
	18.4	1.10	39.5	6.97	42.6	B
	18.1	1.05	38.0	6.51	43.9	B
	18.3	1.01	35.8	5.86	45.9	B
	18.7	1.01	34.1	5.43	47.2	B
	21.0	1.07	29.0	4.36	50.0	B
	24.3	1.20	24.5	3.60	51.2	B
	25.9	1.27	22.3	3.24	51.8	B
	30.2	1.46	17.2	2.46	52.6	B
	35.1	1.74	13.7	2.01	51.2	B
	38.9	1.98	11.2	1.69	49.9	B
	43.8	2.27	7.2	1.1	49.0	B
	47.0	2.54	6.0	0.96	47.0	B
	51.2	2.82	2.7	0.44	46.1	B
	55.95	3.223	0	0	44.05	B

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{Be}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

^cThe sum of mass % is equal to 100.1 (compilers).

COMMENTS AND/OR ADDITIONAL DATA:

In the source publication, a phase diagram is given. Each isotherm has one eutonic point.

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{Be}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

^cThe sum of mass % is equal to 100.1 (compilers).

COMMENTS AND/OR ADDITIONAL DATA:

In the source publication, a phase diagram is given. Each isotherm has one eutonic point.

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Yakimov, M. A.; Nosova, N. F. <i>Zh. Neorg. Khim.</i> , 1960, 5, 720 - 721. <i>Russ. J. Inorg. Chem.</i> , 1960, 5, 346. (Eng. trans.)			
(2) Magnesium nitrate; $\text{Mg}(\text{NO}_3)_2$; [10377-60-3]						
(3) Water; H_2O ; [7732-18-5]						
VARIABLES:			PREPARED BY:			
Composition at 273 and 298 K			A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2 - \text{Mg}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System at 0°C Composition of Saturated Solutions ^a						
$\text{UO}_2(\text{NO}_3)_2$			$\text{Mg}(\text{NO}_3)_2$			Solid Phase ^b
mol %	mass %	mol/kg	mol %	mass %	mol/kg	
0	0	0	7.12	38.8	4.27	A
0.18	2.6	0.11	7.24	38.0	4.31	A
0.34	4.6	0.20	7.16	37.0	4.27	A
0.41	5.5	0.24	7.29	37.2	4.38	A+B
0.53	7.2	0.32	7.20	36.2	4.31	B
0.61	8.2	0.37	6.90	34.9	4.14	B
0.79	10.8	0.474	6.15	31.4	3.66	B
0.92	12.6	0.545	5.57	28.7	3.30	B
1.26	17.0	0.752	5.08	25.6	3.01	B
1.62	21.5	0.966	4.47	22.0	2.63	B
1.90	24.6	1.12	4.05	19.7	2.38	B
2.02	26.0	1.19	3.80	18.4	2.23	B
2.18	27.7	1.28	3.63	17.4	2.14	B
2.34	29.6	1.37	3.59	15.7	1.94	B
2.56	32.0	1.51	3.03	14.2	1.78	B
2.89	35.4	1.70	2.52	11.6	1.48	B
2.89	35.8	1.70	2.30	10.7	1.35	B
3.05	36.8	1.76	2.22	10.2	1.30	B
3.18	38.1	1.85	2.08	9.5	1.2	B
3.37	40.3	1.96	1.70	7.6	0.98	B
3.76	44.5	2.18	0.86	3.8	0.50	B
4.29	49.5	2.49	0	0	0	B
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
The isothermal method described in Ref. (1) was used. For analytical determinations, both uranium and magnesium were separated by ether extraction. Uranium and magnesium were measured gravimetrically as the solids U_3O_8 and $\text{Mg}(\text{C}_9\text{H}_6\text{ON})_2 \cdot 4\text{H}_2\text{O}$ (the oxine method).			No information given.			
			ESTIMATED ERROR:			
			Solubility: Nothing specified. Temperature: Nothing specified.			
			REFERENCES:			
			1. Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. <i>Zh. Neorg. Khim.</i> , 1958, 3, 504			

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Yakimov, M. A.; Nosova, N. F.			
(2) Magnesium nitrate; $\text{Mg}(\text{NO}_3)_2$; [10377-60-3]			<i>Zh. Neorg. Khim.</i> , <u>1960</u> , 5, 720 - 721. <i>Russ. J. Inorg. Chem.</i> , <u>1960</u> , 5, 346. (Eng. trans.)			
(3) Water; H_2O ; [7732-18-5]						

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Mg}(\text{NO}_3)_2$ - H_2O System at 25°C

Composition of Saturated Solutions^a

$\text{UO}_2(\text{NO}_3)_2$			$\text{Mg}(\text{NO}_3)_2$			Solid _p Phase
mol %	mass %	mol/kg	mol %	mass %	mol/kg	
0	0	0	8.07	41.94	4.870	A
0.08	1.15	0.0507	8.05	41.30	4.838	A
0.58	7.10	0.344	8.57	40.50	5.211	A
0.73	9.2	0.45	8.37	38.8	5.03	A
0.97	11.9	0.596	8.15	37.4	4.97	A
1.09	13.2	0.675	8.35	37.2	5.06	A
1.46	16.0	0.864	8.95	37.0	5.31	A+B
1.64	18.4	1.01	8.37	35.4	5.17	B
1.67	19.2	1.02	7.59	33.0	4.65	B
1.78	20.0	1.09	7.90	33.6	4.88	B
1.81	21.0	1.11	7.18	31.0	4.35	B
2.20	24.8	1.33	6.59	28.0	4.00	B
2.26	25.4	1.37	6.51	27.6	3.96	B
2.28	25.8	1.39	6.35	27.0	3.86	B
2.34	26.7	1.41	5.89	25.3	3.55	B
2.65	30.0	1.60	5.30	22.5	3.19	B
2.88	31.8	1.73	5.18	21.6	3.13	B
3.41	36.8	2.05	4.35	17.6	2.60	B
3.43	37.0	2.06	4.28	17.4	2.57	B
3.72	39.6	2.23	3.80	15.3	2.29	B
4.07	43.4	2.43	2.81	11.2	1.66	B
4.52	47.2	2.67	2.03	8.0	1.2	B
4.74	49.8	2.81	1.32	5.2	0.78 ^c	B
5.12	52.8	3.03	0.77	3.0	0.46	B
5.41	55.95	3.223	0	0	0	B

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

^cThe sum of uranium and magnesium nitrate and water is equal to 99.98 mol % (compilers).

COMMENTS AND/OR ADDITIONAL DATA:

In the source publication, a phase diagram is given.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Calcium nitrate; $\text{Ca}(\text{NO}_3)_2$; [10124-37-5] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. <i>Zh. Neorg. Khim.</i> , 1958, 3, 504 - 507. <i>Russ. J. Inorg. Chem.</i> , 1958, 3, 358. (Eng. trans.)																																																																																																																	
VARIABLES: Composition at 273 and 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																																																																																	
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{Ca}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System at 0.1°C Composition of Saturated Solutions ^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{Ca}(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th><th>mass %</th></tr><tr><td>49.50</td><td>2.488</td><td>0</td><td>0</td><td>50.50</td><td>A</td></tr><tr><td>43.22</td><td>2.084</td><td>4.16</td><td>0.482</td><td>52.60</td><td>A</td></tr><tr><td>37.21</td><td>1.802</td><td>10.41</td><td>1.210</td><td>52.39</td><td>A</td></tr><tr><td>31.25</td><td>1.490</td><td>15.52</td><td>1.777</td><td>53.23</td><td>A</td></tr><tr><td>26.02</td><td>1.235</td><td>20.49</td><td>2.334</td><td>53.49</td><td>A</td></tr><tr><td>23.30</td><td>1.104</td><td>23.15</td><td>2.635</td><td>53.55</td><td>A</td></tr><tr><td>22.05</td><td>1.056</td><td>24.95</td><td>2.869</td><td>53.00</td><td>A</td></tr><tr><td>20.82</td><td>0.9966</td><td>26.16</td><td>3.007</td><td>53.02</td><td>A</td></tr><tr><td>12.21</td><td>0.5962</td><td>35.82</td><td>4.200</td><td>51.97</td><td>A</td></tr><tr><td>10.15</td><td>0.4920</td><td>37.49</td><td>4.363</td><td>52.36</td><td>A</td></tr><tr><td>8.75</td><td>0.429</td><td>39.43</td><td>4.637</td><td>51.82</td><td>A</td></tr><tr><td>8.44</td><td>0.415</td><td>39.95</td><td>4.717</td><td>51.61</td><td>A</td></tr><tr><td>6.76</td><td>0.344</td><td>43.32</td><td>5.288</td><td>49.92</td><td>A+B</td></tr><tr><td>5.10</td><td>0.248</td><td>42.69</td><td>4.983</td><td>52.21</td><td>B</td></tr><tr><td>4.55</td><td>0.221</td><td>43.20</td><td>5.039</td><td>52.25</td><td>B</td></tr><tr><td>2.55</td><td>0.123</td><td>45.00</td><td>5.229</td><td>52.45</td><td>B</td></tr><tr><td>0</td><td>0</td><td>50.63</td><td>6.250</td><td>49.37</td><td>B</td></tr></table>		$\text{UO}_2(\text{NO}_3)_2$		$\text{Ca}(\text{NO}_3)_2$		H_2O	Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	mass %	49.50	2.488	0	0	50.50	A	43.22	2.084	4.16	0.482	52.60	A	37.21	1.802	10.41	1.210	52.39	A	31.25	1.490	15.52	1.777	53.23	A	26.02	1.235	20.49	2.334	53.49	A	23.30	1.104	23.15	2.635	53.55	A	22.05	1.056	24.95	2.869	53.00	A	20.82	0.9966	26.16	3.007	53.02	A	12.21	0.5962	35.82	4.200	51.97	A	10.15	0.4920	37.49	4.363	52.36	A	8.75	0.429	39.43	4.637	51.82	A	8.44	0.415	39.95	4.717	51.61	A	6.76	0.344	43.32	5.288	49.92	A+B	5.10	0.248	42.69	4.983	52.21	B	4.55	0.221	43.20	5.039	52.25	B	2.55	0.123	45.00	5.229	52.45	B	0	0	50.63	6.250	49.37	B
$\text{UO}_2(\text{NO}_3)_2$		$\text{Ca}(\text{NO}_3)_2$		H_2O	Solid Phase ^b																																																																																																													
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AUXILIARY INFORMATION																																																																																																																		
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Saturated solutions were obtained in sealed tubes placed in a thermostat. These were shaken 3 to 3-1/2 hours (equilibrium was attained after 2 to 2-1/2 hours). The mixtures were allowed to settle, and aliquots removed with a pipet fitted with a filter. Uranium was analyzed as U_3O_8 . Calcium was precipitated as the oxalate, and ignited to CaO . The oxide was then mixed with sulfuric acid, and excess acid was evaporated. The resulting CaSO_4 was heated at 500°C to 600°C and weighed.	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, recrystallized three times. 2. $\text{Ca}(\text{NO}_3)_2$, chemically pure. 3. H_2O , twice distilled. ESTIMATED ERROR: Nothing specified. REFERENCES:																																																																																																																	

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$;
[15905-86-9]

(2) Calcium nitrate; $\text{Ca}(\text{NO}_3)_2$;
[10124-37-5]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yakimov, M.A.; Nosova, N. F.;
Grishin, V. A.

Zh. Neorg. Khim., 1958, 3, 504 -
507.

Russ. J. Inorg. Chem., 1958, 3,
358. (Eng. trans.)

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - \text{Ca}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System at 25°C

Composition of Saturated Solutions^a

$\text{UO}_2(\text{NO}_3)_2$		$\text{Ca}(\text{NO}_3)_2$		H_2O	Solid _b Phase
mass %	mol/kg	mass %	mol/kg	mass %	
55.92	3.219	0	0	44.08	A
48.83	2.666	4.69	0.615	46.48	A
45.75	2.457	7.00	0.903	47.25	A
34.75	1.861	17.87	2.299	47.38	A
31.10	1.686	22.08	2.874	46.82	A
29.65	1.569	22.40	2.847	47.95	A
26.02	1.383	26.23	3.348	47.75	A
22.98	1.216	29.05	3.691	47.97	A
17.60	0.9288	34.31	4.348	48.09	A
16.40	0.8747	37.02	4.742	47.58 ^c	A
15.18	0.8446	39.21	5.239	45.61	A
13.25	0.7358	41.05	5.474	45.70	A
9.66	0.558	46.40	6.435	43.94	A
8.72	0.506	47.51	6.615	43.77	A
7.97	0.460	48.10	6.673	43.93	A
7.92	0.483	50.48	7.395	41.60	A+B
7.41	0.437	49.59	7.028	43.00	B
6.88	0.398	49.20	6.827	43.92	B
4.18	0.232	50.00	6.650	45.82	B
2.01	0.113	52.81	7.123	45.18	B
0	0	57.97	8.405	42.03	B

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$.

^cThe sum of mass % is not equal to 100 (compilers).

COMMENTS AND/OR ADDITIONAL DATA:

Phase diagram is given in the source publication. Solubility isotherms consist of two branches: the shorter for calcium nitrate tetrahydrate, and the longer for uranyl nitrate hexahydrate. This means that calcium nitrate has a larger influence on uranyl nitrate solubility than uranyl nitrate has on the solubility of calcium nitrate.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Strontium nitrate; $\text{Sr}(\text{NO}_3)_2$; [10042-76-9] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. <i>Zh. Neorg. Khim.</i> , 1958, 3, 504 - 507. <i>Russ. J. Inorg. Chem.</i> , 1958, 3 358. (Eng. trans.)																																																																																																					
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																																																																					
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{Sr}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Solutions ^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{Sr}(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th><th>mass %</th></tr><tr><td>55.87</td><td>3.213</td><td>0</td><td>0</td><td>44.13</td><td>A</td></tr><tr><td>52.64</td><td>2.887</td><td>1.09</td><td>0.111</td><td>46.35^c</td><td>A</td></tr><tr><td>51.55</td><td>2.856</td><td>2.65</td><td>0.273</td><td>45.80</td><td>A</td></tr><tr><td>51.39</td><td>2.976</td><td>4.78</td><td>0.515</td><td>43.83</td><td>A+B</td></tr><tr><td>49.76</td><td>2.826</td><td>5.55</td><td>0.587</td><td>44.69</td><td>B</td></tr><tr><td>47.48</td><td>2.647</td><td>7.00</td><td>0.727</td><td>45.52</td><td>B</td></tr><tr><td>46.05</td><td>2.542</td><td>7.97</td><td>0.819</td><td>45.98</td><td>B</td></tr><tr><td>45.24</td><td>2.456</td><td>8.02</td><td>0.811</td><td>46.74</td><td>B</td></tr><tr><td>40.39</td><td>2.126</td><td>11.39</td><td>1.116</td><td>48.22</td><td>B</td></tr><tr><td>37.33</td><td>1.942</td><td>13.88</td><td>1.344</td><td>48.70^c</td><td>B+C</td></tr><tr><td>34.10</td><td>1.681</td><td>14.42</td><td>1.324</td><td>51.48</td><td>C</td></tr><tr><td>27.75</td><td>1.367</td><td>20.75</td><td>1.904</td><td>51.50</td><td>C</td></tr><tr><td>20.40</td><td>0.9670</td><td>26.06</td><td>2.300</td><td>53.54</td><td>C</td></tr><tr><td>11.20</td><td>0.5192</td><td>34.05</td><td>2.939</td><td>54.75</td><td>C</td></tr><tr><td>0</td><td>0</td><td>4.12</td><td>3.731</td><td>55.88</td><td>C</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{Sr}(\text{NO}_3)_2$, C = $\text{Sr}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$. ^c The sum of mass % is not equal to 100 (compilers). COMMENTS AND/OR ADDITIONAL DATA: The solubility diagram is given in the source publication. Solubility isotherm consists of three branches: solubility curves: of $\text{Sr}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$, anhydrous $\text{Sr}(\text{NO}_3)_2$, and $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.		$\text{UO}_2(\text{NO}_3)_2$		$\text{Sr}(\text{NO}_3)_2$		H_2O	Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	mass %	55.87	3.213	0	0	44.13	A	52.64	2.887	1.09	0.111	46.35 ^c	A	51.55	2.856	2.65	0.273	45.80	A	51.39	2.976	4.78	0.515	43.83	A+B	49.76	2.826	5.55	0.587	44.69	B	47.48	2.647	7.00	0.727	45.52	B	46.05	2.542	7.97	0.819	45.98	B	45.24	2.456	8.02	0.811	46.74	B	40.39	2.126	11.39	1.116	48.22	B	37.33	1.942	13.88	1.344	48.70 ^c	B+C	34.10	1.681	14.42	1.324	51.48	C	27.75	1.367	20.75	1.904	51.50	C	20.40	0.9670	26.06	2.300	53.54	C	11.20	0.5192	34.05	2.939	54.75	C	0	0	4.12	3.731	55.88	C
$\text{UO}_2(\text{NO}_3)_2$		$\text{Sr}(\text{NO}_3)_2$		H_2O	Solid Phase ^b																																																																																																	
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AUXILIARY INFORMATION																																																																																																						
METHOD/Apparatus/Procedure: Isothermal analytical method used. Saturated solutions in sealed tubes placed in thermostat. Tubes were shaken 3 to 3-1/2 hours (equilibrium attained after 2 to 2-1/2 hours). The mixtures were allowed to settle, and samples then taken for uranium and strontium analysis. The solid phase composition found by Schreinemaker's method. Uranium and strontium found gravimetrically. Low concentrations of Sr radiometrically by Sr^{89} .	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, recrystallized three times. 2. $\text{Sr}(\text{NO}_3)_2$, chemically pure. 3. Water, twice distilled. ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Precision $\pm 0.05\text{K}$. REFERENCES:																																																																																																					

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Yakimov, M. A.; Nosova, N. F.; Grishin, V. A.			
(2) Barium nitrate; $\text{Ba}(\text{NO}_3)_2$; [10022-31-8]			Zh. Neorg. Khim., 1958, 3, 504 - 507.			
(3) Water; H_2O ; [7732-18-5]			Russ. J. Inorg. Chem., 1958, 3, 358. (Eng. trans.)			
VARIABLES:			PREPARED BY:			
Composition and temperature			A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2 - \text{Ba}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System						
Composition of Saturated Solutions ^a						
$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Ba}(\text{NO}_3)_2$		H_2O	Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
0.1	49.39	2.477	0	0	50.61	A
	39.41	1.658	0.27	0.017	60.32	B
	31.64	1.182	0.42	0.024	67.94	B
	21.65	0.7067	0.60	0.030	77.75	B
	17.36	0.5383	0.80	0.037	81.84	B
	11.82	0.3467	1.67	0.0739	86.51	B
	8.82	0.251	2.00	0.0858	89.18	B
	5.20	0.143	2.60	0.108	92.20	B
	0	0	4.88	0.196	95.12	B
25	56.12	3.246	0	0	43.88	A
	49.51	2.501	0.25	0.019	50.24	B
	40.12	1.712	0.40	0.026	59.48	B
	33.16	1.271	0.65	0.038	66.19	B
	30.74	1.139	0.74	0.041	68.52	B
	23.34	0.7876	1.45	0.0738	75.21	B
	21.04	0.6903	1.61	0.0796	77.35	B
	19.37	0.6254	2.03	0.0988	78.60	B
	16.78	0.5274	2.37	0.112	80.75 ^c	B
	14.00	0.4284	3.06	0.141	82.94	B
	11.54	0.3452	3.63	0.164	84.83	B
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. Saturated solutions were added to sealed tubes, and placed in a thermostat. The solutions were shaken 3 to 3-1/2 hours (equilibrium was reached after 2 to 2-1/2 hours). The mixtures were allowed to settle, after which samples were obtained using a pipet. The samples were filtered and used for uranium and barium analysis. The composition of the solid phase was determined by Schreinemakers method. Uranium and barium were then measured gravimetrically as U_3O_8 , and barium sulfate.			1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ was recrystallized three times.			
			2. $\text{Ba}(\text{NO}_3)_2$, chemically pure.			
			3. Water, twice distilled.			
			ESTIMATED ERROR:			
			Solubility: Nothing specified.			
			Temperature: 0°C and 25°C , $\pm 0.05\text{K}$; 50°C , $\pm 0.1\text{K}$.			
			REFERENCES:			

COMPONENTS:	ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Yakimov, M. A.; Nosova, N. F.				
(2) Zinc nitrate; $\text{Zn}(\text{NO}_3)_2$; [7779-88-6]	<i>Vestn. Lenigr. Univ.</i> , <u>1962</u> , 4, 106 - 114.				
(3) Water; H_2O ; [7732-18-5]					
VARIABLES:	PREPARED BY:				
Composition at 273 and 298 K	L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES:					
The $\text{UO}_2(\text{NO}_3)_2 - \text{Zn}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System at 0°C Composition of Saturated Solutions ^a					
$\text{UO}_2(\text{NO}_3)_2$	$\text{Zn}(\text{NO}_3)_2$	H_2O	Solid _b Phase		
mass %	mol/kg	mass %			
0	0	48.3	4.96	51.4	A
1.6	0.08	48.0	5.02	50.4	A
2.9	0.15	48.0	5.16	49.1	A+B
3.3	0.17	46.3	4.85	50.4	B
3.8	0.19	45.1	4.66	51.1	B
3.6	0.18	44.5	4.53	51.9	B
6.5	0.31	40.3	4.00	53.2 ^c	B
12.9	0.603	32.8	3.19	54.2 ^c	B
16.5	0.764	28.7	2.77	54.8	B
17.8	0.807	26.2	2.47	56.0	B
21.9	1.01	23.1	2.22	55.0	B
24.0	1.12	21.8	2.12	54.2	B
28.1	1.30	17.0	1.17	54.9	B
32.3	1.56	15.0	1.50	52.7	B
37.3	1.77	9.3	0.92	53.4	B
38.3	1.82	8.2	0.81	53.5	B
41.6	2.05	6.0	0.70	51.6	B
49.50	2.49	0	0	50.5	B
(Continued on the next page)					
AUXILIARY INFORMATION					
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. The nitrates and water or supersaturated solution were placed in ampoules and shaken in a thermostat for 4 hours (equilibrium attained in 2-1/2 to 3 hours). Details of the procedure are described in Ref. (1). For analytical purposes, uranium was extracted from the solution as described in (2), then reextracted, precipitated with ammonia, and ignited to oxide, U_3O_8 . Zinc determined in the raffinate ³ radiometrically measuring gamma radiation with MS-7 counter (Zn^{65}). The composition of the solid phases was determined by Schreinemakers method.			Nothing specified.		
			ESTIMATED ERROR:		
			Nothing specified.		
			REFERENCES:		
			1. Yakimov, M. A.; Nosova, N. F.; <i>Zh. Neorg. Khim.</i> , <u>1958</u> , 3, 504.		
			2. Yakimov, M. A. <i>Zh. Neorg. Khim.</i> , <u>1960</u> , 5, 720.		

COMPONENTS:				ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]				Yakimov, M. A. Nosova, N.F.;	
(2) Zinc nitrate; $\text{Zn}(\text{NO}_3)_2$; [7779-88-6]				Vestn. Leningr. Univ., 1962, 4, 106 - 114.	
(3) Water; H_2O ; [7732-18-5]					

EXPERIMENTAL VALUES: (Continued)					
The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Zn}(\text{NO}_3)_2$ - H_2O System at 25°C					
Composition of Saturated Solutions ^a					
$\text{UO}_2(\text{NO}_3)_2$		$\text{Zn}(\text{NO}_3)_2$		H_2O	Solid Phase ^b
mass %	mol/kg	mass %	mol/kg	mass %	
0	0	55.9	6.69	44.1	A
2.2	0.13	54.2	6.56	43.6	A
3.9	0.23	53.3	6.58	42.8	A
6.3	0.38	51.9	6.56	41.8	A
8.1	0.50	51.1	6.61	40.8	A
8.2	0.50	50.3	6.40	41.5	A
10.0	0.634	50.0	6.60	40.0	A
12.0	0.767	48.3	6.42	39.7	A+B
12.2	0.759	47.0	6.08	40.8	B
12.1	0.724	45.5	5.67	42.4	B
11.1	0.639	44.8	5.36	44.1	B
14.6	0.778	37.6	4.17	47.6 ^c	B
14.8	0.781	37.1	4.07	48.1	B
19.3	1.01	32.0	3.47	48.7	B
24.0	1.27	28.2	3.11	47.8	B
25.8	1.35	25.8	2.81	48.4	B
34.4	1.85	18.3	2.04	47.3	B
40.6	2.21	12.8	1.45	46.6	B
45.8	2.52	8.0	0.91	46.2	B
48.9	2.80	6.8	0.81	44.3	B
55.9	3.22	0	0	44.1	B

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

^cThe sum of mass % is not equal to 100 (compilers).

COMMENTS AND/OR ADDITIONAL DATA:
The phase diagram is given in the source publication. The solubility isotherm consists of two branches, corresponding to solid phases $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ and $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Cadmium nitrate; $\text{Cd}(\text{NO}_3)_2$; [10325-94-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yakimov, M. A.; Nosova, N. F. <i>Vestn. Leningr. Univ.</i> , <u>1962</u> , 4, 106 - 114.																																																																																																																																			
VARIABLES: Composition at 273 and 298 K	PREPARED BY: L. Fuks; S. Siekierski																																																																																																																																			
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{Cd}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System at 0°C Composition of Saturated Solutions ^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{Cd}(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th><th>mass %</th></tr><tr><td>0</td><td>0</td><td>55.6</td><td>5.30</td><td>44.4</td><td>A</td></tr><tr><td>2.9</td><td>0.17</td><td>52.6</td><td>5.00</td><td>44.5</td><td>A</td></tr><tr><td>3.9</td><td>0.22</td><td>52.1</td><td>5.01</td><td>44.0</td><td>A</td></tr><tr><td>6.1</td><td>0.35</td><td>49.8</td><td>4.78</td><td>44.1</td><td>A</td></tr><tr><td>6.6</td><td>0.38</td><td>49.5</td><td>4.77</td><td>43.9</td><td>A+B</td></tr><tr><td>7.6</td><td>0.43</td><td>48.0</td><td>4.57</td><td>44.4</td><td>B</td></tr><tr><td>9.9</td><td>0.53</td><td>43.0</td><td>3.86</td><td>47.1</td><td>B</td></tr><tr><td>12.2</td><td>0.634</td><td>39.0</td><td>3.38</td><td>48.8</td><td>B</td></tr><tr><td>17.8</td><td>0.913</td><td>32.7</td><td>2.79</td><td>50.5^c</td><td>B</td></tr><tr><td>17.9</td><td>0.909</td><td>32.1</td><td>2.72</td><td>50.0</td><td>B</td></tr><tr><td>19.8</td><td>1.00</td><td>30.1</td><td>2.54</td><td>50.1</td><td>B</td></tr><tr><td>25.6</td><td>1.28</td><td>23.8</td><td>1.99</td><td>50.6</td><td>B</td></tr><tr><td>25.8</td><td>1.29</td><td>23.5</td><td>1.96</td><td>50.7</td><td>B</td></tr><tr><td>27.3</td><td>1.37</td><td>22.3</td><td>1.87</td><td>50.4</td><td>B</td></tr><tr><td>30.7</td><td>1.55</td><td>19.0</td><td>1.60</td><td>50.3</td><td>B</td></tr><tr><td>37.1</td><td>1.83</td><td>11.5</td><td>0.946</td><td>51.4</td><td>B</td></tr><tr><td>38.0</td><td>1.88</td><td>10.6</td><td>0.872</td><td>51.4</td><td>B</td></tr><tr><td>40.6</td><td>2.03</td><td>8.6</td><td>0.72</td><td>50.8</td><td>B</td></tr><tr><td>44.7</td><td>2.21</td><td>3.9</td><td>0.32</td><td>51.4</td><td>B</td></tr><tr><td>49.5</td><td>2.49</td><td>0</td><td>0</td><td>50.5</td><td>B</td></tr></table>		$\text{UO}_2(\text{NO}_3)_2$		$\text{Cd}(\text{NO}_3)_2$		H_2O	Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	mass %	0	0	55.6	5.30	44.4	A	2.9	0.17	52.6	5.00	44.5	A	3.9	0.22	52.1	5.01	44.0	A	6.1	0.35	49.8	4.78	44.1	A	6.6	0.38	49.5	4.77	43.9	A+B	7.6	0.43	48.0	4.57	44.4	B	9.9	0.53	43.0	3.86	47.1	B	12.2	0.634	39.0	3.38	48.8	B	17.8	0.913	32.7	2.79	50.5 ^c	B	17.9	0.909	32.1	2.72	50.0	B	19.8	1.00	30.1	2.54	50.1	B	25.6	1.28	23.8	1.99	50.6	B	25.8	1.29	23.5	1.96	50.7	B	27.3	1.37	22.3	1.87	50.4	B	30.7	1.55	19.0	1.60	50.3	B	37.1	1.83	11.5	0.946	51.4	B	38.0	1.88	10.6	0.872	51.4	B	40.6	2.03	8.6	0.72	50.8	B	44.7	2.21	3.9	0.32	51.4	B	49.5	2.49	0	0	50.5	B
$\text{UO}_2(\text{NO}_3)_2$		$\text{Cd}(\text{NO}_3)_2$		H_2O	Solid Phase ^b																																																																																																																															
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METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The nitrates and water or supersaturated solutions were placed in ampoules and shaken in a thermostat for 4 hours (equilibrium was attained after 2-1/2 to 3 hours). Details of the procedure have been described (1). Cadmium was analyzed by precipitation with H_2S . The resulting precipitate of CdS was solubilized in concentrated hydrochloric acid, then precipitated with $(\text{NH}_4)_2\text{HPO}_4$, and ignited to $\text{Cd}_2\text{P}_2\text{O}_7$. Uranium was determined in filtrate by precipitation with ammonia, and subsequent ignition to U_3O_8 .	SOURCE AND PURITY OF MATERIALS: Nothing specified.																																																																																																																																			
	ESTIMATED ERROR: Nothing specified.																																																																																																																																			
	REFERENCES: 1. Yakimov, M. A.; Nosova, N. F. <i>Zh. Neorg. Khim.</i> , <u>1958</u> , 3, 504.																																																																																																																																			

COMPONENTS:		ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Yakimov, M. A.; Nosova, N. F.			
(2) Cadmium nitrate; $\text{Cd}(\text{NO}_3)_2$; [10325-94-7]		Vestn. Leningr. Univ., 1962, 4, 106 - 114.			
(3) Water; H_2O ; [7732-18-5]					

EXPERIMENTAL VALUES: (Continued)					
The $\text{UO}_2(\text{NO}_3)_2 - \text{Cd}(\text{NO}_3)_2 - \text{H}_2\text{O}$ System at 25°C					
Composition of Saturated Solutions ^a					
$\text{UO}_2(\text{NO}_3)_2$		$\text{Cd}(\text{NO}_3)_2$		H_2O	Solid ^b Phase
mass %	mol/kg	mass %	mol/kg	mass %	
0	0	61.4	6.73	38.6	A
1.2	0.078	60.0	6.54	38.8	A
3.2	0.21	58.3	6.41	38.5	A
5.9	0.39	56.0	6.22	38.1	A
8.4	0.58	54.6	6.24	37.0	A
9.7	0.67	53.5	6.15	36.8	A+B
9.5	0.63	52.5	5.84	38.0	B
9.5	0.63	52.2	5.77	38.3	B
9.9	0.66	51.8	5.72	38.3	B
10.2	0.672	51.6	5.71	38.2	B
10.9	0.692	49.1	5.18	40.0	B
12.9	0.795	45.9	4.71	41.2	B
13.0	0.813	46.4	4.83	40.6	B
15.2	0.932	43.4	4.43	41.4	B
20.2	1.21	37.5	3.75	42.3	B
26.8	1.56	29.7	2.89	43.5	B
33.4	1.91	22.3	2.13	44.3	B
48.1	2.74	7.4	0.70	44.5	B
55.9	3.22	0	0	44.1	B

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{Cd}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

^cThe sum of mass % is not equal to 100 (compilers).

COMMENTS AND/OR ADDITIONAL DATA:
A phase diagram is given in the source publication. The solubility isotherm exhibits one eutonic point.

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Yakimov, M. A.; Nosova, N. F.			
(2) Mercury nitrate; $\text{Hg}(\text{NO}_3)_2$; [10045-94-0]			Vestn. Leningr. Univ., 1962, 4, 106 - 114.			
(3) Water; H_2O ; [7732-18-5]						
VARIABLES:			PREPARED BY:			
Composition and temperature			A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Hg}(\text{NO}_3)_2$ - H_2O System at 0°C , 15°C and 25°C						
Composition of Saturated Solutions ^a						
$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Hg}(\text{NO}_3)_2$		H_2O	Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	mass %	
0	1.9	0.17	69.6	7.52	28.5	A+B
	3.0	0.25	66.2	6.62	30.8	B
	4.1	0.32	63.2	5.95	32.7	B
	6.7	0.48	58.2	5.11	35.1	B
	9.5	0.65	53.6	4.47	36.9	B
	12.5	0.815	48.6	3.85	38.9	B
	13.2	0.850	47.4	3.71	39.4	B
	15.5	0.981	44.4	3.41	40.1	B
	19.0	1.17	39.7	2.96	41.3	B
	22.7	1.37	35.2	2.58	42.1	B
	24.3	1.40	31.6	2.21	44.1	B
	28.2	1.61	27.3	1.89	44.5	B
	31.0	1.69	22.4	1.48	46.7 ^c	B
	34.0	1.81	18.4	1.19	47.6	B
	35.6	1.87	16.2	1.04	48.2	B
	36.2	1.89	15.2	0.964	48.6	B
	39.0	2.00	11.6	0.723	49.4	B
	42.8	2.16	7.0	0.43	50.2	B
	46.4	2.34	3.2	0.20	50.4	B
	49.5	2.49	0	0	50.5	B

(Continued on the next page)

AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. Nitrates and water or supersaturated solution were placed in ampoules and shaken in a thermostat for 4 hours (equilibrium was attained after 2-1/2 to 3 hours). Details of the procedure are given in Ref. (1).	Nothing specified.
	ESTIMATED ERROR:
	Nothing specified.
REFERENCES:	
1. Yakimov, M. A.; Nosova, N. F. Zh. Neorg. Khim., 1958, 3, 504.	

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Mercury nitrate; $\text{Hg}(\text{NO}_3)_2$; [10045-94-0]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yakimov, M. A.; Nosova, N. F.;

Vestn. Leningr. Univ., 1962, 4, 106 - 114.

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Hg}(\text{NO}_3)_2$ - H_2O System at 0°C, 15°C and 25°C

Composition of Saturated Solutions^a

$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Hg}(\text{NO}_3)_2$		H_2O	Solid _b Phase
	mass %	mol/kg	mass %	mol/kg	mass %	
15	2.9	0.38	77.6	12.3	19.5	A+B
	11.6	0.889	55.3	5.15	33.1	B
	13.8	1.04	52.5	4.80	33.7	B
	15.3	1.11	49.8	4.40	34.9	B
	19.5	1.37	44.4	3.79	36.1	B
	22.0	1.52	41.2	3.45	36.8	B
	26.4	1.69	34.0	2.65	39.6	B
	30.8	1.89	27.8	2.07	41.4	B
	36.5	2.16	20.7	1.49	42.8	B
	39.0	2.20	16.0	1.10	45.0	B
	44.3	2.34	7.7	0.49	48.0	B
	49.0	2.61	3.3	0.21	47.7	B
	52.9	2.85	0	0	47.1	B
25	4.8	0.69	77.6	13.6	17.6	A+B
	6.2	0.73	72.1	10.2	21.7	B
	8.1	0.86	68.0	8.77	23.9	B
	9.1	0.93	66.0	8.17	24.9	B
	10.0	0.984	64.2	7.67	25.2 ^c	B
	11.1	1.06	62.4	7.25	26.5	B
	11.4	1.03	60.5	6.63	28.1	B
	12.0	1.05	59.0	6.27	29.0	B
	13.0	1.11	57.2	5.91	29.8	B
	15.0	1.24	54.3	5.45	30.7	B
	18.7	1.48	49.2	4.72	32.1	B
	19.3	1.48	47.7	4.45	33.0	B
	25.7	1.81	38.2	3.26	36.1	B
	29.6	2.08	34.2	2.91	36.2	B
	31.4	2.15	31.6	2.63	37.0	B
	33.1	2.20	28.7	2.31	38.2	B
	35.2	2.33	26.5	2.13	38.3	B
	36.7	2.39	24.3	1.92	39.0	B
	39.1	2.51	21.3	1.66	39.6	B
	41.2	2.56	17.9	1.35	40.9	B
	43.2	2.65	15.4	1.15	41.4	B
	44.0	2.68	14.4	1.07	41.6	B
	47.2	2.82	10.3	0.747	42.5	B
	50.8	2.96	5.7	0.40	43.5	B
	55.9	3.22	0	0	44.1	B

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{Hg}(\text{NO}_3)_2 \cdot 0.5\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

^cThe sum of mass % does not equal 100 (compilers).

COMMENTS AND/OR ADDITIONAL DATA:

The source publication contains a phase diagram. Only the branch which corresponds to solutions in equilibrium with uranyl nitrate hexahydrate was studied due to strong hydrolysis of $\text{Hg}(\text{NO}_3)_2$.

COMPONENTS:		ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Bol'shakov, K. A.; Korovin, S. S. <i>Zh. Neorg. Khim.</i> , <u>1957</u> , 2, 1940 - 1950.			
(2) Uranyl oxalate; $\text{UO}_2\text{C}_2\text{O}_4$; [2031-89-2]		<i>Russ. J. Inorg. Chem.</i> , <u>1957</u> , 2, 365. (Eng. trans.)			
(3) Water; H_2O ; [7732-18-5]					
VARIABLES:		PREPARED BY:			
Composition at 298 K		A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:					
The $\text{UO}_2(\text{NO}_3)_2 - \text{UO}_2\text{C}_2\text{O}_4 - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Solutions ^a					
$\text{UO}_2(\text{NO}_3)_2$		$\text{UO}_2\text{C}_2\text{O}_4$		H_2O	Solid _b Phase
mass %	mol/kg	mass %	mol/kg	mass %	
0	0	0.58	0.016	99.42	A
1.26	0.0326	0.58	0.017	98.16	A
5.18	0.140	0.60	0.018	94.22	A
9.55	0.270	0.63	0.020	89.82	A
12.66	0.3705	0.63	0.020	86.71	A
18.76	0.5905	0.62	0.021	80.62	A
20.40	0.6553	0.60	0.021	79.00	A
23.64	0.7917	0.58	0.021	75.78	A
31.03	1.151	0.54	0.022	68.43	A
34.39	1.960	0.44	0.022	56.17 ^c	A
51.78	2.745	0.35	0.020	47.97 ^c	A
55.50	3.187	0.31	0.020	44.19	A+B
55.85	3.229	0.26	0.017	43.89	B
56.00	3.239	0.12	0.0076	43.88	B
56.23	3.260	0	0	43.77	B
^a Molalities calculated by the compilers.					
^b Solid phases: A = $\text{UO}_2\text{C}_2\text{O}_4 \cdot 3\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.					
^c The sum of mass % is equal to 100.1 (compilers).					
COMMENTS AND/OR ADDITIONAL DATA:					
Source paper has a phase diagram. Solubility curve of uranyl oxalate has a maximum at 12 mass % of $\text{UO}_2(\text{NO}_3)_2$.					
AUXILIARY INFORMATION					
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. Appropriate amounts of uranyl nitrate and uranyl oxalate were shaken for 3 to 4 days with water in a vessel protected from light to prevent the formation of basic uranium(IV) oxalate. Uranium and oxalate were measured by potentiometric titration. Nitrates were determined by the Kjeldahl method. Details of the procedure are given in (1).			No information given.		
			ESTIMATED ERROR:		
			Solubility: Nothing specified.		
			Temperature: Nothing specified.		
			REFERENCES:		
			1. Bol'shakov, K. A.; Korovin, S. S.; Plyushchev, V. E.; Ermakova, T.A.		
			<i>Zh. Neorg. Khim.</i> , <u>1954</u> , 2, 222.		

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Uranium oxide; UO_3 ; [1344-58-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Cordfunke, E. H. P. <i>J. Inorg. Nucl. Chem.</i> , 1972, 34, 531 - 544.
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>Numerical data for the system $\text{UO}_2(\text{NO}_3)_2 - \text{UO}_3 - \text{H}_2\text{O}$ at 25°C are not given. The phase diagram is given on the next page.</p> <p style="text-align: center;">COMMENTS AND/OR ADDITIONAL DATA:</p> <p>The results are given in the phase diagram. Two solubility regions have been found with the corresponding solids $\text{UO}_3 \cdot 2\text{H}_2\text{O}$ and $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. Within the solubility region of $\text{UO}_3 \cdot 2\text{H}_2\text{O}$, a small region exists in which a basic salt (w, on the phase diagram) is formed after short equilibration times. This is gradually converted into the mixture of uranyl nitrate hexahydrate and $\alpha\text{-UO}_3 \cdot \text{H}_2\text{O}$, and a new phase which closely resembles $\text{UO}_2 \cdot 2\text{H}_2\text{O}$, but still has a different structure.</p> <p style="text-align: right;">(Continued on the next page)</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Isothermal method used. Known amounts of uranyl nitrate hexahydrate, amorphous uranium oxide, and water were equilibrated in sealed glass ampoules, and set in a water bath at 25°C. After 3 to 20 weeks, uranium and nitrate were analyzed both in the saturated solution and in the wet residue by Schreinemakers method. Uranium was determined by evaporation of the solution and ignition of the residue to U_3O_8 , nitrate as NH_3 after reduction with Devarda's metal. Since direct analysis of uranium in the solution gave low results, it was first separated by ion exchange, then eluted with 2N perchloric acid solution.	SOURCE AND PURITY OF MATERIALS: 1. The uranyl nitrate hexahydrate was purified by recrystallizing several times and drying over H_2SO_4 to constant composition. 2. UO_3 was obtained by ignition of hydrated $\text{UO}_2 \cdot 2\text{H}_2\text{O}$ at 425°C. ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Kraus, C. A. Brown Univ. (1944), quoted in J.J.Katz and E. Rabinowitch, The Chemistry of Uranium, McGraw - Hill, New York, 1951, 329.

COMPONENTS:

- (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]
 (2) Uranium oxide; UO_3 ; [1344-58-7]
 (3) Water; H_2O ; [7732-18-5]

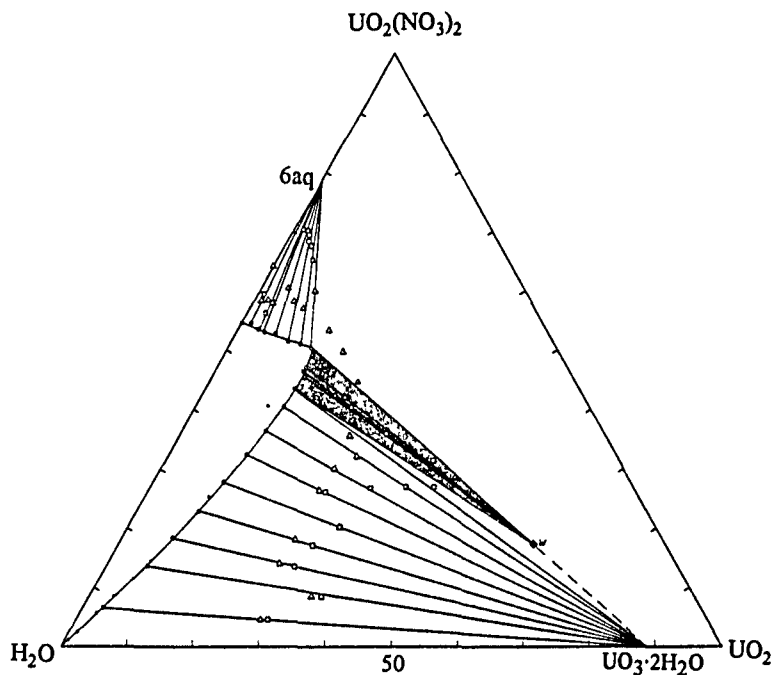
ORIGINAL MEASUREMENTS:

Cordfunke, E. H. P.

J. Inorg. Nucl. Chem., 1972, 34,
 531 - 544.

EXPERIMENTAL VALUES: (Continued)

Numerical data for the system $\text{UO}_2(\text{NO}_3)_2 - \text{UO}_3 - \text{H}_2\text{O}$ at 25°C are not given. The phase diagram is:



COMPONENTS:				ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]				Harmon, M. K.; Cooper, V. R.			
(2) Ammonium nitrate; NH_4NO_3 ; [6484-52-2]				Report, 1948, HW-10137.			
(3) Nitric acid; HNO_3 ; [7697-37-2]							
(4) Water; H_2O ; [7732-18-5]							
VARIABLES:				PREPARED BY:			
Composition and temperature				A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:							
The $\text{UO}_2(\text{NO}_3)_2$ - NH_4NO_3 - HNO_3 - H_2O System							
Composition of Saturated Solutions ^{a,b}							
	density	UNH ^c	$\text{UO}_2(\text{NO}_3)_2$	NH_4NO_3		HNO_3	
$t/^\circ\text{C}$	g/cm^3	mass %	mol/kg	g/dm^3	mol/kg	g/dm^3	mol/kg
-19.3	1.4133	33.1	1.28	318.0	5.458	0	0
-18.9	1.4037	29.8	1.11	326.1	5.438	0	0
-17.9	1.4367	35.6	1.41	315.6	5.474	0	0
-17.2	1.3304	25.3	0.895	315.3	5.250	0	0
-16.6	1.4808	38.2	1.59	329.0	5.809	0	0
-16.2	1.5026	40.7	1.74	323.06	5.764	0	0
-15.9	1.2927	21.4	0.728	318.6	5.259	0	0
-15.4	1.5052	41.0	1.75	318.3	5.663	0	0
-15.0	1.5536	43.7	1.91	314.5	5.564	0	0
-14.9	1.2637	17.6	0.577	322.0	5.243	0	0
-13.9	1.5921	47.5	2.21	317.3	5.821	0	0
-13.9	1.6062	48.5	2.30	320.3	5.938	0	0
-13.3	1.2019	10.9	0.335	320.9	5.151	0	0
-13.1	1.6260	50.3	2.45	318.1	5.970	0	0
-11.1	1.1196	0.0	0.0	317.1	4.937	0	0
- 7.9	1.6618	52.7	2.70	327.0	6.316	0	0
6.7	1.7590	59.4	3.39	326.5	6.656	0	0
13.3	1.8066	61.7	3.53	319.6	6.423	0	0
-19.7	1.3559	26.8	0.984	319.8	5.439	16.79	0.3627
-19.2	1.3840	28.6	1.08	327.4	5.623	19.20	0.4189
-18.3	1.3251	23.6	0.840	321.0	5.415	18.33	0.3928
(Continued on the next page)							
AUXILIARY INFORMATION							
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:			
The synthetic method was used. Freezing points for the solutions were established in an apparatus consisting of a round bottom tube containing the sample, suspended in a larger tube. This pair of tubes was suspended in a Dewar flask which contained a mixture of dry ice and acetone. The sample was stirred constantly as the temperature decreased, and was observed closely with the aid of a Spencer micro-lamp.				Nothing specified.			
				ESTIMATED ERROR:			
				Solubility: The freezing points are the average of four or more replicates.			
				Temperature: Precision $\pm 0.1\text{K}$.			
				REFERENCES:			

COMPONENTS:			ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Kurnakova, A. G.; Nikolaev, A. V.		
(2) Ammonium nitrate; NH_4NO_3 ; [6484-52-2]			<i>Zh. Neorg. Khim.</i> , 1958, 3, 1028 - 1036.		
(3) Nitric acid; HNO_3 ; [7697-37-2]			<i>Russ. J. Inorg. Chem.</i> , 1958, 3, 298. (Eng. trans.)		
(4) Water; H_2O ; [7732-18-5]					
VARIABLES:			PREPARED BY:		
Composition at 298 K			L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES:					
The $\text{UO}_2(\text{NO}_3)_2 - \text{NH}_4\text{NO}_3 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C					
Composition of Saturated Solutions ^a					
Density g/cm ³	NH_4NO_3		$\text{UO}_2(\text{NO}_3)_2$		Solid Phase ^b
	mass %	mol/kg	mass %	mol/kg	
1.318	61.09	7.63	---	---	A
1.433	51.09	6.38	13.88	0.35	A
1.563	43.50	5.43	25.36	0.64	A
1.620	40.46	5.05	28.84	0.73	A
1.667	38.73	4.84	30.58	0.78	A+B
1.720	35.80	4.47	36.09	0.92	B
1.910	23.25	2.90	48.51	1.23	B
1.900	21.56	2.70	49.68	1.26	B
1.916	20.36	2.54	50.74	1.29	B
1.928	19.83	2.48	51.19	1.30	B+C
1.850	16.68	2.08	49.50	1.26	C
1.766	10.60	1.32	47.76	1.21	C
1.684	---	---	48.79	1.24	C
^a The HNO_3 concentration is 1.5N.					
^b Solid phases: A = NH_4NO_3 , B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{NH}_4\text{NO}_3 \cdot 2\text{H}_2\text{O}$, C = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.					
AUXILIARY INFORMATION: Nothing specified.					
Solubility and specific gravity of saturated solutions for the system at 25°C: $\text{UO}_2(\text{NO}_3)_2 - \text{NH}_4\text{NO}_3 - \text{HNO}_3 - \text{H}_2\text{O}$ 1. NH_4NO_3 . 2. $2\text{NH}_4\text{NO}_3 \cdot \text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$. 3. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. 1.5 mol/dm ³ HNO_3 .					

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Cesium nitrate; CsNO_3 ; [7789-18-6] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Christensen, H.Th.; Holmberg, K.E. <i>Nukleonik</i> , <u>1968</u> , 11, 165 - 170.																																																							
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																							
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2$ - CsNO_3 - HNO_3 - H_2O System at 25°C Composition of Saturated Solutions ^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{CsNO}_3$</th><th colspan="2">$\text{HNO}_3$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mol %</th><th>mol/kg</th><th>mol %</th><th>mol/kg</th><th>mol %</th><th>mol/kg</th></tr><tr><td>1.682</td><td>1.018</td><td>0.445</td><td>0.269</td><td>6.14</td><td>3.72</td><td>A+B</td></tr><tr><td>1.113</td><td>0.6837</td><td>0.483</td><td>0.297</td><td>8.04</td><td>4.94</td><td>A+B</td></tr><tr><td>0.577</td><td>0.363</td><td>0.539</td><td>0.339</td><td>10.70</td><td>6.735</td><td>A+B</td></tr><tr><td>0.227</td><td>0.152</td><td>0.752</td><td>0.503</td><td>16.06</td><td>10.75</td><td>A+B</td></tr><tr><td>0.201</td><td>0.138</td><td>0.874</td><td>0.602</td><td>18.27</td><td>12.57</td><td>A+B</td></tr><tr><td>0.192</td><td>0.136</td><td>0.744</td><td>0.527</td><td>20.70</td><td>14.66</td><td>A+B</td></tr></table> <p>^a Molalities calculated by the compilers.</p> <p>^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = CsNO_3.</p>		$\text{UO}_2(\text{NO}_3)_2$		CsNO_3		HNO_3		Solid Phase ^b	mol %	mol/kg	mol %	mol/kg	mol %	mol/kg	1.682	1.018	0.445	0.269	6.14	3.72	A+B	1.113	0.6837	0.483	0.297	8.04	4.94	A+B	0.577	0.363	0.539	0.339	10.70	6.735	A+B	0.227	0.152	0.752	0.503	16.06	10.75	A+B	0.201	0.138	0.874	0.602	18.27	12.57	A+B	0.192	0.136	0.744	0.527	20.70	14.66	A+B
$\text{UO}_2(\text{NO}_3)_2$		CsNO_3		HNO_3		Solid Phase ^b																																																		
mol %	mol/kg	mol %	mol/kg	mol %	mol/kg																																																			
1.682	1.018	0.445	0.269	6.14	3.72	A+B																																																		
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0.192	0.136	0.744	0.527	20.70	14.66	A+B																																																		
AUXILIARY INFORMATION																																																								
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A 20 mL portion of the solution being investigated was placed in an ultra-cryostat with stirring and cooled. After 2 to 3 hours, crystals were separated by centrifugation (4 min, 2000 g). Nitric acid and uranium were measured by potentiometric titration (1,2), cesium by polarographic analysis, after separation of uranium by anion exchange resin.			SOURCE AND PURITY OF MATERIALS: "AR" $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, CsNO_3 , HNO_3 . Water was purified on ion exchange resins, and twice distilled from quartz.																																																					
			ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Precision ± 0.02 to 0.04 K.																																																					
			REFERENCES: 1. Ahrlund, S. <i>Acta Chem. Scand.</i> , <u>1960</u> , 14, 2035. 2. Motojima, K.; Izawa, K. <i>Anal. Chem.</i> , <u>1964</u> , 36, 733.																																																					

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Magnesium nitrate; $\text{Mg}(\text{NO}_3)_2$; [10377-60-3] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Kurnakova, A. G.; Nikolaev, A. V. <i>Zh. Neorg. Khim.</i> , 1958, 3, 1028 - 1036. <i>Russ. J. Inorg. Chem.</i> , 1958, 3, 298. (Eng. trans.)		
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{Mg}(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Solutions ^a			
Density g/cm ³	$\text{Mg}(\text{NO}_3)_2$ mass %	$\text{UO}_2(\text{NO}_3)_2$ mass %	Solid Phase ^b
1.409	38.94	---	A
1.415	35.74	4.18	A
1.448	34.34	8.21	A
1.485	33.00	12.12	A
1.527	30.19	16.07	A
1.543	29.88	17.73	A
1.547	29.20	17.91	A
1.549	29.31	18.25	A+B
1.548	28.67	18.29	B
1.548	27.38	18.37	B
1.536	26.71	18.85	B
1.532	25.26	19.49	B
1.538	22.39	21.39	B
1.538	22.20	21.85	B
1.533	20.98	23.14	B
1.535	19.46	23.90	B
1.555	17.02	26.27	B
1.560	16.24	27.69	B
1.563	13.91	29.41	B
1.578	11.52	31.96	B
1.618	7.01	38.09	B
1.657	3.56	41.60	B
1.684	---	48.79	B
^a Nitric acid concentration, 1.5N.			
^b Solid phases: A = $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.			
AUXILIARY INFORMATION: Nothing specified.			
Solubility and specific gravity of saturated solutions at 25°C of the system: $\text{Mg}(\text{NO}_3)_2 - \text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ 1.5 mol/dm ³ HNO_3 .		 sp grav	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Kurnakova, A. G.; Nikolaev, A. V.
(2) Calcium nitrate; $\text{Ca}(\text{NO}_3)_2$; [10124-37-5]	<i>Zh. Neorg. Khim.</i> , <u>1958</u> , 3, 1028 - 1036.
(3) Nitric acid; HNO_3 ; [7697-37-2]	<i>Russ. J. Inorg. Chem.</i> , <u>1958</u> , 3, 298. (Eng. trans.)
(4) Water; H_2O ; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 298 K	L. Fuks; S. Siekierski

EXPERIMENTAL VALUES:

The $\text{UO}_2(\text{NO}_3)_2 - \text{Ca}(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C^a
Composition of Saturated Solutions^b

Density g/cm^3	$\text{Ca}(\text{NO}_3)_2$		$\text{UO}_2(\text{NO}_3)_2$		Solid ^c Phase ^c
	mass %	mol/kg	mass %	mol/kg	
1.508	48.72	2.97	---	---	A
1.551	45.36	2.76	5.93	0.15	A
1.582	41.68	2.54	10.18	0.26	A
1.590	40.80	2.49	10.35	0.27	A
1.604	40.08	2.44	10.69	0.27	A+B
1.604	40.29	2.46	11.28	0.27	B
1.576	38.94	2.37	12.21	0.31	B
1.578	32.58	2.19	16.80	0.43	B
1.584	25.87	1.58	22.01	0.56	B
1.604	18.18	1.11	29.05	0.74	B
1.626	13.42	0.82	33.92	0.86	B
1.650	8.15	0.50	38.72	0.98	B
1.648	6.80	0.41	39.35	0.99	B
1.684	---	---	48.79	1.24	B

^a HNO_3 concentration 1.5N. ^bMolalities calculated by compilers.

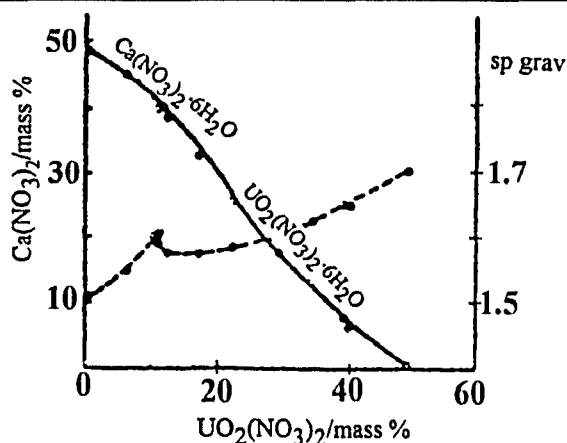
^cSolid phases: A = $\text{Ca}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

AUXILIARY INFORMATION: Nothing specified.

Solubility and specific gravity of the system at 25°C :

$\text{Ca}(\text{NO}_3)_2 - \text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$

1.5 mol/dm³ HNO_3



COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Strontium nitrate; $\text{Sr}(\text{NO}_3)_2$; [10042-76-9] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Christensen, H. Th.; Holmberg, K. E. <i>Nukleonik</i> , <u>1968</u> , 11, 165 - 170.																																																							
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																							
EXPERIMENTAL VALUES: <div>The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Sr}(\text{NO}_3)_2$ - HNO_3 - H_2O System at 25°C^a</div> <table><thead><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{Sr}(\text{NO}_3)_2$</th><th colspan="2">$\text{HNO}_3$</th><th rowspan="2">Solid₀ Phase^b</th></tr><tr><th>mol %</th><th>mol/kg</th><th>mol %</th><th>mol/kg</th><th>mol%</th><th>mol/kg</th></tr></thead><tbody><tr><td>0.983</td><td>0.589</td><td>0.0935</td><td>0.0560</td><td>6.32</td><td>3.79</td><td>A+B</td></tr><tr><td>0.774</td><td>0.477</td><td>0.087</td><td>0.054</td><td>9.05</td><td>5.58</td><td>A+B</td></tr><tr><td>0.405</td><td>0.256</td><td>0.0652</td><td>0.0412</td><td>11.63</td><td>7.34</td><td>A+B</td></tr><tr><td>0.167</td><td>0.111</td><td>0.142</td><td>0.0941</td><td>15.96</td><td>10.6</td><td>A+B</td></tr><tr><td>0.156</td><td>0.105</td><td>0.0856</td><td>0.0578</td><td>17.57</td><td>11.9</td><td>A+B</td></tr><tr><td>0.144</td><td>0.100</td><td>0.0448</td><td>0.0313</td><td>20.30</td><td>14.2</td><td>A+B</td></tr></tbody></table> <div>^aMolalities calculated by the compilers. ^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{Sr}(\text{NO}_3)_2$.</div>		$\text{UO}_2(\text{NO}_3)_2$		$\text{Sr}(\text{NO}_3)_2$		HNO_3		Solid ₀ Phase ^b	mol %	mol/kg	mol %	mol/kg	mol%	mol/kg	0.983	0.589	0.0935	0.0560	6.32	3.79	A+B	0.774	0.477	0.087	0.054	9.05	5.58	A+B	0.405	0.256	0.0652	0.0412	11.63	7.34	A+B	0.167	0.111	0.142	0.0941	15.96	10.6	A+B	0.156	0.105	0.0856	0.0578	17.57	11.9	A+B	0.144	0.100	0.0448	0.0313	20.30	14.2	A+B
$\text{UO}_2(\text{NO}_3)_2$		$\text{Sr}(\text{NO}_3)_2$		HNO_3		Solid ₀ Phase ^b																																																		
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AUXILIARY INFORMATION																																																								
METHOD/Apparatus/PROCEDURE: The isothermal method was used. A 20 mL portion of the solution being investigated was placed in an ultra-cryostat, stirred and cooled. After 2 to 3 hours, crystals were separated by centrifugation (4 minutes at 2000 g). Nitric acid and uranium were determined by potentiometric titration (1,2).			SOURCE AND PURITY OF MATERIALS: The $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $\text{Sr}(\text{NO}_3)_2$ and HNO_3 were all AR grade.																																																					
			ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Precision ± 0.02 to 0.04 K.																																																					
			REFERENCES: 1. Ahrland, S. <i>Acta Chem. Scand.</i> , <u>1960</u> , 14, 2035. 2. Motojima, K.; Izawa, K. <i>Anal. Chem.</i> , <u>1964</u> , 36, 733.																																																					

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Barium nitrate; $\text{Ba}(\text{NO}_3)_2$; [10022-31-8] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Christensen, H. Th.; Holmberg, K. E. <i>Nukleonik</i> , <u>1968</u> , 11, 165 - 170.																																																							
VARIABLES: One temperature: 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																							
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{Ba}(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">$\text{Ba}(\text{NO}_3)_2$</th><th colspan="2">$\text{HNO}_3$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mol %</th><th>mol/kg</th><th>mol %</th><th>mol/kg</th><th>mol %</th><th>mol/kg</th></tr><tr><td>1.72</td><td>1.03</td><td>0.0057</td><td>0.0034</td><td>5.79</td><td>3.48</td><td>A+B</td></tr><tr><td>1.34</td><td>0.813</td><td>0.0051</td><td>0.0031</td><td>7.17</td><td>4.35</td><td>A+B</td></tr><tr><td>0.75</td><td>0.46</td><td>0.0042</td><td>0.0026</td><td>9.61</td><td>5.95</td><td>A+B</td></tr><tr><td>0.22</td><td>0.14</td><td>0.0035</td><td>0.0023</td><td>14.17</td><td>9.188</td><td>A+B</td></tr><tr><td>0.16</td><td>0.11</td><td>0.0029</td><td>0.0019</td><td>16.32</td><td>10.85</td><td>A+B</td></tr><tr><td>0.15</td><td>0.10</td><td>0.0024</td><td>0.0017</td><td>19.40</td><td>13.39</td><td>A+B</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{Ba}(\text{NO}_3)_2$.		$\text{UO}_2(\text{NO}_3)_2$		$\text{Ba}(\text{NO}_3)_2$		HNO_3		Solid Phase ^b	mol %	mol/kg	mol %	mol/kg	mol %	mol/kg	1.72	1.03	0.0057	0.0034	5.79	3.48	A+B	1.34	0.813	0.0051	0.0031	7.17	4.35	A+B	0.75	0.46	0.0042	0.0026	9.61	5.95	A+B	0.22	0.14	0.0035	0.0023	14.17	9.188	A+B	0.16	0.11	0.0029	0.0019	16.32	10.85	A+B	0.15	0.10	0.0024	0.0017	19.40	13.39	A+B
$\text{UO}_2(\text{NO}_3)_2$		$\text{Ba}(\text{NO}_3)_2$		HNO_3		Solid Phase ^b																																																		
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METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A 20 mL portion of the solution being investigated was placed in an ultracryostat, stirred and cooled. After 2 to 3 hours, crystals were separated by centrifuging (4 minutes, 2000 g). Nitric acid and uranium were measured by potentiometric titration (1,2).			SOURCE AND PURITY OF MATERIALS: "AR" $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $\text{Ba}(\text{NO}_3)_2$, HNO_3 . Ion ³ exchanged water was distilled twice from a quartz apparatus.																																																					
			ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Precision ± 0.02 to 0.04 K.																																																					
			REFERENCES: 1. Ahrland, S. <i>Acta Chem. Scand.</i> , <u>1960</u> , 14, 2035. 2. Motojima, K.; Izawa, K. <i>Anal. Chem.</i> , <u>1964</u> , 36, 733.																																																					

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Zinc nitrate; $\text{Zn}(\text{NO}_3)_2$; [7779-88-6] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Kurnakova, A. G.; Nikolaev, A. V. <i>Zh. Neorg. Khim.</i> , <u>1958</u> , 3, 1028 - 1036. <i>Russ. J. Inorg. Chem.</i> , <u>1958</u> , 3, 298. (Eng. trans.)		
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{Zn}(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C^a Composition of Saturated Solutions			
Density g/cm^3	$\text{Zn}(\text{NO}_3)_2$ mass %	$\text{UO}_2(\text{NO}_3)_2$ mass %	Solid Phase ^b
1.659	51.94	---	A
1.717	48.81	6.87	A
1.754	44.87	12.05	A
1.797	41.91	17.56	A
1.810	41.23	18.44	A
1.738	38.50	16.35	A+B
1.707	37.66	16.06	B
1.670	36.47	15.36	B
1.637	34.56	17.15	B
1.596	27.49	19.74	B
1.594	15.83	29.16	B
1.661	4.02	45.56	B
1.684	---	48.79	B
^a 1.5N HNO_3 , presumably in the initial solution (compilers). ^b Solid phase: A = $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.			
AUXILIARY INFORMATION: Nothing specified.			
Solubility and specific gravity at 25°C for the system: $\text{Zn}(\text{NO}_3)_2 - \text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ 1.5 mol/dm ³ HNO_3		 <div>$\text{Zn}(\text{NO}_3)_2/\text{mass \%}$ $\text{UO}_2(\text{NO}_3)_2/\text{mass \%}$ sp grav</div>	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Copper nitrate; $\text{Cu}(\text{NO}_3)_2$; [3251-23-8] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Kurnakova, A. G.; Nikolaev, A. V. <i>Zh. Neorg. Khim.</i> , 1958 , 3, 1028 - 1036. <i>Russ. J. Inorg. Chem.</i> , 1958 , 3, 298. (Eng. trans.)
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski

EXPERIMENTAL VALUES:

The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Cu}(\text{NO}_3)_2$ - HNO_3 - H_2O System at 25°C^a
Composition of Saturated Solutions

Density g/cm ³	$\text{Cu}(\text{NO}_3)_2$ mass %	$\text{UO}_2(\text{NO}_3)_2$ mass %	Solid Phase ^b
1.709	56.43	---	A
1.732	49.56	5.05	A
1.770	47.12	10.06	A
1.806	45.29	13.94	A
1.804	44.00	13.77	A+B
1.785	43.02	13.00	B
1.745	41.63	12.63	B
1.716	41.60	11.97	B
1.676	38.71	12.27	B
1.672	38.50	13.26	B
1.652	37.85	13.07	B
1.641	34.20	14.88	B
1.619	24.87	21.68	B
1.624	13.07	32.72	B
1.670	6.52	40.40	B
1.684	---	48.79	B

^a1.5N HNO_3 , presumably, in the initial solution (compilers).

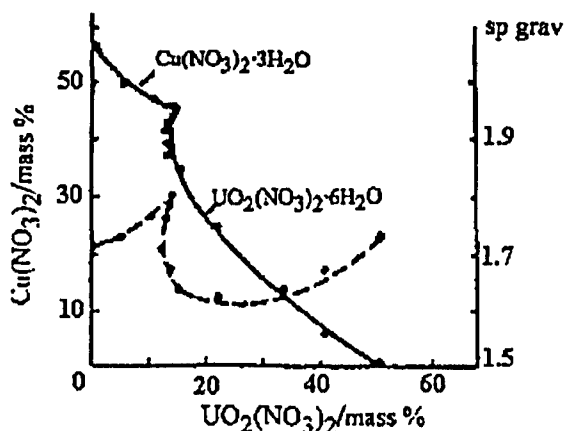
^bSolid phases: A = $\text{Cu}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

AUXILIARY INFORMATION: Nothing specified.

Solubility and specific gravity
at 25°C for the system:

$\text{Cu}(\text{NO}_3)_2$ - $\text{UO}_2(\text{NO}_3)_2$ - HNO_3 - H_2O

1.5 mol/dm³ HNO_3 .



COMPONENTS:		ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Bol'shakov, K. A.; Korovin, S. S.				
(2) Uranyl oxalate; $\text{UO}_2\text{C}_2\text{O}_4$; [2031-89-2]		Zh. Neorg. Khim., <u>1957</u> , 2, 1940 - 1950.				
(3) Nitric acid; HNO_3 ; [7697-37-2]		Russ. J. Inorg. Chem., <u>1957</u> , 2, 365. (Eng. trans.)				
(4) Water; H_2O ; [7732-18-5]						
VARIABLES:		PREPARED BY:				
Composition at 298 K		A. Sozanski; S. Siekierski				
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2 - \text{UO}_2\text{C}_2\text{O}_4 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C						
Composition of Saturated Solutions ^a						
$\text{UO}_2(\text{NO}_3)_2$		$\text{UO}_2\text{C}_2\text{O}_4$		HNO_3		Solid Phase ^b
mass %	mol/kg	mass %	mol/kg	mass %	mol/kg	
Section I						
47.50	2.596	0	0	6.06	2.07	A
47.10	2.572	0.43	0.026	6.00	2.05	A+B
39.90	1.854	0.38	0.019	5.11	1.48	B
28.31	1.062	0.46	0.019	3.55	0.832	B
21.21	0.6879	0.54	0.019	---	---	B
14.42	0.4305	0.57	0.019	---	---	B
7.58	0.209	0.53	0.016	---	---	B
Section II						
42.93	2.373	0	0	11.16	3.858	A
41.06	2.179	0.46	0.027	10.66	3.538	A+B
40.13	2.075	0.44	0.025	10.35	3.347	B
35.28	1.622	0.37	0.019	9.15	2.63	B
31.97	1.200	0.43	0.018	---	---	B
22.80	0.7541	0.47	0.017	---	---	B
14.90	0.4472	0.55	0.018	---	---	B
8.83	0.247	0.75	0.018	---	---	B
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:				
Various sections of the 4-component system have been studied by the analytical isothermal method. In the case of Section I through Section III the ratio of uranyl nitrate to nitric acid was constant. In the case of Section IV, the concentration of nitric acid was constant at about 22 mass %. The solutions and solid phases were shaken at constant temperature for 3 to 6 days. Uranium and oxalate were measured by potentiometric titration with KMnO_4 , nitrate by Kjeldahl's method (1). ⁴		Nothing specified.				
		ESTIMATED ERROR:				
		Nothing specified.				
		REFERENCES:				
		1. Bol'shakov, K.A.; Korovin, S.S.; Plyushchev, V.E.; Ermakova, T.A. Zh. Neorg. Khim., <u>1954</u> , 2, 222.				

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Uranium oxide; UO_3 ; [1344-58-7] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Lacher, J. R.; Ensley, K.; Park, J. D. <i>Inorg. Chem.</i> , <u>1962</u> , <u>1</u> , 944 - 945.
VARIABLES: Composition and temperature	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>The composition of aqueous phases saturated with uranyl nitrate hexa-, tri- and dihydrate salts is presented in the form of a triangular phase diagram (1). The solubility curves were obtained at temperatures of 30°C, 40°C, 50°C and 59°C. The highest temperature studied (59°C) is one degree below the melting point of the hexahydrate. The phase diagram also includes the solubility of UO_3 in water-nitric acid mixtures (2).</p> <p>COMMENTS AND/OR ADDITIONAL DATA:</p> <p>Uranyl nitrate hexahydrate has the largest solubility, while the dihydrate exhibits the lowest solubility. An increase in the temperature influences the solubility of the hexahydrate to a greater extent than that of the lower hydrates. The nitric acid decomposes in the acid-rich region. In this region, the compound $\text{UO}_2(\text{NO}_3)_2 \cdot \text{N}_2\text{O}_4 \cdot \text{H}_2\text{O}$ has been identified. Uranyl nitrate dissolves UO_3.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Standard procedures (3) were used to produce and equilibrate mixtures of UO_3 , HNO_3 and water.	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Nothing specified. REFERENCES: 1. Colani, A. <i>Bull. Soc. Chim. France</i> , <u>1926</u> , <u>39</u> , 1243. 2. Kraus, Brown Univ., Private Communication. 3. Ensley, E. K. A Study of Some Chemical Properties of Uranium Compounds, Ph.D. Thesis, University of Colorado, <u>1960</u> .

COMPONENTS:			ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Thibodeau, R. D.; Adelman, M.				
(2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0]			Can. J. Chem., 1963, 41, 531-536.				
(3) Nitric acid; HNO_3 ; [7697-37-2]							
(4) Water; H_2O ; [7732-18-5]							
VARIABLES:			PREPARED BY:				
Composition and temperature			A. Sozanski; S. Siekierski				
EXPERIMENTAL VALUES:							
The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Al}(\text{NO}_3)_3$ - HNO_3 - H_2O System							
Composition of Saturated Solutions ^a							
$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Al}(\text{NO}_3)_3$		HNO_3		Solid Phase ^e
	mass %	mol/kg	mass %	mol/kg	mass %	mol/kg	
0 ^b	45.8	2.43	5.7	0.56	0.7	0.2	A+B
	41.5	2.13	6.1	0.58	2.9	0.93	A+B
	35.7	1.74	6.5	0.58	5.6	1.7	A+B
	29.9	1.40	6.8	0.59	9.1	2.7	A+B
	22.9	1.01	6.7	0.55	12.8	3.53	A+B
	17.1	0.742	7.3	0.59	17.1	4.64	A+B
	13.0	0.565	7.2	0.58	21.4	5.82	A+B
	10.2	0.449	7.3	0.59	24.8	6.82	A+B
	8.9	0.405	7.2	0.61	28.1	7.99	B+C
	9.3	0.447	5.2	0.46	32.7	9.83	B+C
	10.5	0.527	2.2	0.20	36.7	11.5	B+C
(Continued on the next page)							
AUXILIARY INFORMATION							
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:			
Isothermal method used. The solutions were prepared to range from 0 to 10 mol/dm ³ HNO_3 , and 0.5, 1.0, 1.5 mol/dm ³ aluminum nitrate. 10 mL of each of these solutions was pipetted into a glass bottle which contained sufficient uranyl nitrate hexahydrate to saturate the solutions. Bottles were sealed with polyethylene tops, heated until complete dissolution, and then suspended in a water bath for 48 hours. Equilibrium attained within 12 hours. Samples of liquid phase were weighed and diluted. Aliquots were analyzed for uranium by titrating the reduced form with ceric sulphate. The nitric acid was measured by titration with NaOH after precipitation of uranium and aluminum by KF (1). The Al was separated from U by addition of ammonium bicarbonate solution. Aluminum nitrate dissolved in sulfuric acid and analyzed by the volumetric oxine method (2).				Nothing specified.			
				ESTIMATED ERROR:			
				Solubility: Accuracy of analytical method $\pm 0.1\%$. All analyses in duplicate.			
				Temperature: Precision $\pm 0.1\text{K}$.			
REFERENCES:							
				1. Brothers, J. A.; Olmstead, W. J. Unpublished Communication, AECL, Chalk River (1955).			
				2. Lundell, G.E.F.; Knowles, H.B. Bur. Std. J. Res., 1929, 3, 91.			

COMPONENTS:					ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]					Thibodeau, R. D.; Adelman, M. <i>Can. J. Chem.</i> , <u>1963</u> , 41, 531-536.			
(2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0]								
(3) Nitric acid; HNO_3 ; [7697-37-2]								
(4) Water; H_2O ; [7732-18-5]								
EXPERIMENTAL VALUES: (Continued)								
The $\text{UO}_2(\text{NO}_3)_2 - \text{Al}(\text{NO}_3)_3 - \text{HNO}_3 - \text{H}_2\text{O}$ System								
Composition of Saturated Solutions ^a								
	$\text{UO}_2(\text{NO}_3)_2$		$\text{Al}(\text{NO}_3)_3$		HNO_3		Solid Phase ^e	
$t/^{\circ}\text{C}$	mass %	mol/kg	mass %	mol/kg	mass %	mol/kg		
0 ^c	34.6	1.55	8.2	0.68	0.7	0.20	A+B	
	29.3	1.26	8.9	0.71	2.9	0.78	A+B	
	23.8	0.984	8.9	0.68	5.9	1.5	A+B	
	18.7	0.759	9.9	0.74	8.9	2.3	A+B	
	13.8	0.558	10.9	0.815	12.5	3.16	A+B	
	10.1	0.415	12.1	0.921	16.1	4.14	A+B	
	8.5	0.36	12.9	1.01	18.5	4.89	A+B	
	8.4	0.37	11.5	0.942	22.8	6.31	B+C	
	9.2	0.42	7.8	0.66	27.5	7.86	B+C	
	9.7	0.45	4.8	0.41	31.1	9.07	B+C	
	10.3	0.509	2.6	0.24	35.7	11.0	B+C	
	0 ^d	20.9	0.770	9.1	0.62	1.1	0.25	A+B
		15.2	0.540	10.1	0.664	3.3	0.73	A+B
		12.4	0.443	10.7	0.708	5.9	1.3	A+B
		9.1	0.33	11.8	0.788	8.8	2.0	A+B
7.3		0.27	12.4	0.843	11.2	2.57	A+B	
7.5		0.30	13.1	0.958	15.2	3.76	B+C	
8.6		0.37	12.1	0.973	20.9	5.68	B+C	
9.1		0.41	9.2	0.76	25.2	7.08	B+C	
9.7		0.43	5.5	0.45	28.0	7.82	B+C	
10.2		0.480	3.7	0.32	32.2	9.48	B+C	
10.6		0.536	2.6	0.24	36.6	11.6	B+C	
10 ^b		48.5	2.64	4.2	0.42	0.6	0.2	A+B
		44.0	2.29	4.8	0.46	2.5	0.81	A+B
		39.5	1.99	5.0	0.46	5.0	1.6	A+B
		35.0	1.69	4.6	0.41	7.9	2.4	A+B
	29.6	1.40	5.6	0.49	11.2	3.32	A+B	
	24.5	1.14	5.8	0.50	15.3	4.46	A+B	
	20.3	0.959	7.3	0.64	18.7	5.53	A+B	
	17.1	0.807	7.3	0.64	21.8	6.43	A+B	
	15.4	0.747	7.6	0.68	24.7	7.49	A+B	
	15.2	0.749	6.1	0.56	27.2	8.38	B+C	
	15.9	0.823	5.6	0.54	29.5	9.55	B+C	
	10 ^c	38.9	1.74	3.9	0.32	0.4	0.1	A+B
		33.8	1.47	5.0	0.40	2.8	0.76	A+B
		29.3	1.25	5.7	0.45	5.3	1.4	A+B
		24.7	1.02	5.7	0.43	8.0	2.1	A+B
20.2		0.824	6.1	0.46	11.5	2.93	A+B	
16.2		0.659	6.4	0.48	15.0	3.81	A+B	
14.4		0.606	8.0	0.62	17.3	4.55	A+B	
13.2		0.584	9.4	0.77	20.0	5.53	A+B	
14.0		0.678	9.3	0.83	24.3	7.36	A+B	
13.7		0.630	6.3	0.54	24.8	7.13	A+B	
16.6		0.902	5.1	0.51	31.6	10.7	A+B	

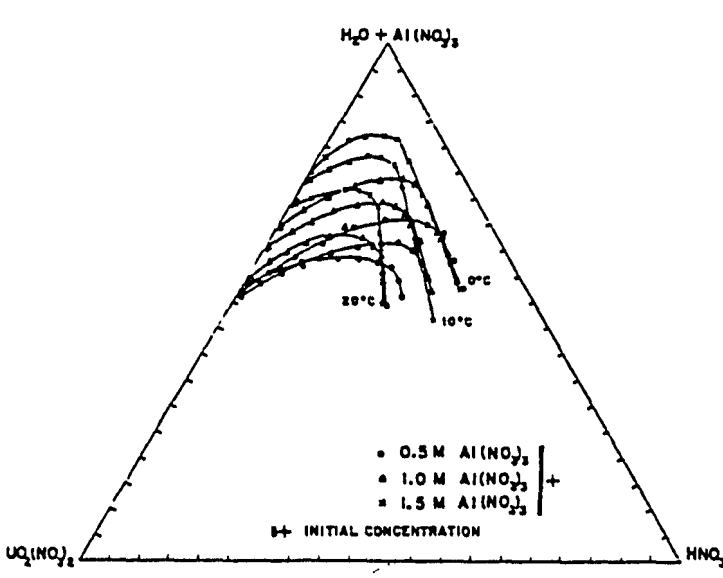
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COMPONENTS:					ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]					Thibodeau, R. D.; Adelman, M.		
(2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0]					<i>Can. J. Chem.</i> , <u>1963</u> , 41, 531-536.		
(3) Nitric acid; HNO_3 ; [7697-37-2]							
(4) Water; H_2O ; [7732-18-5]							
EXPERIMENTAL VALUES: (Continued)							
The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Al}(\text{NO}_3)_3$ - HNO_3 - H_2O System							
Composition of Saturated Solutions ^a							
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Al}(\text{NO}_3)_3$		HNO_3		Solid Phase ^e
	mass %	mol/kg	mass %	mol/kg	mass %	mol/kg	
10 ^d	25.8	1.00	8.3	0.60	0.6	0.1	A+B
	21.4	0.807	8.5	0.59	2.8	0.66	A+B
	17.6	0.658	9.0	0.62	5.5	1.3	A+B
	14.1	0.522	9.3	0.64	8.0	1.9	A+B
	11.9	0.443	9.3	0.64	10.6	2.47	A+B
	10.6	0.407	10.1	0.717	13.2	3.17	A+B
	11.0	0.438	8.5	0.63	16.8	4.19	B+C
	13.5	0.642	11.4	1.00	21.7	6.45	B+C
	14.0	0.678	8.8	0.79	24.8	7.51	B+C
	15.3	0.767	5.2	0.48	28.9	9.06	B+C
	18.2	1.09	4.2	0.46	35.1	13.1	B+C
20 ^b	48.2	2.69	6.4	0.66	0.0	0.0	A
	42.0	2.14	6.2	0.59	2.1	0.67	A
	39.0	1.98	6.7	0.63	4.4	1.4	A
	35.1	1.75	6.9	0.64	7.2	2.2	A
	31.4	1.56	7.2	0.66	10.2	3.16	A
	28.6	1.44	7.8	0.73	13.3	4.20	A
	25.2	1.28	8.0	0.75	16.9	5.37	A
	22.8	1.17	7.7	0.73	20.0	6.41	A
	20.9	1.08	7.5	0.72	22.6	7.32	A
	21.0	1.14	7.3	0.74	25.1	8.55	A
	22.2	1.30	7.1	0.77	27.3	9.98	A
20 ^c	46.4	2.68	9.7	1.04	0.0	0.0	A+B
	40.2	2.13	10.0	0.982	2.0	0.66	A+B
	36.4	1.89	10.6	1.02	4.0	1.3	A+B
	32.3	1.62	10.9	1.01	6.3	2.0	A+B
	28.1	1.40	11.2	1.03	9.6	3.0	A+B
	24.6	1.19	11.4	1.02	11.6	3.51	A+B
	23.0	1.17	11.9	1.12	15.2	4.83	A+B
	21.8	1.14	11.9	1.15	17.7	5.78	A+B
	21.6	1.14	10.5	1.03	20.0	6.63	B+C
	22.7	1.28	10.3	1.07	21.9	7.71	B+C
	25.3	1.48	5.7	0.62	25.6	9.36	B+C
20 ^d	30.9	1.31	8.7	0.68	0.5	0.1	A+B
	27.8	1.17	9.2	0.71	2.5	0.66	A+B
	25.0	1.05	9.7	0.75	4.8	1.3	A+B
	21.2	0.878	10.2	0.781	7.3	1.9	A+B
	19.1	1.784	9.4	0.71	9.7	2.5	A+B
	17.8	0.744	9.5	0.73	12.0	3.14	A+B
	17.2	0.762	10.9	0.893	14.6	4.04	B+C
	19.6	0.946	10.4	0.928	17.4	5.25	B+C
	21.2	1.09	10.1	0.962	19.4	6.24	B+C
	23.5	1.32	8.7	0.90	22.6	7.93	B+C
	25.6	1.50	6.1	0.66	25.0	9.16	B+C

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COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Thibodeau, R. D.; Adelman, M. <i>Can. J. Chem.</i> , 1963, 41, 531-536.
EXPERIMENTAL VALUES: (Continued) <p style="text-align: center;">The $\text{UO}_2(\text{NO}_3)_2 - \text{Al}(\text{NO}_3)_3 - \text{HNO}_3 - \text{H}_2\text{O}$ System</p> <p>^aMolalities calculated by the compilers.</p> <p>^bInitial concentration of aluminum nitrate was 0.5 mol/dm³.</p> <p>^cInitial concentration of aluminum nitrate was 1.0 mol/dm³.</p> <p>^dInitial concentration of aluminum nitrate was 1.5 mol/dm³.</p> <p>^eSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, C = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$.</p> <p>COMMENTS AND/OR ADDITIONAL DATA: The phase diagram for the system at 0°C, 10°C and 20°C is:</p> <div style="text-align: center;">  </div>	

COMPONENTS:			ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Medkov, B. K.; Petrov, M. R.; Roslyakova, O. N.		
(2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0]			Radiokhim., 1988, 30, 272 - 274.		
(3) Nitric acid; HNO_3 ; [7697-37-2]			Sov. Radiochem., 1988, 253 - 255, Eng. translation.		
(4) Water; H_2O ; [7732-18-5]					
VARIABLES: Composition at 298 K			PREPARED BY: S. L. Phillips		
EXPERIMENTAL VALUES:					
The $\text{UO}_2(\text{NO}_3)_2 - \text{Al}(\text{NO}_3)_3 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C					
Composition of Saturated Solutions					
Initial HNO_3	Density	$\text{UO}_2(\text{NO}_3)_2$	$\text{Al}(\text{NO}_3)_3$	HNO_3	Solid Phase ^a
mass %	g/cm ³	mass %	mass %	mass %	
10	1.379	---	29.63	8.73	A
	1.409	3.94	25.75	8.82	A
	1.444	8.77	21.80	10.33	A
	1.516	15.04	22.77	9.00	A+B
	1.521	18.54	18.96	9.85	B
	1.533	22.66	15.46	9.77	B
	1.555	26.12	10.36	10.09	B
	1.583	32.18	6.23	9.45	B
	1.623	35.09	3.12	9.25	B
	1.663	40.44	---	10.12	B
20	1.364	---	22.51	20.03	A
	1.387	2.82	21.24	19.02	A
	1.424	7.54	16.98	18.04	A
	1.432	8.84	16.68	19.84	A
	1.482	14.04	13.55	19.00	A
	1.565	21.41	10.65	19.68	A+B
	1.567	21.87	8.04	19.48	B
	1.568	22.83	7.49	17.86	B
	1.575	26.45	3.32	19.87	B
(Continued on the next page)					
AUXILIARY INFORMATION					
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:		
Isothermal method used. Equilibrium approached from side of the saturated solutions, to reduce time (10 h). After establishing equilibrium, samples were taken of both the solid and liquid phases using a constant temperature device (1). Samples were analyzed volumetrically for uranium (2); nitrate by potentiometry (3). Nitric acid content was measured by potentiometric titration to pH 6 in the presence of ammonium oxalate buffer. Solid phase composition was determined by Schreinemakers method (4). Density was determined pycnometrically.			"AR" $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$.		
			ESTIMATED ERROR:		
			Nothing specified.		
			1. Thibodeau, R.D.; Adelman, M. Can. J. Chem., 1963, 41, 531.		
			2. Petrov, M.R.; Zhukharev, M.I.; Roslyakova, O.N. Zh. Neorg. Khim., 1979, 24, 1413.		
			3. Markov, V.K.; Vinograd, A.V., et al. Uranium Methods for Its Determination, Atomizdat, Moscow (1960).		
			4. Schreinemakers, F. A. H. Z. physik. Chem., 1893, 11, 81.		

COMPONENTS:

- (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]
 (2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0]
 (3) Nitric acid; HNO_3 ; [7697-37-2]
 (4) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Medkov, B. K.; Petrov, M. R.;
 Roslyakova, O. N.
Radiokhim., 1988, 30, 272 - 274.
Sov. Radiochem., 1988, 253 - 255.

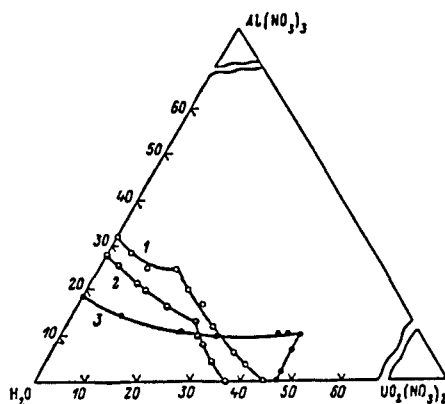
EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - $\text{Al}(\text{NO}_3)_3$ - HNO_3 - H_2O System at 25°C

Composition of Saturated Solutions

Initial HNO_3 mass %	Density g/cm^3	$\text{UO}_2(\text{NO}_3)_2$ mass %	$\text{Al}(\text{NO}_3)_3$ mass %	HNO_3 mass %	Solid Phase ^a
30	1.348	---	12.82	30.68	A
	1.408	6.28	10.12	31.90	A
	1.511	16.47	7.37	29.93	A
	1.611	21.79	6.67	28.79	A
	1.702	28.29	7.04	31.54	A
	1.708	30.36	7.46	30.55	A
	1.734	32.41	7.61	30.03	A+C
	1.727	30.95	4.49	33.88	C
	1.725	32.02	---	32.88	C

^aSolid phase: A = $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$,
 C = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$.



COMMENTS AND/OR ADDITIONAL DATA:

A phase diagram is given in the source paper which shows:
 Projections of the solubility isotherms at 25°C for the
 system $\text{UO}_2(\text{NO}_3)_2$ - $\text{Al}(\text{NO}_3)_3$ - HNO_3 - H_2O . Mass % HNO_3 :

Curve 1, 10%; Curve 2, 20%; Curve 3, 30% mass % HNO_3 .

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (3) Plutonyl nitrate; $\text{PuO}_2(\text{NO}_3)_2$; [22853-0-5] (4) Nitric acid; HNO_3 ; [7697-37-2] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vogler, S.; Grosvenor, D. E.; Lewitz, N. M. Report, 1972, ANL-7917.																																																				
VARIABLES: Composition and temperature	PREPARED BY: A. Sozanski; S. Siekierski																																																				
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{Pu}(\text{NO}_3)_4^a - \text{HNO}_3 - \text{H}_2\text{O}$ System Composition of Saturated Solutions ^b <table><tr><td></td><td>U</td><td>Pu</td><td>HNO_3</td></tr><tr><td>t/$^\circ\text{C}$</td><td>mol/dm³</td><td>mol/dm³</td><td>mol/dm³</td></tr><tr><td>1.5</td><td>0.70</td><td>0.70</td><td>3.4</td></tr><tr><td>3.2</td><td>1.28</td><td>0.34</td><td>2.0</td></tr><tr><td>5.3</td><td>0.98</td><td>0.42</td><td>3.4</td></tr><tr><td>10.2</td><td>1.12</td><td>0.28</td><td>3.4</td></tr><tr><td>12.6^c</td><td>1.4</td><td>0</td><td>3.4</td></tr><tr><td>13.2</td><td>1.6</td><td>0.2</td><td>2.0</td></tr><tr><td>15.3</td><td>1.28</td><td>0.34</td><td>3.4</td></tr><tr><td>15.9</td><td>1.6</td><td>0.3</td><td>2.0</td></tr><tr><td>17.6</td><td>1.12</td><td>0.28</td><td>4.8</td></tr><tr><td>18.0</td><td>1.6</td><td>0.4</td><td>2.0</td></tr><tr><td>20.8</td><td>1.28</td><td>0.34</td><td>4.8</td></tr></table>			U	Pu	HNO_3	t/ $^\circ\text{C}$	mol/dm ³	mol/dm ³	mol/dm ³	1.5	0.70	0.70	3.4	3.2	1.28	0.34	2.0	5.3	0.98	0.42	3.4	10.2	1.12	0.28	3.4	12.6 ^c	1.4	0	3.4	13.2	1.6	0.2	2.0	15.3	1.28	0.34	3.4	15.9	1.6	0.3	2.0	17.6	1.12	0.28	4.8	18.0	1.6	0.4	2.0	20.8	1.28	0.34	4.8
	U	Pu	HNO_3																																																		
t/ $^\circ\text{C}$	mol/dm ³	mol/dm ³	mol/dm ³																																																		
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^a See Comments, next page. ^b Solid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. ^c Extrapolated from Dillon's data (1). (Continued on the next page)																																																					
AUXILIARY INFORMATION																																																					
METHOD/APPARATUS/PROCEDURE: Synthetic method was used. The test solution was prepared from 2.52 mol/dm ³ uranyl nitrate, 1.5 mol/dm ³ plutonium nitrate, and 16 mol/dm ³ HNO_3 . The test solution was heated to approximately 5°C above the temperature of first crystallization, and the solution was allowed to cool slowly at a steady rate while stirring. The change in solution temperature as a function of time was recorded. Onset of crystallization resulted in a decrease in the rate of temperature change because of the heat evolved during the process of crystallization. The crystallization point was taken as the intersection of the two lines drawn through the cooling-curve segments.	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Solubility: Crystallization point determined 2 or 3 times for each solution. Temperature: Precision $\pm 1\text{K}$, above 10°C, $\pm 1.5\text{K}$, below 10°C. REFERENCES: 1. Dillon, I. ANL, Private Communication, 1950.																																																				

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (3) Plutonyl nitrate; $\text{PuO}_2(\text{NO}_3)_2$; [22853-0-5] (4) Nitric acid; HNO_3 ; [7697-37-2] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vogler, S.; Grosvenor, D. E.; Lewitz, N. M. Report 1972, ANL-7917.
EXPERIMENTAL VALUES: (Continued) About 30% of plutonium in the stock solution was present as hexavalent plutonyl ions (and the remainder apparently as the tetravalent plutonium, compilers). Preliminary tests in which crystallization points were determined from cooling curves of uranyl nitrate solutions demonstrated good agreement in the experimental results with published data of uranyl nitrate solutions. Upon standing, hexavalent plutonium was reduced to the tetravalent oxidation state. The crystallization experiments were repeated on the same solutions after they had stood for three months. Essentially, the same crystallization temperatures were obtained. The analyses confirmed that the solid was uranyl nitrate, even for the solution with a Pu/U ration of one. Plutonium does not crystallize from solution. The replacement of uranyl ions with plutonium increases the total metal solubility.	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various organics	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.												
CRITICAL EVALUATION: <p style="text-align: center;">$\text{THE } \text{UO}_2(\text{NO}_3)_2 - (\text{C}_2\text{H}_5)_2\text{O} - \text{H}_2\text{O} \text{ SYSTEM}$</p> <p><u>INTRODUCTION</u></p> <p>The solubility of uranyl nitrate in diethyl ether has been extensively investigated (2,4-8,10-14,16,18,19,22-25,27,34,35). The experimental data are of uneven quality, and selected values are compiled in Table 17.</p> <p>In this system, five solids with both waters of crystallization and diethyl ethers of crystallization have been reported. The composition of the solids is dependent on both the temperature and composition of the solutions. The following solid phases have been identified:</p> <table border="1" data-bbox="251 858 1078 1205"> <thead> <tr> <th>Solid Phase</th><th>Formula</th></tr> </thead> <tbody> <tr> <td>Uranyl nitrate hexahydrate</td><td>$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$</td></tr> <tr> <td>Uranyl nitrate trihydrate monoetherate</td><td>$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot (\text{C}_2\text{H}_5)_2\text{O}$</td></tr> <tr> <td>Uranyl nitrate dihydrate dietherate</td><td>$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$</td></tr> <tr> <td>Uranyl nitrate dihydrate etherate</td><td>$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 4(\text{C}_2\text{H}_5)_2\text{O}$</td></tr> <tr> <td>Uranyl nitrate dietherate</td><td>$\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$</td></tr> </tbody> </table> <p>Misciattelli claimed that $\text{UO}_2(\text{NO}_3)_2$ was the solid phase in the ether system when water was absent (6,8); however, this assignment is most improbable (35).</p> <p>The phase diagram for the system $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_2\text{H}_5)_2\text{O} - \text{H}_2\text{O}$ at 298.15K based on data reported by Katzin and Sullivan (16) and Vdovenko et al. (27) is given in Figure 4. The figure shows tie-lines for the two liquid phases which are saturated with uranyl nitrate hexahydrate at 273.2 K, and 293.2 K. These two tie-lines join data points published in two papers (7,8). In this system, there are four univariant points, i.e. points of fixed composition at a given temperature and pressure. Three of these points define two solids and one liquid, and one defines two liquids and one solid. The composition at the univariant points is given in Table 18.</p> <p style="text-align: right;">(Continued on the next page)</p>		Solid Phase	Formula	Uranyl nitrate hexahydrate	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	Uranyl nitrate trihydrate monoetherate	$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot (\text{C}_2\text{H}_5)_2\text{O}$	Uranyl nitrate dihydrate dietherate	$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$	Uranyl nitrate dihydrate etherate	$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 4(\text{C}_2\text{H}_5)_2\text{O}$	Uranyl nitrate dietherate	$\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$
Solid Phase	Formula												
Uranyl nitrate hexahydrate	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$												
Uranyl nitrate trihydrate monoetherate	$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot (\text{C}_2\text{H}_5)_2\text{O}$												
Uranyl nitrate dihydrate dietherate	$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$												
Uranyl nitrate dihydrate etherate	$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 4(\text{C}_2\text{H}_5)_2\text{O}$												
Uranyl nitrate dietherate	$\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$												

COMPONENTS:				EVALUATOR:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]				S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.			
(2) Various organics							

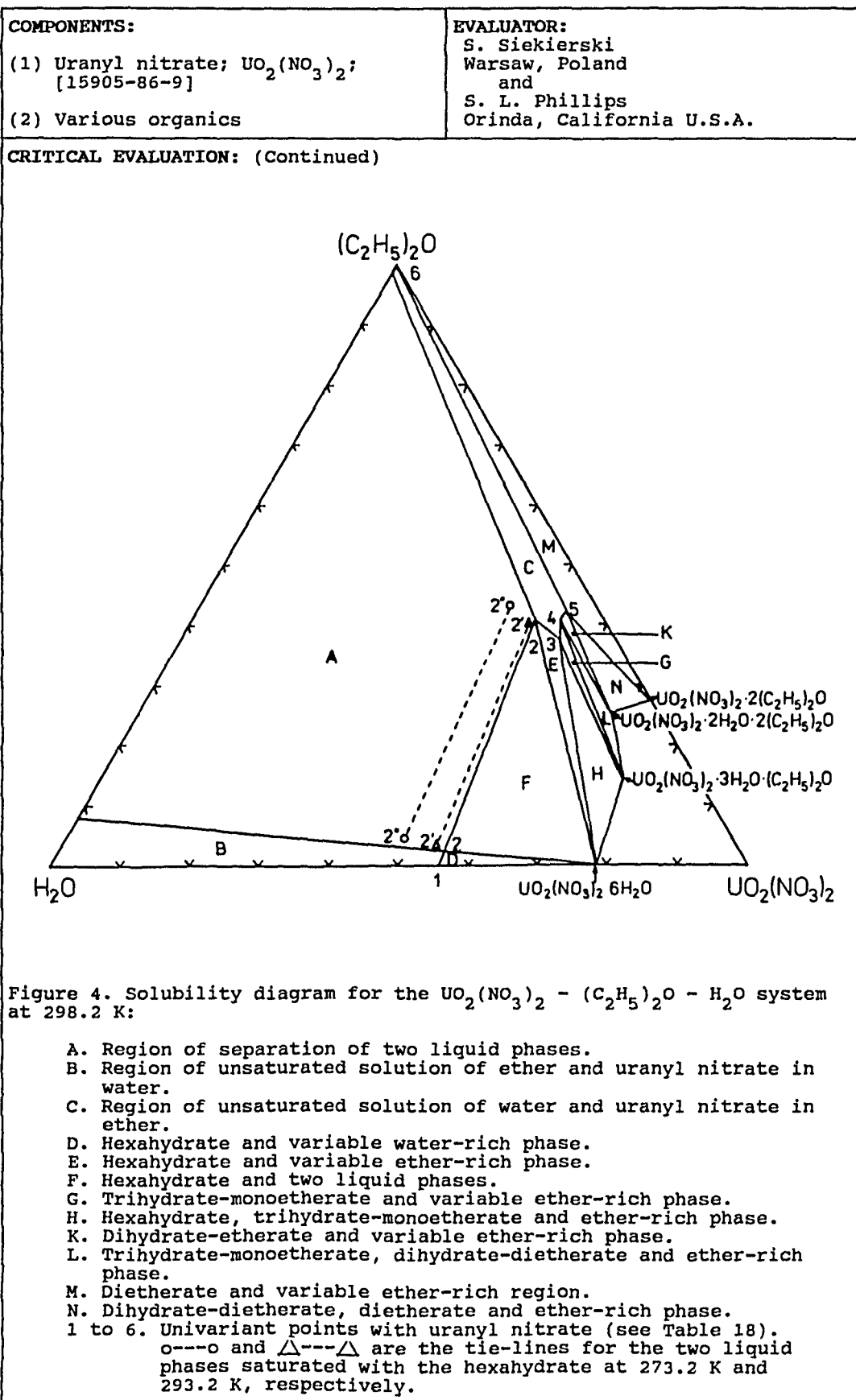
CRITICAL EVALUATION: (Continued)							
Table 17. Summary of the solubility of $\text{UO}_2(\text{NO}_3)_2$ in the system $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} - (\text{C}_2\text{H}_5)_2\text{O} - \text{H}_2\text{O}$ with two liquid phases.							
Aqueous Phase				Ether Phase			
T/K	$\text{UO}_2(\text{NO}_3)_2$		$(\text{C}_2\text{H}_5)_2\text{O}$	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Ref.
	mass %	mol/kg	mass %	mass %	mol/kg	mass %	
273.2	48.54 ^a	2.394 ^a	4.58 ^a	44.92 ^a	2.070 ^a	11.92 ^a	8
275.2	48.31	2.37	---	46.3	2.19	---	18
280.2	49.0	2.44	---	46.3	2.19	---	5
290.1 ^b	---	---	---	47.85	2.329	---	14
293.2	54.23	3.007	3.30	49.08	2.446	12.80	7
293.2	52.61	2.817	3.87	49.02	2.440	8.10	8
293.2 ^b	---	---	---	49.16	2.459	---	14
293.2	54.3	3.01	---	49.1	2.45	---	18
298.2 ^b	---	---	---	50.52	2.591	---	14
298.2	55.53 ^a	3.169 ^a	2.41 ^a	49.65 ^a	2.503 ^a	9.34 ^a	16
313.2 ^b	---	---	---	51.01	2.642	---	14

^aMean value.

^bThe presence of the aqueous phase is not reported in the source publication.

^aMean value.

^bThe presence of the aqueous phase is not reported in the source publication.



COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various organics	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p>The published solubilities for uranyl nitrate in the two liquid phases system $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_2\text{H}_5)_2\text{O} - \text{H}_2\text{O}$ with the exception of the rejected values (10,13,34) are given in Table 17. There is conflicting evidence on the subject of the number of equilibrium phases which are present when uranyl nitrate hexahydrate is equilibrated with ethyl ether. Most authors assign two liquid phases over the temperature range 273.2 - 293.2 K, when $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ is dissolved in ethyl ether. However De Keyser et al. (14) and Yaffe (13) do not report the presence of an aqueous phase at temperature of 290.1 K, 293.2 K, 298.2 K and 303.2 K. which exceed 8.2 mol/kg in concentration have been assigned to the It can be seen from Fig. 4 that if a line is drawn between the point at the base of the triangle which represents the composition of the hexahydrate, and the apex of the triangle, it would intersect the tie-lines for the two liquid phases saturated with the hexahydrate very near to the organic-rich end. This means that the amount of the water-rich phase which is formed when the hexahydrate dissolves, particularly at low temperatures, is small. If the salt has a slightly lower water content than theoretically predicted, then the aqueous phase may not form. The solubilities selected for Table 17 have been smoothed by a graphical method, and the results given in Table 18. In the smoothing procedure for solubilities in the water-rich phase, the shape of the liquidus curve for the $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} - \text{H}_2\text{O}$ binary system has been used as a reference because of the low ether content in the water-rich phase. The recommended solubilities obtained in this manner are given in Table 19 at temperature intervals of 5 K. The overall uncertainty in these values is about ± 0.05 mol/kg.</p> <p>The solubility in the $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} - (\text{C}_2\text{H}_5)_2\text{O} - \text{H}_2\text{O}$ system as a function of temperature has been investigated (24). The solubility value reported at 298.2 K is 2.775 mol/kg. This value appears too low because the phase diagram in Fig. 4 shows that the solubility at 298.2 K of the uranyl trihydrate-monoetherate should be between 2.92 mol/kg and 3.10 mol/kg,</p> <p style="text-align: right;">(Continued on the next page)</p>	

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$;
[15905-86-9]

(2) Various organics

EVALUATOR:

S. Siekierski
Warsaw, Poland
and
S. L. Phillips
Orinda, California U.S.A.

CRITICAL EVALUATION: (Continued)

Table 18. Univariant points in the $\text{UO}_2(\text{NO}_3)_2-(\text{C}_2\text{H}_5)_2\text{O}-\text{H}_2\text{O}$ System^a

T/K	Point ^b	Phases in Equilibrium ^c	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Ref.
			mass %	mol/kg ^a	mass %	
273.2	2'	A+ sat. ether-rich	44.91	2.070	11.92	8
		sat. water-rich	48.54	2.394	46.89	
293.2	2''	A+ sat. ether-rich	49.05	2.443	10.45	7, 8
		sat. water-rich	53.42	2.910	43.00	
298.2	1	A + sat. aqueous	56.0	3.23	44.0	d
298.2	2	A+ sat. ether-rich	49.7	2.50	9.3	16
		sat. water-rich	55.5	3.17	42.1	
298.2	3	A + B + sat. liquid	54.9	3.08	7.7	16
298.2	4	B + C + sat. liquid	53.4	2.90	6.2	16
298.2	5	C + D + sat. liquid	53.6	2.93	5.0	e
298.2	6	D + sat. ether	1.0	0.026	--	7, 27

^aMolalities calculated by the compilers.

^bNumbers refer to the points in Fig. 4.

^cSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot (\text{C}_2\text{H}_5)_2\text{O}$;
C = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.2(\text{C}_2\text{H}_5)_2\text{O}$, D = $\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$

^dRecommended solubility value: refer to evaluation of the binary system.

^eEstimated by the evaluators from data in Ref. (27).

Table 19. Recommended solubilities in the two liquid phase system
 $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_2\text{H}_5)_2\text{O} - \text{H}_2\text{O}$.

T/K	$\text{UO}_2(\text{NO}_3)_2$	
	Aqueous Phase	Organic Phase
	mol/kg	mol/kg
273.2	2.37	2.15
278.2	2.50	2.20
283.2	2.63	2.26
288.2	2.79	2.34
293.2	2.96	2.44
298.2	3.15	2.54
303.2	3.35	2.66

(Continued on the next page)

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various organics	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ in dry ethyl ether is the subject of a number of publications (5,11,22,23,35). The composition of the solid under conditions of equilibrium is dependent on the temperature. When temperatures exceed 273.2 K, the solid material is the dihydrate - dietherate (11,22,23). Below this temperature, the solid material at equilibrium is the dihydrate-tetraetherate. Both of these solids are in equilibrium with the solution at 273.2 K. Solubility values published by Lebeau (5) and Vdovenko et al. (22,23) differ by about 0.2 mol/kg at 283.2 K. Solubility data reported by Bachelet and Cheylan (11) in the form of a plot of solubility as a function of temperature are significantly lower for temperatures below 273.2 K, and also differ significantly at temperatures above 273.2 K when compared to the data in Vdovenko et al. (22,23). The latter values can be used as tentative solubility data for $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ in diethyl ether.</p> <p>The solubility of $\text{UO}_2(\text{NO}_3)_2$ in anhydrous ethyl ether has been studied by a number of investigators (6-8,22,25,27). Experimental values in the temperature range 283.2 K - 298.2 K published by Misciattelli (6) are much too high, probably due to water content, and have been rejected. There is a serious discrepancy between solubility data published by Vdovenko et al. (22,25), and in their later publication (27). The solubility of anhydrous $\text{UO}_2(\text{NO}_3)_2$ in dry ethyl ether at 293.2 K is given as 10.3 mass % (0.291 mol/kg) (22,25), at 293.2 K. However, the solubility is given as 1.01 mass % (0.0259 mol/kg) at 298.2 K (27). According to the phase diagram in Fig. 4, the solubility of 10.3 mass % is improbably high. The discrepancy may be due to the presence of water in the earlier studies (22,25), and the absence of water in the later work (27). The solubility reported in (27) is in excellent agreement with the solubility of 0.024 mol/kg reported by Guempel (7).</p> <p>The $\text{UO}_2(\text{NO}_3)_2$ - Other Organic Solvents - H_2O Systems</p>	
<p>The solubility of uranyl nitrate in a variety of alcohols, ketones,</p> <p style="text-align: right;">(Continued on the next page)</p>	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various organics	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p>ethers, esters, nitro compounds and other organics has been reported in a number of papers (1,3,9,13-21,26-31,33,34). In many publications, neither the equilibrium solid nor the number of liquid phases which form when $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ is dissolved are specified. There are only a few systems which can be critically evaluated.</p> <p>The $\text{UO}_2(\text{NO}_3)_2$ - isobutyl alcohol - water system was thoroughly studied by Katzin and Sullivan (16). According to this study, the solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ at 298.2 K is 2.176 mol/kg in the organic-rich phase. De Keyser et al. (14) reported a solubility value of 2.000 mol/kg at 293.2 K. The agreement between the two sets of data appears to be satisfactory. However, it should be noted that in paper (14) the formation of two liquid phases following the dissolution of the hexahydrate is not reported. The system with isoamyl alcohol has also been extensively investigated (16). The solubility at 298.2 K estimated by the evaluators from the phase diagram in (16) is about 2.1 mol/kg. This value appears to be in satisfactory agreement with 2.00 mol/kg reported by Templeton and Hall (15).</p> <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in acetone at 293.2 K according to Warner (19) is 4.09 mol/kg. The solubility at 298.2 K estimated by the evaluators from the phase diagram in Katzin and Sullivan (16) is 4.26 mol/kg. The difference in solubility is as expected, considering the difference in temperature. The results reported in other publications (1,3,34) are much too low and should be rejected. The solubility value of 1065.75 g/dm³ of solution cannot be compared with other data because the density is not given. The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ at 293.2 K in 2-butanone has been studied (14,19), and agreement between the two results is very good. The system $\text{UO}_2(\text{NO}_3)_2$ - hexone - water was also studied (16). It follows from the phase diagram in the publication that dissolution of the hexahydrate in hexone produces two liquid phases. The solubility at 298.2 K is 3.154 mol/kg in the water-rich phase, and 2.005 mol/kg in the organic-rich phase (16). According to</p> <p style="text-align: right;">(Continued on the next page)</p>	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various organics	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p>Warner (19), the corresponding solubilities at 293.2 K are 3.03 mol/kg and 1.91 mol/kg. De Keyser et al. (14) found the solubility at 293.2 K is 1.920 mol/kg. However, the formation of two liquid phases is not reported (14). The solubility value reported by Yaffe (13) is much lower and should be rejected.</p> <p>The $\text{UO}_2(\text{NO}_3)_2$ - diisopropyl ether - water system was investigated by Vdovenko et al. (28). They found the solubility is 2.42 mol/kg in the water-rich phase, and 0.295 mol/kg in the organic-rich phase. Warner (18) reported solubility values at 293.2 K of 2.31 mol/kg in the water-rich phase, and 0.26 mol/kg in the organic-rich phase. The difference in solubilities reported in (28) and (29) is as might be expected, when considering the difference in temperatures. According to Yaffe (13), the solubility in diisopropyl ether at 293.2 K is 0.24 mol/kg, a value close to that reported by Warner. However, in Ref. (13) the formation of two liquid phases was not noted. Also, De Keyser et al. (14) did not report the formation of two liquid phases. The solubility value of 0.4496 mol/kg at 293.2 K given in (14) appears to refer to a mixture of two unseparated liquid phases.</p> <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in tri-n-butyl phosphate (TBP) was studied by a number of investigators (20,21,29,31). There is good agreement among the values reported in three (20,21,31). Solubilities over the temperature range 273.2 K - 373.2 K measured by Nikolaev et al. (31) can be used as tentative values.</p> <p>In the case of the other solvents, the most reliable solubility data appear to be those measured by Katzin and Sullivan, Vdovenko et al., Warner, and De Keyser et al. As a rule, these are accurate and can be used as tentative solubilities. However, the solubility values reported by De Conninck and Yaffe are of rather poor quality, and should be rejected. Data for the system $\text{UO}_2(\text{NO}_3)_2$ - $(\text{C}_2\text{H}_5)_2\text{O}$ - D_2O can be found in Vdovenko and Legin (32).</p>	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various organics	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) <p style="text-align: center;">REFERENCES</p> <ol style="list-style-type: none"> 1. De Conninck, Oe. <i>Compt. Rend.</i>, <u>1900</u>, 131, 1303. 2. De Conninck, Oe. <i>Compt. Rend.</i>, <u>1901</u>, 132, 90. 3. Moore, R. B.; Schlundt, H. <i>Phil. Mag.</i>, <u>1906</u>, 12, 393. 4. Lebeau, P. <i>Bull. Soc. Chim. France</i>, <u>1911</u>, 9, 295. 5. Lebeau, P. <i>Bull. Soc. Chim. France</i>, <u>1911</u>, 9, 298. 6. Misciattelli, P. <i>Phil. Mag.</i>, <u>1929</u>, 670. 7. Guempel, O. <i>Bull. Soc. Chim. Belg.</i>, <u>1929</u>, 38, 443. 8. Misciattelli, P. <i>Gazz. Chim. Italiana</i>, <u>1930</u>, 60, 839. 9. Kraus, C. A. <i>Report</i>, <u>1942</u>, AECD-3867. 10. Van Name, R. G. <i>Report</i>, <u>1942</u>, AECD-4086. 11. Bachelet, M.; Cheylan, E. J. <i>Chim. Phys.</i>, <u>1947</u>, 44, 234. 12. Norstrom, A.; Sillen, L. G. <i>Svensk. Kem.</i>, <u>1948</u>, 11, 227. 13. Yaffe, L. <i>Can. J. Res.</i>, <u>1949</u>, 27B, 638. 14. De Keyser, W. L.; Cypres, R.; Herrmann, M. <i>Bull. Centre Phys. Nucl. Universite Libre de Bruxelles</i>, <u>1950</u>, No. 17. 15. Templeton, C. C.; Hall, N. F. <i>Can. J. Res.</i>, <u>1950</u>, 28B, 156. 16. Katzin, L. I.; Sullivan, J. C. <i>J. Phys. Chem.</i>, <u>1951</u>, 55, 346. 17. Warner, R. K. <i>Australian J. Appl. Sci.</i>, <u>1952</u>, 3, 156. 18. Warner, R. K. <i>Australian J. Appl. Sci.</i>, <u>1953</u>, 4, 427. 19. Warner, R. K. <i>Australian J. Appl. Sci.</i>, <u>1953</u>, 4, 581. 20. Wendlandt, W. W.; Bryant, J. M. <i>J. Phys. Chem.</i>, <u>1956</u>, 60, 1145. 21. Healy, T. V.; McKay, H. A. C. <i>Trans. Faraday Soc.</i>, <u>1956</u>, 52, 633. 22. Vdovenko, V. M.; Kovalskaya, M. P.; Kovaleva, T. V. <i>Zh. Neorg. Khim.</i>, <u>1957</u>, 2, 1677. <i>Russ. J. Inorg. Chem.</i>, <u>1957</u>, 2, 359. 23. Vdovenko, V. M.; Kovalskaya, M. P.; Gerbanevskaya, M. M. <i>Trudy Radiovogo Inst. im. V. G. Khlopina</i>, <u>1958</u>, 8, 8. 24. Vdovenko, V. M.; Kovaleva, T. V.; Moskalkova, A. E. <i>Trudy Radiovogo Inst. im. V. G. Khlopina</i>, <u>1958</u>, 8, 17. 25. Vdovenko, V. M.; Kovaleva, T. V. <i>Trudy Radiovogo Inst. im. V. G. Khlopina</i>, <u>1958</u>, 8, 22. 26. Vdovenko, V. M.; Suglobova, I. G. <i>Zh. Neorg. Khim.</i>, <u>1958</u>, 3, 1403. <i>Russ. J. Inorg. Chem.</i>, <u>1958</u>, 3, 187. 27. Vdovenko, V. M.; Suglobova, I. G.; Suglov, D. N. <i>Radiokhim.</i>, <u>1959</u>, 1, 637. <p style="text-align: right;">(Continued on the next page)</p>	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various organics	EVALUATOR: S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.
CRITICAL EVALUATION: (Continued) 28. Vdovenko, V. M.; Suglobova, I. G.; Mezei, M. <i>Radiokhim.</i> , <u>1962</u> , 4, 388. <i>Sov. Radiochem.</i> , <u>1962</u> , 4, 342. 29. Hurwic, J.; Michalczyk, J. <i>Proc. Symp. Theory and Structure of Complex Compounds</i> , Wroclaw, <u>1962</u> , Pergamon Press, Oxford and WNT, Warszawa, <u>1964</u> , 289. 30. Verstegen, J. M. P. <i>J. Inorg. Nucl. Chem.</i> , <u>1964</u> , 26, 1589. 31. Nikolaev, A. V.; Dyadin, Yu. A.; Yakovlev, I. I. <i>Dokl. Akad. Nauk SSSR</i> , <u>1964</u> , 158, 1130. 32. Vdovenko, V. M.; Legin, E. K. <i>Radiokhim.</i> , <u>1966</u> , 8, 317. 33. Ripan, R.; Eger, I.; Bojan, N. <i>Rev. Roum. Chim.</i> , <u>1968</u> , 13, 421. 34. Marcus, Y.; Kertes, A. S. <i>Ion Exchange and Solvent Extraction of Metal Complexes</i> , J. Wiley - Interscience, London, <u>1969</u> . 35. Khod'ko, N. N.; Kolevich, T. A.; Umreiko, D. S. <i>Zh. Neorg. Khim.</i> , <u>1989</u> , 34, 1808. <i>Russ. J. Inorg. Chem.</i> , <u>1989</u> , 34, 1025.	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Methanol; CH_4O ; [67-56-1] (3) Ethanol; $\text{C}_2\text{H}_6\text{O}$; [64-17-5] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Conninck, Oe. <i>Compt. Rend.</i> , <u>1900</u> , 131, 1303 - 1305.									
VARIABLES: Temperature: 285 to 287 K	PREPARED BY: L. Fuks; S. Siekierski									
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in methanol and ethanol is reported to be as follows:</p> <table border="1" data-bbox="403 711 1117 899"> <thead> <tr> <th>Material</th> <th>Formula</th> <th>$\text{UO}_2(\text{NO}_3)_2$</th> </tr> </thead> <tbody> <tr> <td>Methanol</td> <td>CH_3OH</td> <td>1 part/55 parts alcohol</td> </tr> <tr> <td>Ethanol</td> <td>$\text{CH}_3\text{CH}_2\text{OH}$</td> <td>1 part/30 parts alcohol</td> </tr> </tbody> </table> <p>COMMENTS AND/OR ADDITIONAL DATA:</p> <p>The solubility of methanol is an average value of determinations at temperatures of 11°C, 11.8°C and 12.6°C.</p> <p>The solubility of ethanol is an average value of determinations at temperatures of 12.7°C, 12.9°C and 13°C.</p>		Material	Formula	$\text{UO}_2(\text{NO}_3)_2$	Methanol	CH_3OH	1 part/55 parts alcohol	Ethanol	$\text{CH}_3\text{CH}_2\text{OH}$	1 part/30 parts alcohol
Material	Formula	$\text{UO}_2(\text{NO}_3)_2$								
Methanol	CH_3OH	1 part/55 parts alcohol								
Ethanol	$\text{CH}_3\text{CH}_2\text{OH}$	1 part/30 parts alcohol								
AUXILIARY INFORMATION										
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate, presumably the hexahydrate (compilers), dried 5 hours 90°C . 2. Rectified pure grade methanol.									
	ESTIMATED ERROR: Nothing specified.									
	REFERENCES:									

COMPONENTS:		ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Yaffe, L.
(2) Various alcohols		Can. J. Res., 1949, 27B, 638 - 645.
(3) Water; H_2O ; [7732-18-5]		
VARIABLES: One temperature: 293 K		PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:		
Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in various alcohols is reported to be:		
Alcohol	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ g/(100 cm^3)
1-Pentanol	$\text{CH}_3(\text{CH}_2)_4\text{OH}$; [71-41-0]	55
3-Methyl-1-butanol	$(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{OH}$; [123-51-3]	57
3-Pentanol	$\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$; [584-02-1]	57
2-Methyl-1-pentanol	$\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$; [105-30-6]	43
2-Ethyl-1-butanol	$\text{CH}_3\text{CH}_2\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{OH}$; [97-95-0]	49
1-Heptanol	$\text{CH}_3(\text{CH}_2)_6\text{OH}$; [111-70-6]	43
1-Octanol	$\text{CH}_3(\text{CH}_2)_7\text{OH}$; [111-87-5]	37
Geraniol	$(\text{CH}_2)_2\text{C}=\text{CHCH}_2\text{CH}_2\text{C}(\text{CH}_3)=\text{CHCH}_2\text{OH}$; [106-24-1]	36
1-Undecanol	$\text{CH}_3(\text{CH}_2)_{10}\text{OH}$; [112-42-5]	27
2-Ethoxyethanol (cellosolve)	$\text{CH}_3\text{CH}_2\text{O}(\text{CH}_2)_2\text{OH}$; [110-80-5]	102
2-Hexoxyethanol	$\text{CH}_3(\text{CH}_2)_5\text{OCH}_2\text{CH}_2\text{OH}$; [112-25-4]	68
4-Methoxy-4-butoxy- 1-butanol	$\text{CH}_3(\text{CH}_2)_3\text{O}(\text{CH}_2)_4\text{CH}_2\text{OH}$; [112-25-4]	44
2,3-Dibromo-1- propanol	$\text{CH}_2\text{BrCHBrCH}_2\text{OH}$; [96-13-6]	32
AUXILIARY INFORMATION		
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A 25 mL portion of the solvent and a few grams of uranyl nitrate hexahydrate were placed in a thermostated water bath at 20°C. Additional solid added until solution was saturated. The minimum time for saturation to occur was taken to be 24 hr. Before an analysis, solution was centrifuged to remove any suspended solid material. The uranyl nitrate was back-extracted into water, and the concentration measured colorimetrically after diluting solution to a concentration where Beer's law applied. Results of these analyses were checked using U-233 as tracer (1).		SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate hexahydrate was obtained from the Eldorado Mining and Refining Co. The maximum impurities consisted of <0.01% rare earths. 2. Alcohols were "practical" grade, or better.
		ESTIMATED ERROR: Solubility: Nothing specified. The results of the two methods of analysis agreed to within $\pm 5\%$. Temperature: Precision ± 0.5 K.
		REFERENCES: 1. Yaffe, L. Can. Chem. Process Inds., 1947, 31, 812.

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	De Keyser, W. L.; Cypres, R.; Herrmann, M.		
(2) Various alcohols	<i>Bull. Centre Phys. Nucl. Universite Libre de Bruxelles, No. 17, 1950.</i>		
(3) Water; H_2O ; [7732-18-5]			
VARIABLES:	PREPARED BY:		
One temperature: 293 K	A. Sozanski; S. Siekierski		
EXPERIMENTAL VALUES:			
The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ at 20°C in various organic solvents is tabulated as follows:			
Organic	Formula	$\text{UO}_2(\text{NO}_3)_2^a$	
		mass %	mol/kg
2-butanol (sec-butyl alcohol)	$\text{CH}_3\text{CH}_2\text{CHOHCH}_3$; [78-92-2]	47.12	2.261
2-Methyl-1-propanol (isobutyl alcohol)	$(\text{CH}_3)_2\text{CHCH}_2\text{OH}$; [78-83-1]	44.07	2.000
3-Methyl-1-butanol (isoamyl alcohol)	$(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$; [123-51-3]	39.45	1.653
4-Methyl-2-pentanol (methyl isobutyl carbinol)	$(\text{CH}_3)_2\text{CHCH}_2\text{CHOHCH}_3$; [108-11-2]	34.00	1.307
^a Molalities calculated by the compilers. Mass % calculated from g of anhydrous salt per 100 g of solution.			
AUXILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm ³ of solvent, and mixed for 30 min. at 10 - 20°C above the desired temperature. The liquid with crystals was transferred to a thermostat where it was stirred for another 30 min. After settling for 15 min., a 10 cm ³ sample was pipetted for weighing. Uranium was determined as U_3O_8 , after water and solvent were evaporated, the residue was dried at 120°C, and then calcined at 900°C in a platinum crucible to constant weight.	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, nothing specified. Crystallization water, 21.30%, theor. 21.52%.		
	ESTIMATED ERROR:		
	Solubility: reported solubility is the mean of two values which differ by 0.001 mol/kg.		
	REFERENCES:		

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) 3-Methyl-1-butanol; $\text{C}_5\text{H}_{11}\text{OH}$; [123-51-3] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F. <i>Can. J. Res.</i> , <u>1950</u> , 28B, 156 - 160.
VARIABLES: Temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$ (isoamyl alcohol) is: 44.1 g $\text{UO}_2(\text{NO}_3)_2$ /100 g solution, or 2.00 mol/kg ^a ^a Molality calculated by the compilers as moles/kg of the mixture which consists of the alcohol and water.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: A suitable volume of solvent was mixed in a test tube with appropriate amount of the uranyl nitrate hexahydrate. The sample was rotated at 30 rpm at 25°C for 5 days. Saturation was assured by the presence of distinct lumps in the final solid phase. The solution was then filtered and the solubility determined by weighing the solution in a covered platinum crucible and igniting.	SOURCE AND PURITY OF MATERIALS: "Practical" grade solvent was used. ESTIMATED ERROR: Temperature: Within ± 0.05 . REFERENCES:

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Katzin, L. I.; Sullivan, J. C. <i>J. Phys. Colloid Chem.</i> , <u>1951</u> , <i>55</i> , 346-374.			
(2) 2-Methyl-1-propanol; $\text{C}_4\text{H}_{10}\text{O}$; [78-83-1]						
(3) Water; H_2O ; [7732-18-5]						
VARIABLES:			PREPARED BY:			
Composition at 298 K			A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
2-Methyl-1-Propanol						
The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3)_2\text{CHCH}_2\text{OH} - \text{H}_2\text{O}$ System ^a						
Aqueous Phase			Organic Phase			
$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Solid Phase ^b
mass %	mol/kg	mass %	mass %	mol/kg	mass %	
---	---	86.04	---	---	---	
6.67	0.181	82.04	0.02	0.0005	15.00	
12.87	0.3749	77.45	0.86	0.022	14.42	
16.28	0.4935	74.28	1.56	0.0402	13.34	
30.15	1.095	61.93	10.63	0.3019	14.75	
33.91	1.302	56.74	16.02	0.4841	14.82	
38.40	1.582	52.83	24.17	0.8089	14.82	
43.69	1.969	49.52	30.89	1.134	14.66	
55.61	3.179	39.66	46.06	2.167	15.34	A
55.39	3.151	39.97	46.26	2.184	15.03	A
			46.06	2.167	12.18	A
			46.16	2.176	9.11	A
			49.59	2.496	6.84	A
			49.96	2.534	6.04	A
			51.37	2.861	6.13	A
			51.74	2.721	5.97	A
			54.43	3.031	6.04	A
			55.57	3.174	5.52	A
			57.54	3.439	5.12	A
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. Solid and liquid mixture equilibrated by stirring for about one week. Liquid-liquid distribution mixtures were equilibrated for only a few hours. Equilibration vessels closed to the atmosphere, and protected from strong light. Analyses based on principle of wet residues (1). Weighed samples analyzed for uranium and water. To avoid difficulties from solvent, samples for uranium made up to volume in mixture of water and alcohol. The aliquots were withdrawn, evaporated, and ignited to U_3O_8 . Alcohols were estimated by difference. Water by Karl Fischer reagent. Solid phase was dried between filter papers. One sample weighed for uranium, three for water analysis.			1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, C. P. grade, Mallinckrodt Chemical Co. Lower hydrates prepared by desiccation over concentrated H_2SO_4 under reduced pressure.			
			2. Alcohols were C. P. grade.			
			ESTIMATED ERROR:			
			Solubility: nothing specified. The average deviation of uranium and water determinations, $\pm 0.1\%$ and $\pm 0.3\%$, respectively.			
			Temperature: Precision $\pm 0.03\text{K}$.			
			REFERENCES:			
			1. Schreinemakers, F. A. H. <i>Z. physik. Chem.</i> , <u>1893</u> , <i>11</i> , 81.			

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Katzin, L. I.; Sullivan, J. C.
(2) 2-Methyl-1-propanol; $\text{C}_4\text{H}_{10}\text{O}$; [78-83-1]	<i>J. Phys. Colloid Chem.</i> , 1951 , <i>55</i> , 346-374.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

2-Methyl-1-Propanol

The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3)_2\text{CHCH}_2\text{OH} - \text{H}_2\text{O}$ System^a

Organic Phase

$\text{UO}_2(\text{NO}_3)_2$		H_2O	Solid Phase ^b
mass %	mol/kg	mass %	
57.35	3.412	4.42	A+B
57.08	3.375	4.52	A+B
57.83	3.480	4.57	A+B
57.36	3.414	4.71	A+B
57.68	3.459	4.78	A+B
57.74	3.467	4.90	A+B
57.29	3.404	4.65	A+B
58.69	3.606	3.98	B+C
58.59	3.591	3.86	B+C
58.36	3.557	4.13	B+C
58.19	3.532	4.64	B+C
55.05	3.108	2.26	C+D
55.69	3.190	2.28	C+D
51.07	2.649	0.53	D
51.20	2.663	0.75	D

^aMolalities calculated by compilers as moles per 1 kg of the mixture consisting of isobutyl alcohol and water.

^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$,

C = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot \text{C}_4\text{H}_9\text{OH}$, D = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{C}_4\text{H}_9\text{OH}$.

COMMENTS AND/OR ADDITIONAL DATA:

A plot of the water molality versus uranyl nitrate molality in organic phase gives the relationship between the increase in water and the increase in uranyl nitrate concentration. The set of points is well represented by a straight line. The slope is within experimental error, 4.0. Phase diagrams for the system are given on the next page.

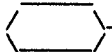
(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Katzin, L. I.; Sullivan, J. C.
(2) 2-Methyl-2-propanol; $\text{C}_4\text{H}_{10}\text{O}$; [75-65-0]	<i>J. Phys. Colloid Chem.</i> , 1951, 55, 346-374.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)			
2-Methyl-2-Propanol			
The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3)_3\text{COH} - \text{H}_2\text{O}$ System ^a			
$\text{UO}_2(\text{NO}_3)_2$		H_2O	Solid _b Phase
mass %	mol/kg	mass %	
54.50	3.040	45.50	A
55.33	3.143	39.79	A
47.86	2.330	43.25	B
45.16	2.090	44.40	B
41.46	1.797	37.51	B
37.26	1.507	29.41	B
24.73	0.8338	9.47	B
22.64	0.7427	7.86	B
15.15	0.4531	2.54	B
17.25	0.5290	2.25	B+C
16.95	0.5180	2.06	B+C
17.11	0.5239	1.91	B+C
24.11	0.8063	1.36	C
34.51	1.337	1.30	C

^aMolalities calculated by the compilers as moles/kg of the mixture consisting of tertiary butyl alcohol and water.

^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot 3(\text{CH}_3)_3\text{COH}$,
C = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 4(\text{CH}_3)_3\text{COH}$, D = $\text{UO}_2(\text{NO}_3)_2 \cdot 3(\text{CH}_3)_3\text{COH}$.

COMPONENTS:		ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Warner, R. K.	
(2) Various alcohols		Australian J. Appl. Sci., 1953, 4, 581 - 589.	
(3) Water; H_2O ; [7732-18-5]			
VARIABLES:		PREPARED BY:	
One temperature: 293 K		L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:			
The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in various alcohols is reported to be:			
Alcohol	Formula	$\text{UO}_2(\text{NO}_3)_2$ g/(g soln)	mol/kg ^a
Methanol	CH_3OH ; [67-56-1]	0.675	5.27
Ethanol	$\text{CH}_3\text{CH}_2\text{OH}$; [64-17-5]	0.615	4.05
1-Propanol	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$; [71-23-8]	0.529	2.85
2-Propanol	$\text{CH}_3\text{CHOHCH}_3$; [67-63-0]	0.549	3.09
1-Butanol	$\text{CH}_3(\text{CH}_2)_3\text{OH}$; [71-36-3]	0.462	2.18
1-Pentanol	$\text{CH}_3(\text{CH}_2)_4\text{OH}$; [71-41-0]	0.387	1.60
1-Hexanol	$\text{CH}_3(\text{CH}_2)_5\text{OH}$; [111-27-3]	0.341	1.31
1-Heptanol	$\text{CH}_3(\text{CH}_2)_6\text{OH}$; [111-70-6]	0.310	1.14
2-Ethyl-1-hexanol	$\text{CH}_3(\text{CH}_2)_3\text{CH}(\text{C}_2\text{H}_5)\text{CH}_2\text{OH}$; [104-76-7]	0.235	0.780
1-Octanol	$\text{CH}_3(\text{CH}_2)_7\text{OH}$; [111-87-5]	0.280	0.987
2-Octanol	$\text{CH}_3(\text{CH}_2)_5\text{CHOHCH}_3$; [123-96-6]	0.271	0.943
Cyclohexanol	 -OH ; [108-93-0]	0.403	1.71
^a Molalities calculated by the compilers, mol/kg of the mixture consisting of the alcohol and water.			
AUXILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:	
The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed with the appropriate amount of pure solvent in a small flask, warmed to between 30°C-50°C, and agitated for 15 min. The flask was then set in a thermostated bath at 20°C, and shaken for 6 to 8 hours. When equilibrium was attained, the solution was decanted, filtered, and sampled for analysis. The analysis consisted of total uranium nitrate concentration. This was determined by evaporation of the weighed aliquots, followed by ignition to U_3O_8 .		1. "AR" $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.	
		2. C.P. grade anhydrous alcohols.	
		ESTIMATED ERROR:	
		Solubility: Determinations repeated until agreement within 0.2 mass %.	
		Temperature: Precision ± 0.05 K.	
		REFERENCES:	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Ethyl acetate; $\text{C}_4\text{H}_8\text{O}_2$; [141-78-6] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Conninck, Oe. <i>Compt. Rend.</i> , <u>1901</u> , 132, 90-91.
VARIABLES: One temperature: about 283 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in $\text{CH}_3\text{COOC}_2\text{H}_5$ is reported to be 1 part of the salt per 18.4 parts of ethyl acetate. This value is an average of determinations at 10.3°C, and at 10.7°C.</p> <p>The initial salt was probably a mixture of hexa- and trihydrate (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Ethyl acetate; $\text{C}_4\text{H}_8\text{O}_2$; [141-78-6] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Kraus, C. A. Report, 1942, AECD-3867.
VARIABLES: One temperature: 299 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $\text{CH}_3\text{COOC}_2\text{H}_5$ at 26°C was reported to be 66.74 mass %, i.e. 200.7 g/100 g of the solvent.</p> <p>The corresponding molality was calculated by the compilers as 2.790^{a} mol/kg, assuming that the solubility value in mass % refers to the content of the hexahydrate.</p> <p>^aMoles of $\text{UO}_2(\text{NO}_3)_2$ in 1 kg of the mixture consisting of ethyl acetate and water.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A supersaturated solution was seeded and allowed to come to equilibrium at 26°C . Samples of the solution were analyzed by converting the solute to U_3O_8 . No additional information.	SOURCE AND PURITY OF MATERIALS: 1. C. P. uranyl nitrate hexahydrate was twice recrystallized. 2. Ethyl acetate, anhydrous. Carbide and Carbon Chemical, 99% pure, not degatured, b.p. range 75°C to 85°C .
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various esters (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yaffe, L. <i>Can. J. Res.</i> , <u>1949</u> , 27B, 638-645.																														
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski																														
EXPERIMENTAL VALUES: The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in various esters is reported to be:																															
<table><tr><th>Ester</th><th>Formula</th><th>$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ g/(100 cm^3)</th></tr><tr><td>2-Ethyl-1-butanol [97-95-0]</td><td>$(\text{C}_2\text{H}_5)_2\text{CHCH}_2\text{OH}$</td><td>49</td></tr><tr><td>Vinyl acetate [108-05-4]</td><td>$\text{CH}_3\text{COOCH}=\text{CH}_2$</td><td>31</td></tr><tr><td>Ethyl acetate [141-78-6]</td><td>$\text{CH}_3\text{COOCH}_2\text{CH}_3$</td><td>82</td></tr><tr><td>Isopropyl acetate [108-21-4]</td><td>$\text{CH}_3\text{COOCH}(\text{CH}_3)_2$</td><td>64</td></tr><tr><td>Ethyl acetylglycolate</td><td>$\text{CH}_3\text{COOCH}_2\text{COOCH}_2\text{CH}_3$</td><td>110</td></tr><tr><td>Isoamyl formate [35073-27-9]</td><td>$\text{CHOO}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$</td><td>24</td></tr><tr><td>Amyl formate [638-49-3]</td><td>$\text{CHOO}(\text{CH}_2)_4\text{CH}_3$</td><td>56</td></tr><tr><td>Butyl acetate [123-86-4]</td><td>$\text{CH}_3\text{COO}(\text{CH}_2)_3\text{CH}_3$</td><td>68</td></tr><tr><td>sec-Butyl acetate [105-46-4]</td><td>$\text{CH}_3\text{COOCH}(\text{CH}_3)_2\text{C}_2\text{H}_5$</td><td>61</td></tr></table>		Ester	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ g/(100 cm^3)	2-Ethyl-1-butanol [97-95-0]	$(\text{C}_2\text{H}_5)_2\text{CHCH}_2\text{OH}$	49	Vinyl acetate [108-05-4]	$\text{CH}_3\text{COOCH}=\text{CH}_2$	31	Ethyl acetate [141-78-6]	$\text{CH}_3\text{COOCH}_2\text{CH}_3$	82	Isopropyl acetate [108-21-4]	$\text{CH}_3\text{COOCH}(\text{CH}_3)_2$	64	Ethyl acetylglycolate	$\text{CH}_3\text{COOCH}_2\text{COOCH}_2\text{CH}_3$	110	Isoamyl formate [35073-27-9]	$\text{CHOO}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$	24	Amyl formate [638-49-3]	$\text{CHOO}(\text{CH}_2)_4\text{CH}_3$	56	Butyl acetate [123-86-4]	$\text{CH}_3\text{COO}(\text{CH}_2)_3\text{CH}_3$	68	sec-Butyl acetate [105-46-4]	$\text{CH}_3\text{COOCH}(\text{CH}_3)_2\text{C}_2\text{H}_5$	61
Ester	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ g/(100 cm^3)																													
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(Continued on the next page)																															
AUXILIARY INFORMATION																															
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A 25 cm^3 portion of the solvent and a few grams of uranyl nitrate hexahydrate were placed in a sealed centrifuge tube, and agitated in a water bath thermostatically set at 20°C. Additional solid was added until a saturated solution was obtained. The minimum time for saturation to occur was 24 hr. Prior to analysis, the solution was centrifuged to remove any suspended solid material. The uranyl nitrate was back-extracted into water, and the concentration determined colorimetrically after diluting the solution so that the uranium content was in the proper range to obey Beer's law. Results were checked with U-233 as tracer	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate hexahydrate was obtained from the Eldorado Mining and Refining Co. The maximum impurities consisted of <0.1% rare earths. 2. Esters "practical grade" or better. ESTIMATED ERROR: Solubility: Results of the two analysis methods agreed to within $\pm 5\%$. Temperature: Precision ± 0.05 K. REFERENCES:																														

COMPONENTS:		ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]		Yaffe, L.
(2) Various esters		Can. J. Res., 1949, 27B, 638-645.
(3) Water; H_2O ; [7732-18-5]		
EXPERIMENTAL VALUES: (Continued)		
The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in various esters is reported to be:		
Ester	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ g/(100 cm^3)
Isobutyl acetate [110-19-0]	$\text{CH}_3\text{COOCH}_2\text{CH}(\text{CH}_3)_2$	50
2-Ethoxyethyl acetate [111-15-9]	$\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OC}_2\text{H}_5$	125
Isoamyl acetate [123-92-2]	$\text{CH}_3\text{COO}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$	55
Amyl acetate [628-63-7]	$\text{CH}_3\text{COO}(\text{CH}_2)_4\text{CH}_3$	46
Isobutyl propionate [540-42-1]	$\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}(\text{CH}_3)_2$	31
Butyl propionate [590-01-2]	$\text{CH}_3\text{CH}_2\text{COO}(\text{CH}_2)_3\text{CH}_3$	55
Amyl propionate [624-54-4]	$\text{CH}_3\text{CH}_2\text{COO}(\text{CH}_2)_4\text{CH}_3$	37
Methyl phenyl acetate [101-41-7]	$\text{C}_6\text{H}_5\text{CH}_2\text{COOCH}_3$	33
Amyl butyrate [540-18-1]	$\text{CH}_3(\text{CH}_2)_2\text{COO}(\text{CH}_2)_4\text{CH}_3$	25
Phenyl ethyl acetate [103-45-7]	$\text{CH}_3\text{COO}(\text{CH}_2)_2\text{C}_6\text{H}_5$	35
Butyl oxalate [2050-60-4]	$[-\text{COO}(\text{CH}_2)_3\text{CH}_3]_2$	20
Pentanoic acid pentyl ester; [2173-56-0]	$\text{CH}_3(\text{CH}_2)_3\text{COO}(\text{CH}_2)_4\text{CH}_3$	21
Butyl cellosolve acetate; [112-07-2]	$\text{CH}_3\text{COOCH}_2(\text{CH}_2)_2\text{CH}_2\text{O}(\text{CH}_2)_3\text{CH}_3$	77
Isoamyl caproate [2198-61-0]	$\text{CH}_3(\text{CH}_2)_4\text{COO}(\text{CH}_2)_2\text{CH}(\text{CH}_3)_2$	7
Geraniol acetate [16409-44-2]	$\text{CH}_3\text{COOCH}_2\text{CH}=\text{C}(\text{CH}_3)(\text{CH}_2)_2\text{CH}=\text{C}(\text{CH}_3)_2$	16
Amyl succinate [645-69-2]	$[-\text{CH}_2\text{COO}(\text{CH}_2)_4\text{CH}_3]_2$	25
Butyl adipate [105-99-7]	$[-(\text{CH}_2)_2\text{COO}(\text{CH}_2)_3\text{CH}_3]_2$	40
Ethyl sebacate [110-40-7]	$[-(\text{CH}_2)_4\text{COOCH}_2\text{CH}_3]_2$	48
Butyl sebacate [109-43-3]	$[-(\text{CH}_2)_4\text{COO}(\text{CH}_2)_3\text{CH}_3]_2$	37

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various esters (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Keyser, W. L.; Cypres, R.; Herrmann, M. <i>Bull. Centre Phys. Nucl. Universite Libre de Bruxelles</i> , No. 17, 1950.																																																						
VARIABLES: One temperature: 293 K	PREPARED BY: A. Sozanski; S. Siekierski																																																						
EXPERIMENTAL VALUES: The Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in Various Esters Composition of Saturated Solutions ^a <table><tr><th rowspan="2">Ester</th><th rowspan="2">Formula</th><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th></tr><tr><th>mass %</th><th>mol/kg</th></tr><tr><td rowspan="4">Ethyl acetate [141-78-6]</td><td rowspan="4">$\text{CH}_3\text{COOC}_2\text{H}_5$</td><td>15.7</td><td>44.68</td><td>2.050</td></tr><tr><td>20.3</td><td>46.29</td><td>2.187</td></tr><tr><td>25</td><td>48.33</td><td>2.374</td></tr><tr><td>30</td><td>50.67</td><td>2.607</td></tr><tr><td>Isopropyl acetate [108-21-4]</td><td>$\text{CH}_3\text{COOCH}(\text{CH}_3)_2$</td><td>20</td><td>41.70</td><td>1.815</td></tr><tr><td rowspan="4">Butyl acetate [123-86-4]</td><td rowspan="4">$\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$</td><td>15.9</td><td>33.49</td><td>1.278</td></tr><tr><td>20</td><td>34.40</td><td>1.331</td></tr><tr><td>25</td><td>35.92</td><td>1.423</td></tr><tr><td>30</td><td>38.39</td><td>1.581</td></tr><tr><td rowspan="4">Amyl acetate [628-63-7]</td><td rowspan="4">$\text{CH}_3\text{COO}(\text{CH}_2)_4\text{CH}_3$</td><td>16.4</td><td>33.24</td><td>1.264</td></tr><tr><td>20</td><td>34.54</td><td>1.339</td></tr><tr><td>25</td><td>36.08</td><td>1.432</td></tr><tr><td>30</td><td>37.65</td><td>1.532</td></tr></table> ^a Molalities calculated by the compilers. Solid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ (compilers).		Ester	Formula	$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		mass %	mol/kg	Ethyl acetate [141-78-6]	$\text{CH}_3\text{COOC}_2\text{H}_5$	15.7	44.68	2.050	20.3	46.29	2.187	25	48.33	2.374	30	50.67	2.607	Isopropyl acetate [108-21-4]	$\text{CH}_3\text{COOCH}(\text{CH}_3)_2$	20	41.70	1.815	Butyl acetate [123-86-4]	$\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$	15.9	33.49	1.278	20	34.40	1.331	25	35.92	1.423	30	38.39	1.581	Amyl acetate [628-63-7]	$\text{CH}_3\text{COO}(\text{CH}_2)_4\text{CH}_3$	16.4	33.24	1.264	20	34.54	1.339	25	36.08	1.432	30	37.65	1.532
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METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm ³ of solvent, and mixed for 30 min at 10°C to 20°C above the desired temperature. The liquid with crystals was transferred to a thermostat, and stirred for 30 min more. After 15 min settling time, a 10 cm ³ portion was pipetted for weighing. Uranium was determined as U_3O_8 in samples which had the liquid phase evaporated. The samples were then dried and calcined in platinum crucible to constant weight of U_3O_8 at 900°C.	SOURCE AND PURITY OF MATERIALS: The uranyl nitrate hexahydrate had 21.30 % water of crystallization, theor. 21.52 %. ESTIMATED ERROR: Solubility: reported solubilities are the mean of two values. Temperature: Nothing specified. REFERENCES:																																																						

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Ethyl butyrate; $\text{C}_6\text{H}_{12}\text{O}_2$; [105-54-4] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F. <i>Can. J. Res.</i> , <u>1950</u> , <i>28B</i> , 156-160.
VARIABLES: One temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $\text{CH}_3(\text{CH}_2)_2\text{COOCH}_2\text{CH}_3$ at 25°C is reported to be 40.6 g of the anhydrous uranyl nitrate per 100 g of solution. The compilers calculate this solubility as 1.73 mol/kg of the mixture consisting of ethyl butyrate and water.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: A suitable volume of solvent was mixed in a test tube with appropriate amount of the hexahydrate. The sample was then rotated at 30 rpm at 25°C for 5 days. Saturation was ensured by the presence of distinct lumps in the final solid phase. The solution was then filtered and the solubility was determined by the weighing of a desired amount of the solution in a covered platinum crucible, followed by ignition (1).	SOURCE AND PURITY OF MATERIALS: "Practical" grade solvent was used. ESTIMATED ERROR: Temperature: Within $\pm 0.05^\circ\text{C}$. REFERENCES: 1. Templeton, C. C.; Hall, N. F. <i>J. Phys. Colloid Chem.</i> , <u>1947</u> , <i>51</i> , 1441.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Conninck, Oe. <i>Compt. Rend.</i> , <u>1900</u> , 131, 1303 - 1305.
VARIABLES: One temperature: about 285 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in acetone was reported to be one part of nitrate per 60 parts CH_3COCH_3. This value is the average of two values at 11.9°C, and at 12.2°C.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate, presumably the hexahydrate (compilers), was dried at 90°C. Acetone was purified with sodium hydrogen sulfite.
	ESTIMATED ERRORS: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Moore, R. B.; Schlundt, H. <i>Phil. Mag.</i> , <u>1906</u> , 12, 93-396.
VARIABLES: Room temperature	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in CH_3COCH_3 at room temperature was reported to be less than 83 g of the nitrate per 1000 mL of acetone. The initial solid was not specified, presumably the hexahydrate (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Five grams of uranyl nitrate were dissolved in 60 cm ³ of acetone. The solution was slightly cloudy, probably due to the presence of a small amount of undissolved nitrate.	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate - Kahlbaum's best.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various aldehydes and ketones (3) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Yaffe, L. <i>Can. J. Res.</i> , <u>1949</u> , 27B, 638-645.
VARIABLES: One temperature: 293 K		PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in various aldehydes and ketones is reported to be:		
Aldehyde	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ g/100 cm^3
Butanal (butyraldehyde) [123-72-8]	$\text{CH}_3(\text{CH}_2)_2\text{CHO}$	22
4-Methoxybenzaldehyde [123-11-5]	$\text{CH}_3\text{OC}_6\text{H}_4\text{CHO}$	27
5[R]-3,7-Dimethyl-6-octenal (citronellal) [106-23-0]	$(\text{CH}_3)_2\text{C}=\text{CH}(\text{CH}_2)_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CHO}$	34
Ketone	Formula	g/100 cm^3
2-Butanone ^a [78-93-3]	$\text{CH}_3\text{CH}_2\text{COCH}_3$	100
3-Pentanone [96-22-0]	$\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$	76
Cyclohexanone [108-94-1]	$\text{CH}_2(\text{CH}_2)_4\text{CO}$ —————	105
4-Methyl-2-pentanone [108-10-1]	$(\text{CH}_3)_2\text{CHCH}_2\text{COCH}_3$	75
2-Heptanone [110-43-0]	$\text{CH}_3(\text{CH}_2)_4\text{COCH}_3$	68
2,4-Dimethyl-3-pentanone [565-80-0]	$(\text{CH}_3)_2\text{CHCO}(\text{CH}_3)_2$	41
^a actually a mixture of 85% ketone and 15% xylene, C_6H_{10} .		
AUXILIARY INFORMATION		
METHOD/APPARATUS/PROCEDURE: Isothermal method was used. A 25 cm^3 portion of the solvent and a few grams of uranyl nitrate hexahydrate were placed in a sealed centrifuge tube and agitated in a water bath thermostatically controlled at 20°C. Solid was added until a saturated solution was obtained. The minimum time for saturation to occur was taken to be 24 hr. Before analysis, solution was centrifuged to remove any suspended material. Uranyl nitrate was back-extracted into water and analyzed colorimetrically after suitable dilution. Results were checked using U-233 as tracer.		SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate hexahydrate from Eldorado Mining and Refining. Maximum impurities consisted of <0.1% rare earths. 2. Organic solvents "practical" grade or better.
		ESTIMATED ERROR: Soly: Nothing specified. Results of two methods agreed to $\pm 5\%$. Temp: Precision ± 0.5 K.
		REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) 2-Butanone; $\text{C}_4\text{H}_8\text{O}$; [78-93-3] (3) 4-Methyl-2-pentanone; $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Keyser, W. L.; Cypres, R.; Herrmann, M. <i>Bull. Centre Phys. Nucl. Universite Libre de Bruxelles</i> , No. 17, 1950.											
VARIABLES: One temperature: 293 K	PREPARED BY: A. Sozanski; S. Siekierski											
EXPERIMENTAL VALUES: The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in the two ketones at 20°C is reported to be: <table><tr><th rowspan="2">Ketone</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2^a$</th></tr><tr><th>mass %</th><th>mol/kg</th></tr><tr><td>2-Butanone</td><td>54.67</td><td>3.061</td></tr><tr><td>4-Methyl-2-pentanone</td><td>43.07</td><td>1.920</td></tr></table> ^a Molalities calculated by the compilers as moles per 1 kg of the mixture consisting of the ketone and water.		Ketone	$\text{UO}_2(\text{NO}_3)_2^a$		mass %	mol/kg	2-Butanone	54.67	3.061	4-Methyl-2-pentanone	43.07	1.920
Ketone	$\text{UO}_2(\text{NO}_3)_2^a$											
	mass %	mol/kg										
2-Butanone	54.67	3.061										
4-Methyl-2-pentanone	43.07	1.920										
AUXILIARY INFORMATION												
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm ³ of solvent, and mixed for 30 min at a temperature 10°C to 20°C above the desired 20°C. The liquid together with the crystals was transferred to a thermostat where the liquid was stirred for 30 more min. After 15 min. settling, a 10 cm ³ portion was pipetted for weighing. Uranium was determined by evaporating the water and solvent, drying at 120°C, and calcining at 900°C in a platinum crucible to a constant weight of U_3O_8 .	SOURCE AND PURITY OF MATERIALS: Nothing specified. The uranyl nitrate hexahydrate had 21.30 % water of crystallization, compared with a theoretical 21.52 %. ESTIMATED ERROR: Soly: The reported solubility is the mean of two values which differ by 0.003 and 0.07 mol/kg. Temp: Nothing specified. REFERENCES:											

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) 2-Octanone; $\text{C}_8\text{H}_{16}\text{O}$; [111-13-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F. <i>Can. J. Res.</i> , <u>1950</u> , <i>28B</i> , 156-160.
VARIABLES: One temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $\text{CH}_3(\text{CH}_2)_5\text{COCH}_3$ at 25°C was reported to be 38.6 g of the anhydrous nitrate per 1 kg of the mixture consisting of methyl-n-hexyl ketone and water (compilers).	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: A suitable volume of solvent was mixed in a test tube with an appropriate amount of uranyl nitrate hexahydrate. The sample was then rotated at 30 rpm at 25°C for a period of 5 days. Saturation was ensured by the presence of distinct lumps in the final solid phase. The solution was then filtered, and the solubility determined by weighing the solution in a covered platinum crucible and igniting.	SOURCE AND PURITY OF MATERIALS: "Practical" grade solvent was used.
	ESTIMATED ERROR: Temperature: Within $\pm 0.05^\circ\text{C}$.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Katzin, L. I.; Sullivan, J. C. <i>J. Phys. Chem.</i> , <u>1951</u> , 55, 346 - 374.																																																															
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																																															
EXPERIMENTAL VALUES: <div style="text-align: center;">Acetone</div> <div style="text-align: center;">The $\text{UO}_2(\text{NO}_3)_2$ - CH_3COCH_3 - H_2O System at 25°C</div> <div style="text-align: center;">Composition of Saturated Solutions^a</div> <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th rowspan="2">Solid_b Phase</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th></tr><tr><td>54.5</td><td>3.040</td><td>45.5</td><td>A</td></tr><tr><td>56.77</td><td>3.333</td><td>37.54</td><td>A</td></tr><tr><td>59.99</td><td>3.805</td><td>27.14</td><td>A</td></tr><tr><td>60.75</td><td>3.928</td><td>25.12</td><td>A</td></tr><tr><td>62.06</td><td>4.151</td><td>21.21</td><td>A</td></tr><tr><td>61.37</td><td>4.032</td><td>22.39</td><td>A</td></tr><tr><td>62.71</td><td>4.268</td><td>17.41</td><td>A</td></tr><tr><td>63.29</td><td>4.375</td><td>15.55</td><td>A</td></tr><tr><td>64.46</td><td>4.603</td><td>15.37</td><td>A</td></tr><tr><td>70.34</td><td>6.019</td><td>11.73</td><td>A+B</td></tr><tr><td>70.45</td><td>6.050</td><td>11.71</td><td>A+B</td></tr><tr><td>70.30</td><td>6.007</td><td>11.33</td><td>A+B</td></tr><tr><td>70.88</td><td>6.177</td><td>10.40</td><td>B+C</td></tr><tr><td>70.42</td><td>6.042</td><td>10.61</td><td>B+C</td></tr></table> <div style="text-align: right;">(Continued on the next page)</div>		$\text{UO}_2(\text{NO}_3)_2$		H_2O	Solid _b Phase	mass %	mol/kg	mass %	54.5	3.040	45.5	A	56.77	3.333	37.54	A	59.99	3.805	27.14	A	60.75	3.928	25.12	A	62.06	4.151	21.21	A	61.37	4.032	22.39	A	62.71	4.268	17.41	A	63.29	4.375	15.55	A	64.46	4.603	15.37	A	70.34	6.019	11.73	A+B	70.45	6.050	11.71	A+B	70.30	6.007	11.33	A+B	70.88	6.177	10.40	B+C	70.42	6.042	10.61	B+C
$\text{UO}_2(\text{NO}_3)_2$		H_2O	Solid _b Phase																																																													
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AUXILIARY INFORMATION																																																																
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Solid and liquid mixture equilibrated by stirring, usually for approximately 1 week. Liquid-liquid distribution mixtures were equilibrated for only a few hours. Equilibration vessels were closed to the atmosphere, and protected from strong light. Analyses were carried out on the principle of wet residues (1). Weighed samples were analyzed for uranium and water. Aliquots were withdrawn, evaporated, and ignited to U_2O_8 . The organic component was estimated by difference. Water was determined using Karl Fischer reagent. The solid phase was dried between sheets of filter paper until moderate pressure produced only a barely perceptible wetting of the paper. One sample was weighed for uranium analysis, and three samples weighed for water analysis.	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate hexahydrate was C.P. grade, Mallinckrodt Chem. Co. Lower hydrates prepared by desiccation over concentrated H_2SO_4 under reduced pressure. 2. Acetone, C.P. grade. 3. 4-Methyl-2-pentanone, C.P. grade treated to remove alcoholic impurities, washed with water. ESTIMATED ERROR: Soly: The average deviation of uranium and water analyses $\pm 0.1\%$ and $\pm 0.3\%$, respectively. Temp: Precision ± 0.03 K. REFERENCES: 1. Schreinemakers, F. A. H. <i>Z. physik. Chem.</i> , <u>1893</u> , 11, 81.																																																															

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Katzin, L. I.; Sullivan, J. C.
(2) Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1]	<i>J. Phys. Chem.</i> , <u>1951</u> , 55, 346 - 374.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

Acetone

The $\text{UO}_2(\text{NO}_3)_2 - \text{CH}_3\text{COCH}_3 - \text{H}_2\text{O}$ System at 25°C
Composition of Saturated Solutions^a

$\text{UO}_2(\text{NO}_3)_2$		H_2O	Solid ^b Phase
mass %	mol/kg	mass %	
70.82	6.159	9.76	C+D
70.78	6.147	9.88	C+D
71.66	6.417	7.54	D+E
69.51	5.786	8.48	D+E
68.86	5.612	9.21	D+E
69.20	5.702	9.57	D+E

^aMolalities calculated by the compilers as moles per 1 kg of the mixture consisting of acetone and water.

^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$,
C = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, D = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot \text{CH}_3\text{COCH}_3$,
E = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{CH}_3\text{COCH}_3$.

COMMENT AND/OR ADDITIONAL DATA:

Existence of the tetrahydrate is unlikely (compilers).

(Continued on the next page)

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) 4-Methyl-2-pentanone; $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Katzin, L. I.; Sullivan, J. C.

J. Phys. Chem., 1951, 55, 346 - 374.

EXPERIMENTAL VALUES: (Continued)

4-Methyl-2-pentanone

The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3)_2\text{CHCH}_2\text{COCH}_3 - \text{H}_2\text{O}$ System at 25°C

Aqueous Phase

Organic Phase

$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Solid Phase ^b
mass %	mol/kg	mass %	mass %	mol/kg	mass %	
---	---	94.23	---	---	1.68	
14.41	0.4273	76.60	0.37	0.0094	2.06	
16.68	0.5081	78.70	0.64	0.016	4.11	
28.80	1.027	67.58	7.12	0.195	3.08	
35.48	1.396	62.38	16.67	0.5077	5.00	
37.93	1.51	57.95	20.52	0.6552	5.04	
38.69	1.602	57.41	21.93	0.7129	5.75	
41.24	1.781	55.03	26.50	0.9150	6.04	
55.41	3.154	42.94	44.14	2.005	8.11	A
			44.01	1.995	8.04	A
			46.42	2.199	7.24	A
			47.86	2.330	6.71	A
			54.53	3.043	5.97	A+B
			54.10	2.991	5.70	A+B
			54.78	3.074	5.59	A+B
			55.13	3.118	5.47	A+B
			55.21	3.128	5.34	A+B
			55.56	3.173	5.05	B
			55.92	3.219	5.04	B
			56.04	3.235	5.06	B
			56.15	3.250	5.33	B
			57.71	3.463	4.78	B
			58.45	3.570	4.17	B
			60.29	3.853	3.75	B+C
			59.45	3.721	3.99	B+C
			60.08	3.819	3.75	B+C
			55.56	3.173	3.95	C+D
			57.92	3.493	3.76	C+D
			55.21	3.128	3.62	C+D
			56.67	3.319	3.41	C+D
			53.85	2.961	3.39	D
			52.25	2.777	2.98	D
			51.21	2.664	3.38	D
			49.78	2.516	2.83	D

^aMolalities calculated by the compilers as moles per 1 kg of the mixture consisting of ketone and water.

^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$,

C = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot \text{CH}_3\text{COC}_4\text{H}_9$, D = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{CH}_3\text{COC}_4\text{H}_9$.

(Continued on the next page)

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1] (3) 4-Methyl-2-pentanone; $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Katzin, L. I.; Sullivan, J. C. <i>J. Phys. Chem.</i> , <u>1951</u> , 55, 346 - 374.
EXPERIMENTAL VALUES: (Continued) COMMENTS AND/OR ADDITIONAL DATA: A plot of the water molality versus the uranyl nitrate molality in the organic phase yields the relationship between the increase in water content, and the increase in uranyl nitrate concentration. The set of points is well represented by a straight line. The slope is, within experimental error, 4.0. Only the highest points deviate from this line. A phase diagram is given in the source paper.	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) 3,3-Dimethyl-2-butanone; $\text{C}_6\text{H}_{12}\text{O}$; [75-97-8] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Warner, R. K. <i>Australian J. Appl. Sci.</i> , <u>1953</u> , 4, 427 - 443.																									
VARIABLES: Temperature: 275, 293, 313 K	PREPARED BY: L. Fuks; S. Siekierski																									
EXPERIMENTAL VALUES: Solubility of $\text{UO}_2(\text{NO}_3)_2$ in $\text{CH}_3\text{C}(\text{CH}_3)_2\text{COCH}_3 - \text{H}_2\text{O}$ Two Phase System ^a <table><tr><td></td><td colspan="2">Aqueous Phase</td><td colspan="2">Organic Phase</td></tr><tr><td>$t/^{\circ}\text{C}$</td><td>mass %</td><td>mol/kg</td><td>mass %</td><td>mol/kg</td></tr><tr><td>2</td><td>48.9</td><td>2.43</td><td>38.6</td><td>1.60</td></tr><tr><td>20</td><td>54.4</td><td>3.03</td><td>43.0</td><td>1.91</td></tr><tr><td>40</td><td>56.4</td><td>3.28</td><td>43.9</td><td>1.99</td></tr></table> ^a Molalities calculated by the compilers as moles per 1 kg of the mixture of ketone and water. The composition of the equilibrium solid is unknown (compilers).			Aqueous Phase		Organic Phase		$t/^{\circ}\text{C}$	mass %	mol/kg	mass %	mol/kg	2	48.9	2.43	38.6	1.60	20	54.4	3.03	43.0	1.91	40	56.4	3.28	43.9	1.99
	Aqueous Phase		Organic Phase																							
$t/^{\circ}\text{C}$	mass %	mol/kg	mass %	mol/kg																						
2	48.9	2.43	38.6	1.60																						
20	54.4	3.03	43.0	1.91																						
40	56.4	3.28	43.9	1.99																						
AUXILIARY INFORMATION																										
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The procedure was based on the two phases equilibration in the presence of excess solid for a period of 8 to 10 hours at 20°C. After sampling each phase, the system was stored overnight at 20°C. On the following day, it was intermittently agitated for an additional 2 hours, and the phases were analyzed for solute content to ensure saturation had been attained. The uranium nitrate concentration was determined by evaporation of weighed aliquots, followed by ignition to U_3O_8 .	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ was purified (1). 2. 3,3-Dimethyl-2-butanone was redistilled prior to use. ESTIMATED ERROR: Soly: Nothing specified. Temp: Precision ± 0.05 K. REFERENCES: 1. Warner, R. K. <i>Australian J. Appl. Sci.</i> , <u>1952</u> , 3, 156.																									

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Warner, R. K.
(2) Various ketones	<i>Australian J. Appl. Sci.</i> , 1953, 4, 581 - 589.
(3) Water; H_2O ; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 293 K	L. Fuks; S. Siekierski

EXPERIMENTAL VALUES:

The Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in Various Ketones at 20°C is:

Ketone	Formula	$\text{UO}_2(\text{NO}_3)_2^a$	
		g/(g soln)	mol/kg
Acetone	CH_3COCH_3 ; [67-64-1]	0.617	4.09
2-Butanone	$\text{CH}_3\text{CH}_2\text{COCH}_3$; [78-93-3]	0.547	3.06
2-Hexanone	$\text{CH}_3(\text{CH}_2)_3\text{COCH}_3$; [591-78-6]	0.425	1.83
3,3-Dimethyl-2-butanone	$\text{CH}_3\text{C}(\text{CH}_3)_2\text{COCH}_3$; [75-97-8]	0.415	1.80

^aMolalities calculated by compilers as moles per 1 kg of the mixture consisting of ketone and water.

(Continued on the next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. Excess uranyl nitrate hexahydrate was placed with the appropriate amount of pure solvent in a small flask, warmed to between 30°C - 50°C, and agitated for 15 min. Then the flask was placed in a thermostat bath at 20°C and shaken for 6 to 8 hours. When equilibrium was attained, the solution was decanted, filtered, and sampled for subsequent analysis. The analysis consisted of the total uranium nitrate concentration, determined by evaporation of the weighed aliquots, and subsequent ignition to U_3O_8 .	1. "AR" $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.
	2. C.P. grade anhydrous ketones.
	ESTIMATED ERROR:
	Soly: Repeat determinations of the solubility made until agreed within 0.2 mass %.
	Temp: Precision ± 0.05 K.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Warner, R. K.
(2) Various ketones	<i>Australian J. Appl. Sci.</i> , 1953, 4, 581 - 589.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in Various Ketones at 20°C is^a

Ester	Formula	$\text{UO}_2(\text{NO}_3)_2$ ^b	
		g/(g soln)	mol/kg
2-Pentanone [107-87-9]	$\text{CH}_3(\text{CH}_2)_2\text{COCH}_3$	0.484	2.38
4-Methyl-2-pentanone [108-10-1]	$(\text{CH}_3)_2\text{CHCH}_2\text{COCH}_3$	0.428	1.90
2-Heptanone [110-43-0]	$\text{CH}_3(\text{CH}_2)_4\text{COCH}_3$	0.382	1.57
Methyl phenyl ketone [98-86-2]	$\text{CH}_3\text{COC}_6\text{H}_5$	0.312	1.15

^aThe solubility of uranyl nitrate hexahydrate reported as the solubility of the anhydrous nitrate in the organic solvent-rich (upper) phase.

^bMolalities calculated by the compilers as moles per 1 kg of the mixture consisting of the ketone and water.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Ripan, R.; Eger, I.; Bojan, N. <i>Rev. Roum. Chim.</i> , <u>1968</u> , 13, 421 - 424.						
VARIABLES: One temperature: 298 K	PREPARED BY: A. Sozanski; S. Siekierski						
EXPERIMENTAL VALUES: The solubility of uranyl nitrate hydrates in acetone, CH_3COCH_3 is reported to be: <table data-bbox="408 680 975 901"> <thead> <tr> <th data-bbox="408 731 728 762">Uranyl nitrate hydrate</th><th data-bbox="842 680 975 762">$\text{UO}_2(\text{NO}_3)_2$ g/dm³</th></tr> </thead> <tbody> <tr> <td data-bbox="454 809 659 840">$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$</td><td data-bbox="858 809 960 840">1065.75</td></tr> <tr> <td data-bbox="454 860 659 891">$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$</td><td data-bbox="858 860 960 891">1225.52</td></tr> </tbody> </table>		Uranyl nitrate hydrate	$\text{UO}_2(\text{NO}_3)_2$ g/dm ³	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	1065.75	$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$	1225.52
Uranyl nitrate hydrate	$\text{UO}_2(\text{NO}_3)_2$ g/dm ³						
$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	1065.75						
$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$	1225.52						
AUXILIARY INFORMATION							
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hydrate was mixed with acetone in a test tube, and placed in a Webser thermostat for an approximate time. Uranium was determined in the organic phase by a gravimetric method.	SOURCE AND PURITY OF MATERIALS: 1. AR $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, Analar. 2. $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ prepared by dehydration of the hexahydrate over H_2SO_4 . 3. AR grade acetone.						
	ESTIMATED ERROR: Nothing specified.						
	REFERENCES:						

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Carbon tetrachloride; CCl_4 ; [56-23-5] (3) Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Ripan, R.; Eger, I.; Bojan, N. <i>Rev. Roum. Chim.</i> , <u>1968</u> , <u>13</u> , 421 - 424.
VARIABLES: Composition and number of waters of uranyl nitrate hydrate	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in the two phase system consisting of $\text{CH}_3\text{COCH}_3 - \text{CCl}_4$:</p> <p>Acetone phase: 977.10 g of anhydrous $\text{UO}_2(\text{NO}_3)_2$ per 1 dm^3 of solution.</p> <p>CCl_4 phase: 1.16 g of anhydrous $\text{UO}_2(\text{NO}_3)_2$ per 1 dm^3 of solution.</p> <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ in the two phase system consisting of $\text{CH}_3\text{COCH}_3 - \text{CCl}_4$:</p> <p>Acetone phase: 1203.60 g of anhydrous $\text{UO}_2(\text{NO}_3)_2$ per 1 dm^3 of solution.</p> <p>CCl_4 phase: 1.26 g of anhydrous $\text{UO}_2(\text{NO}_3)_2$ per 1 dm^3 of solution.</p> <p>COMMENTS AND/OR ADDITIONAL DATA:</p> <p>Volume ratio of $\text{CH}_3\text{COCH}_3:\text{CCl}_4$ was changed from 1:9 to 9:1. In each case, after equilibration two organic phases were observed. The uranium concentration was constant in each organic phase, and was independent of the initial volume ratio.</p> <p style="text-align: right;">(Continued on the next page)</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of the uranyl hydrate was mixed with the mixtures of acetone and carbon tetrachloride. The test tube was thermostated in a Webser thermostat. Two organic phases were observed in each case. Uranium was determined by gravimetric or photometric (small amounts) methods.	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, Analar. 2. $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ prepared by dehydration of the hexahydrate over H_2SO_4 . 4. CCl_4 , acetone: AR grade. ESTIMATED ERROR: Nothing specified. REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Ripan, R.; Eger, I.; Bojan, N.	
(2) Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1]	Rev. Roum. Chim., <u>1968</u> , <u>13</u> , 421 - 424.	
(3) Carbon tetrachloride; CCl_4 ; [56-23-5]		
(4) Water; H_2O ; [7732-18-5]		
EXPERIMENTAL VALUES: (Continued)		
The $\text{UO}_2(\text{NO}_3)_2 - \text{CH}_3\text{COCH}_3 - \text{CCl}_4$ - System at 25°C Solubility of Solid Uranyl Nitrates		
$\text{CH}_3\text{COCH}_3/\text{CCl}_4^a$ v/v	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}^b$ g/dm ³	$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}^b$ g/dm ³
10:90	0.62	6.24
20:80	2.64	18.84
30:70	7.64	84.38
40:60	76.10	169.00
50:50	170.40	272.40
60:40	266.40	386.80
70:30	394.00	490.00
80:20	609.00	700.00
90:10	820.00	930.00
100 acetone	1065.70	1225.52
^a Volume/volume ratio.		
^b Solubility of hydrate in units of $\text{UO}_2(\text{NO}_3)_2$ (anhydrous nitrate).		
AUXILIARY INFORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	
Carbon tetrachloride was added to a known amount of saturated acetone solution of uranyl nitrate hydrate until the desired composition, acetone - carbon tetrachloride, was obtained. Small volumes of acetone - carbon tetrachloride mixture of the same composition were added to solubilize a precipitate, and to obtain the homogeneous solution. Uranium was then determined either gravimetrically, or photometrically for small quantities.	Same as previous page.	
	ESTIMATED ERROR:	
	Nothing specified.	
	REFERENCES:	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Conninck, Oe. <i>Compt. Rend.</i> , <u>1901</u> , 132, 90 - 91.
VARIABLES: One temperature: About 285 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in diethyl ether is reported to be one part of the nitrate per 16 parts of $(\text{C}_2\text{H}_5)_2\text{O}$. This value is an average of values at 11.9°C, 12.4°C, and 12.7°C.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate, presumably the hexahydrate (compilers) was dried for 4 hours at 85°C to 90°C.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Lebeau, P. <i>Bull. Soc. Chim. France</i> , <u>1911</u> , 9, 295 - 297.
VARIABLES: One temperature: 280 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate hexahydrate in $(\text{CH}_3\text{CH}_2)_2\text{O}$ at 7°C is reported to be 59 mass %. The conjugated aqueous phase is reported to contain 62.5 mass % of the solute.</p> <p>Apparently, the mass % values refer to the hexahydrate and not to the anhydrous salt. If so, then the corresponding molalities are 2.19 mol/kg and 2.44 mol/kg (compilers).</p> <p>COMMENT AND/OR ADDITIONAL DATA:</p> <p>Two species of crystals were obtained from the ether phase after water removal with $\text{Ca}(\text{NO}_3)_2$ and cooling: one at -70°C, the other at -10°C. These crystals lose ether in dry air. The residue is $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was contacted with the diethyl ether by shaking. In the course of the experiment, an aqueous phase formed under the diethyl ether solution.	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ was crystallized from an aqueous solution at room temperature. 2. Dried diethyl ether was used.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Lebeau, P. <i>Bull. Soc. Chim. France</i> , <u>1911</u> , 9, 298 - 300.
VARIABLES: Two temperatures: 280 and 283 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ in $(\text{C}_2\text{H}_5)_2\text{O}$ at 7°C and 10°C is reported to be 52.39 mass % and 54.25 mass %, respectively.</p> <p>Apparently, the mass % values refer to the dihydrate and not to the anhydrous salt. If so, then the corresponding molalities are 2.343 mol/kg and 2.507 mol/kg (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate dihydrate was obtained by the evaporation of ethyl ether solution of CaO dried uranyl nitrate hexahydrate. The wet residue was dried under vacuum in the presence of concentrated H_2SO_4 .
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Guempel, O. <i>Bull. Soc. Chim. Belg.</i> , 1929, 38, 443 - 477.
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of anhydrous uranyl nitrate in diethyl ether was reported to be 0.95 mass %, i.e. 0.024 mol/kg (compilers).</p> <p>The ternary $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} - (\text{C}_2\text{H}_5)_2\text{O} - \text{H}_2\text{O}$ system consists of two liquid and one solid phase. The composition of the water-rich phase is 49.08 mass % $\text{UO}_2(\text{NO}_3)_2$, i.e. 2.446 mol/kg of a mixture consisting of ether and water (compilers). The composition of the ether-rich phase is 54.23 mass % of $\text{UO}_2(\text{NO}_3)_2$, i.e. 3.007 mol/kg of a mixture consisting of water and ether (compilers), and 3.30 mass % of ether.</p>	
AUXILIARY INFORMATION	
METHOD/Apparatus/Procedure: The uranyl nitrate concentration in both liquid phases was determined gravimetrically. Diethyl ether was determined in the aqueous phase by a comparison with the amount of ether which should be added to a saturated uranyl nitrate - aqueous solution. Diethyl ether and water contents in the ether phase were calculated from the masses of the two phases, the total quantity of uranyl nitrate, and the total amount of ether.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS:			ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Misciattelli, P.				
(2) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]			Phil. Mag., 1929, 670 - 674.				
(3) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]							
VARIABLES:			PREPARED BY:				
Composition and temperature			L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES:							
The $\text{UO}_2(\text{NO}_3)_2 - \text{Th}(\text{NO}_3)_4 - (\text{CH}_3\text{CH}_2)_2\text{O}$ System at 0°C and 20°C							
Composition of the Saturated Solutions ^{a,b}							
$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		$\text{Th}(\text{NO}_3)_4$		Ether	Solid Phase ^c	
	mass %	mol/kg	mass %	mol/kg	mass %		
0	22	0.716	0	0	78	A	
	22.5	0.747	1.02	0.0278	74.48	A	
	24	0.840	3.5	0.100	72.57 ^d	A+B	
	24	0.839	3.43	0.0984	72.50	A+B	
	19.2	0.639	4.5	0.12	76.3	B	
	18	0.593	5	0.14	77	B	
	16.5	0.537	5.6	0.15	77.9 ^d	B	
	12.2	0.383	7	0.18	81 ^d	B	
	8.2	0.25	8.3	0.21	82.5 ^d	B	
	3.0	0.086	8	0.19	89	B	
	0	0	5.8	0.13	94.2	B	
	10	8.78	0.244	0	0	91.22	A
		5.5	0.15	0.5	0.011	94	B
		3.1	0.082	1	0.022	95.9	B
		0	0	1.4	0.030	98.6	B
		0	0	1.6	0.034	98.4	B

(Continued on the next page)

AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. The solubilities were determined by shaking the solutions in the presence of an excess of one or both solid phases in a large test tube placed in a Dewar vessel containing melting ice or in a thermostat at the required temperature. Portions of the solution were weighed and analyzed separately. The ether was removed by distillation after the addition of water. The cold nearly neutral solution was treated with a boiling oxalic acid solution. The resulting thorium oxalate was ignited and weighed as oxide. The uranium was precipitated from the filtrate as ammonium uranate by the addition of ammonia. The precipitate was heated to constant weight, and determined as U_3O_8 .			Anhydrous uranium nitrate, thorium nitrate and ether were used.			
			ESTIMATED ERROR:			
			Nothing specified.			
			REFERENCES:			

COMPONENTS:				ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]				Misciatelli, P.				
(2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]				<i>Gazz. Chim. Italiana</i> , <u>1930</u> , 60, 839 - 842.				
(3) Water; H_2O ; [7732-18-5]								
VARIABLES:				PREPARED BY:				
Composition at 273 and 293 K				L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES:								
The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3\text{CH}_2)_2\text{O} - \text{H}_2\text{O}$ System								
Composition of the Saturated Solutions at 0°C^a								
Water Phase				Ether Phase				Solid Phase ^b
H_2O	Ether	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Ether	$\text{UO}_2(\text{NO}_3)_2$		
mass %	mass %	mass %	mol/kg	mass %	mass %	mass %	mol/kg	
---	---	---	---	---	78.00	22.00	0.7158	A
---	---	---	---	7.00	68.50	24.50	0.8235	A
47.47	4.15	48.38	2.379	10.29	45.15	44.56	2.040	B
46.30	5.00	48.70	2.409	13.56	41.17	45.27	2.099	B
30.60 ^c	---	69.40 ^c	5.756	---	---	---	---	B
Composition of the Saturated Solutions at 20°C^a								
---	---	---	---	---	91.22	8.78	0.244	A
---	---	---	---	1.10	86.40	12.50	0.3625	A
43.52	3.87	52.61	2.817	8.10	42.88	49.02	2.440	B
45.60	---	54.40	3.028	---	---	---	---	B
^a Moles per 1 kg of the mixture consisting of water and ether (compilers).								
^b Solid phase: A = $\text{UO}_2(\text{NO}_3)_2$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.								
^c Typographical errors in the table. From the phase diagram the values are: 51 mass % of water and 49 mass % of $\text{UO}_2(\text{NO}_3)_2$ (compilers).								
AUXILIARY INFORMATION								
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:				
The isothermal method was used. The procedure was the same as described in the paper devoted to the thorium nitrate solubility (1). Uranyl nitrate content was determined after calcination as U_3O_8 .				Anhydrous uranyl nitrate prepared according to the procedures by Marketos (2) and DeForcrand (3).				
				ESTIMATED ERRORS:				
				Nothing specified.				
				REFERENCES:				
				1. Misciatelli, P. <i>Gazz. Chim. Italiana</i> , <u>1930</u> , 60, 83.				
				2. Marketos, M. <i>Bull. Soc. Chim.</i> , <u>1912</u> , 11, 244. <i>Compt. Rend.</i> , <u>1912</u> , 155, 210.				
				3. DeForcrand, R. <i>Ann. Chim.</i> , <u>1915</u> , 3, 5.				

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Van Name, R. G. Report, 1942, AECD-4086.												
VARIABLES: Composition at 274 K	PREPARED BY: A. Sozanski; S. Siekierski												
EXPERIMENTAL VALUES: A few small crystals ^a were observed at the following organic phase composition: <table><tr><td>Component</td><td>Mol fraction</td><td>mol/kg^b</td></tr><tr><td>Ether</td><td>0.4365</td><td>---</td></tr><tr><td>Water</td><td>0.0797</td><td>---</td></tr><tr><td>$\text{UO}_2(\text{NO}_3)_2$</td><td>0.4838</td><td>14.31</td></tr></table>		Component	Mol fraction	mol/kg ^b	Ether	0.4365	---	Water	0.0797	---	$\text{UO}_2(\text{NO}_3)_2$	0.4838	14.31
Component	Mol fraction	mol/kg ^b											
Ether	0.4365	---											
Water	0.0797	---											
$\text{UO}_2(\text{NO}_3)_2$	0.4838	14.31											
^a The composition of the equilibrium solid was not specified. ^b Molality calculated by the compilers.													
AUXILIARY INFORMATION													
METHOD/APPARATUS/PROCEDURE: Experiments were conducted in 50 cm ³ conical flask. The uranyl nitrate was weighed, then partially dehydrated by connecting the flask immersed in water at 50°C with a vacuum line and finally weighed again. Slightly more than proper amt. of ether was added, and the desired phase equilibrium was approached by cautious addition of known small quantities of water and stirring in a thermostat at 50°C. In the final adjustment, the water phase is a minute viscous drop which will only just show appreciable flow when the flask is inclined, and this condition must persist for at least an hour. A final weighing, to find the weight of ether, completed the determination.	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate hexahydrate; U_3O_8 content 78.52, 78.58 mass %, (theor. 78.48). Absolute ether, Merck reagent. ESTIMATED ERROR: Nothing specified. REFERENCES:												

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Bachelet, M.; Cheylan, E. <i>J. Chim. Phys.</i> , 1947, 44, 234 - 253.
VARIABLES: $T/\text{K} = 113 \text{ to } 303 \text{ K}$	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate dihydrate in ethyl ether, $(\text{C}_2\text{H}_5)_2\text{O}$, in the temperature range 113 - 303 K is presented only in the form of a phase diagram.</p> <p>The composition of the crystals which are in equilibrium with the solution was established as $\text{UO}_2(\text{NO}_3)_2 \cdot x(\text{C}_2\text{H}_5)_2\text{O}$. In the temperature range $+15^\circ\text{C}$ to 0°C, $x \approx 1.98$ with a standard deviation of 0.08 (calculated by the compilers from 12 of the experimental values). In the temperature range from 0°C to -80°C, $x = 4.27$ with a standard deviation of 0.18 (calculated by the compilers from 11 experimental values).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of the solid salt was shaken with ether at the desired temperature. After filtering the crystals, uranium nitrate content was measured as U_3O_8 by precipitation as ammonium uranate and subsequent calcining. Formula of the uranyl species which precipitated from solution was found by analysis of the crystals. These crystals precipitated upon cooling the saturated solutions to desired temperature: from $+45^\circ\text{C}$ to $+15^\circ\text{C}$; from $+15^\circ\text{C}$ to 0°C ; from 0 to -3°C , -7°C or -15°C , respectively; from -15°C to -30°C ; and from -30°C to -80°C . When the required temperature was reached, the crystals in water were allowed to precipitate over a 30 min time, then filtered. Uranium content was measured twice: after dissolution of the crystals in water, precipitation with ammonia and calcining at 700°C to U_3O_8 ; or by weighing the uranium nitrate dihydrate crystals after ether evaporation in an air stream at room temperature. Ether content calculated as the mass difference of the crystals and the measured uranium nitrate dihydrate.	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate dihydrate and anhydrous ether were used. ESTIMATED ERRORS: Temperature: $\pm 1 \text{ K}$. REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various ethers (3) Water; H_2O ; [7732-18-5]		EVALUATOR: Yaffe, L. Can. J. Res., 1949, 27B, 638 - 645.
VARIABLES: One temperature: 293 K		PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The solubility of $\text{UO}_2(\text{NO}_3)_2$ in various ethers at 25°C is reported as:		
Ether	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ g/100 cm ³
Diethyl ether [60-29-7]	$(\text{C}_2\text{H}_5)_2\text{O}$	74
Triethylene glycol dichloride [112-26-5]	$(-\text{CH}_2\text{OCH}_2\text{CH}_2\text{Cl})_2$	57
Dichloroisopropyl ether	$(\text{CH}_3)_2\text{C}(\text{Cl})\text{OC}(\text{Cl})(\text{CH}_3)_2$	5
Diisopropyl ether [108-20-3]	$(\text{CH}_3)_2\text{CHOCH}(\text{CH}_3)_2$	9
Dimethyl dioxane	$\text{C}_6\text{H}_{14}\text{O}_2$	92
Butyl ether [142-96-1]	$\text{CH}_3(\text{CH}_2)_3\text{O}(\text{CH}_2)_3\text{CH}_3$	16
4-Butoxy butanol	$\text{CH}_3(\text{CH}_2)_3\text{O}(\text{CH}_2)_4\text{OH}$	49
(Continued on the next page)		
AUXILIARY INFORMATION		
METHOD/APPARATUS/PROCEDURE: Isothermal method was used. 25 cm ³ of the solvent and a few grams of uranyl nitrate hexahydrate were placed in a sealed centrifuge tube and agitated in a water bath set thermostatically at 20°C. Additional solid was added until a saturated solution was obtained. The minimum time for occurrence of saturation was taken to be 24 hours. Before analysis the solution was centrifuged to remove any suspended particles. The uranyl nitrate was back-extracted into water, and the concentration determined colorimetrically after suitable dilution to a range of concentration where Beer's law applied. Results of these analyses were checked using U-233 as tracer.		SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate hexahydrate was obtained from Eldorado Mining and Refining Co. The maximum impurities consisted of <0.1% rare earths. 2. Practical grade or better ether. ESTIMATED ERROR: Soly: Nothing specified. Results of two methods of analysis agree to within ±5 %. Temp: Precision ±0.5 K.
		REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Yaffe, L.
(2) Various ethers	<i>Can. J. Res.</i> , <u>1949</u> , 27B, 638 - 645.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)		
The solubility of $\text{UO}_2(\text{NO}_3)_2$ in various ethers at 25°C is reported as:		
Ether	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ g/100 cm^3
Pentyl ether [693-65-2]	$\text{CH}_3(\text{CH}_2)_4\text{O}(\text{CH}_2)_4\text{CH}_3$	11
Hexyl ether [112-58-3]	$\text{CH}_3(\text{CH}_2)_5\text{O}(\text{CH}_2)_5\text{CH}_3$	9
Octyl ether [629-82-3]	$\text{CH}_3(\text{CH}_2)_7\text{O}(\text{CH}_2)_7\text{CH}_3$	17
Tetraethylene glycol dibutyl ether	$\text{CH}_3(\text{CH}_2)_3\text{OCH}_2(\text{CH}_2\text{OCH}_2)_3\text{CH}_2\text{O}(\text{CH}_2)_3\text{CH}_3$	90
Xanthyl ether	$\text{C}_{26}\text{H}_{18}\text{O}_3$	14

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Keyser, W. L.; Cypres, R.; Herrmann, M. <i>Bull. Centre Phys. Nucl. Universite Libre de Bruxelles, No. 17, 1950.</i>																						
VARIABLES: $T/K = 290 \text{ to } 303 \text{ K}$	PREPARED BY: A. Sozanski; S. Siekierski																						
EXPERIMENTAL VALUES: <div>The Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ Composition of Saturated Solutions^a</div> <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th rowspan="2">Solid_b Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th></tr><tr><td>16.9</td><td>47.85</td><td>2.329</td><td>A</td></tr><tr><td>20</td><td>49.16</td><td>2.454</td><td>A</td></tr><tr><td>25</td><td>50.52</td><td>2.591</td><td>A</td></tr><tr><td>30</td><td>51.01</td><td>2.642</td><td>A</td></tr></table> <div>^aMolalities calculated by the compilers. ^bSolid phase: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.</div>		$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		Solid _b Phase ^b	mass %	mol/kg	16.9	47.85	2.329	A	20	49.16	2.454	A	25	50.52	2.591	A	30	51.01	2.642	A
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		Solid _b Phase ^b																				
	mass %	mol/kg																					
16.9	47.85	2.329	A																				
20	49.16	2.454	A																				
25	50.52	2.591	A																				
30	51.01	2.642	A																				
(Continued on the next page)																							
AUXILIARY INFORMATION																							
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20cm ³ of solvent and mixed for 30 min. at 10°C to 20°C above the desired temperature. The liquid with crystals was transferred to a thermostat, and was stirred for an additional 30 min. After 15 min. settling time, a 10 cm ³ aliquot was pipetted for weighing. Uranium was analyzed as U_3O_8 after evaporation of solvent and water. The solid was then dried at 120°C and calcined at 900°C in a platinum crucible to a constant weight.	SOURCE AND PURITY OF MATERIALS: 1. Nothing specified for the uranyl nitrate hexahydrate. The water of crystallization was 21.30 %, with 21.52 % theoretical.																						
	ESTIMATED ERROR: Soly: Reported solubilities are the mean of two values (except 25°C). Temp: Nothing specified.																						
	REFERENCES:																						

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	De Keyser, W. L.; Cypres, R.; Herrmann, M.
(2) 2-Propoxy-2-propane; $\text{C}_6\text{H}_{14}\text{O}$; [108-20-3]	<i>Bull. Centre Phys. Nucl.</i> <i>Universite Libre de Bruxelles,</i> <i>No. 17, 1950.</i>
(3) Water; H_2O ; [7732-18-5]	
EXPERIMENTAL VALUES: (Continued)	
<p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $(\text{CH}_3)_2\text{CHOCH}(\text{CH}_3)_2$ was reported to be 15.05 of the anhydrous salt per 100 g of the solution. The corresponding molality was calculated by the compilers as 0.4496 mol/kg (moles per 1 kg of the mixture consisting of isopropyl ether and water).</p>	

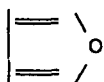

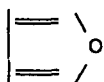

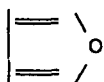

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Katzin, L. I.; Sullivan, J. C.			
(2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]			<i>J. Phys. Chem.</i> , 1951, 55, 346 - 374.			
(3) Water; H_2O ; [7732-18-5]						
VARIABLES:			PREPARED BY:			
Composition at 298 K			A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3\text{CH}_2)_2\text{O} - \text{H}_2\text{O}$ System at 25°C ^a						
Aqueous Phase			Organic Phase			Solid Phase ^b
$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$		H_2O	
mass %	mol/kg	mass %	mass %	mol/kg	mass %	
---	---	94	---	---	1.25	
8.80	0.245	83.49	0.00	0.000	1.25	
10.27	0.2905	80.86	0.00	0.000	1.10	
29.05	1.039	66.44	5.80	0.156	2.04	
36.23	1.442	59.71	19.35	0.6089	4.23	
38.44	1.585	56.14	24.32	0.8155	5.49	
44.24	2.014	51.75	34.52	1.338	7.55	
44.89	2.067	53.25	39.42	1.651	7.79	
47.28	2.276	44.23	49.97	2.535	8.95	
55.48	3.163	42.20	49.60	2.498	9.32	A
55.47	3.174	41.93	49.70	2.508	9.36	A
			54.95	3.096	8.36	A+B
			54.28	3.013	7.56	A+B
			54.71	3.066	7.21	A+B
			55.49	3.164	7.56	A+B
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. The solid and liquid mixture was equilibrated by stirring for approximately one week. Liquid-liquid distribution mixtures were equilibrated for only a few hours. Equilibrium vessels were closed to the atmosphere, and protected from strong light. Analyses were performed on the principle of wet residues (1). Weighed samples analyzed for uranium and water. To avoid difficulties from solvent, the samples to be analyzed for uranium were made up to volume in a mixture of water and methanol. Aliquots were withdrawn, evaporated, and ignited to U_3O_8 ; the organic component was estimated by the difference. Water was measured by Karl Fischer reagent. Solid phase was dried between sheets of filter paper until moderate pressure produced only a barely perceptible wetting of the paper. One sample was weighed for the uranium analysis, and three samples were weighed for water analysis.			1. Uranyl nitrate hexahydrate, C.P. grade. Mallinckrodt Chemical Co. Lower hydrates prepared by desiccation over concentrated H_2SO_4 , under reduced pressure.			
			2. Diethyl ether, C.P. grade, redistilled.			
			ESTIMATED ERROR:			
			Soly: The average deviation of uranium and water analyses were $\pm 0.1\%$ and $\pm 0.3\%$, respectively.			
			Temp: Precision ± 0.03 K.			
			REFERENCES:			
			1. Schreinemakers, F. A. H. <i>Z. physik. Chem.</i> , 1893, 11, 81.			

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) 2-Propoxy-2-propane; $\text{C}_6\text{H}_{14}\text{O}$; [108-20-3] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Warner, R. K. <i>Australian J. Appl. Sci.</i> , 1952 , <i>3</i> , 156 - 172.
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p style="text-align: center;">Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $(\text{CH}_3)_2\text{CHOCH}(\text{CH}_3)_2 - \text{H}_2\text{O}$ System</p> <p>The two phase system consisting of ether and water and in the presence of the solid complex (probably $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot \text{ether}$) was reported to contain 0.092 g of the anhydrous salt per 1 g of the ether-rich phase, and 0.476 g of the anhydrous salt per 1 g of the water-rich phase (i.e., 0.26 mol/kg in the ether-rich phase, and 2.31 mol/kg in the water-rich phase; compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Approximately equal volumes of saturated, filtered aqueous solution and diisopropyl ether were brought to equilibrium by periodically shaking in a stoppered water-jacketed glass cylinder at 20°C. Agitation was continued for 2 to 3 min every 10 min during 1 to 1-1/2 hours. A light yellow solid of uranyl nitrate complex separated from the solvent phase after standing several days, remained at the interphase and did not dissolve after extended agitation. No attempt was made to identify the diisopropyl ether uranyl complex. Aliquots of aqueous and solvent phase samples were pipetted into tared small porcelain evaporating dishes and evaporated to dryness in an air oven. An equal volume of water was added to the solvent phase samples. The solid uranyl nitrate was gently ignited to U_3O_8 , and then calcined at 900°C to 950°C for 2 hours in a muffle furnace to the black urano-uranic oxide, U_3O_8 .	SOURCE AND PURITY OF MATERIALS: 1. AR grade $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, or purified by diethyl ether dissolving, evaporating the solvent, and crystallization from distilled water. 2. Diisopropyl ether redistilled after peroxide removal by the standard sulfate method. ESTIMATED ERROR: Soly: Nothing specified. Temp: Within ± 0.01 K. REFERENCES:

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Katzin, L. I.; Sullivan, J. C.			
(2) 1,2-Diethoxy ethane; $\text{C}_6\text{H}_{14}\text{O}_2$; [629-14-1]			<i>J. Phys. Chem.</i> , <u>1951</u> , 55, 346 - 374.			
(3) Water; H_2O ; [7732-18-5]						
VARIABLES:			PREPARED BY:			
Composition at 298 K			A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:						
The $\text{UO}_2(\text{NO}_3)_2 - \text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_3 - \text{H}_2\text{O}$ System at 25°C ^a						
Aqueous Phase			Organic Phase			Solid Phase ^b
$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$		H_2O	
mass %	mol/kg	mass %	mass %	mol/kg	mass %	
---	---	74.51	---	---	3.28	
16.55	0.5033	61.06	8.16	0.225	4.56	
20.47	0.6532	55.52	17.22	0.5279	6.88	
25.93	0.8884	56.19	24.14	0.8076	9.10	
29.13	1.043	55.83	29.69	1.702	10.45	
42.47	1.873	47.47	43.73	1.972	11.52	
54.73	3.068	39.63	53.49	2.919	12.55	A
55.48	3.163	39.83	54.05	2.985	12.22	A
			54.18	3.001	11.91	A
			55.31	3.141	10.77	A
			54.25	3.009	10.31	A+B
(Continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. Solid and liquid mixtures were equilibrated by stirring, usually for about one week. Liquid-liquid distribution mixtures were equilibrated for only a few hours. Equilibration vessels were closed to atmosphere, and protected from strong light. Analyses were carried out on the principle of wet residues (1). Samples were analyzed for uranium and water. To avoid solvent difficulties, samples for uranium analysis were made up to volume in a mixture of water and methanol. Aliquots were withdrawn, evaporated, and ignited to U_3O_8 . Organic component was estimated by difference. Water determined by Karl Fischer reagent. Solid phase was dried between sheets of filter paper until moderate pressure produced only a barely perceptible wetting of the paper. One sample was weighed for the uranium, three for water analysis.			1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, C. P. grade.			
			2. Lower hydrates prepared by dehydration of hexahydrate over H_2SO_4 under reduced pressure.			
			3. Ethylene glycol diethyl ether, C. P. grade.			
			ESTIMATED ERROR:			
			Soly: The average deviation of uranium and water analyses was $\pm 0.1\%$ and $\pm 0.3\%$, respectively.			
			Temp: Precision ± 0.03 K.			
			REFERENCES:			
			1. Schreinemakers, F. A. H.			
			<i>Z. physik. Chem.</i> , <u>1893</u> , 11, 81.			

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Hexyl ether; $\text{C}_{12}\text{H}_{26}\text{O}$; [112-58-3] (3) Water; H_2O ; [7732-18-5]			ORIGINAL MEASUREMENTS: Katzin, L. I.; Sullivan, J. C. <i>J. Phys. Chem.</i> , 1951, 55, 346 - 374.			
VARIABLES: Composition at 298 K			PREPARED BY: A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OCH}_2(\text{CH}_2)_4\text{CH}_3 - \text{H}_2\text{O}$ System at 25°C						
Aqueous Phase			Organic Phase			
$\text{UO}_2(\text{NO}_3)_2^a$		H_2O	$\text{UO}_2(\text{NO}_3)_2^a$		H_2O	Solid Phase ^b
mass %	mol/kg	mass %	mass %	mol/kg	mass %	
---	---	99	---	---	0.1	
38.30	1.575	60.44	0.00	0.00	0.1	
55.31	3.141	43.42	3.27	0.0858	0.31	A
			13.54	0.3974	1.27	A
			18.09	0.5603	1.92	A+B
			18.55	0.5780	2.11	A+B
			17.82	0.5503	1.93	A+B
			22.19	0.7237	2.66	B+C
			23.08	0.7615	2.06	B+C
^a Molalities calculated by compilers as moles per 1 kg of the mixture consisting of hexyl ether and water.						
^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, C = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.2(\text{C}_6\text{H}_{13})_2\text{O}$ (?).						
COMMENTS AND/OR ADDITIONAL DATA: A plot of the water molality versus the uranyl nitrate molality in the organic phase is well represented by a straight line. The slope is equal to 2.0, within experimental error. A phase diagram is given in the source publication.						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Solid and liquid mixture were equilibrated by stirring, usually for about one week. Liquid-liquid distribution mixtures were equilibrated for only a few hours. Equilibrium vessels were closed to atmosphere, and protected from strong light. Analyses were carried out on the principle of wet residues (1). Samples were analyzed for uranium and water. To avoid solvent difficulties, samples for uranium analysis were made up to volume in a mixture of water and of methanol. Aliquots were withdrawn, evaporated, and ignited to U_3O_8 . Organic component was estimated by difference. Water determined by Karl Fischer reagent. Solid phase was dried between sheets of filter paper until moderate pressure produced only a barely perceptible wetting of the paper. One sample was weighed for the uranium, three for water analysis.			SOURCE AND PURITY OF MATERIALS: 1. Uranyl hydrate hexahydrate, C.P. Lower hydrates prepared by desiccation over concentrated sulfuric acid. 2. Hexyl ether, C.P.			
			ESTIMATED ERROR: Soly: The average deviation of uranium and water analyses were ± 0.1 and $\pm 0.3\%$, respectively. Temp: Precision ± 0.03 K.			
			REFERENCES: 1. Schreinemakers, F. A. H. <i>Z. physik. Chem.</i> , 1893, 11, 81.			

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Warner, R. K. <i>Australian J. Appl. Sci</i> , 1953, 4, 427 - 443.																			
VARIABLES: Temperature: 275 and 293 K	PREPARED BY: L. Fuks; S. Siekierski																			
EXPERIMENTAL VALUES: Solubility of $\text{UO}_2(\text{NO}_3)_2$ in the $(\text{CH}_3\text{CH}_2)_2\text{O} - \text{H}_2\text{O}$ System ^a Composition of the Ether Saturated Phase <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">Aqueous phase</th><th colspan="2">Ether Phase</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th></tr><tr><td>2</td><td>48.3</td><td>2.37</td><td>46.3</td><td>2.19</td></tr><tr><td>20</td><td>54.3</td><td>3.01</td><td>49.1</td><td>2.45</td></tr></table> ^a Molalities calculated by the compilers as moles per 1 kg of the mixture consisting of diethyl ether and water. The equilibrium solid is the hexahydrate (compilers).		$t/^{\circ}\text{C}$	Aqueous phase		Ether Phase		mass %	mol/kg	mass %	mol/kg	2	48.3	2.37	46.3	2.19	20	54.3	3.01	49.1	2.45
$t/^{\circ}\text{C}$	Aqueous phase		Ether Phase																	
	mass %	mol/kg	mass %	mol/kg																
2	48.3	2.37	46.3	2.19																
20	54.3	3.01	49.1	2.45																
AUXILIARY INFORMATION																				
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The procedure was based on the two phases equilibration in the presence of an excess solid for a period of 8 to 10 hours at 20°C. After sampling each phase, the system stood overnight at 20°C. The following day it was intermittently agitated for further 2 hours, and the phases were analyzed for solute content to ensure saturation had been reached. The uranium nitrate concentration was determined by evaporation of weighed aliquots, followed by ignition to U_3O_8 .	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate hexahydrate, not specified, was purified (1). 2. Diethyl ether redistilled after removal of peroxides by the standard sulfate method. ESTIMATED ERROR: Soly: Nothing specified. Temp: Precision ± 0.05 K. REFERENCES: 1. Warner, R. K. <i>Australian J. Appl. Sci.</i> , 1952, 3, 156.																			

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various ethers (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Warner, R. K. <i>Australian J. Appl. Sci.</i> , 1953, 4, 581 - 589.																						
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski																						
EXPERIMENTAL VALUES: The Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in Various Ethers Composition of Saturated Solutions ^a <table><tr><th rowspan="2">Ether</th><th rowspan="2">Formula</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th></tr><tr><th>g/(g soln)</th><th>mol/kg</th></tr><tr><td>Furan [110-00-9]</td><td></td><td>0.003</td><td>0.0076</td></tr><tr><td>Diethyl ether [60-29-7]</td><td>$(\text{C}_2\text{H}_5)_2\text{O}$</td><td>0.491</td><td>2.451</td></tr><tr><td>Dioxane [123-91-1]</td><td></td><td>0.291</td><td>1.04</td></tr><tr><td>Dibenzyl ether [103-50-4]</td><td>$(\text{C}_5\text{H}_5\text{CH}_2)_2\text{O}$</td><td>0.017</td><td>0.044</td></tr></table> ^a Molalities calculated by the compilers.		Ether	Formula	$\text{UO}_2(\text{NO}_3)_2$		g/(g soln)	mol/kg	Furan [110-00-9]		0.003	0.0076	Diethyl ether [60-29-7]	$(\text{C}_2\text{H}_5)_2\text{O}$	0.491	2.451	Dioxane [123-91-1]		0.291	1.04	Dibenzyl ether [103-50-4]	$(\text{C}_5\text{H}_5\text{CH}_2)_2\text{O}$	0.017	0.044
Ether	Formula			$\text{UO}_2(\text{NO}_3)_2$																			
		g/(g soln)	mol/kg																				
Furan [110-00-9]		0.003	0.0076																				
Diethyl ether [60-29-7]	$(\text{C}_2\text{H}_5)_2\text{O}$	0.491	2.451																				
Dioxane [123-91-1]		0.291	1.04																				
Dibenzyl ether [103-50-4]	$(\text{C}_5\text{H}_5\text{CH}_2)_2\text{O}$	0.017	0.044																				
AUXILIARY INFORMATION																							
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed with the appropriate amount of pure solvent in a small flask, maintained at 20°C, and equilibrated from undersaturation. Owing to the slow rate of diffusion of the solute from the crystals into the solution, particularly as saturation was approached, period of contact of 4 to 5 days with an intermittent agitation was required. The total uranium nitrate concentration was measured by evaporation of the weighed aliquots, followed by ignition to U_3O_8 .	SOURCE AND PURITY OF MATERIALS: 1. AR grade $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. 2. Anhydrous furan synthesized by a standard method. 3. C.P. anhydrous diethyl ether, dioxane, and dibenzyl ether. ESTIMATED ERROR: Soly: Repeat determinations made until results agreed to within 0.2 mass %. Temp: Precision ± 0.05 K. REFERENCES:																						

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Ethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Kovalskaya, M. P.; Kovaleva, T. V. <i>Zh. Neorg. Khim.</i> , <u>1957</u> , 2, 1677 - 1681. <i>Russ. J. Inorg. Chem.</i> , <u>1957</u> , 2, 359-367.																				
VARIABLES: $T/K = 273$ to 298 K	PREPARED BY: L. Fuks; S. Siekierski																				
EXPERIMENTAL VALUES: $\text{UO}_2(\text{NO}_3)_2 - \text{C}_2\text{H}_5\text{OC}_2\text{H}_5$ Anhydrous System at Various Temperatures Composition of Saturated Solutions ^a <table><tr><td></td><td>Uranium</td><td>$\text{UO}_2(\text{NO}_3)_2$</td><td>Solid</td></tr><tr><td>$t/^{\circ}\text{C}$</td><td>g/(100 g ether)</td><td>mol/kg</td><td>Phase^b</td></tr><tr><td>0</td><td>4.6</td><td>0.24</td><td>A</td></tr><tr><td>15</td><td>5.3</td><td>0.28</td><td>A</td></tr><tr><td>25</td><td>6.2</td><td>0.29</td><td>A</td></tr></table> <p>^aMolalities calculated by the compilers.</p> <p>^bSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$.</p>			Uranium	$\text{UO}_2(\text{NO}_3)_2$	Solid	$t/^{\circ}\text{C}$	g/(100 g ether)	mol/kg	Phase ^b	0	4.6	0.24	A	15	5.3	0.28	A	25	6.2	0.29	A
	Uranium	$\text{UO}_2(\text{NO}_3)_2$	Solid																		
$t/^{\circ}\text{C}$	g/(100 g ether)	mol/kg	Phase ^b																		
0	4.6	0.24	A																		
15	5.3	0.28	A																		
25	6.2	0.29	A																		
(Continued on the next page)																					
AUXILIARY INFORMATION																					
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.																				
	ESTIMATED ERROR: Soly: Nothing specified. Temp: Nothing specified.																				
	REFERENCES:																				

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Ethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Vdovenko, V. M.; Kovalskaya, M. P.; Kovaleva, T. V.

Zh. Neog. Khim., 1957, 2, 1677 - 1681.

Russ. J. Inorg. Chem., 1957, 2, 359-367.

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - \text{C}_2\text{H}_5\text{OC}_2\text{H}_5 - \text{H}_2\text{O}$ System at Various Temperatures

Composition of Saturated Solutions^a

$t/^{\circ}\text{C}$	Uranium g/(100 g ether)	$\text{UO}_2(\text{NO}_3)_2$ mol/kg	Solid _b Phase
-60	0.9	0.039	A
-50	3.1	0.14	A
-40	6.6	0.31	A
-30	9.7	0.48	A
-20	15.5	0.878	A
-10	21.0	1.35	A
0	28.7	2.30	A+B
10	31.1	2.69	B
15	31.8	---	B
20	32.6	2.98	B

^aMolalities calculated by the compilers.

^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.4(\text{C}_2\text{H}_5)_2\text{O}$.

B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.2(\text{C}_2\text{H}_5)_2\text{O}$.

The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_2\text{H}_5)_2\text{O} - \text{H}_2\text{O}$ System at 15°C

Composition of Saturated Solutions

Uranium g/(100 g ether)	Solid Phase ^a
31.8	$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.2(\text{C}_2\text{H}_5)_2\text{O}$
29.9	$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot (\text{C}_2\text{H}_5)_2\text{O}$
5.3	$\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$

Heat of Solution of Uranyl Nitrate Hydrates in Ether and Water

Formula	Heat of Solution, kJ/mol	
	H_2O	$(\text{C}_2\text{H}_5)_2\text{O}$
$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	23.0	5.23
$\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$	-7.07	-29.6
$\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$	-20.7	-45.4
$\text{UO}_2(\text{NO}_3)_2$	-49.8	-76.8

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Kovalskaya, M. P. Gerbanevskaya, M. M. <i>Trudy Radievogo Inst. im. V. G. Khlopina</i> , 1958, 8, 8-16. (Report, 1958, AEC-tr-4474, 8-19.)																																																					
VARIABLES: $T/K = 213 - 293$	PREPARED BY: A. Sozanski; S. Siekierski																																																					
EXPERIMENTAL VALUES: The Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ in $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ Composition of Saturated Solutions ^a <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th>U</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mass %</th><th>mol/kg</th></tr><tr><td>20</td><td>32.6</td><td>54.0</td><td>2.989</td><td>A</td></tr><tr><td>10</td><td>31.1</td><td>51.5</td><td>2.69</td><td>A</td></tr><tr><td>0</td><td>28.7</td><td>47.5</td><td>2.30</td><td>A</td></tr><tr><td>-10</td><td>21.0</td><td>34.8</td><td>1.35</td><td>B</td></tr><tr><td>-20</td><td>15.5</td><td>25.7</td><td>0.878</td><td>B</td></tr><tr><td>-30</td><td>9.7</td><td>16</td><td>0.48</td><td>B</td></tr><tr><td>-40</td><td>6.6</td><td>11</td><td>0.31</td><td>B</td></tr><tr><td>-50</td><td>3.1</td><td>5.1</td><td>0.14</td><td>B</td></tr><tr><td>-60</td><td>0.9</td><td>1.5</td><td>0.039</td><td>B</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.2(\text{C}_2\text{H}_5)_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.4(\text{C}_2\text{H}_5)_2\text{O}$.		$t/^{\circ}\text{C}$	U	$\text{UO}_2(\text{NO}_3)_2$		Solid Phase ^b	mass %	mass %	mol/kg	20	32.6	54.0	2.989	A	10	31.1	51.5	2.69	A	0	28.7	47.5	2.30	A	-10	21.0	34.8	1.35	B	-20	15.5	25.7	0.878	B	-30	9.7	16	0.48	B	-40	6.6	11	0.31	B	-50	3.1	5.1	0.14	B	-60	0.9	1.5	0.039	B
$t/^{\circ}\text{C}$	U		$\text{UO}_2(\text{NO}_3)_2$		Solid Phase ^b																																																	
	mass %	mass %	mol/kg																																																			
20	32.6	54.0	2.989	A																																																		
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-50	3.1	5.1	0.14	B																																																		
-60	0.9	1.5	0.039	B																																																		
AUXILIARY INFORMATION																																																						
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Approximately 20 mL of the saturated ether solution of uranyl nitrate dihydrate was placed in a test tube provided with a mercury seal, and was agitated for 4 hours at a specified temperature, which was always below the temperature of the saturated solution which was used as the starting material. The crystals were then allowed to settle, and the clear supernatant solution was used for analysis.	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate dihydrate was obtained by vacuum drying of a hexahydrate which had been recrystallized three times. 2. Diethyl ether, for narcosis, was distilled and carefully dried. ESTIMATED ERROR: Soly: Error in uranium analysis was $\pm 0.2\%$. Temp: Nothing specified. REFERENCES:																																																					

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Kovaleva, T. V.; Moskalkova, E. A. <i>Trudy Radievogo Institute im. V.G. Khlopina</i> , 1958, 8, 17-21. Report, 1958, AEC-tr-4474, 20-26.																																	
VARIABLES: $T/K = 263 - 298$	PREPARED BY: A. Sozanski; S. Siekierski																																	
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3\text{CH}_2)_2\text{O} - \text{H}_2\text{O}$ System Composition of the Ether Phase of the Saturated Solutions <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th>U</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2^a$</th><th rowspan="2">Solid_b Phase^b</th></tr><tr><th>mass %</th><th>mass %</th><th>mol/kg</th></tr><tr><td>25</td><td>31.55</td><td>52.23</td><td>2.775</td><td>A</td></tr><tr><td>15</td><td>29.88</td><td>49.46</td><td>2.484</td><td>A</td></tr><tr><td>5</td><td>29.42</td><td>48.70</td><td>2.409</td><td>A</td></tr><tr><td>0</td><td>28.63</td><td>47.39</td><td>2.286</td><td>A</td></tr><tr><td>-10</td><td>27.94</td><td>46.25</td><td>2.184</td><td>A</td></tr></table> ^a Both mass % and molalities were calculated by the compilers. ^b Solid phase: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot (\text{C}_2\text{H}_5)_2\text{O}$. Initial solid: $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.		$t/^{\circ}\text{C}$	U	$\text{UO}_2(\text{NO}_3)_2^a$		Solid _b Phase ^b	mass %	mass %	mol/kg	25	31.55	52.23	2.775	A	15	29.88	49.46	2.484	A	5	29.42	48.70	2.409	A	0	28.63	47.39	2.286	A	-10	27.94	46.25	2.184	A
$t/^{\circ}\text{C}$	U		$\text{UO}_2(\text{NO}_3)_2^a$		Solid _b Phase ^b																													
	mass %	mass %	mol/kg																															
25	31.55	52.23	2.775	A																														
15	29.88	49.46	2.484	A																														
5	29.42	48.70	2.409	A																														
0	28.63	47.39	2.286	A																														
-10	27.94	46.25	2.184	A																														
AUXILIARY INFORMATION																																		
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The determinations were made in an apparatus consisting of a glass cylinder provided with a stirrer, and fitted with a mercury seal. Uranyl nitrate and ether were placed in the apparatus which was then set in a thermostat. The temperature of the thermostat was 10 °C higher than the desired temperature. The ether solution was stirred with the aqueous layer and with the undissolved salt for 2 hours, the solution was then allowed to settle for 30 min. Thereafter the ether solution was transferred to another apparatus, and was cooled to the desired temperature. On cooling, the solid phase separated, and the solution was stirred for 3 hours. The solid was allowed to settle for 30 min. Analysis for the uranium content of the ether solution was carried out gravimetrically.	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate hexahydrate, not specified. Probably three times recrystallized (compilers). 2. Diethyl ether, not specified. Probably "for narcosis," carefully distilled and dried. (compilers). ESTIMATED ERROR: Nothing specified. REFERENCES:																																	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Kovaleva, T. V. <i>Trudy Radievogo Institute im. V.G. Khlopina</i> , 1958, 8, 22-24. Report, 1958, AEC-tr-4474, 27-30.																							
VARIABLES: $T/K = 273$ to 298	PREPARED BY: A. Sozanski; S. Siekierski																							
EXPERIMENTAL VALUES: The Solubility of $\text{UO}_2(\text{NO}_3)_2$ in $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ Composition of Saturated Solutions ^a <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th>U</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th rowspan="2">Solid^b Phase</th></tr><tr><th>mass %</th><th>mass %</th><th>mol/kg</th></tr><tr><td>0</td><td>4.6</td><td>7.6</td><td>0.21</td><td>A</td></tr><tr><td>15</td><td>5.3</td><td>8.8</td><td>0.24</td><td>A</td></tr><tr><td>25</td><td>6.2</td><td>10.3</td><td>0.291</td><td>A</td></tr></table> ^a Molalities calculated by the compilers. ^b Solid phase: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$. The initial solid phase was anhydrous $\text{UO}_2(\text{NO}_3)_2$.		$t/^{\circ}\text{C}$	U	$\text{UO}_2(\text{NO}_3)_2$		Solid ^b Phase	mass %	mass %	mol/kg	0	4.6	7.6	0.21	A	15	5.3	8.8	0.24	A	25	6.2	10.3	0.291	A
$t/^{\circ}\text{C}$	U		$\text{UO}_2(\text{NO}_3)_2$		Solid ^b Phase																			
	mass %	mass %	mol/kg																					
0	4.6	7.6	0.21	A																				
15	5.3	8.8	0.24	A																				
25	6.2	10.3	0.291	A																				
AUXILIARY INFORMATION																								
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The procedure is described in another publication (1).	SOURCE AND PURITY OF MATERIALS: 1. Anhydrous uranyl nitrate was prepared according to Marketos (2) from $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$. 2. Diethyl ether not specified. Probably "for narcosis," and purified by distillation and drying (compilers). ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Vdovenko, V.M.; Kovalskaya, M.P. in, Report, 1958, AECD-tr-4474, 8-19. 2. Marketos, M. <i>Compt. Rend.</i> , 1912, 155, 210.																							

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Butyl ether; $\text{C}_8\text{H}_{18}\text{O}$; [142-96-1] (3) Water; H_2O ; [7732-18-5]	EVALUATOR: Vdovenko, V. M.; Suglobova, I. G. <i>Zh. Neorg. Khim.</i> , <u>1958</u> , 3, 1403 - 1409. <i>Russ. J. Inorg. Chem.</i> , <u>1958</u> , 3, 187-196.																																																																								
VARIABLES: One temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski																																																																								
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - [\text{CH}_3(\text{CH}_2)_3]_2\text{O} (\text{Bu}_2\text{O}) - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Solutions ^a																																																																									
<table><tr><th colspan="4">Aqueous Phase</th><th colspan="4">Ether Phase</th></tr><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th>$\text{Bu}_2\text{O}^b$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th>$\text{Bu}_2\text{O}^b$</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mass %</th><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mass %</th></tr><tr><td>0</td><td>0</td><td>99.9</td><td>0.1</td><td>0</td><td>0</td><td>0.15</td><td>99.85</td></tr><tr><td>32.0</td><td>1.19</td><td>58.0</td><td>0</td><td>0.06</td><td>0.002</td><td>0.15</td><td>99.79</td></tr><tr><td>38.92</td><td>1.617</td><td>57.5</td><td>3.58</td><td>0.28</td><td>0.0071</td><td>0.16</td><td>99.56</td></tr><tr><td>44.37</td><td>2.024</td><td>---</td><td>---</td><td>1.05</td><td>0.0269</td><td>0.24</td><td>98.71</td></tr><tr><td>46.50</td><td>2.206</td><td>51.2</td><td>2.30</td><td>1.64</td><td>0.0423</td><td>0.35</td><td>98.01</td></tr><tr><td>52.02</td><td>2.752</td><td>---</td><td>---</td><td>5.22</td><td>0.140</td><td>0.74</td><td>94.04</td></tr></table>		Aqueous Phase				Ether Phase				$\text{UO}_2(\text{NO}_3)_2$		H_2O	Bu_2O^b	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Bu_2O^b	mass %	mol/kg	mass %	mass %	mass %	mol/kg	mass %	mass %	0	0	99.9	0.1	0	0	0.15	99.85	32.0	1.19	58.0	0	0.06	0.002	0.15	99.79	38.92	1.617	57.5	3.58	0.28	0.0071	0.16	99.56	44.37	2.024	---	---	1.05	0.0269	0.24	98.71	46.50	2.206	51.2	2.30	1.64	0.0423	0.35	98.01	52.02	2.752	---	---	5.22	0.140	0.74	94.04
Aqueous Phase				Ether Phase																																																																					
$\text{UO}_2(\text{NO}_3)_2$		H_2O	Bu_2O^b	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Bu_2O^b																																																																		
mass %	mol/kg	mass %	mass %	mass %	mol/kg	mass %	mass %																																																																		
0	0	99.9	0.1	0	0	0.15	99.85																																																																		
32.0	1.19	58.0	0	0.06	0.002	0.15	99.79																																																																		
38.92	1.617	57.5	3.58	0.28	0.0071	0.16	99.56																																																																		
44.37	2.024	---	---	1.05	0.0269	0.24	98.71																																																																		
46.50	2.206	51.2	2.30	1.64	0.0423	0.35	98.01																																																																		
52.02	2.752	---	---	5.22	0.140	0.74	94.04																																																																		
(Continued on the next page)																																																																									
AUXILIARY INFORMATION																																																																									
METHOD/APPARATUS/PROCEDURE: Dibutyl ether, uranyl nitrate hydrates and water were shaken in a thermostatted ampoule at 25°C, 7 to 10 days. After reaching equilibrium, the liquid phases were analyzed for uranium and water contents. Analysis for water was carried out by Karl Fischer titration; for uranium by the ammonium diuranate precipitation followed by ignition to U_3O_8 . Two different methods for the solid phase composition analysis were used: 1. The solid was pressed between two sheets of filter paper in a steam of dry CO_2 , and then analyzed. 2. The Cameron method (1), using radioactive $\text{Sn}-(\text{C}_6\text{H}_5)_4$ as an additional component of the solution.	SOURCE AND PURITY OF MATERIALS: 1. Dibutyl ether of the "purum" quality was dried (2). 2. Various hydrates of uranyl nitrate were obtained carefully purified $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. ESTIMATED ERROR: Temp: Precision to $\pm 0.02^\circ\text{C}$. Water content: ± 0.5 to 1% of the investigated value. Uranium content: Cameron method ± 1 to 1.5%. Ignition method ± 3 to 6%. REFERENCES: 1. Anosov, V. Ya.; Pogodin, S. A. "Basic Principles of Physico-Chemical Analysis," in Russian, Moscow, <u>1957</u> . 2. Weigand, K. "Organic Preparations," Vol. I, in German, Barth Leipzig, <u>1938</u> ; in English, Interscience, NY, <u>1947</u> ; in Russian, Foreign Lit. Publ., Moscow, <u>1950</u> .																																																																								

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]

(2) Butyl ether; $\text{C}_8\text{H}_{18}\text{O}$; [142-96-1]

(3) Water; H_2O ; [7732-18-5]

EVALUATOR:

Vdovenko, V. M.; Suglobova, I. G.

Zh. Neorg. Khim., 1958, 3, 1403 - 1409.

Russ. J. Inorg. Chem., 1958, 3, 187-196.

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - [\text{CH}_3(\text{CH}_2)_3]_2\text{O} (\text{Bu}_2\text{O}) - \text{H}_2\text{O}$ System at 25°C

Composition of Saturated Solutions^a

Aqueous Phase				Ether Phase			
$\text{UO}_2(\text{NO}_3)_2$		H_2O	Bu_2O^b	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Bu_2O^b
mass %	mol/kg	mass %	mass %	mass %	mol/kg	mass %	mass %
53.90	2.967	45.5	0.60	7.72	0.212	0.96	91.32
54.48	3.037	43.4	2.12	8.39	0.232	1.02	90.59
55.21	3.128	42.5	2.29	9.12	0.255	1.15	89.73
55.74	3.196	---	---	10.14	0.2864	1.27	88.59
55.81	3.205	41.8	2.39	10.14	0.2864	1.28	88.58
				17.65	0.5439	2.05	80.30 ^c
				18.33	0.5696	2.09	79.58 ^c
				26.27	0.9042	2.85	70.88 ^c
				32.07	1.198	3.35	64.58 ^c
				31.90	1.189	3.32	64.78 ^d
				31.31	1.157	3.39	65.30 ^d
				31.70	1.178	3.30	65.00 ^d
				31.48	1.166	3.07	65.45 ^d
				42.19	1.852	3.62	54.19 ^e
				41.80	1.823	3.44	54.78 ^e
				42.22	1.854	3.32	54.46 ^e
				41.44	1.796	3.57	54.99 ^e
				44.05	1.998	2.97	52.98 ^f
				7.46	0.205	0.21	92.33 ^g
				4.17	0.110	0.03	95.80 ^g
				4.17	0.110	---	95.83 ^g

^aMolalities calculated by the compilers as moles per 1 kg of a mixture consisting of water and dibutyl ether (Bu_2O).

^bCalculated by compilers as difference: 100 mass % (U) - mass % (H_2O).

^cSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$

^dSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} + \text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$

^eSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} + \text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 2\text{Bu}_2\text{O}$

^fSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 2\text{Bu}_2\text{O} + \text{UO}_2(\text{NO}_3)_2 \cdot 2\text{Bu}_2\text{O}$

^gSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{Bu}_2\text{O}$.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Suglobova, I. G. Suglovov, D. N. <i>Radiokhim.</i> , 1959, 1, 637 - 644.																																																												
VARIABLES: Composition at 298 K		PREPARED BY: A. Sozanski; S. Siekierski																																																												
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3\text{CH}_2)_2\text{O} - \text{H}_2\text{O}$ System at 25°C Composition of Saturated Organic Phase ^a <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th>Ether</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mass %</th></tr><tr><td>53.61</td><td>2.933</td><td>4.95</td><td>41.44</td><td>A</td></tr><tr><td>32.56</td><td>1.225</td><td>2.50</td><td>64.94</td><td>B</td></tr><tr><td>31.44</td><td>1.164</td><td>2.48</td><td>66.08</td><td>B</td></tr><tr><td>13.75</td><td>0.4046</td><td>1.02</td><td>85.23</td><td>B</td></tr><tr><td>11.23</td><td>0.3211</td><td>0.80</td><td>87.97</td><td>B</td></tr><tr><td>10.61</td><td>0.3012</td><td>0.78</td><td>88.61</td><td>B</td></tr><tr><td>2.31</td><td>0.0600</td><td>0.17</td><td>97.52</td><td>B</td></tr><tr><td>2.16</td><td>0.0560</td><td>0.15</td><td>97.69</td><td>B</td></tr><tr><td>1.33</td><td>0.0342</td><td>0.07</td><td>98.6</td><td>B</td></tr><tr><td>1.01</td><td>0.0259</td><td>---</td><td>98.99</td><td>B</td></tr></table> ^a Molality of uranyl nitrate (moles of uranyl nitrate per 1 kg of the mixture consisting of water and diethyl ether) and mass % of ether calculated by the compilers. ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$. B = $\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_2\text{H}_5)_2\text{O}$. (Continued on the next page)				$\text{UO}_2(\text{NO}_3)_2$		H_2O	Ether	Solid Phase ^b	mass %	mol/kg	mass %	mass %	53.61	2.933	4.95	41.44	A	32.56	1.225	2.50	64.94	B	31.44	1.164	2.48	66.08	B	13.75	0.4046	1.02	85.23	B	11.23	0.3211	0.80	87.97	B	10.61	0.3012	0.78	88.61	B	2.31	0.0600	0.17	97.52	B	2.16	0.0560	0.15	97.69	B	1.33	0.0342	0.07	98.6	B	1.01	0.0259	---	98.99	B
$\text{UO}_2(\text{NO}_3)_2$		H_2O	Ether	Solid Phase ^b																																																										
mass %	mol/kg	mass %	mass %																																																											
53.61	2.933	4.95	41.44	A																																																										
32.56	1.225	2.50	64.94	B																																																										
31.44	1.164	2.48	66.08	B																																																										
13.75	0.4046	1.02	85.23	B																																																										
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10.61	0.3012	0.78	88.61	B																																																										
2.31	0.0600	0.17	97.52	B																																																										
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1.33	0.0342	0.07	98.6	B																																																										
1.01	0.0259	---	98.99	B																																																										
AUXILIARY INFORMATION																																																														
METHOD/APPARATUS/PROCEDURE: Solubility was determined as described previously (1).		SOURCE AND PURITY OF MATERIALS: Nothing specified. The uranyl nitrate hydrates were obtained as described previously (1).																																																												
		ESTIMATED ERROR: Nothing specified.																																																												
		REFERENCES: 1. Vdovenko, V.M.; Suglobova, I.G. <i>Zh. Neorg. Khim.</i> , 1958, 3, 1403.																																																												

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Vdovenko, V. M.; Suglobova, I. G.; Suglobov, D. N.
(2) 2,2'-Dichloroethoxyethane; $\text{C}_4\text{H}_8\text{Cl}_2\text{O}$; [111-44-4]	<i>Radiokhim.</i> , 1959, 1, 637 - 644.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_2\text{ClCH}_2)_2\text{O} - \text{H}_2\text{O}$ System at 25°CComposition of Saturated Solutions^a

$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$		H_2O	Ether
mass %	mol/kg	mass %	mass %	mol/kg	mass %	mass %
0	0	98.9	0	0	0.526	99.474 ^b
55.85	3.210	44.15	0.248	0.0645	0.824	96.696 ^b
			3.25	0.0852	0.910	95.84 ^b
			11.44	0.0852	1.80	86.84 ^b
			12.81	0.3729	1.66	85.53 ^c
			14.24	0.4214	2.12	83.64 ^c
			22.95	0.7559	2.33	74.72 ^c
			22.45	0.7347	2.35	75.2 ^d
			25.00	0.8459	2.38	75.72 ^d
			26.03	0.8931	2.25	71.72 ^e
			16.32	0.4949	1.53	82.15 ^e
			10.00	0.2820	0.844	89.156 ^f
			0.762	0.0195	0.060	99.178 ^f

^aMolality of uranyl nitrate and mass % of ether calculated by the compilers.^bSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.^cSolid phases = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} + \text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$.^dSolid phases = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} + \text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$.^eSolid phases = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} + \text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{CH}_2\text{ClCH}_2)_2\text{O}$ ^fSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{CH}_2\text{ClCH}_2)_2\text{O}$

A triangular phase diagram is given in the source publication.

COMPONENTS:			ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Vdovenko, V. M.; Suglobova, I. G.; Mezei, M.				
(2) 2-Propoxy-2-propane (isopropyl ether); $\text{C}_6\text{H}_{14}\text{O}$; [108-20-3]			Radiokhim., 1962, 4, 388 - 392.				
(3) Water; H_2O ; [7732-18-5]			Sov. Radiochem., 1962, 4, 342-346.				
VARIABLES:			PREPARED BY:				
Composition at 298 K			A. Sozanski; S. Siekierski				
EXPERIMENTAL VALUES:							
The $\text{UO}_2(\text{NO}_3)_2 - [(\text{CH}_3)_2\text{CH}]_2\text{O} - \text{H}_2\text{O}$ System at 25°C ^a							
Aqueous Phase ^b			Organic Phase ^b			Solid Phase	
$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$	H_2O
mass %	mol/kg	mass %	mass %	mol/kg	mass %	mass %	mass %
---	---	---	---	---	0.90	---	---
36.65	1.468	62.81	0.69	0.018	0.55	---	---
45.40	2.110	53.42	5.33	0.143	1.45	---	---
48.82	2.421	50.10	9.98	0.281	2.15	---	---
---	---	---	10.60	0.3009	2.18	51.06	7.26 ^c
48.82	2.421	50.60	10.40	0.2946	2.10	51.69	7.80 ^c
---	---	---	10.70	0.3041	2.17	50.84	7.78 ^c
48.85	2.424	50.00	10.45	0.2962	2.14	52.00	7.10 ^c
48.82	2.421	50.50	10.52	0.2984	2.09	52.05	7.30 ^c
48.80	2.419	50.32	10.50	0.2977	2.00	52.11	7.18 ^c
48.79	2.418	50.00	10.40	0.2946	2.17	52.19	7.07 ^c
48.81	2.420	50.21	10.57	0.3000	2.15	52.08	7.15 ^c
---	---	---	10.00	0.2820	1.95	52.41	7.19 ^c
(Continued on the next page)							
AUXILIARY INFORMATION							
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:				
The solubility was determined as described in a previous publication (1).			1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, purified (1).				
			2. Isopropyl ether, purified (2).				
			ESTIMATED ERROR:				
			Nothing specified.				
			REFERENCES:				
			1. Vdovenko, V.M.; Suglobova, I.G.				
			Zh. Neorg. Khim., 1958, 3, 1403.				
			2. Vaisberger, A.; Proskauer, E.S.; Riddik, D.; Tups, E.E.				
			Organicheski Restvoriteli. Moskva, 1958.				

COMPONENTS:			ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]			Vdovenko, V. M.; Suglobova, I. G.; Mezei, M.				
(2) 2-Propoxy-2-propane (isopropyl ether); $\text{C}_6\text{H}_{14}\text{O}$; [108-20-3]			Radiokhim., 1962, 4, 388 - 392.				
(3) Water; H_2O ; [7732-18-5]			Sov. Radiochem., 1962, 4, 342-346.				
EXPERIMENTAL VALUES: (Continued)							
The $\text{UO}_2(\text{NO}_3)_2 - [(\text{CH}_3)_2\text{CH}]_2\text{O} - \text{H}_2\text{O}$ System at 25°C^a							
Aqueous Phase ^b			Organic Phase ^b			Solid Phase	
$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$		H_2O	$\text{UO}_2(\text{NO}_3)_2$	H_2O
mass %	mol/kg	mass %	mass %	mol/kg	mass %	mass %	mass %
---	---	---	9.45	0.265	1.86	50.60	6.06 ^d
---	---	---	9.33	0.261	1.80	49.41	5.15 ^d
---	---	---	9.38	0.263	1.77	49.98	4.78 ^d
---	---	---	9.42	0.264	1.80	50.50	4.75 ^d
---	---	---	7.64	0.210	1.35	48.00	4.12 ^e
---	---	---	4.32	0.115	0.72	47.47	4.09 ^e
---	---	---	2.37	0.0616	0.22	47.10	4.15 ^e
---	---	---	2.35	0.0611	0.20	47.40	4.28 ^e
---	---	---	2.36	0.0613	0.20	47.40	4.28 ^e
---	---	---	2.38	0.0619	0.20	47.39	4.20 ^e
---	---	---	2.34	0.0608	0.14	61.15	2.30 ^f
---	---	---	3.50	0.0920	0.06	66.00	0.24 ^g
---	---	---	4.50	0.120	0.06	65.86	0.21 ^g
---	---	---	4.38	0.116	0.12	65.85	0.32 ^g
---	---	---	4.50	0.120	0.08	65.80	0.24 ^g

^aMolalities calculated by the compilers.

^bMoles $\text{UO}_2(\text{NO}_3)_2$ in 1 kg of the mixture consisting of isopropyl ether and water (compilers).

^cSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot 0.3(\text{C}_3\text{H}_7)_2\text{O}$.

^dSolid phases = $\text{UO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} \cdot 0.3(\text{C}_3\text{H}_7)_2\text{O} + \text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.4(\text{C}_3\text{H}_7)_2\text{O}$.

^eSolid phase = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.4(\text{C}_3\text{H}_7)_2\text{O}$.

^fSolid phases = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O} \cdot 0.4(\text{C}_3\text{H}_7)_2\text{O} + \text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_3\text{H}_7)_2\text{O}$.

^gSolid phases = $\text{UO}_2(\text{NO}_3)_2 \cdot 2(\text{C}_3\text{H}_7)_2\text{O}$.

The phase diagram is given in the source publication.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) 2-Propoxy-2-propane (isopropyl ether); $\text{C}_6\text{H}_{14}\text{O}$; [108-20-3] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Suglobova, I. G.; Mezei, M. <i>Radiokhim.</i> , 1962, 4, 388 - 392. <i>Sov. Radiochem.</i> , 1962, 4, 342-346.
EXPERIMENTAL VALUES: (Continued) <p>The $\text{UO}_2(\text{NO}_3)_2 - [(\text{CH}_3)_2\text{CH}]_2\text{O} - \text{H}_2\text{O}$ System Phase Diagram at 25°C contains the following information:</p> <ol style="list-style-type: none"> Region of layer formation by aqueous and ether solutions of uranyl nitrate. Field of unsaturated solutions of uranyl nitrate and ether in water. Field of mixtures of crystals of uranyl nitrate trihydrate trietherate and saturated aqueous solutions. Region of equilibrium of uranyl nitrate trihydrate trietherate and aqueous and ether saturated solutions. Field of mixtures of uranyl nitrate trihydrate trietherate and saturated ether solutions. Field of mixtures of uranyl nitrate trihydrate trietherate and dihydrate tetraetherate and saturated ether solution. Field of mixtures of uranyl nitrate dihydrate tetraetherate and saturated ether solutions. Field of mixtures of uranyl nitrate dihydrate tetraetherate and uranyl nitrate dietherate and saturated ether solution. Field of mixtures of uranyl nitrate dietherate and saturated ether solutions. Field of unsaturated ether solutions of uranyl nitrate and water in ether. 	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Ethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Heptane; C_7H_{16} ; [142-82-5] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Suglobova, I. G.; I-Wui, Wang; Suglobov, D. N. <i>Radiokhim.</i> , 1964, 6, 532 - 538. <i>Sov. Radiochem.</i> , 1964, 6, 514-519.																										
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski																										
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3\text{CH}_2)_2\text{O} - \text{CH}_3(\text{CH}_2)_5\text{CH}_3$ System Composition of the Saturated Solutions at 25°C ^a <table> <tr> <th>$\text{UO}_2(\text{NO}_3)_2$ mol/dm³</th><th>$(\text{C}_2\text{H}_5)_2\text{O}$ mol/dm³</th></tr> <tr><td>0.97</td><td>233</td></tr> <tr><td>7.75</td><td>670</td></tr> <tr><td>8.53</td><td>636</td></tr> <tr><td>10.98</td><td>724</td></tr> <tr><td>24.6</td><td>1205</td></tr> <tr><td>27.6</td><td>1292</td></tr> <tr><td>31.2</td><td>1510</td></tr> <tr><td>45.2</td><td>1850</td></tr> <tr><td>58.6</td><td>1930</td></tr> <tr><td>62.5</td><td>2020</td></tr> <tr><td>84.0</td><td>2390</td></tr> <tr><td>102</td><td>---</td></tr> </table> <p>^aThe initial organic phase consisted of a mixture of diethyl ether and heptane. It is not clear whether uranium nitrate dihydrate-dietherate was the initial or equilibrium solid (compilers).</p> <p>(Continued on the next page)</p>		$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_2\text{H}_5)_2\text{O}$ mol/dm ³	0.97	233	7.75	670	8.53	636	10.98	724	24.6	1205	27.6	1292	31.2	1510	45.2	1850	58.6	1930	62.5	2020	84.0	2390	102	---
$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_2\text{H}_5)_2\text{O}$ mol/dm ³																										
0.97	233																										
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8.53	636																										
10.98	724																										
24.6	1205																										
27.6	1292																										
31.2	1510																										
45.2	1850																										
58.6	1930																										
62.5	2020																										
84.0	2390																										
102	---																										
AUXILIARY INFORMATION																											
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate dihydrate-dietherate and organic phase of the composition under investigation were shaken for 7 to 8 hours, then allowed to stand for several hours in a thermostatted vessel. The uranium content in the solution was measured using gravimetric and colorimetric procedures.	SOURCE AND PURITY OF MATERIALS: Nothing specified.																										
	ESTIMATED ERROR: Temp: Precision ± 0.05 K.																										
	REFERENCES:																										

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Vdovenko, V. M.; Suglobova, I. G.; I-Wui, Wang; Suglovov, D. N.
(2) Ethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]	<i>Radiokhim.</i> , 1964, 6, 532 - 538.
(3) Chloroform; CHCl_3 ; [67-66-3]	<i>Sov. Radiochem.</i> , 1964, 6, 514-519.
(4) Carbon tetrachloride; CCl_4 ; [56-23-5]	
(5) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_2\text{H}_5)_2\text{O} - \text{CHCl}_3$ SystemComposition of the Saturated Solutions at 25°C^a

$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_2\text{H}_5)_2\text{O}$ mol/dm ³
4.05	242
11.5	453
25.8	665
36.2	864
63.7	1230
66.9	1230
104	1257
129.7	1563
156	1870

^aThe initial organic phase consisted of a mixture of diethyl ether and chloroform. It is not clear whether uranium nitrate dihydrate-dietherate was the initial or equilibrium solid (compilers)

The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_2\text{H}_5)_2\text{O} - \text{CCl}_4$ SystemComposition of the Saturated Solutions at 25°C^a

$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_2\text{H}_5)_2\text{O}$ mol/dm ³
4.17	232
16.4	455
17.7	453
18.4	487
57.5	856
127.3	1260
169	1511
190	1552
184	1510

^aThe initial organic phase consisted of a mixture of diethyl ether and carbon tetrachloride. It is not clear whether uranium nitrate dihydrate-dietherate was the initial or equilibrium solid (compilers).

(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Vdovenko, V. M.; Suglobova, I. G.; I-Wui, Wang; Suglovov, D. N.
(2) Ethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]	<i>Radiokhim.</i> , 1964, 6, 532 - 538.
(3) Benzene; C_6H_6 ; [71-43-2]	<i>Sov. Radiochem.</i> , 1964, 6, 514-519.
(4) Water; H_2O ; [7735-18-5]	
EXPERIMENTAL VALUES: (Continued)	
The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_2\text{H}_5)_2\text{O} - \text{C}_6\text{H}_6$ System	
Composition of the Saturated Solutions at 25°C ^a	
$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_2\text{H}_5)_2\text{O}$ mol/dm ³
13.1	239
28.0	464
32.2	454
87.0	863
174	1210
182	1122
275	1550
329	1840
408	2020
540	2340
^a The initial organic phase consisted of a mixture of diethyl ether and benzene. It is not clear whether uranyl nitrate dihydrate-dietherate was the initial or equilibrium solid (compilers).	

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Butyl ether; $\text{C}_8\text{H}_{18}\text{O}$; [142-96-1] (3) Heptane; C_7H_{16} ; [142-82-5] (4) Chloroform; CHCl_3 ; [67-66-3] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Suglobova, I. G.; I-Wui, Wang; Suglovov, D. N. <i>Radiokhim.</i> , 1964, 6, 532 - 538. <i>Sov. Radiochem.</i> , 1964, 6, 514-519.																														
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski																														
EXPERIMENTAL VALUES: <p style="text-align: center;">The $\text{UO}_2(\text{NO}_3)_2 - [\text{CH}_3(\text{CH}_2)_3]_2\text{O} - \text{CH}_3(\text{CH}_2)_5\text{CH}_3$ System Composition of the Saturated Solutions at 25°C^a</p> <table> <tr> <th>$\text{UO}_2(\text{NO}_3)_2$ mol/dm³</th><th>$(\text{C}_4\text{H}_9)_2\text{O}$ mol/dm³</th></tr> <tr><td>2.7</td><td>298</td></tr> <tr><td>10.05</td><td>535</td></tr> <tr><td>20.3</td><td>757</td></tr> <tr><td>44.6</td><td>1051</td></tr> <tr><td>47.5</td><td>1130</td></tr> <tr><td>71.6</td><td>1370</td></tr> </table> <p>^aThe initial organic phase consisted of a mixture of dibutyl ether and heptane (compilers).</p> <p style="text-align: center;">The $\text{UO}_2(\text{NO}_3)_2 - [\text{CH}_3(\text{CH}_2)_3]_2\text{O} - \text{CHCl}_3$ System Composition of the Saturated Solutions at 25°C^a</p> <table> <tr> <th>$\text{UO}_2(\text{NO}_3)_2$ mol/dm³</th><th>$(\text{C}_4\text{H}_9)_2\text{O}$ mol/dm³</th></tr> <tr><td>0.26</td><td>281</td></tr> <tr><td>0.35</td><td>298</td></tr> <tr><td>1.42</td><td>466</td></tr> <tr><td>5.49</td><td>768</td></tr> <tr><td>8.1</td><td>864</td></tr> <tr><td>16.0</td><td>1032</td></tr> <tr><td>24.0</td><td>1178</td></tr> </table> <p>^aThe initial organic phase consisted of a mixture of dibutyl ether and chloroform.</p> <p style="text-align: right;">(Continued on the next page)</p>		$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_4\text{H}_9)_2\text{O}$ mol/dm ³	2.7	298	10.05	535	20.3	757	44.6	1051	47.5	1130	71.6	1370	$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_4\text{H}_9)_2\text{O}$ mol/dm ³	0.26	281	0.35	298	1.42	466	5.49	768	8.1	864	16.0	1032	24.0	1178
$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_4\text{H}_9)_2\text{O}$ mol/dm ³																														
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8.1	864																														
16.0	1032																														
24.0	1178																														
AUXILIARY INFORMATION																															
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Excess uranyl nitrate dihydrate and organic phase of the desired composition were shaken for 7 to 8 hours in a thermostatted vessel. Uranium content in the solution was determined by gravimetric and colorimetric procedures.	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Temp: Precision to ± 0.05 K. REFERENCES:																														

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Vdovenko, V. M.; Suglobova, I. G.; I-Wui, Wang; Suglovov, D. N.
(2) Butyl ether; $\text{C}_8\text{H}_{18}\text{O}$; [142-96-1]	<i>Radiokhim.</i> , 1964, 6, 532 - 538.
(3) Carbon tetrachloride; CCl_4 ; [56-23-5]	<i>Sov. Radiochem.</i> , 1964, 6, 514-519.
(4) Benzene; C_6H_6 ; [71-43-2]	
(5) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - $[(\text{CH}_3(\text{CH}_2)_3)_2\text{O} - \text{CCl}_4$ System
Composition of the Saturated Solutions at 25°C^a

$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_4\text{H}_9)_2\text{O}$ mol/dm ³
1.04	298
3.45	466
13.2	768
19.0	841
34.0	980
43.6	1137
78.0	1350
128	1640

^aThe initial organic phase consisted of a mixture of dibutyl ether and carbon tetrachloride.

The $\text{UO}_2(\text{NO}_3)_2$ - $[(\text{CH}_3(\text{CH}_2)_3)_2\text{O} - \text{C}_6\text{H}_6$ System
Composition of the Saturated Solutions at 25°C^a

$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$(\text{C}_4\text{H}_9)_2\text{O}$ mol/dm ³
6.9	280
7.1	280
28.4	570
56.5	765
59.0	780
67.5	870
86.0	970
97.3	971

^aThe initial organic phase consisted of a mixture of dibutyl ether and benzene.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) d_2 -Water; D_2O ; [7789-20-0]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Legin, E. K. <i>Radiokhim</i> , 1966, 8, 317 - 323. <i>Sov. Radiochem.</i> , 1966, 8, 293.
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3 - \text{D}_2\text{O}$ System at 25°C^a Aqueous Phase	

COMPONENTS:

(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$;
[15905-86-9]

(2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$;
[60-29-7]

(3) d_2 -Water; D_2O ; [7789-20-0]

ORIGINAL MEASUREMENTS:

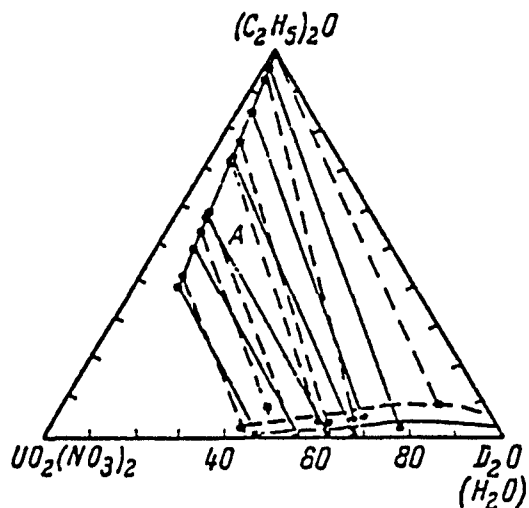
Vdovenko, V. M.; Legin, E. K.

Radiokhim, 1966, 8, 317 - 323.

Sov. Radiochem., 1966, 8, 293.

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2$ - $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ - D_2O System at 25°C^a



^aSolid phase: $\text{A} = \text{UO}_2(\text{NO}_3)_2 \cdot 6\text{D}_2\text{O}$.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Formic acid; CH_2O_2 ; [64-18-6] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Conninck, Oe. <i>Compt. Rend.</i> , 1901, 132, 90 - 91.
VARIABLES: One temperature: about 288 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in concentrated formic acid is reported to be one part of the salt to 5.3 parts of HCOOH. It is an average value of determinations at 15°C, 15.4°C and 15.6°C.</p> <p>The initial salt was probably a mixture of hexa- and trihydrate (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Acetic acid; $\text{C}_2\text{H}_4\text{O}_2$; [64-19-7] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: De Conninck, Oe. <i>Compt. Rend.</i> , <u>1900</u> , 131, 1303 - 1305.
VARIABLES: One temperature: about 287 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of uranyl nitrate in CH_3COOH is reported to be 1 part of the salt per 5.6 parts of the acid. It is an average value of determinations at 14°C and 14.5°C.</p> <p>The initial salt was probably a mixture of hexa- and trihydrate. (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate, presumably the hexahydrate (compilers) was dried at 90°C. Acetic acid with a density of 1.035 g/cm ³ was used.
	ESTIMATED ERROR: Nothing specified
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various nitro organics (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yaffe, L. <i>Can. J. Res.</i> , 1949, 27B, 638-645.															
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski															
EXPERIMENTAL VALUES: The Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in Various Nitro Compounds is: <table><tr><th>Nitro Compound</th><th>Formula</th><th>$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}^a$ g/(100 cm^3)</th></tr><tr><td>Nitromethane</td><td>CH_3NO_2; [75-52-5]</td><td>64</td></tr><tr><td>1-Nitropropane</td><td>$\text{C}_3\text{H}_7\text{NO}_2$; [108-03-2]</td><td>8</td></tr><tr><td>2-Nitropropane</td><td>$(\text{CH}_3)_2\text{CHNO}_2$; [79-46-9]</td><td>4</td></tr><tr><td>Nitrobenzene</td><td>$\text{C}_6\text{H}_5\text{NO}_2$; [98-95-3]</td><td>1.5</td></tr></table> ^a Solubilities are g of the hydrated salt per 100 cm^3 of the solvent. Initial Solid phase: $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.		Nitro Compound	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}^a$ g/(100 cm^3)	Nitromethane	CH_3NO_2 ; [75-52-5]	64	1-Nitropropane	$\text{C}_3\text{H}_7\text{NO}_2$; [108-03-2]	8	2-Nitropropane	$(\text{CH}_3)_2\text{CHNO}_2$; [79-46-9]	4	Nitrobenzene	$\text{C}_6\text{H}_5\text{NO}_2$; [98-95-3]	1.5
Nitro Compound	Formula	$\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}^a$ g/(100 cm^3)														
Nitromethane	CH_3NO_2 ; [75-52-5]	64														
1-Nitropropane	$\text{C}_3\text{H}_7\text{NO}_2$; [108-03-2]	8														
2-Nitropropane	$(\text{CH}_3)_2\text{CHNO}_2$; [79-46-9]	4														
Nitrobenzene	$\text{C}_6\text{H}_5\text{NO}_2$; [98-95-3]	1.5														
AUXILIARY INFORMATION																
METHOD/APPARATUS/PROCEDURE: Isothermal method was used. 25 cm^3 of the solvent and a few grams of uranyl nitrate hexahydrate were set in a sealed centrifuge tube and agitated in a water bath controlled thermostatically at 20°C. Additional solid was added until a saturated solution was obtained. The minimum time for saturation to occur was taken to be 24 hours. Before analysis the solution was centrifuged to remove any suspended solid. The uranyl nitrate was back-extracted into water, and its concentration determined colorimetrically after suitable dilution to ensure obedience to Beer's law. Results of these analyses were checked using U-233 as a tracer.	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ obtained from the Eldorado Mining and Refining Co. The maximum impurities were <0.1% of rare earths. 2. Organics were "practical" grade or better. ESTIMATED ERROR: Soly: Nothing specified. Results of the two methods of analysis agreed within $\pm 5\%$. Temp: Precision to ± 0.5 K. REFERENCES:															

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Nitromethane; CH_3NO_2 ; [75-52-5] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Warner, R. K. <i>Australian J. Appl. Sci.</i> , 1953, 6, 427 - 443.																																
VARIABLES: Concentration of HNO_3 at 293 K	PREPARED BY: L. Fuks; S. Siekierski																																
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{CH}_3\text{NO}_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 20°C Composition of Saturated Solutions ^a <table><tr><th rowspan="3">HNO_3^b mol/dm³</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th rowspan="3">Number of Liquid Phases</th></tr><tr><th>Aqueous Phase</th><th>Organic Phase</th></tr><tr><th>mass %</th><th>mass %</th></tr><tr><td>15</td><td>---</td><td>40.7</td><td>1</td></tr><tr><td>10</td><td>---</td><td>35.4</td><td>1</td></tr><tr><td>5</td><td>42.5</td><td>25.5</td><td>2</td></tr><tr><td>2.5</td><td>48.5</td><td>18.1</td><td>2</td></tr><tr><td>1.0</td><td>51.3</td><td>15.0</td><td>2</td></tr><tr><td>0.0</td><td>53.8</td><td>13.2</td><td>2</td></tr></table> ^a Both solvent and aqueous phases consisted of water, nitromethane and nitric acid. Initial solid phase was $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. ^b Initial normality of HNO_3 .		HNO_3^b mol/dm ³	$\text{UO}_2(\text{NO}_3)_2$		Number of Liquid Phases	Aqueous Phase	Organic Phase	mass %	mass %	15	---	40.7	1	10	---	35.4	1	5	42.5	25.5	2	2.5	48.5	18.1	2	1.0	51.3	15.0	2	0.0	53.8	13.2	2
HNO_3^b mol/dm ³	$\text{UO}_2(\text{NO}_3)_2$		Number of Liquid Phases																														
	Aqueous Phase			Organic Phase																													
	mass %	mass %																															
15	---	40.7	1																														
10	---	35.4	1																														
5	42.5	25.5	2																														
2.5	48.5	18.1	2																														
1.0	51.3	15.0	2																														
0.0	53.8	13.2	2																														
AUXILIARY INFORMATION																																	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The effect of nitric acid concentration on the distribution of uranyl nitrate was studied by adding 10 mL of pure nitromethane and 10 mL of aqueous nitric acid solution of differing normalities to excess uranyl nitrate hexahydrate crystals. The systems were equilibrated during 6 to 8 hours and the liquid phases were sampled for analysis. Repeat determinations were made to ensure equilibrium had been established. The uranium nitrate was determined by evaporation of weighed aliquots, followed by ignition to urano-uranic oxide, U_3O_8 .	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ of unspecified purity was purified (1). 2. Nitromethane was redistilled prior to use. ESTIMATED ERROR: Soly: Nothing specified. Temp: Precision ± 0.1 K. REFERENCES: 1. Warner, R. K. <i>Australian J. Appl. Sci.</i> , 1952, 3, 156.																																

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Various nitro organics (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Warner, R. K. <i>Australian J. Appl. Sci.</i> , 1953, 4, 581 - 589.																		
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski																		
EXPERIMENTAL VALUES: <table><tr><th rowspan="2">Nitro Organic</th><th rowspan="2">Formula</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2^a$</th></tr><tr><th>g/(g soln)</th><th>mol/kg</th></tr><tr><td>Nitromethane</td><td>CH_3NO_2; [75-52-5]</td><td>0.140</td><td>0.413</td></tr><tr><td>Nitroethane</td><td>$\text{C}_2\text{H}_5\text{NO}_2$; [79-24-3]</td><td>0.051</td><td>0.136</td></tr><tr><td>1-Nitropropane</td><td>$\text{C}_3\text{H}_7\text{NO}_2$; [108-03-2]</td><td>0.011</td><td>0.028</td></tr></table> <p>^aMolalities calculated by the compilers as moles per 1 kg of the mixture consisting of the nitro compound and water. The initial solid phase was $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.</p>		Nitro Organic	Formula	$\text{UO}_2(\text{NO}_3)_2^a$		g/(g soln)	mol/kg	Nitromethane	CH_3NO_2 ; [75-52-5]	0.140	0.413	Nitroethane	$\text{C}_2\text{H}_5\text{NO}_2$; [79-24-3]	0.051	0.136	1-Nitropropane	$\text{C}_3\text{H}_7\text{NO}_2$; [108-03-2]	0.011	0.028
Nitro Organic	Formula			$\text{UO}_2(\text{NO}_3)_2^a$															
		g/(g soln)	mol/kg																
Nitromethane	CH_3NO_2 ; [75-52-5]	0.140	0.413																
Nitroethane	$\text{C}_2\text{H}_5\text{NO}_2$; [79-24-3]	0.051	0.136																
1-Nitropropane	$\text{C}_3\text{H}_7\text{NO}_2$; [108-03-2]	0.011	0.028																
AUXILIARY INFORMATION																			
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Excess uranyl nitrate hexahydrate was placed with the appropriate amount of pure solvent in a small flask, warmed to 30°C to 50°C and agitated for 15 min. Then the flask was set in a thermostat bath at 20°C and shaken for 6 to 8 hours. When equilibrium was attained, the solution was decanted, filtered, and sampled for analysis. The analysis consisted of the total uranium nitrate concentration determination by evaporation of the weighed aliquots, followed by ignition to U_3O_8 .	SOURCE AND PURITY OF MATERIALS: 1. AR grade $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. 2. C.P. grade anhydrous nitrate compounds. ESTIMATED ERROR: Soly: Repeat determinations of the solubility were made until agreement within 0.2 mass %. Temp: Precision ± 0.05 K. REFERENCES:																		

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Trioctylamine nitrate ($\text{TOA} \cdot \text{HNO}_3$); $\text{C}_{24}\text{H}_{52}\text{N}_2\text{O}_3$; [1116-76-3] (3) Chloroform; CHCl_3 ; [67-66-3] (4) Carbon tetrachloride; CCl_4 ; [56-23-5] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Kuzina, M. G. Lipovskij, A. A. <i>Radiokhim.</i> , 1964, 6, 121 - 123.																																
VARIABLES: One temperature: probably 298 K	PREPARED BY: L. Fuks; S. Siekierski																																
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{N}(\text{C}_8\text{H}_{17})_3 \cdot \text{HNO}_3 - \text{CHCl}_3 - \text{H}_2\text{O}$ System ^a Composition of Saturated Solutions <table><tr><td>$\text{UO}_2(\text{NO}_3)_2$ mol/dm³</td><td>$\text{TOA} \cdot \text{HNO}_3$ mol/dm³</td><td>H_2O mol/dm³</td><td>Initial Solid Phase^b</td></tr><tr><td>69</td><td>42</td><td>30</td><td>A</td></tr><tr><td>14</td><td>39</td><td>60</td><td>B</td></tr><tr><td>88</td><td>203</td><td>70</td><td>B</td></tr></table> ^a Temperature not specified; probably 25°C (compilers). ^b Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. The $\text{UO}_2(\text{NO}_3)_2 - \text{N}(\text{C}_8\text{H}_{17})_3 \cdot \text{HNO}_3 - \text{CCl}_4 - \text{H}_2\text{O}$ System Composition of Saturated Solutions ^b <table><tr><td>$\text{UO}_2(\text{NO}_3)_2$ mol/dm³</td><td>$\text{TOA} \cdot \text{HNO}_3$ mol/dm³</td><td>H_2O mol/dm³</td><td>Initial Solid Phase^c</td></tr><tr><td>3^d</td><td>---</td><td>---</td><td>A</td></tr><tr><td>615^e</td><td>705^e</td><td>130^e</td><td>A</td></tr><tr><td>325^e</td><td>517^e</td><td>150^e</td><td>B</td></tr></table> ^a Temperature not specified, probably 25°C (compilers). ^b Two organic phases were observed. ^c Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. ^d Lighter organic phase. ^e Heavier organic phase. (Continued on the next page)		$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$\text{TOA} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³	Initial Solid Phase ^b	69	42	30	A	14	39	60	B	88	203	70	B	$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$\text{TOA} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³	Initial Solid Phase ^c	3 ^d	---	---	A	615 ^e	705 ^e	130 ^e	A	325 ^e	517 ^e	150 ^e	B
$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$\text{TOA} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³	Initial Solid Phase ^b																														
69	42	30	A																														
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$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$\text{TOA} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³	Initial Solid Phase ^c																														
3 ^d	---	---	A																														
615 ^e	705 ^e	130 ^e	A																														
325 ^e	517 ^e	150 ^e	B																														
AUXILIARY INFORMATION																																	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Uranyl nitrate dihydrate or hexahydrate was equilibrated with the TOA nitrate solution at the desired concentration. Uranium, TOA nitrate, and water content were determined in the organic phase.	SOURCE AND PURITY OF MATERIALS: Nothing specified.																																
	ESTIMATED ERROR: Nothing specified.																																
	REFERENCES:																																

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Vdovenko, V. M.; Kuzina, M. G. Lipovskij, A. A.
(2) Trioctylamine nitrate ($\text{TOA} \cdot \text{HNO}_3$) $\text{C}_{24}\text{H}_{52}\text{N}_2\text{O}_3$; [1116-76-3]	<i>Radiokhim.</i> , 1964, 6, 121 - 123.
(3) 1,2-Dichloroethane; $\text{C}_2\text{H}_4\text{Cl}_2$; [107-06-2]	
(4) Benzene; C_6H_6 ; [71-43-2]	
(5) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - \text{N}(\text{C}_8\text{H}_{17})_3 \cdot \text{HNO}_3 - \text{ClCH}_2\text{CH}_2\text{Cl} - \text{H}_2\text{O}$ System^a

Composition of Saturated Solutions

$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$\text{TOA} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³	Initial Solid Phase
45	46	30	A
214	226	80	A
29	43	120	B
127	210	130	B

^aTemperature not specified, probably 25°C (compilers).

^bSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

The $\text{UO}_2(\text{NO}_3)_2 - \text{N}(\text{C}_8\text{H}_{17})_3 \cdot \text{HNO}_3 - \text{C}_6\text{H}_6 - \text{H}_2\text{O}$ System^a

Composition of Saturated Solutions^b

$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	$\text{TOA} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³	Initial Solid Phase
41 ^d	44 ^d	---	A
356 ^e	38.8 ^e	---	A
28	47	30	B
143	228	60	B
300	510	---	B

^aTemperature not specified, probably 25°C (compilers).

^bIn the case of $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$, two organic phases were observed.

^cSolid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$, B = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

^dLighter organic phase.

^eHeavier organic phase.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Trichloromethane; CHCl_3 ; [67-66-3] (3) Nitrobenzene; $\text{C}_6\text{H}_5\text{NO}_2$; [98-95-3] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Verstegen, J. M. P. J. <i>J. Inorg Nucl. Chem.</i> , 1964, 26, 1589 - 1599.
VARIABLES: One temperature: 294 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in CHCl_3 at 21°C was reported as 0.00410 mol/dm ³ . The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $\text{C}_6\text{H}_5\text{NO}_2$ at 21°C was reported as 0.011 mol/dm ³ .	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Finely ground uranyl nitrate hexahydrate was shaken for at least 12 hours with the solvent, separated by filtration, replaced by fresh solid, and then shaken for another 6 hours. Final separation was by centrifuging. Stripping from the organic phase was applied to measure the solubility of the metal nitrate. Uranium was determined by thiocyanate (1) and by precipitation with oxine (2).	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, Merck p.a. 2. Chloroform, nitrobenzene, nothing specified. ESTIMATED ERROR: Soly: nothing specified. Temp: Precision ± 2 K. REFERENCES: 1. Master Analytical Manual, TID-7015, Section 1, 1958. 2. Claassen, A.; Visser, J. <i>Rec. Trav. Chim.</i> , 1946, 65, 211.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Trioctylamine nitrate; $\text{C}_{24}\text{H}_{52}\text{N}_2\text{O}_3$; [1116-76-3] (3) Benzene; C_6H_6 ; [71-43-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Verstegen, J. M. P. J. <i>J. Inorg. Nucl. Chem.</i> , 1964 , <i>26</i> , 1589-1599.												
VARIABLES: Composition at 294 K	PREPARED BY: A. Sozanski; S. Siekierski												
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3 - \text{C}_6\text{H}_6 - \text{H}_2\text{O}$ System at 21°C Composition of the Saturated Solutions <table><tr><td>$\text{UO}_2(\text{NO}_3)_2^a$ mol/dm³</td><td>$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm³</td><td>H_2O mol/dm³</td></tr><tr><td>0.063</td><td>0.1</td><td>0.022</td></tr><tr><td>0.029</td><td>0.05</td><td>0.016</td></tr><tr><td>0.016</td><td>0.025</td><td>0.016</td></tr></table> ^a The values of the uranyl nitrate solubility in the pure diluent have been subtracted from those in the amine nitrate phase. The initial solid was $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. <div>(Continued on the next page)</div>		$\text{UO}_2(\text{NO}_3)_2^a$ mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³	0.063	0.1	0.022	0.029	0.05	0.016	0.016	0.025	0.016
$\text{UO}_2(\text{NO}_3)_2^a$ mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³											
0.063	0.1	0.022											
0.029	0.05	0.016											
0.016	0.025	0.016											
AUXILIARY INFORMATION													
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phase prepared by shaking 0.01 mol/dm ³ amine solutions with empirically determined amounts of aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentration to the desired value. Finely ground hydrated uranyl nitrate was shaken for at least 12 hours with the solvent, replaced by fresh solid, and shaken for an additional 6 hours. Final separation of solid and liquid was accomplished by centrifugation. The metal was extracted back from the saturated organic phase with 0.5 mol/dm ³ HNO_3 . Uranium determined by thiocyanate and precipitated with oxine. Water was determined by the Karl Fischer method.	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, Merck p.a. 2. Tri-n-octylamine nitrate was purified (3). ESTIMATED ERROR: Soly: Nothing specified. Amine nitrate concentration $\pm 2\%$ to the desired value. Temp: Precision ± 2 K. REFERENCES: 1. Verstegen, J. M. P. J. <i>Trans. Faraday Soc.</i> , 1962 , <i>58</i> , 1878. 2. Verstegen, J. M. P. J. <i>J. Inorg. Nucl. Chem.</i> , 1964 , <i>26</i> , 1085. 3. Verstegen, J. M. P. J. Ketelaar, A. A. <i>Trans. Faraday Soc.</i> , 1961 , <i>57</i> , 1572.												

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-octylamine nitrate; $\text{C}_{24}\text{H}_{52}\text{N}_2\text{O}_3$; [1116-76-3] (3) Dodecane; $\text{C}_{12}\text{H}_{26}$; [112-40-3] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Verstegen, J. M. P. J. <i>J. Inorg. Nucl. Chem.</i> , 1964 , <i>26</i> , 1589 - 1599.												
VARIABLES: Composition at 294 K	PREPARED BY: A. Sozanski; S. Siekierski												
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3 - \text{CH}_3(\text{CH}_2)_{10}\text{CH}_3^a$ System at 21°C Composition of Saturated Solutions <table><tr><th>$\text{UO}_2(\text{NO}_3)_2^{b,c}$ mol/dm³</th><th>$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm³</th><th>H_2O mol/dm³</th></tr><tr><td>0.018</td><td>0.1</td><td>0.022</td></tr><tr><td>0.029</td><td>0.05</td><td>0.023</td></tr><tr><td>0.034</td><td>0.025</td><td>0.038</td></tr></table> <p>^aModified dodecane with 6 mole % of 1-octanol as diluent. The initial solid phase was $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. ^bThe value of the uranyl solubility in the pure diluent has been subtracted from those in the amine nitrate phase. ^cConcentration measured in the light portion of the organic phase.</p> <p>(Continued on the next page)</p>		$\text{UO}_2(\text{NO}_3)_2^{b,c}$ mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³	0.018	0.1	0.022	0.029	0.05	0.023	0.034	0.025	0.038
$\text{UO}_2(\text{NO}_3)_2^{b,c}$ mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³											
0.018	0.1	0.022											
0.029	0.05	0.023											
0.034	0.025	0.038											
AUXILIARY INFORMATION													
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phase was prepared by shaking 0.01 mol/dm ³ amine solutions with empirically determined amounts of aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentration to the desired level. Finely ground hydrated uranyl hydrate was shaken at least 12 hours with the solvent, replaced by fresh solid, and shaken for another 6 hours. Final separation of solid and liquid phases was done by centrifuging. Metal was extracted back from the saturated organic phase with 0.5 mol/dm ³ HNO_3 . Uranium was determined by the thiocyanate method and precipitation with oxine. Water analyses were performed by Karl Fischer titrations.	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, Merck p.a. 2. $(\text{C}_8\text{H}_{17})_3\text{N}$ was purified (3). ESTIMATED ERROR: Soly: Nothing specified. Amine nitrate concentration $\pm 2\%$ of the desired value. Temp: Precision ± 2 K. REFERENCES: 1. Verstegen, J. M. P. J. <i>Trans. Faraday Soc.</i> , 1962 , <i>58</i> , 1878. 2. Verstegen, J. M. P. J. <i>J. Inorg. Nucl. Chem.</i> , 1964 , <i>26</i> , 1085. 3. Verstegen, J. M. P. J.; Ketelaar, A. A. <i>Trans. Faraday Soc.</i> , 1961 , <i>57</i> , 1527.												

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Verstegen, J. M. P. J.
(2) Tri-n-octyl amine nitrate; $\text{C}_{24}\text{H}_{52}\text{N}_2\text{O}_3$; [1116-76-3]	<i>J. Inorg. Nucl. Chem.</i> , <u>1964</u> , 26, 1589 - 1599.
(3) Trichloromethane; CHCl_3 ; [67-66-3]	
(4) Nitrobenzene; $\text{C}_6\text{H}_5\text{NO}_2$; [98-95-3]	
(5) Water; H_2O ; [7735-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3 - \text{CHCl}_3 - \text{H}_2\text{O}$ System at 21°C

Composition of the Saturated Solutions

$\text{UO}_2(\text{NO}_3)_2^a$ mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³
0.045	0.1	0.051
0.022	0.05	0.052
0.012	0.025	0.052

The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3 - \text{C}_6\text{H}_5\text{NO}_2 - \text{H}_2\text{O}$ System at 21°C

Composition of the Saturated Solutions

$\text{UO}_2(\text{NO}_3)_2^a$ mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³
0.093	0.1	0.133
0.054	0.05	0.117
0.026	0.025	0.099

^aThe values of the uranyl nitrate solubility in the pure diluent have been subtracted from those in the amine nitrate phase. The initial solid was $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$.

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Carbon tetrachloride; CCl_4 ; [56-23-5] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Fedorov, Yu. S.; Zil'berman, B. Ya. <i>Radiokhim.</i> , 1986, 28, 33 - 37. <i>Sov. Radiochem.</i> , 1986, 28, 26-29.																																																						
VARIABLES: One temperature: 293 K	PREPARED BY: S. L. Phillips																																																						
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{CCl}_4 - \text{H}_2\text{O}$ System at 20°C Distribution of HNO_3 Between Aqueous and Organic Phases ^a <table><tr><th colspan="4">Aqueous Phase</th><th colspan="2">Organic Phase</th></tr><tr><th>HNO_3</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th>Density</th><th>H_2O</th><th>HNO_3</th></tr><tr><th>mol/dm³</th><th>mol/dm³</th><th>mol/kg</th><th>g/cm³</th><th>mol/dm³</th><th>mol/dm³</th></tr><tr><td>4.6</td><td>1.24</td><td>1.18</td><td>1.541</td><td>42.5</td><td>0.00072</td></tr><tr><td>6.6</td><td>0.97</td><td>0.85</td><td>1.517</td><td>40.0</td><td>0.0015</td></tr><tr><td>7.6</td><td>1.09</td><td>0.957</td><td>1.568</td><td>36.6</td><td>0.0027</td></tr><tr><td>9.6</td><td>1.45</td><td>1.28</td><td>1.701</td><td>29.1</td><td>0.0064</td></tr><tr><td>13.4</td><td>1.05</td><td>0.860</td><td>1.634</td><td>20.9</td><td>0.022</td></tr><tr><td>16.0</td><td>1.20</td><td>0.977</td><td>1.701</td><td>12.3</td><td>0.101</td></tr></table> ^a Molalities calculated by the compiler. Solid phase was $\text{UO}_2(\text{NO}_3)_2$, probably hexahydrate (compiler). Initial CCl_4 concentration was probably 10.3 mol/dm ³ .		Aqueous Phase				Organic Phase		HNO_3	$\text{UO}_2(\text{NO}_3)_2$		Density	H_2O	HNO_3	mol/dm ³	mol/dm ³	mol/kg	g/cm ³	mol/dm ³	mol/dm ³	4.6	1.24	1.18	1.541	42.5	0.00072	6.6	0.97	0.85	1.517	40.0	0.0015	7.6	1.09	0.957	1.568	36.6	0.0027	9.6	1.45	1.28	1.701	29.1	0.0064	13.4	1.05	0.860	1.634	20.9	0.022	16.0	1.20	0.977	1.701	12.3	0.101
Aqueous Phase				Organic Phase																																																			
HNO_3	$\text{UO}_2(\text{NO}_3)_2$		Density	H_2O	HNO_3																																																		
mol/dm ³	mol/dm ³	mol/kg	g/cm ³	mol/dm ³	mol/dm ³																																																		
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16.0	1.20	0.977	1.701	12.3	0.101																																																		
AUXILIARY INFORMATION																																																							
METHOD/APPARATUS/PROCEDURE: Nitric acid was extracted into CCl_4 at 20°C. The phases were separated and, after blending, the reextraction was carried out at a high ratio of the organic phase to the aqueous one, the ratio was several tens at a low HNO_3 concentration. The concentration of acid in the absence of uranium was determined by potentiometric titration (0.1 mol/dm ³ NaOH). Concentration of uranium and HNO_3 in the presence of uranium, present in equilibrium with the solid salt, was determined by differential potentiometric titration (0.1 mol/dm ³ NaOH) in a 0.4 mol/dm ³ NaF medium.	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate was purified. 2. CCl_4 was purified. No additional details given. ESTIMATED ERROR: Nothing specified. REFERENCES:																																																						

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-butyl phosphate; $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Wendlandt, W. W.; Bryant, J. M. <i>J. Phys. Chem.</i> , <u>1956</u> , <i>60</i> , 1145 - 1146.
VARIABLES: One temperature: Room	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in $(\text{C}_4\text{H}_9\text{O})_3\text{PO}$ at room temperature was reported to be 43.4 and 43.6 g of the anhydrous nitrate per 100 g of solution, i.e., 1.95 and 1.96 moles in 1 kg of the mixture consisting of TBP and water (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/Apparatus/Procedure: <p>Twenty-five grams of the hydrated salt were added to 20 mL of TBP and equilibrated by shaking for 48 to 72 hours at room temperature. At the end of this time, three phases were present: a solid hydrated salt phase, an aqueous phase containing a saturated solution of metal nitrate salt, and an organic phase containing the dissolved metal salt. The organic phase was separated, centrifuged, and analyzed for the metal salt content. The metal ion content, after reextraction into the TBP/benzene-water system, was determined in the aqueous phase by standard procedures (1,2).</p>	SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, reagent grade. 2. TBP, commercial product with no purification. ESTIMATED ERROR: Soly: nothing specified, but standard deviation is about 0.15 mass % (compilers). REFERENCES: 1. Scott, W. W. <i>Standard Methods of Chemical Analysis</i> , Vol. I, Van Nostrand Inc., New York, <u>1946</u> . 2. Lundell, G.E.F.; Bright, H.A.; Hoffman, J. I. <i>Applied Inorganic Chemistry</i> , J. Wiley & Sons, New York <u>1953</u> .

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Water; H_2O ; [7732-18-5]	EVALUATOR: Healy, T. V.; McKay, H. A. C. <i>Trans. Faraday Soc.</i> , <u>1956</u> , 52, 633 - 642.																							
VARIABLES: Temperature: 273 to 323 K	PREPARED BY: L. Fuks; S. Siekierski																							
EXPERIMENTAL VALUES: The solubility of $\text{UO}_2(\text{NO}_3)_2$ in TBP was reported at 0°C, 25°C and 50°C																								
<div>Saturated Solution</div> <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th>$\text{UO}_2(\text{NO}_3)_2$</th><th colspan="2">mole ratios</th><th rowspan="2">Number^a</th></tr><tr><th>mol/kg</th><th>TBP/nitrate</th><th>H_2O/nitrate</th></tr><tr><td>0</td><td>1.61</td><td>2.01</td><td>---</td><td>---</td></tr><tr><td>25</td><td>1.60</td><td>1.99</td><td>0.04</td><td>2</td></tr><tr><td>50</td><td>1.59</td><td>1.98</td><td>---</td><td>---</td></tr></table>		$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$	mole ratios		Number ^a	mol/kg	TBP/nitrate	H_2O /nitrate	0	1.61	2.01	---	---	25	1.60	1.99	0.04	2	50	1.59	1.98	---	---
$t/^{\circ}\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		mole ratios		Number ^a																			
	mol/kg	TBP/nitrate	H_2O /nitrate																					
0	1.61	2.01	---	---																				
25	1.60	1.99	0.04	2																				
50	1.59	1.98	---	---																				
^a From TBP dilution data.																								
AUXILIARY INFORMATION																								
METHOD/APPARATUS/PROCEDURE: Solubility determinations were made by solid uranyl nitrate hexahydrate with TBP for several days in a thermostat, and then analyzing the TBP phase. Analysis for water was carried out by the Karl Fischer titration, and colorimetrically for uranium by the peroxide method.	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate hexahydrate was A. R. product. 2. TBP was purified (1).																							
	ESTIMATED ERROR: Nothing specified.																							
	REFERENCES: 1. Alcock, K.; Grimley, S. S.; Healy, T. V.; Kennedy, J.; McKay, H. A. C. <i>Trans. Faraday Soc.</i> , <u>1956</u> , 52, 39-47.																							

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Water; H_2O ; [7732-18-5]	EVALUATOR: Hurwic, J.; Michalczyk, J. <i>Proc. Symp. Theory and Structure of Complex Compounds</i> , Wroclow, 1962, Pergamon Press, Oxford and WNT, Warszawa, 1964, 289 - 294.
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The concentration of uranium in the saturated solution of uranyl nitrate in TBP after dehydration as described in the procedure was reported to be 0.4260 mole fraction. The water content was found to be 0.19 mass %.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Uranyl nitrate hexahydrate was dissolved in the anhydrous TBP. Three layers were observed: liquid organic phase, a liquid aqueous phase, and the solid uranyl hexahydrate. After several hours, samples of the organic phase in equilibrium with the aqueous phase were dried and deacidified using a mixture of uranyl nitrate hexahydrate dried at 190°C and 260°C. Uranyl nitrate content was determined spectrophotometrically. Water concentration was measured by the Karl Fischer method.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Nikolaev, A. V.; Dyadin, Yu. A.; Yakovlev, I. I. <i>Dokl. Akad. Nauk SSSR</i> , <u>1964</u> , <i>158</i> , 1130 - 1132.																																			
VARIABLES: $T/K = 273$ to 373 K	PREPARED BY: A. Sozanski; S. Siekierski																																			
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{H}_2\text{O}$ System at 0°C to 100°C Composition of Organic Phase of Saturated Solutions ^a <table><tr><th rowspan="2">$t/^\circ\text{C}$</th><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th></tr><tr><td>0</td><td>42.31</td><td>1.861</td><td>0.15</td></tr><tr><td>25</td><td>44.26</td><td>2.015</td><td>0.25</td></tr><tr><td>50</td><td>46.30</td><td>2.188</td><td>0.54</td></tr><tr><td>65</td><td>48.38</td><td>2.379</td><td>0.76</td></tr><tr><td>78</td><td>50.14</td><td>2.552</td><td>1.14</td></tr><tr><td>92</td><td>51.70</td><td>2.716</td><td>1.53</td></tr><tr><td>100</td><td>53.11</td><td>2.874</td><td>1.59</td></tr></table> ^a Molalities calculated by the compilers as moles of $\text{UO}_2(\text{NO}_3)_2$ per 1 kg of the mixture consisting of TBP and water. COMMENTS AND/OR ADDITIONAL DATA: The phase diagram is in the source publication.		$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		H_2O	mass %	mol/kg	mass %	0	42.31	1.861	0.15	25	44.26	2.015	0.25	50	46.30	2.188	0.54	65	48.38	2.379	0.76	78	50.14	2.552	1.14	92	51.70	2.716	1.53	100	53.11	2.874	1.59
$t/^\circ\text{C}$	$\text{UO}_2(\text{NO}_3)_2$		H_2O																																	
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AUXILIARY INFORMATION																																				
METHOD/Apparatus/Procedure: The isothermal method was used. The components were placed in a test tube and kept in a thermostat to obtain equilibrium. In each test tube there were always at least three phases: two liquid and one solid phase. Uranium was determined by an improved Klygin's method (1,2). Water content in the organic phase was measured by the Karl Fischer titration.	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Nikolaev, A. V.; Dyadin, Yu. A. <i>Dokl. Akad. Nauk SSSR</i> , <u>1963</u> , <i>153</i> , 118. 2. Markov, V. K.; Vinogradov, A. V. <i>Ukrain. Metody ego opredeleniya</i> . Moskva, <u>1960</u> , p. 175.																																			

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Nikolaev, A. V.; Yakovlev, I. I. <i>Dokl. Akad. Nauk SSSR</i> , <u>1962</u> , 145, 1064 - 1067.
VARIABLES: Composition at 295 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The composition of saturated solutions in the ternary system $\text{UO}_2(\text{NO}_3)_2$ - HNO_3 - H_2O was presented graphically in the form of a triangular phase diagram which was the basis of a tetrahedron representing the quaternary system at 22°C of $\text{UO}_2(\text{NO}_3)_2$ - TBP - HNO_3 - H_2O. The equilibrium solid phases in the ternary system are the hexa-, tri-, and dihydrate.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used.	SOURCE AND PURITY OF MATERIALS: Nothing specified except that distilled TBP was used.
	ESTIMATED ERROR: Soly: Nothing specified. Temp: Precision ± 1 K.
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Carbon tetrachloride; CCl_4 ; [56-23-5] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Aartsen, J. J. V.; Korvezee, A. E. <i>Trans. Faraday Soc.</i> , 1964 , <i>60</i> , 510 - 518.																																								
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																								
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2$ - $[\text{CH}_3(\text{CH}_2)_3\text{O}]_3\text{PO}$ - CCl_4 - H_2O System ^a Composition of Organic Phase in Equilibrium with $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ <table><tr><th colspan="2">$\text{UO}_2(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th>$\text{CCl}_4$</th><th>TBP</th></tr><tr><th>mol fract.</th><th>mol/kg</th><th>mol fract.</th><th>mol fract.</th><th>mol fract.</th></tr><tr><td>0.320</td><td>1.87</td><td>0.0394</td><td>0.000</td><td>0.640</td></tr><tr><td>0.272</td><td>1.64</td><td>0.0354</td><td>0.170</td><td>0.523</td></tr><tr><td>0.234</td><td>1.41</td><td>0.0199</td><td>0.291</td><td>0.455</td></tr><tr><td>0.189</td><td>1.14</td><td>0.0142</td><td>0.418</td><td>0.379</td></tr><tr><td>0.153</td><td>0.939</td><td>0.0112</td><td>0.532</td><td>0.304</td></tr><tr><td>0.120</td><td>0.743</td><td>0.0067</td><td>0.632</td><td>0.241</td></tr></table> ^a Molalities calculated by the compilers as moles of uranyl nitrate per 1 kg of the mixture consisting of CCl_4 , H_2O and TBP.		$\text{UO}_2(\text{NO}_3)_2$		H_2O	CCl_4	TBP	mol fract.	mol/kg	mol fract.	mol fract.	mol fract.	0.320	1.87	0.0394	0.000	0.640	0.272	1.64	0.0354	0.170	0.523	0.234	1.41	0.0199	0.291	0.455	0.189	1.14	0.0142	0.418	0.379	0.153	0.939	0.0112	0.532	0.304	0.120	0.743	0.0067	0.632	0.241
$\text{UO}_2(\text{NO}_3)_2$		H_2O	CCl_4	TBP																																					
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AUXILIARY INFORMATION																																									
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The components were weighed and then equilibrated at 25°C for a period of 2 days. Uranyl content of the organic phase was determined by reextraction with water followed by a density determination (1). The water content of the organic phase was determined by the Karl Fischer titration, or from the weight loss after suction with a vacuum pump.	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Kapustinsky; Lipilena <i>Izv. Akad. Nauk SSSR, Otdel. Khim. Nauk</i> , 1956 , <i>6</i> , 649. Eng. trans. IGRL-T/W-39, 1957 .																																								

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Kerosine; [8008-20-6] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Lerner, M. W.; Petretic, G. Report, 1951, Decl. 1955, CF-51-12-43.																						
VARIABLES: Composition at 300 K	PREPARED BY: A. Sozanski; S. Siekierski																						
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{HNO}_3 - \text{Kerosine} - \text{H}_2\text{O}$ System Composition of Saturated Solutions at 27°C <table><tr><th rowspan="3">HNO_3^a mol/dm³</th><th colspan="2">Equilibrium concentration of uranium</th></tr><tr><th>Aqueous Phase</th><th>Organic Phase^b</th></tr><tr><th>g/cm³</th><th>g/dm³</th></tr><tr><td>0</td><td>616.3</td><td>102.0</td></tr><tr><td>0.5</td><td>575.2</td><td>100.9</td></tr><tr><td>1.0</td><td>553.3</td><td>99.5</td></tr><tr><td>3.0</td><td>430.4</td><td>97.9</td></tr><tr><td>6.0</td><td>362.9</td><td>96.1</td></tr></table> ^a Initial concentration in aqueous phase. ^b Organic phase: 25% by volume solution of TBP in kerosine.		HNO_3^a mol/dm ³	Equilibrium concentration of uranium		Aqueous Phase	Organic Phase ^b	g/cm ³	g/dm ³	0	616.3	102.0	0.5	575.2	100.9	1.0	553.3	99.5	3.0	430.4	97.9	6.0	362.9	96.1
HNO_3^a mol/dm ³	Equilibrium concentration of uranium																						
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COMMENTS AND/OR ADDITIONAL DATA: The organic volume was not equal to the volume of unsaturated TBP, it was felt that the use of this slightly smaller volume would only affect the nitric acid concentration in the TBP, and for concentrated solutions this concentration is so low that the volume difference can be neglected (authors).																							
AUXILIARY INFORMATION																							
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Calculated amounts of nitric acid were placed in 50 mL cylinders and brought up to the 25 mL mark gradually with either a saturated solution of uranyl nitrate hexahydrate in water, or with water so that a few crystals of uranium salt remained undissolved when the 25 mL mark was reached. 25 mL of 25% TBP saturated with uranium salt were then added, and the cylinder was shaken for 15 min in the water bath. After the phases had separated and cleared, suitable aliquots for analyses were removed from each layer by pipetting. The uranium in higher concentrations was determined gravimetrically by ignition to U_3O_8 at 1000°C. Analyses were carried out polarographically on less concentrated fractions. The organic aliquots were stripped by hot water prior to analyses.	SOURCE AND PURITY OF MATERIALS: 1. Mallinckrodt Chemical Works $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. 2. TBP, Commercial Solvents Corp. 25% solution made up to volume with kerosine (Gulfspray naphtha, $d = 0.754$ at 27°C). ESTIMATED ERROR: Soly: Nothing specified. Temp: Precision ± 0.5 K. REFERENCES:																						

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Di-2-phenylbutane phosphonate; (DSBPP) $\text{C}_{20}\text{H}_{27}\text{O}_3\text{P}$; (4) Sec-butylbenzene; $\text{C}_{10}\text{H}_{14}$; [135-98-8] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Gresky, A. T.; Mansfield, R. G. Report, 1960, CF-60-7-108, p. 46.
VARIABLES: One temperature: Room (compilers)	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in 1.03 mol/dm^3 $(\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO}$ in $\text{C}_6\text{H}_5\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ at room temperature was reported to be 0.496 mol/dm^3.</p> COMMENTS AND/OR ADDITIONAL DATA: <p>Assuming 10% volume increase of the organic phase, the value corresponds to a soluble TBP complex with the formula $\text{UO}_2(\text{NO}_3)_2 \cdot 2.0(\text{TBP})$.</p> <p>Solubility of $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ in 1.12 mol/dm^3 $[\text{CH}_3\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2\text{O}]_2\text{P}(\text{H})\text{O}$ in $\text{CH}_3\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_3$ was reported to be 492 mol/dm^3.</p> COMMENTS AND/OR ADDITIONAL DATA: <p>A small amount of crystallization occurred after standing a few weeks but resolution was affected by warming.</p> <p>Assuming an organic volume increase of 10%, the solubility value corresponds to the complex $\text{UO}_2(\text{NO}_3)_2 \cdot 2.01(\text{DSBPP})$.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: <p>The isothermal method was used. The organic phase of TBP and DSBPP in sec-butyl benzene was contacted and equilibrated with crystalline uranium nitrate hexahydrate to effect uranium saturation of organic reagent. After centrifugation, uranium was determined in the organic phase. No additional information was given.</p>	SOURCE AND PURITY OF MATERIALS: <p>Nothing specified.</p>
	ESTIMATED ERROR: <p>Nothing specified.</p>
	REFERENCES:

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Fedorov, Yu. S.; Zil'berman, B. Ya. <i>Radiokhim.</i> , 1986, 28, 37-42. <i>Sov. Radiochem.</i> , 1986, 26, 30-34.																																																																								
VARIABLES: Composition at 293 K	PREPARED BY: S. L. Phillips																																																																								
EXPERIMENTAL VALUES: The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_4\text{H}_9\text{O})_3\text{PO} - \text{HNO}_3 - \text{H}_2\text{O}$ System at 20°C Composition of the Saturated Solutions ^a <table><tr><th colspan="3">Aqueous Phase</th><th colspan="5">Organic Phase</th></tr><tr><th>HNO_3</th><th>$\text{UO}_2(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th>$\text{HNO}_3$</th><th>$\text{UO}_2(\text{NO}_3)_2$</th><th>$\text{H}_2\text{O}$</th><th>Density</th><th>TBP</th></tr><tr><th>mol/dm³</th><th>mol/dm³</th><th>mol/dm³</th><th>mol/dm³</th><th>mol/dm³</th><th>mol/dm³</th><th>g/cm³</th><th>mol/dm³</th></tr><tr><td>0</td><td>2.40</td><td>44</td><td>0</td><td>1.60</td><td>0.16</td><td>1.475</td><td>3.16</td></tr><tr><td>5.7</td><td>1.07</td><td>42</td><td>0.34</td><td>1.58</td><td>0.24</td><td>1.474</td><td>3.11</td></tr><tr><td>8.7</td><td>1.32</td><td>32</td><td>0.73</td><td>1.61</td><td>0.55</td><td>1.484</td><td>2.98</td></tr><tr><td>10.3</td><td>1.44</td><td>29</td><td>1.50</td><td>1.48</td><td>0.65</td><td>1.471</td><td>2.94</td></tr><tr><td>12.5</td><td>1.07</td><td>26</td><td>2.3</td><td>1.46</td><td>1.04</td><td>1.485</td><td>1.92</td></tr><tr><td>15.1</td><td>1.28</td><td>16</td><td>3.8</td><td>1.31</td><td>1.65</td><td>1.475</td><td>2.59</td></tr></table> ^a Equilibrium solid phase uranyl nitrate hexahydrate. <div>(Continued on the next page)</div>		Aqueous Phase			Organic Phase					HNO_3	$\text{UO}_2(\text{NO}_3)_2$	H_2O	HNO_3	$\text{UO}_2(\text{NO}_3)_2$	H_2O	Density	TBP	mol/dm ³	mol/dm ³	mol/dm ³	mol/dm ³	mol/dm ³	mol/dm ³	g/cm ³	mol/dm ³	0	2.40	44	0	1.60	0.16	1.475	3.16	5.7	1.07	42	0.34	1.58	0.24	1.474	3.11	8.7	1.32	32	0.73	1.61	0.55	1.484	2.98	10.3	1.44	29	1.50	1.48	0.65	1.471	2.94	12.5	1.07	26	2.3	1.46	1.04	1.485	1.92	15.1	1.28	16	3.8	1.31	1.65	1.475	2.59
Aqueous Phase			Organic Phase																																																																						
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mol/dm ³	mol/dm ³	mol/dm ³	mol/dm ³	mol/dm ³	mol/dm ³	g/cm ³	mol/dm ³																																																																		
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AUXILIARY INFORMATION																																																																									
METHOD/APPARATUS/PROCEDURE: A dissolvate of $\text{UO}_2(\text{NO}_3)_2$ with TBP was prepared by dissolving over a period of several hours purified uranyl nitrate hexahydrate in the TBP, up to equilibrium with the solid salt. The concentration of $\text{UO}_2(\text{NO}_3)_2$ in the organic phase during extraction of HNO_3 into it corresponded to the maximally possible saturation of TBP with uranyl nitrate. This was achieved by many hours of contact of the organic phase with highly concentrated aqueous-acidic solutions of uranyl nitrate present at equilibrium with the solid salt. The concentrations of HNO_3 and $\text{UO}_2(\text{NO}_3)_2$ in the aqueous and organic phases were found by differential potentiometric titration (0.1 mol/dm ³ KOH), in 0.4 mol/dm ³ NaF. Water in the organic phase was determined by Karl Fischer titration.			SOURCE AND PURITY OF MATERIALS: 1. $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ was purified. 2. TBP, nothing specified. ESTIMATED ERROR: Soly: Nothing specified. Temp: Precision ± 0.5 K. REFERENCES:																																																																						

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]	Fedorov, Yu. S.; Zil'berman, B. Ya.
(2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]	<i>Radiokhim.</i> , 1986, 28, 37-42.
(3) Nitric acid; HNO_3 ; [7697-37-2]	<i>Sov. Radiochem.</i> , 1986, 26, 30-34.
(4) Carbon tetrachloride; CCl_4 ; [56-23-5]	
(5) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)			
The $\text{UO}_2(\text{NO}_3)_2 - (\text{C}_4\text{H}_9\text{O})_3\text{PO} - \text{HNO}_3 - \text{CCl}_4 - \text{H}_2\text{O}$ System at 20°C Composition of Saturated Solutions ^a			
Aqueous Phase		Organic Phase	
HNO_3 mol/dm ³	$\text{UO}_2(\text{NO}_3)_2$ mol/dm ³	HNO_3 mol/dm ³	Initial TBP mol/dm ³
---	1.04	---	2.13
4.4	1.05	0.13	
7.1	1.05	0.29	
10.1	1.02	0.95	
---	0.53	---	1.08
2.1	0.53	0.023	
4.9	0.53	0.068	
8.4	0.52	0.23	
12.6	0.50	0.82	
---	0.28	---	0.57
4.5	0.28	0.38	
7.6	0.27	0.090	
10.7	0.28	0.28	
---	0.097	---	0.20
9.8	0.092	0.087	
12.3	0.092	0.157	

Equilibrium solid phase $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ (compiler).

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Nitrosoruthenium nitrate; $\text{RuNO}(\text{NO}_3)_3$ (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Ochkin, A. V.; Obruchnikov, A. V.; Smelov, V. S.; Chubukov, V. V. <i>Radiokhim.</i> , 1989, 31, 143-147. <i>Sov. Radiochem.</i> , 1990, 759-763.
VARIABLES: One temperature: 293 K	PREPARED BY: S. L. Phillips
EXPERIMENTAL VALUES: <p>In the system $3 \text{ mol/dm}^3 \text{ HNO}_3$, $1.1 \text{ mol/dm}^3 \text{ TBP}$, and $\text{RuNO}(\text{NO}_3)_3$, the concentration of uranium in the organic phase under conditions of saturation is reported to be 0.55 mol/dm^3.</p>	
AUXILIARY INFORMATION	
METHOD/Apparatus/Procedure: The effect of macro quantities of uranyl nitrate on the extraction of nitrosoruthenium nitrates was studied in nitric acid solutions. Ruthenium nitrate was present in micro amounts. The uranium concentration in the aqueous solutions was determined with Arsenazo III (1). Uranium content in the uranyl nitrate extract was determined by back-extraction with five (1:1) portions of distilled water.	SOURCE AND PURITY OF MATERIALS: 1. Uranyl nitrate (pure) was recrystallized from water. 2. TBP, nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES: 1. Markov, Y.V.; Vinogradov, A.V. Elinson, S.V., et al. <i>Methods of Uranium Determination</i> , Atomizdat, Moscow (1960). (in Russian).

COMPONENTS: (1) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (2) Dibutyl butyl phosphonate; $\text{C}_{12}\text{H}_{27}\text{O}_2\text{P}$; [78-46-6] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Nikolaev, A. V.; Yakovlev, I. I.; Dyadin, Yu. A. <i>Solvent Extraction Chemistry</i> , Proc. Intl. Conf., Gothenburg, 1966. (Dryssen, D.; Liljenzin, J. O.; Rydberg, J., eds.). North-Holland Publishing Co., Amsterdam, 1967, pp. 312 - 321.
VARIABLES: Composition and temperature	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: <p style="text-align: center;">The $\text{UO}_2(\text{NO}_3)_2 - \text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OPO}(\text{CH}_2(\text{CH}_2)_2\text{CH}_3)_2 - \text{H}_2\text{O}$ System</p> <p>The experimental results are given in the form of two triangular phase diagrams.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5] (2) Water; H ₂ O; [7732-18-5]		EVALUATOR: S. Siekierski Department of Radiochemistry Institute of Nuclear Research Warsaw, Poland S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA	
CRITICAL EVALUATION:			
THE BINARY SYSTEM			
Data evaluated for the solubility of Th(NO ₃) ₄ in water were selected from ten publications (2-5,7,8,10-13). Some of these papers also contained data on the ternary systems (8,10,11,13). In these studies, the primary method of solubility measurement was the analytical isothermal method. There is some controversy and confusion in the publications on the formulas for the hydrates of thorium nitrate. It is thought that there are nine solids, including eight hydrates, with the following formulas:			
Formula	Molar mass g/mol	Chemical Abstracts Registry	Chemical Abstracts Nomenclature
Th(NO ₃) ₄ ·12H ₂ O	696.2425	[61443-54-7]	Nitric acid, thorium, (4+)salt,dodecahydrate
Th(NO ₃) ₄ ·6H ₂ O	588.1501	[23739-44-8]	Nitric acid, thorium, (4+)salt, hexahydrate
Th(NO ₃) ₄ ·5.5H ₂ O	579.1424	[61443-54-7]	Nitric acid, thorium, (4+)salt, 5.5-hydrate
Th(NO ₃) ₄ ·5H ₂ O	570.1347	[14767-04-5]	Nitric acid, thorium, (4+)salt, pentahydrate
Th(NO ₃) ₄ ·4H ₂ O	552.1193	[13470-07-0]	Nitric acid, thorium, (4+)salt, tetrahydrate
Th(NO ₃) ₄ ·3H ₂ O	534.1039	[87174-21-8]	Nitric acid, thorium, (4+)salt, trihydrate
Th(NO ₃) ₄ ·2H ₂ O	516.0885	[61443-54-7]	Nitric acid, thorium, (4+)salt, dihydrate
Th(NO ₃) ₄ ·H ₂ O	498.0731	[20741-00-8]	Nitric acid, thorium, (4+)salt, monohydrate
Th(NO ₃) ₄	480.0577	[13823-29-5]	Nitric acid, thorium, (4+) salt
The preparation of the dodecahydrate was reported by Berzelius (1); however, Ferraro, et al. (7,8) failed to reproduce his results. At 277 K, a solid containing approximately six hydrate waters and contaminated with partially hydrolyzed salt was obtained from an aqueous solution, whereas			
(continued on the next page)			

<p>COMPONENTS:</p> <p>(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]</p> <p>(2) Water; H_2O; [7732-18-5]</p>	<p>EVALUATOR:</p> <p>S. Siekierski Department of Radiochemistry Institute of Nuclear Research Warsaw, Poland</p> <p>S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA</p>
<p>CRITICAL EVALUATION:</p> <p>when 1 mass % of HNO_3 was present, a solid was obtained which contained approximately ten water molecules per atom of thorium. Both solids lost water at room temperature. There is unequivocal evidence regarding the existence of the pentahydrate, tetrahydrate and of the anhydrous thorium nitrate. Apparently, both the tri- and dihydrates can be prepared from the pentahydrate, and one of these hydrates is the equilibrated solid in the $\text{Th}(\text{NO}_3)_4 - \text{H}_2\text{O}$ system at high temperatures. Mainly, the controversy centers around the existence of the hexahydrate, and the question of which hydrate is the stable solid in the $\text{Th}(\text{NO}_3)_4 - \text{H}_2\text{O}$ system in the interval of temperature from the eutectic point to the transition point where the tetrahydrate exits. According to Misciattelli (2), who first studied the solubility of $\text{Th}(\text{NO}_3)_4$ in water, the solid phase at equilibrium in the temperature range 229.7K to 293.2K is the hexahydrate. According to Marshall et al. (4,5), the hexahydrate is also the stable solid over the temperature range 310.5K to 384.5K. While Kurnakova and Nikolaev (10) report that the hexahydrate is the equilibrium solid in polysystems involving $\text{Th}(\text{NO}_3)_4$ and water, no evidence is presented in their paper. According to Templeton (3), the stable solid in the temperature range 302.9K to 394.7K is either the 5.5-hydrate, $\text{Th}(\text{NO}_3)_4 \cdot 5.5\text{H}_2\text{O}$, or the hexahydrate. Finally, Ferraro et al. (7,8) present evidence for the pentahydrate as the stable solid phase at equilibrium at 298.15K.</p> <p>There appear to be several reasons for these discrepancies. First, the differences in the measured percentages of ThO_2 and H_2O in the higher hydrates are small, and are close to the accuracy limits of the analysis of wet solids. Second, Ferraro et al. (7,8) have pointed out that thorium nitrate hydrolyzes in aqueous solutions in the absence of HNO_3. Nakashima and Zimmer (14) determined the value of the first hydrolysis constant in relation to their study of the extractability of $\text{Th}(\text{NO}_3)_4$ in dodecane by tributylphosphate (TBP) as 7.59×10^{-5}. The solid crystallized from these</p> <p style="text-align: right;">(continued on the next page)</p>	

COMPONENTS:(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$;
[13823-29-5](2) Water; H_2O ; [7732-18-5]**EVALUATOR:**S. Siekierski
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solutions contains an admixture of basic salts and mother liquor (7,8).

Third, it follows from the work of Nikolaev et al. (11) that the hydrate $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, the main constituent of the commercially available salt of thorium nitrate, is very resistant to transformation to the stable pentahydrate or hexahydrate, even when seeded. This is important because a commercial salt is commonly used as the starting material in solubility studies at room temperature. Analytical results on the composition of equilibrated solids reported in different studies are given in Table 20. It is seen

Table 20. Analytical results on the composition of the $\text{Th}(\text{NO}_3)_4 \cdot n\text{H}_2\text{O}$ hydrates.

ThO_2 mass %	H_2O mass %	T/K	Value of n assigned in Ref.	Ref.
45.7 ± 0.1	17.5 ± 0.1	---	5.5 or 6	3
44.65	---	310.5	6	5
44.45	---	363.4	6	5
47.21	---	401.15	4	5
46.33 ± 0.1	15.79 ± 0.1	298.15	5 (1 mass % HNO_3)	7,8
45.6 ± 0.2	17.3 ± 0.2	298.15	5 (without HNO_3)	7,8
35.21	---	293.15	6 (without HNO_3)	10

that the composition of the solid obtained by Ferraro et al. (7,8) at 298.15K from solutions containing at least 1 mass % HNO_3 corresponds exactly to that of the pentahydrate. However, the solid crystallized from water only has a significantly lower thoria content, and a higher water content, similar to those of the solid described by Templeton (3) as the 5.5-hydrate. According to Ferraro et al., the three solids are probably the same, and the analytical differences are due to the admixture of hydrolyzed material and of some mother liquor when the crystallization takes place from pure water. The presence of basic salts in the solid increases the thoria content, but probably also favors the inclusion of the mother liquor with the net result of decreasing the thoria content and increasing the water content. The inclusion of mother liquor is evidenced by the fact that crystals obtained from water are frequently cloudy in the absence of added nitric acid (8).

The idea that the 5.5-hydrate postulated by Templeton, the solid obtained
(continued on the next page)

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Department of Radiochemistry Institute of Nuclear Research Warsaw, Poland Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
<p>CRITICAL EVALUATION: from partially hydrolyzed solutions, and the solid obtained from acidified solutions are essentially the same, i.e. all pentahydrates, is supported by X-ray diffraction data (6,9). In addition, in the system $\text{Th}(\text{NO}_3)_4 - \text{HNO}_3 - \text{H}_2\text{O}$, only the pentahydrate has been found at low and moderate concentrations of nitric acid (7,8). On the other hand, the results of analytical measurements of solids separated at 310.5K and at 363.4K agree well with the hexahydrate formula (5). However, this agreement may be fortuitous, if the mechanisms proposed by Ferraro et al., i.e. hydrolysis with enhanced inclusion of mother liquor, is an increasingly important factor at higher temperatures.</p> <p>In summary, from the available experimental data it is difficult to conclude whether the penta- or hexahydrate is the solid phase which is in equilibrium with water at room and higher temperatures. However, it may be concluded from the analogy between the effect of adding nitric acid to a nitrate - water system and the increase of temperature, that at those temperatures exceeding room temperature the stable solid is very likely the pentahydrate. In view of the results published in the older literature as well as the crystallization experiments at 277K reported by Ferraro et al., it appears that the hexahydrate or even higher hydrates may be the equilibrium solids which exist below room temperature. Because the difference in solubility between the hexahydrate and the pentahydrate is probably small, the formation of metastable phases cannot be excluded. Therefore, the separation of either solid is possible at and near room temperatures, depending on the experimental conditions.</p> <p>According to Templeton (3), the equilibrated solid at temperatures above 394.7K is the tetrahydrate. According to Marshall et al., the transition temperature to form the tetrahydrate is either 383.6K (4) or 384.5K (5). It follows from the data at 384.5K (5) that the thoria content in the</p> <p style="text-align: right;">(continued on the next page)</p>	

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Department of Radiochemistry Institute of Nuclear Research Warsaw, Poland Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
<p>CRITICAL EVALUATION: solid which precipitates at 410.2K is only slightly lower than the theoretical value predicted for the tetrahydrate. However, if the mechanism of hydrolysis and occlusion is also applicable to elevated temperatures, then the agreement between the experimental and theoretical values may be fortuitous, and the equilibrium solid at temperatures above 395K could be a lower hydrate. An important argument in favor of the tetrahydrate as the equilibrium solid at high temperatures can be interpreted from the results of the study of the ternary system with $\text{Th}(\text{NO}_3)_4 - \text{HNO}_3 - \text{H}_2\text{O}$ (7,8). It follows from this study that when HNO_3 is above 73.8 mass %, the solid in equilibrium with the pentahydrate is the tetrahydrate. In view of the similarity between the effect of increasing the concentration of HNO_3 in ternary systems, and that of increasing temperature in binary systems, on the hydration of the precipitating solids, the tetrahydrate appears to be the logical solid at equilibrium for temperatures above about 385K.</p> <p>Marshall et al. (5) reported a transition from the tetrahydrate to a lower hydrate at 424K, but did not identify the lower hydrate. Based on the phase diagram for the $\text{Th}(\text{NO}_3)_4 - \text{H}_2\text{O}$ system given by Marshall et al. (5), the existence of a lower hydrate seems very probable although only two data points have been reported.</p> <p><u>The Solubility of $\text{Th}(\text{NO}_3)_4$ at Temperatures Below 385K</u></p> <p>The solubility values used in this work are in Table 21, and plotted in Figure 5. The five data points reported by Misciattelli (2) have been rejected because the small increase in solubility in the temperature range of 229.7K to 293.2K appears to be incompatible with the changes in the solubility at higher temperatures reported by other researchers. Also a preliminary statistical analysis based on fitting of all the reported solubilities to the general solubility equation has shown that the data points published by Misciattelli are inconsistent with the other data</p> <p style="text-align: right;">(continued on the next page)</p>	

COMPONENTS:
 (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]
 (2) Water; H_2O ; [7732-18-5]

EVALUATOR:
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CRITICAL EVALUATION:
 points, and do not belong to the same parent population. Apelblat et al. (12) found a linear relationship between solubility in units of mol/dm^3 and temperature over the range 278K to 333K. These authors also give empirical equations with which to calculate the density of the aqueous solutions of thorium nitrate over this temperature range. Such equations with relationships between amount dissolved and temperature, and between density and amount dissolved provide for calculating the molalities of saturated solutions at the four temperatures, 298K, 308K, 318K and 333K. It is seen from the data in Table 21 and Figure 5 that the solubility at 298K is in very good agreement with the value reported by Ferraro et al. (8), whereas the remaining solubility values show positive deviations from the values published by Templeton (3) and Marshall et al. (5). The deviations also increase with increasing temperature. The density of saturated thorium nitrate solutions at 298K calculated with the equations given by Apelblat et al. (12) is in very good agreement with the value reported by Kurnakova and Nikolaev (10). In these papers, the calculated

Table 21. The solubility of $\text{Th}(\text{NO}_3)_4$ in water for temperatures below 385K, for the system $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O} - \text{H}_2\text{O}$.

Solubility		
T/K	mol/kg	Ref.
*229.65	3.70	2
*251.15	3.73	2
*273.15	3.87	2
283.15	3.90	2
*293.15	3.713	10
*293.15	3.97	2
298.15	3.723	7
298.15	3.737	12
302.90	4.08	3
*308.15	4.346	12
310.45	4.243	5
313.30	4.33	3
*318.15	4.677	12
323.15	4.66	3

Solubility		
T/K	mol/kg	Ref.
327.65	4.810	5
331.90	4.91	3
*333.15	5.475	12
333.70	5.00	3
345.15	5.745	5
350.70	5.78	3
355.50	6.12	3
363.35	6.740	5
372.30	7.09	3
372.85	7.633	5
382.50 ^a	8.08	3
*383.55 ^a	8.944	5
*384.05 ^b	9.177	5

^aThe hexahydrate (pentahydrate) ---> tetrahydrate transition point (4).
^bMetastable equilibrium if the transition temperature is 383.6K.
 *Not used in fitting to Eq 1.

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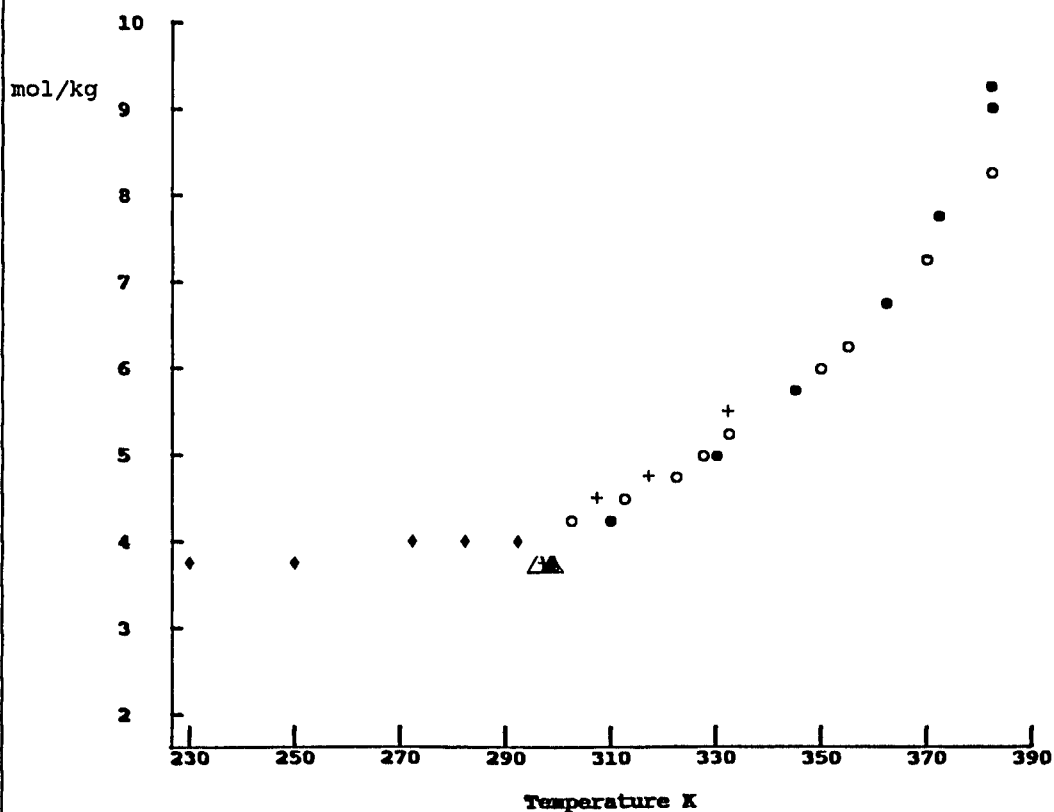
COMPONENTS:(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$;
[13823-29-5](2) Water; H_2O ; [7732-18-5]**EVALUATOR:**S. Siekierski
Department of Radiochemistry
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Figure 5. Plot of the solubility data for $\text{Th}(\text{NO}_3)_4$, at temperatures up to 384K. Data were obtained from Table 21.

Symbols: \diamond , Ref. 2; \circ , Ref. 3; \bullet , Ref. 5;
+, Ref. 12; \triangle , Ref. 7; \blacktriangle , Ref. 10.

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Department of Radiochemistry Institute of Nuclear Research Warsaw, Poland Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
<p>CRITICAL EVALUATION: densities of saturated solutions at higher temperatures are much lower than the experimental values reported by Marshall et al. (4). The calculated densities are independent of temperature, which is highly improbable and is at variance with experimental results (4). Evidently the calculated densities at 35°C, 45°C and at 60°C and consequently the molal solubilities are wrong and have to be rejected. The remaining 17 data points were fitted to the solubility equation, Equation 1,</p> $Y = \ln (m/m_0) - (m/m_0 - 1) = a + b/T + c \ln (T) + d (T) \quad (1)$ <p>where m is the solubility in mol/kg at the temperature T/K, m_0 is the molality at the congruent melting point for the thorium nitrate hydrate, and the quantities a, b, c, d are constants determined from the fitting procedure. The parameters and standard deviations for Equation 1 are summarized in Table 22. Recommended values of the solubilities computed from Equation 1 are given in Table 23 at intervals of 5 and 10 T/K. The equilibrium solid phase is assumed to be $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$.</p> <p>The imprecision in the solubility values from the fitting to Equation 1 is given by the values of the standard deviation in the solubility value, which in turn is calculated from the standard error of the estimate. Solubility values for the pentahydrate system were reported by virtually only two groups of authors, so that the overall uncertainty in the recommended values is greater than the imprecision of the fitting. This uncertainty was estimated by the evaluators to increase from about 0.03 mol/kg at 293.15K to about 0.1 mol/kg at 383.15K.</p> <p>According to Misciattelli (2), the eutectic point is at 229.7K, while the extrapolated portion of the pentahydrate branch intersects the ice branch at about 248K. This discrepancy shows that the low temperature data for the solubility of thorium nitrate, and the ice branch need experimental reexamination. If the pentahydrate is the equilibrated solid over the</p>	

COMPONENTS:(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$;
[13823-29-5](2) Water; H_2O ; [7732-18-5]**EVALUATOR:**S. Siekierski
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temperature interval from 293.2K to about 385K, then its congruent melting temperature can be calculated by extrapolating the pentahydrate branch up to the solubility value 11.10 mol/kg. The congruent melting temperature determined in this manner is about 391K. However, if the

Table 22. Coefficients and standard deviations for the solubility of thorium nitrate based on fitting of the data in Table 21 to Equation 1.

Coefficient in Equation 1	Value of the coefficient	Standard deviation
a	-53.8202	0.01137
b	1222.375	3.711
c	9.3000	0.001969
d	-0.01234	3.54×10^{-5}
m_0	11.10	0.2013

congruent melting point, 393.9 K.

Table 23. Recommended values for the solubility of $\text{Th}(\text{NO}_3)_4$ in water for temperatures less than 384K, from Equation 1, with $n = 5$: $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$.

Solubility		Solubility		Solubility	
T/K	mol/kg	T/K	mol/kg	T/K	mol/kg
223.15	2.24	293.15	3.67	343.15	5.50
233.15	2.38	298.15	3.81	348.15	5.75
243.15	2.54	303.15	3.97	353.15	6.01
253.15	2.73	308.15	4.12	358.15	6.29
263.15	2.93	313.15	4.29	363.15	6.61
273.15	3.15	318.15	4.47	368.15	6.95
283.15	3.39	323.15	4.65	373.15	7.34
		328.15	4.85	378.15	7.79
		333.15	5.05	383.15	8.32
		338.15	5.27	393.15	10.29

hexahydrate is the equilibrated solid over this same temperature range, then the congruent melting point is about 386K, and coincides with the incongruent melting point.

The Solubility of $\text{Th}(\text{NO}_3)_4$ at Temperatures above 384K

The published solubilities are compiled in Table 24, and are plotted in Figure 6. All the data points reported in the temperature interval from 384.1K to 431K were fitted to the general solubility equation with $n = 4$.
(continued on the next page)

COMPONENTS:

- (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$;
[13823-29-5]
(2) Water; H_2O ; [7732-18-5]

EVALUATOR:

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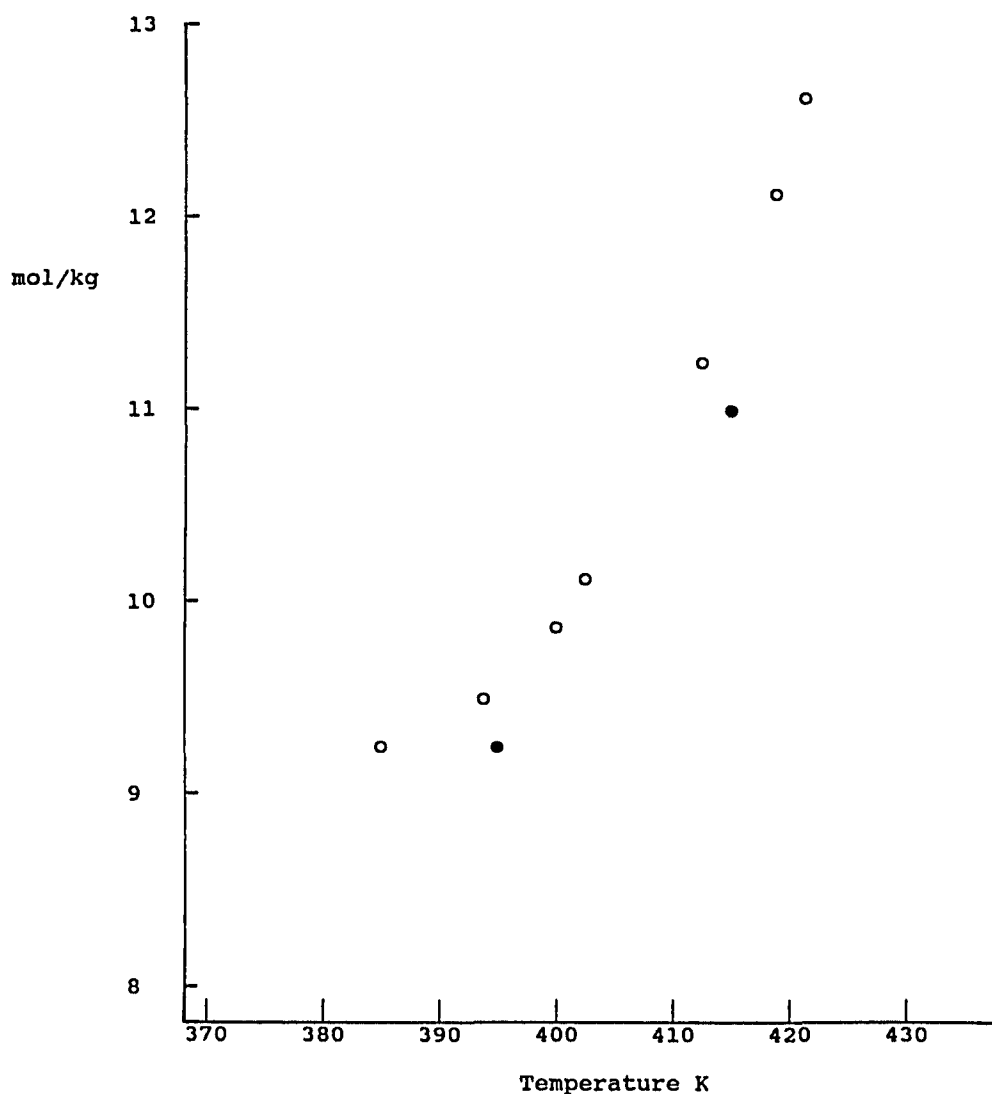
CRITICAL EVALUATION:

Figure 6. Plot of solubility data for $\text{Th}(\text{NO}_3)_4$ at temperatures above 384K, from Table 24.
Symbols: o, Ref. 5; ●, Ref. 3.

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Department of Radiochemistry Institute of Nuclear Research Warsaw, Poland Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
CRITICAL EVALUATION: The results of the analyses are given as the magnitudes of the four coefficients for Equation 1, Table 25, and interpolated solubilities at the intervals of 5 T/K are given in Table 26. The overall uncertainty in the recommended solubilities was estimated to be about 0.1 mol/kg at 390K and 0.3 mol/kg at 420K. Extrapolation by the evaluators of the isotherm for metastable hydrate (11) in the system $\text{Th}(\text{NO}_3)_4 - \text{HNO}_3 - \text{H}_2\text{O}$ to zero HNO_3 concentration results in a solubility of metastable $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ at 298K equal to about 6.0 mol/kg. The solubility obtained by extrapolation of the stable tetrahydrate branch based on the solubility equation, is 5.9 mol/kg. Our evaluation of the phase system is in Figure 7. <p style="text-align: center;">TERNARY SYSTEMS</p> <p><u>The $\text{Th}(\text{NO}_3)_4 - \text{HNO}_3 - \text{H}_2\text{O}$ System</u></p> <p>This ternary system was studied at 298.2K by Ferraro et al. (7,8) and by Nikolaev et al. (11). The majority of the data reported by Nikolaev et al. (11) refer to the metastable equilibrium between the tetrahydrate and the solution. Only two data points can be compared with the results which were reported by Ferraro et al. (7), and the agreement appears to be satisfactory. According to Nikolaev et al., the study of the metastable equilibrium was done because for conditions where the tetrahydrate is unstable, it transforms into the pentahydrate only with difficulty. The solubilities of metastable tetrahydrate at 298.2K in the ternary system $\text{Th}(\text{NO}_3)_4 - \text{HNO}_3 - \text{H}_2\text{O}$ published by Nikolaev et al. (11) appear to be accurate since the solubility of 6.0 mol/kg in the absence of any HNO_3 obtained by extrapolation to zero HNO_3 concentration, is in very good agreement with the solubility of 5.9 mol/kg obtained by extrapolating the stable tetrahydrate branch in the $\text{Th}(\text{NO}_3)_4 - \text{H}_2\text{O}$ system.</p> <p><u>The $\text{Th}(\text{NO}_3)_4 - \text{Al}(\text{NO}_3)_3 - \text{H}_2\text{O}$ System</u></p> <p>The ternary system was studied at 298.15K by Kurnakova and Nikolaev (10). The solubility data included the saturation concentration of $\text{Th}(\text{NO}_3)_4$</p> <p style="text-align: right;">(continued on the next page)</p>	

COMPONENTS:

- (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]
 (2) Nitric acid; HNO_3 ; [7697-37-2]
 (3) Water; H_2O ; [7732-18-5]

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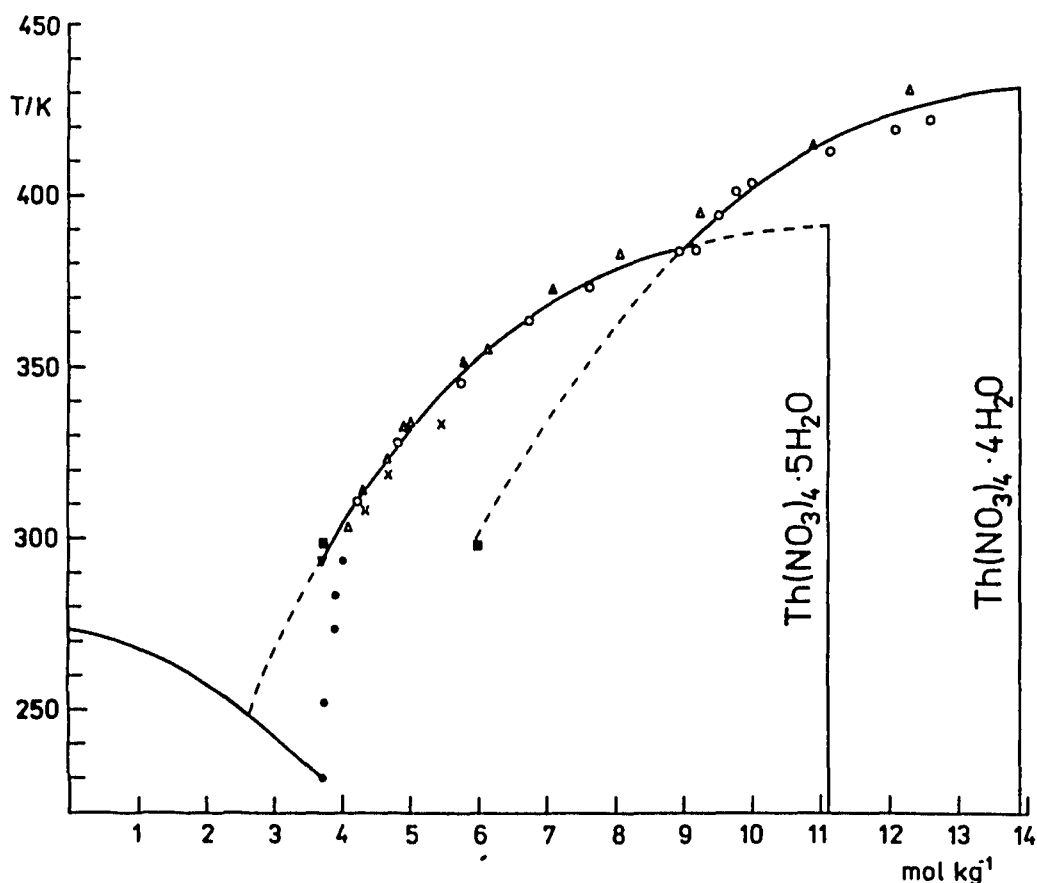
CRITICAL EVALUATION:

Figure 7. Phase diagram for the $\text{Th}(\text{NO}_3)_4$ - H_2O system. Solid lines are for stable phases, dashed lines for metastable phases and the dashed line representing the extrapolated part of the hexahydrate portion of the hexahydrate branch were calculated from the smoothing equation. Solid line for the ice system was obtained by graphic smoothing of data points in (2). Experimental data: ● (2); △ (3); ○ (4); □ (7); ▼ (10); X (11); ■ - solubility of metastable tetrahydrate obtained by evaluators from the ternary system reported in (12).

COMPONENTS:(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$;
[13823-29-5](2) Water; H_2O ; [7732-18-5]**EVALUATOR:**S. Siekierski
Department of Radiochemistry
Institute of Nuclear Research
Warsaw, PolandSidney L. Phillips
Camatx/Basic Data
Orinda, CA 94563 USA**CRITICAL EVALUATION:**Table 24. The solubility data for $\text{Th}(\text{NO}_3)_4$ in the binary system
 $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O} - \text{H}_2\text{O}$.

Solubility			Solubility		
T/K	mol/kg	Ref.	T/K	mol/kg	Ref.
384.05 ^a	9.177	5	415.0	10.9	3
393.75	9.496	5	419.15	12.09	5
394.65	9.24	3	422.15	12.60	5
401.15	9.759	5	431.0	12.3	3
403.65	10.06	5			
412.65	11.16	5			

^aThis point was assumed to belong to both the pentahydrate and the tetrahydrate branches. (Evaluators)

Table 25. Values of the coefficients and their standard deviations, based on fitting the data in Table 24 to Equation 1.

Coefficient	Value	Standard Deviation
a	-5140.514	0.00479
b	173750.11	1.95
c	855.612	0.000796
d	-1.0507	$1.177^a \times 10^{-5}$
m_0	13.88 mol/kg	0.268 ^a

^aStandard error of the estimate.

Table 26. Recommended solubilities computed from Equation 1 with the coefficients in Table 25.

Solubility		Solubility	
T/K	mol/kg	T/K	mol/kg
383.15	9.22	408.15	10.48
388.15	9.17	413.15	11.08
393.15	9.29	418.15	11.74
398.15	9.57	423.15	12.36
403.15	9.97	428.15	12.61
		433.15	12.15
		438.15	11.31

(continued on the next page)

COMPONENTS:

- (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]
- (2) Nitric acid; HNO_3 ; [7697-37-2]
- (3) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0]
- (4) Copper nitrate; $\text{Cu}(\text{NO}_3)_2$; [3251-23-8]
- (5) Ferric nitrate; $\text{Fe}(\text{NO}_3)_3$; [10421-48-4]
- (6) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9]
- (7) Water; H_2O ; [7732-18-5]

EVALUATOR:

S. Siekierski
Department of Radiochemistry
Institute of Nuclear Research
Warsaw, Poland

Sidney L. Phillips
Camatx/Basic Data
Orinda, CA 94563 USA

CRITICAL EVALUATION:

equal to 64.06% (3.713 mol/kg) with the hexahydrate given as the solid phase at equilibrium. However, in our evaluation the pentahydrate has been selected as the solid phase.

THE QUATERNARY SYSTEMS

There have been four studies of the solubility of $\text{Th}(\text{NO}_3)_4$ in systems with four components. These studies are summarized as follows:

Quaternary system components	T/K	Solid phases	Ref.
$\text{Th}(\text{NO}_3)_4$ - $\text{Cu}(\text{NO}_3)_2$ - HNO_3 - H_2O	298.2	A + B + C	10
$\text{Th}(\text{NO}_3)_4$ - $\text{Fe}(\text{NO}_3)_3$ - HNO_3 - H_2O	293.2	B + D	10
$\text{Th}(\text{NO}_3)_4$ - $\text{UO}_2(\text{NO}_3)_2$ - HNO_3 - H_2O	298.2	A + E + F	11
$\text{Th}(\text{NO}_3)_4$ - $\text{Al}(\text{NO}_3)_3$ - HNO_3 - H_2O	298.2, 323.3	---	13

A= $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$; B= $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$; C= $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$; D= $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$;
E= $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; F= $\text{UO}_2(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$.

The quaternary systems with $\text{Cu}(\text{NO}_3)_2$ and $\text{Fe}(\text{NO}_3)_3$ were studied by Kurnakova and Nikolaev (10) who fixed the nitric acid at 1.5 mol/dm³ of HNO_3 . A high concentration of $\text{Cu}(\text{NO}_3)_2$ resulted in dehydration of $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$ to $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$. A system with uranyl nitrate was studied by Nikolaev et al. (11). The solid phases were assigned the formulas $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ and $\text{UO}_2(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$. The tetrahydrate was dominant at the lower concentrations. Phillips and Huber (13) studied the solubility of $\text{Th}(\text{NO}_3)_4$ at temperatures of 298.5K and 323.2K. They did not identify the solid phases.

SOLID PHASES

The structure of the crystalline solid $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ was determined by Charpin et al. (15). The tetrahydrate is a monoclinic crystal, with the thorium atom twelve-coordinated to oxygen atoms. The four H_2O molecules are associated with the Th atom.

(continued on the next page)

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0] (4) Copper nitrate; $\text{Cu}(\text{NO}_3)_2$; [3251-23-8] (5) Ferric nitrate; $\text{Fe}(\text{NO}_3)_3$; [10421-48-4] (6) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (7) Water; H_2O ; [7732-18-5]	EVALUATOR: S. Siekierski Department of Radiochemistry Institute of Nuclear Research Warsaw, Poland Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
CRITICAL EVALUATION: <p style="text-align: center;">REFERENCES</p> <ol style="list-style-type: none"> 1. Berzelius, J. J. <i>Pogg. Ann.</i> <u>1829</u>, 16, 385. 2. Misciattelli, P. <i>Gazz. Chim. Ital.</i> <u>1930</u>, 60, 833. 3. Templeton, C. C. <i>AECU-1721</i>, Report <u>1950</u>. 4. Marshall, W. L.; Gill, J. S.; Secoy, C. H. <i>ORNL-925</i>, Report <u>1951</u>, 279. 5. Marshall, W. L.; Gill, J. S.; Secoy, C. H. <i>J. Am. Chem. Soc.</i> <u>1951</u>, 73, 4991. 6. Staritzky, E.; Walker, D. J. <i>U. S. Atomic Energy Commission</i>, LA-1439, <u>1952</u>. 7. Ferraro, J. R.; Katzin, L. I. <i>ANL-5014</i>, Report <u>1953</u>. 8. Ferraro, J. R.; Katzin, L. I.; Gibson, G. J. <i>Am. Chem. Soc.</i> <u>1954</u>, 76, 909. 9. Staritzky, E. <i>Anal. Chem.</i> <u>1956</u>, 28, 2021. 10. Kurnakova, A. G.; Nikolaev, A. V. <i>Zh. Neorg. Khim.</i> <u>1958</u>, 3, 1028. <i>Russ. J. Inorg. Chem.</i>, <u>1958</u>, 3, 298. 11. Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A. <i>Izv. Sib. Otdel. Akad. Nauk S. S. S. R.</i> <u>1966</u>, 129. 12. Apelblat, A.; Azoulay, D.; Sahar, A. <i>J. Chem. Soc. Faraday Trans. I</i> <u>1973</u>, 69, 1618. 13. Phillips, J. F.; Huber, H. D. <i>BNWL-240 Report</i>, <u>1968</u>. 14. Nakashima, T.; Zimmer, E.; Merz, E. <i>Solvent Extr. Ion Exch.</i> <u>1984</u>, 2, 635 - 658. 15. Charpin, P.; Chevrier, G.; Lance, M.; Nierlich, M.; Vigner, D.; <i>Acta Cryst.</i> <u>1987</u>, C43, 1239 - 1241. 	

COMPONENTS:				ORIGINAL MEASUREMENTS:																																																																																																																																																	
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$T/K = 229 - 293$				L. Fuks; S. Siekierski																																																																																																																																																	
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Solubility of $\text{Th}(\text{NO}_3)_4$ in water ^a																																																																																																																																																					
<table><tr><th colspan="3">$\text{Th}(\text{NO}_3)_4$</th><th rowspan="2">Solid Phase</th><th colspan="3">$\text{Th}(\text{NO}_3)_4$</th><th rowspan="2">Solid Phase</th></tr><tr><th>$t/^\circ\text{C}$</th><th>mass %</th><th>mol/kg</th><th>$t/^\circ\text{C}$</th><th>mass %</th><th>mol/kg</th></tr><tr><td>-0.2</td><td>1.0</td><td>0.021</td><td>ice</td><td>-13.5</td><td>46.2</td><td>1.80</td><td>A</td></tr><tr><td>-0.5</td><td>2.0</td><td>0.040</td><td>"</td><td>-15.0</td><td>47.7</td><td>1.90</td><td>A</td></tr><tr><td>-1.0</td><td>5.2</td><td>0.110</td><td>"</td><td>-16.6</td><td>49.8</td><td>2.07</td><td>A</td></tr><tr><td>-1.5</td><td>9.0</td><td>0.210</td><td>"</td><td>-19.1</td><td>51.0</td><td>2.17</td><td>A</td></tr><tr><td>-2.1</td><td>13.0</td><td>0.311</td><td>"</td><td>-23.3</td><td>53.1</td><td>2.36</td><td>A</td></tr><tr><td>-2.9</td><td>16.0</td><td>0.397</td><td>"</td><td>-25.0</td><td>55.7</td><td>2.62</td><td>A</td></tr><tr><td>-4.0</td><td>20.0</td><td>0.521</td><td>"</td><td>-28.6</td><td>58.0</td><td>2.88</td><td>A</td></tr><tr><td>-4.6</td><td>23.5</td><td>0.640</td><td>"</td><td>-31.3</td><td>59.2</td><td>3.02</td><td>A</td></tr><tr><td>-5.4</td><td>26.4</td><td>0.747</td><td>"</td><td>-35.0</td><td>60.6</td><td>3.20</td><td>A</td></tr><tr><td>-5.6</td><td>27.3</td><td>0.782</td><td>"</td><td>-40.6</td><td>62.0</td><td>3.40</td><td>A</td></tr><tr><td>-6.0</td><td>33.0</td><td>1.030</td><td>"</td><td></td><td></td><td></td><td></td></tr><tr><td>-6.6</td><td>37.0</td><td>1.220</td><td>"</td><td>-43.5</td><td>64.0^b</td><td>3.70</td><td>B</td></tr><tr><td>-9.0</td><td>41.0</td><td>1.450</td><td>"</td><td>-22.0</td><td>64.2^b</td><td>3.73</td><td>B</td></tr><tr><td>-11.2</td><td>43.0</td><td>1.570</td><td>"</td><td>0.0</td><td>65.0^b</td><td>3.87</td><td>B</td></tr><tr><td>-12.2</td><td>44.5</td><td>1.670</td><td>"</td><td>10.0</td><td>65.2^b</td><td>3.90</td><td>B</td></tr><tr><td></td><td></td><td></td><td></td><td>20.0</td><td>65.6^b</td><td>3.97</td><td>B</td></tr></table>								$\text{Th}(\text{NO}_3)_4$			Solid Phase	$\text{Th}(\text{NO}_3)_4$			Solid Phase	$t/^\circ\text{C}$	mass %	mol/kg	$t/^\circ\text{C}$	mass %	mol/kg	-0.2	1.0	0.021	ice	-13.5	46.2	1.80	A	-0.5	2.0	0.040	"	-15.0	47.7	1.90	A	-1.0	5.2	0.110	"	-16.6	49.8	2.07	A	-1.5	9.0	0.210	"	-19.1	51.0	2.17	A	-2.1	13.0	0.311	"	-23.3	53.1	2.36	A	-2.9	16.0	0.397	"	-25.0	55.7	2.62	A	-4.0	20.0	0.521	"	-28.6	58.0	2.88	A	-4.6	23.5	0.640	"	-31.3	59.2	3.02	A	-5.4	26.4	0.747	"	-35.0	60.6	3.20	A	-5.6	27.3	0.782	"	-40.6	62.0	3.40	A	-6.0	33.0	1.030	"					-6.6	37.0	1.220	"	-43.5	64.0 ^b	3.70	B	-9.0	41.0	1.450	"	-22.0	64.2 ^b	3.73	B	-11.2	43.0	1.570	"	0.0	65.0 ^b	3.87	B	-12.2	44.5	1.670	"	10.0	65.2 ^b	3.90	B					20.0	65.6 ^b	3.97	B
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^a Molalities, mol/kg, calculated by the compilers.																																																																																																																																																					
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VARIABLES: $T/K = 302 - 431$			PREPARED BY: A. Sozanski; S. Siekierski																																																								
EXPERIMENTAL VALUES: <div>Composition of Saturated Solutions^a</div> <table><thead><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{Th}(\text{NO}_3)_4$</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th></tr></thead><tbody><tr><td>29.8</td><td>66.2</td><td>4.08</td><td>A or B</td></tr><tr><td>40.1</td><td>67.5</td><td>4.33</td><td>A or B</td></tr><tr><td>50.0</td><td>69.1</td><td>4.66</td><td>A or B</td></tr><tr><td>58.8</td><td>70.2</td><td>4.91</td><td>A or B</td></tr><tr><td>60.5</td><td>70.6</td><td>5.00</td><td>A or B</td></tr><tr><td>77.6</td><td>73.5</td><td>5.78</td><td>A or B</td></tr><tr><td>82.4</td><td>74.6</td><td>6.12</td><td>A or B</td></tr><tr><td>99.2</td><td>77.3</td><td>7.09</td><td>A or B</td></tr><tr><td>109.4</td><td>79.5</td><td>8.08</td><td>A or B</td></tr><tr><td>121.5</td><td>81.6</td><td>9.24</td><td>A or B</td></tr><tr><td>142.0</td><td>83.9</td><td>10.9</td><td>C</td></tr><tr><td>158.0</td><td>85.5</td><td>12.3</td><td>C</td></tr></tbody></table> <div>^aMolalities, mol/kg, calculated by the compilers. ^bSolid phases: A = $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$, B = $\text{Th}(\text{NO}_3)_4 \cdot 5.5\text{H}_2\text{O}$, C = $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$. (continued on the next page)</div>						$t/^{\circ}\text{C}$	$\text{Th}(\text{NO}_3)_4$		Solid Phase ^b	mass %	mol/kg	29.8	66.2	4.08	A or B	40.1	67.5	4.33	A or B	50.0	69.1	4.66	A or B	58.8	70.2	4.91	A or B	60.5	70.6	5.00	A or B	77.6	73.5	5.78	A or B	82.4	74.6	6.12	A or B	99.2	77.3	7.09	A or B	109.4	79.5	8.08	A or B	121.5	81.6	9.24	A or B	142.0	83.9	10.9	C	158.0	85.5	12.3	C
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METHOD/APPARATUS/PROCEDURE: Synthetic and analytical methods were used (1). Solutions were placed in a constant temperature bath, and gently agitated for at least two days. For temperatures between 30°C and 60°C , measurements were made by the analytical method. Thorium was determined by ignition of a solution sample to thoria, ThO_2 , and the hydrated water determined by the Karl Fischer method. Above 70°C , the synthetic method was used. Samples of known composition were weighed, mixed and sealed in glass tubes. The temperature of disappearance of the last speck of solid matter was determined by slowly raising the bath temperature while agitating the sample. The sample was agitated at least 2 hours between temperature increases.			SOURCE AND PURITY OF MATERIALS: $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$, General Chemical Baker ³ & Adamson Reagent Grade. As usual, the solid corresponded to about 4.3 molecules of hydrated water. ESTIMATED ERROR: Solubility: Nothing specified. Over three-fourths of the points are the average of two or more replicates. Temperature: Precision $\pm 0.2\text{K}$ for the analytical method, and $\pm 0.5\text{K}$ for the synthetic method.																																																								
			REFERENCES: 1. Marshall, W. L. Pure Appl. Chem. 1985, 57, 283-301.																																																								

COMPONENTS:		ORIGINAL MEASUREMENTS:	
(1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5]		Templeton, C. C.	
(2) Water; H ₂ O; [7732-18-5]		Atomic Energy Commission Document, AECU-1721, 1950.	

EXPERIMENTAL VALUES: (Continued)			
COMMENTS AND/OR ADDITIONAL DATA:			
In the Compiler's opinion, the Author's data are more consistent with Th(NO ₃) ₄ .5.5H ₂ O, than with the formula Th(NO ₃) ₄ .6H ₂ O:			
Formula	CAS No.	ThO ₂ %	H ₂ O %
Th(NO ₃) ₄ .6H ₂ O	[23739-44-8]	44.9	18.38
Th(NO ₃) ₄ .5.5H ₂ O	[61443-54-7]	45.6	17.11
Author's data	---	45.7±0.1	17.5±0.1
Th(NO ₃) ₄ .5H ₂ O	[14767-04-5]	46.32	15.8

Temperature (°C)	Mass %
29.8	66.2
35	68.2
45	69.2
55	70.8
65	73.8
75	74.8
85	77.5
95	79.8
105	80.2
115	81.8
121.5	82.5

Plot of the tabulated data for the temperature range 29.8 to 121.5°C.

COMPONENTS:			ORIGINAL MEASUREMENTS:	
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]			Marshall, W. L.; Gill, J. S.; Secoy, C. H.	
(2) Water; H_2O ; [7732-18-5]			<i>J. Am. Chem. Soc.</i> <u>1951</u> , 73, 4991- 4992.	
VARIABLES:			PREPARED BY:	
$T/K = 310 - 484$			L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:				
Composition of Saturated Solutions ^a				
$t/^\circ\text{C}$	$\text{Th}(\text{NO}_3)_4$		Solid Phase ^d	Method of Determination
	mass %	mol/kg		
37.3	67.07	4.243	A	analytical
54.5	69.78	4.810	A	"
72.0	73.39	5.745	A	"
90.2	76.39	6.740	A	"
99.7	78.56	7.633	A	"
110.4	81.11	8.944	A	"
110.9	81.50	9.177	A	"
111.0 ^b	--	--	A+B	---
120.6	82.01	9.496	B	analytical
128.0	82.41	9.759	B	synthetic
130.5	82.85	10.06	B	analytical
139.5	84.27	11.16	B	"
146.0	85.30	12.09	B	"
149.0	85.81	12.60	B	"
151.0 ^c	--	--	B+C	
159.0	87.41	14.46	C	synthetic
211.0	91.82	23.38	C	"
(continued on the next page)				
AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:	
Synthetic (1) and analytical methods used. Analytical method: Thorium nitrate solutions were stirred in the presence of excess solid for 40 min. After the solid had settled, duplicate samples of clear solution were taken and analyzed. Synthetic method: $\text{Th}(\text{NO}_3)_4$ - water mixtures of known compositions were slowly heated until complete dissolution. The temperature was probably determined visually (compilers). Samples of the solid phase, as well as those of the saturated solution, were ignited at 900°C and weighed as ThO_2 (1).			CP grade thorium nitrate tetrahydrate from Maywood Company used.	
			ESTIMATED ERROR:	
			Temperature control for analytical method was $\pm 0.05^\circ\text{C}$, and for the synthetic method, $\pm 1^\circ\text{C}$. Maximum deviation for ThO_2 duplicates was $\pm 0.15\%$.	
REFERENCES:				
1. Secoy, C. H. <i>J. Am. Chem. Soc.</i> <u>1950</u> , 72, 3343.				

<p>COMPONENTS:</p> <p>(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]</p> <p>(2) Water; H_2O; [7732-18-5]</p>	<p>ORIGINAL MEASUREMENTS:</p> <p>Marshall, W. L.; Gill, J. S.; Secoy, C. H.</p> <p><i>J. Am. Chem. Soc.</i> <u>1951</u>, 73, 4991 - 4992.</p>
<p>EXPERIMENTAL VALUES: (Continued)</p> <p>^aMolalities calculated by the compilers.</p> <p>^bIntersection temperature for the incongruent melting point of the hexahydrate is $111.3 \pm 0.4^\circ\text{C}$.</p> <p>^cIntersection temperature for the incongruent melting point of the tetrahydrate.</p> <p>^dSolid phases: A = $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$, B = $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, C = $\text{Th}(\text{NO}_3)_4 \cdot x\text{H}_2\text{O}$.</p>	

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Water; H_2O ; [7732-18-5]			ORIGINAL MEASUREMENTS: Marshall, W. L.; Gill, J. S.; Secoy, C. H. Oak Ridge National Laboratory Report ORNL-925, 1951, p. 279 - 290.	
VARIABLES: $T/K = 310 - 484$			PREPARED BY: A. Sozanski; S. Siekierski	
EXPERIMENTAL VALUES: The Solubility of Thorium Nitrate in Water Versus Temperature ^a				
$t/^\circ\text{C}$	$\text{Th}(\text{NO}_3)_4$		Density	Solid _b Phase ^c
	mass %	mol/kg	g/cm^3	
37.3	67.07	4.243	2.09	A ^c
54.5	69.78	4.810	2.17	A ^d
72.0	73.39	5.745	2.23	A
90.2	76.39	6.740	2.37	A
99.7	78.56	7.633	2.41	A
110.4	81.11	8.944	2.44	A+B
110.9	81.50	9.177	2.45	B
120.2	---	---	2.57	B
120.6	82.01	9.496	2.54	B
128.0	82.41	9.759	--	B ^e
129.5	---	---	2.59	B ^e
130.5	82.85	10.06	2.53	B
139.5	84.27	11.16	2.70	B
159.0	87.41	14.46	2.75	B
211.0	91.82	23.38	2.86	?

(continued on the next page)

AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE: Isothermal method used up to 125°C . Thorium nitrate solutions were stirred in the presence of excess salt for about 40 min. in a round-bottom flask set in the thermostat. Preliminary sampling had shown that 10 to 15 min. was sufficient for equilibrium. Then stirring was stopped, the solid phase was allowed to settle, and duplicate samples of clear solutions were removed. These samples were weighed, evaporated to dryness, and ignited to ThO_2 (900°C). Solid phase samples were obtained by direct sampling of the solid, drying between filter papers, and igniting to ThO_2 . Solubility data above 125°C were obtained by the synthetic method in quartz tubing.			SOURCE AND PURITY OF MATERIALS: $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, CP grade from the Maywood Company was used.	
			ESTIMATED ERROR: Solubility: Duplicate samples deviated approximately by about $\pm 0.015\%$. Temperature: Nothing specified.	
			REFERENCES: None.	

<p>COMPONENTS:</p> <p>(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]</p> <p>(2) Water; H_2O; [7732-18-5]</p>	<p>ORIGINAL MEASUREMENTS:</p> <p>Marshall, W. L.; Gill, J. S.; Secoy, C. H.</p> <p>Oak Ridge National Laboratory Report, ORNL-925, <u>1951</u>, 279 - 290.</p>
<p>EXPERIMENTAL VALUES: (Continued)</p> <p>^aMolalities calculated by the compilers.</p> <p>^bSolid phases: A = $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$, B = $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$.</p> <p>^c81.18 mass % $\text{Th}(\text{NO}_3)_4$ in the solid phase. Theoretical value for $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$ is 81.62 mass %.</p> <p>^d80.82 mass % $\text{Th}(\text{NO}_3)_4$ in the solid phase.</p> <p>^e85.84 mass % $\text{Th}(\text{NO}_3)_4$ in the solid phase. Theoretical value for $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ is 86.97 mass %.</p> <p>COMMENTS AND/OR ADDITIONAL DATA</p> <p>An initial hydrolytic decomposition temperature was determined between 115°C and 130°C; above this temperature nitrogen oxides are liberated and basic thorium oxide is precipitated. However, in a closed system, the vapor phase appears to equilibrate with the liquid phase, and the system in this form does not show precipitation up to an experimentally determined curve, at which a solid phase appears even in the closed system. The rates of decomposition precipitation at elevated temperatures were found to be relatively slow compared to the rates for attainment of solubility equilibrium.</p>	

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Apelblat, A.; Azoulay, D.; Sahar, A. <i>J. Chem. Soc. Faraday Trans. I</i> 1973, 69, 1618 - 1623.																											
VARIABLES: $T/K = 278 - 333$	PREPARED BY: A. Sozanski; S. Siekierski																											
EXPERIMENTAL VALUES: The solubility, c , increases linearly with temperature, $^{\circ}\text{C}$, according to the equation, $c, \text{mol/dm}^3 = 2.615 + 0.010 (t - 25)$ The following table of solubilities was calculated by the compilers from this equation: <table><tr><th rowspan="2">$t/^{\circ}\text{C}$</th><th colspan="2">$\text{Th}(\text{NO}_3)_4$</th><th>Density</th></tr><tr><th>mol/dm^3</th><th>mol/kg</th><th>g/cm^3</th></tr><tr><td>5</td><td>2.415</td><td>---</td><td>---</td></tr><tr><td>25</td><td>2.615</td><td>3.74</td><td>1.955</td></tr><tr><td>35</td><td>2.715</td><td>4.35</td><td>1.928</td></tr><tr><td>45</td><td>2.815</td><td>4.68</td><td>1.953</td></tr><tr><td>60</td><td>2.965</td><td>5.47</td><td>1.965</td></tr></table> The densities $d(t)$, were calculated by the compilers from equations given in the source paper. $d(25^{\circ}\text{C}) = 0.9973 + 0.3877c - 0.0082c^2$ $d(35^{\circ}\text{C}) = 0.9941 + 0.3953c - 0.0189c^2$ $d(45^{\circ}\text{C}) = 0.9903 + 0.3992c - 0.0203c^2$ $d(60^{\circ}\text{C}) = 0.9832 + 0.3972c - 0.0223c^2$		$t/^{\circ}\text{C}$	$\text{Th}(\text{NO}_3)_4$		Density	mol/dm^3	mol/kg	g/cm^3	5	2.415	---	---	25	2.615	3.74	1.955	35	2.715	4.35	1.928	45	2.815	4.68	1.953	60	2.965	5.47	1.965
$t/^{\circ}\text{C}$	$\text{Th}(\text{NO}_3)_4$		Density																									
	mol/dm^3	mol/kg	g/cm^3																									
5	2.415	---	---																									
25	2.615	3.74	1.955																									
35	2.715	4.35	1.928																									
45	2.815	4.68	1.953																									
60	2.965	5.47	1.965																									
AUXILIARY INFORMATION																												
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The concentration of thorium was determined by complexometric titration with EDTA, using xylene orange as the indicator (1). Some samples were analyzed gravimetrically. Results by both methods were consistent with each other. The authors did not report their measured solubilities, but instead reported smoothed data in the form of the above equations.	SOURCE AND PURITY OF MATERIALS: $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$ supplied by Merck was used without further purification. ESTIMATED ERROR: Nothing specified. REFERENCES: 1. E. Y. Welcher <i>The Analytical Uses of EDTA</i> , Van Nostrand, N.Y. (1958).																											

COMPONENTS:		ORIGINAL MEASUREMENTS:			
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]		Ferraro, J. R.; Katzin, L. I.			
(2) Nitric acid; HNO_3 ; [7697-37-2]		Report, ANL-5014, 1953.			
(3) Water; H_2O ; [7732-18-5]					
VARIABLES:		PREPARED BY:			
Composition at 298 K		A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:					
The $\text{Th}(\text{NO}_3)_4 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C					
Composition of saturated solutions ^a					
$\text{Th}(\text{NO}_3)_4$		HNO_3		H_2O	Solid _b Phase ^b
mass %	mol/kg	mass %	mol/kg	mass %	
64.12	3.723	0	0	35.88	A + hydrolyzed salt
63.61	3.685	0.43	0.19	35.96	A
62.71	3.621	1.21	0.532	36.08	A
60.78	3.527	3.32	1.47	35.90	A
55.34	3.196	8.59	3.78	36.07	A
52.03	2.995	11.78	5.166	36.19	A
47.10	2.657	15.98	6.869	36.92	A
41.86	2.411	21.97	9.639	36.17	A
41.24	2.370	22.52	9.862	36.24	A
35.16	2.064	29.36	13.13	35.48	A
(continued on the next page)					
AUXILIARY INFORMATION					
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. Mixtures of water and nitric acid were saturated with thorium nitrate at temperatures around 70°C and the solutions were then equilibrated in a thermostatted bath at 25°C for a minimum of 48 hours. In the low water region, anhydrous nitric acid and anhydrous thorium nitrate were used to prepare the solutions. The method of Schreinemakers was used. Thorium determined by ignition to ThO_2 . Water measured by Karl Fischer titration. Nitric acid was determined by difference. Solids used for purposes of identification by X-ray powder diagrams were dried between sheets of filter paper.			1. $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, Baker & Adamson (chloride, 0.003% max.; sulfate, 0.01% max.)		
			2. $\text{Th}(\text{NO}_3)_4$, the anhydrous nitrate was prepared as described in Reference 1.		
			3. Nitric acid, General Chemical Division, 70%, sp. grav. 1.42.		
			4. Anhydrous nitric acid, General Chemical Division.		
			ESTIMATED ERROR:		
			Solubility: nothing specified.		
			Temperature: precision to $\pm 0.03\text{K}$.		
			REFERENCES:		
			1. Ferraro, J. R. Unpublished work.		

COMPONENTS:

(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]

(2) Nitric acid; HNO_3 ; [7697-37-2]

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Ferraro, J. R.; Katzin, L. I. Report, ANL-5014, 1953.

EXPERIMENTAL VALUES: (Continued)

The $\text{Th}(\text{NO}_3)_4 - \text{HNO}_3 - \text{H}_2\text{O}$ system at 25°C

Composition of saturated solutions^a

$\text{Th}(\text{NO}_3)_4$		HNO_3		H_2O	Solid ^b Phase ^b
mass %	mol/kg	mass %	mol/kg	mass %	
30.11	1.935	37.48	18.35	32.41	A
29.57	1.927	38.46	19.09	31.97	A
28.76	1.892	39.58	19.84	31.66	A
25.87	2.118	48.69	30.37	25.44	A
26.04	2.184	49.12	31.38	24.84	A
26.93	2.723	52.47	40.42	20.60	A
27.95	3.076	53.12	44.53	18.93	A
28.85	3.282	52.84	45.80	18.31	A
28.27	3.270	53.72	47.34	18.01	A
28.67	3.374	53.63	48.08	17.70	A+B
27.93	3.513	55.51	53.20	16.56	B
25.95	3.897	60.18	68.86	13.87	B
23.46	4.459	65.58	94.96	10.96	B
22.91	5.06	67.66	114.00	9.43	B
21.11	5.49	70.88	140.00	8.01	B
21.17	7.33	72.81	192.00	6.02	B
22.45	13.1	73.98	329.00	3.57	C or D
22.51	13.9	74.11	348.00	3.38	"
24.48	28.8	73.75	661.00	1.77	"
21.19	8.33	73.51	220.00	5.30	"
21.07	9.05	74.08	242.00	4.85	"

^aMolalities, mol/kg, and mass % of HNO_3 calculated by the compilers.

^bSolid phases:

A = $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$

B = $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$

C = $\text{Th}(\text{NO}_3)_4 \cdot 2\text{HNO}_3$

D = $\text{Th}(\text{NO}_3)_4 \cdot \text{N}_2\text{O}_5$

COMMENTS AND/OR ADDITIONAL DATA:

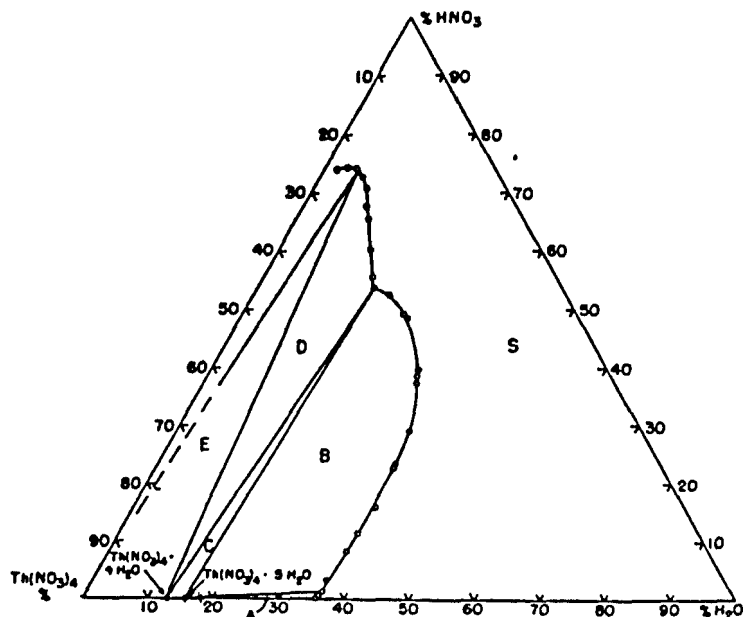
In the original paper, results of an analysis of the solid phases and the phase diagram are given. For solutions containing less than 1% of HNO_3 , the solid phase contains partially hydrolyzed salt.

COMPONENTS:

- (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]
 (2) Nitric acid; HNO_3 ; [7697-37-2]
 (3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

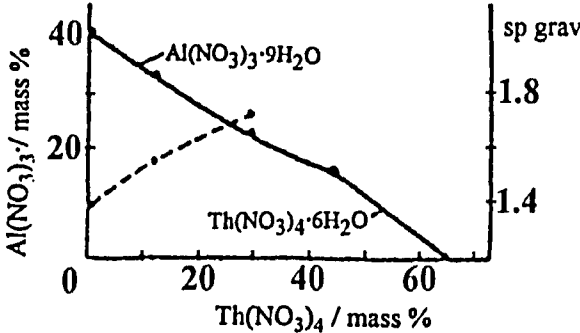
Ferraro, J. R.; Katzin, L. I.;
 Gibson, G.
J. Am. Chem. Soc. **1954**, *76*, 909 - 911.

EXPERIMENTAL VALUES: (Continued)

The system $\text{Th}(\text{NO}_3)_4 - \text{HNO}_3 - \text{H}_2\text{O}$ at 25°C :

- A. The region of the system which exhibits hydrolysis;
 B. The pentahydrate and variable liquid region;
 C. Pentahydrate, tetrahydrate and liquid; D. Tetrahydrate and variable liquid; E. Tetrahydrate, anhydrous phase and liquid; S. Homogeneous solution region.

COMPONENTS: (1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5] (2) Nitric acid; HNO ₃ ; [7697-37-2] (3) Water; H ₂ O; [7732-18-5]	ORIGINAL MEASUREMENTS: Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A. <i>Izv. Sib. Otdel. Akad. Nauk SSSR</i> 1966, 129 - 131.																																																																
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski																																																																
EXPERIMENTAL VALUES: The Th(NO ₃) ₄ - HNO ₃ - H ₂ O System at 25°C Composition of Saturated Solutions ^a <table><tr><th rowspan="2">Density g/cm³</th><th colspan="2">Th(NO₃)₄</th><th colspan="2">HNO₃</th><th rowspan="2">Solid Phase^b</th></tr><tr><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mol/kg</th></tr><tr><td>2.134</td><td>70.00</td><td>5.551</td><td>3.73</td><td>2.25</td><td>---</td></tr><tr><td>2.046</td><td>63.10</td><td>4.801</td><td>9.52</td><td>5.52</td><td>---</td></tr><tr><td>--</td><td>59.98</td><td>4.605</td><td>12.89</td><td>7.54</td><td>A</td></tr><tr><td>1.895</td><td>51.56</td><td>4.090</td><td>22.18</td><td>13.40</td><td>---</td></tr><tr><td>--</td><td>45.00</td><td>3.793</td><td>30.29</td><td>19.45</td><td>A</td></tr><tr><td>1.822</td><td>43.19</td><td>3.552</td><td>31.48</td><td>19.72</td><td>---</td></tr><tr><td>1.756</td><td>35.29</td><td>3.112</td><td>41.09</td><td>27.61</td><td>---</td></tr><tr><td>1.709</td><td>29.33</td><td>3.362</td><td>52.50</td><td>45.86</td><td>---</td></tr><tr><td>1.722</td><td>28.42</td><td>4.027</td><td>56.88</td><td>61.41</td><td>A</td></tr></table> ^a Molalities, mol/kg, calculated by the compilers. ^b Solid phase: A = Th(NO ₃) ₄ ·4H ₂ O.		Density g/cm ³	Th(NO ₃) ₄		HNO ₃		Solid Phase ^b	mass %	mol/kg	mass %	mol/kg	2.134	70.00	5.551	3.73	2.25	---	2.046	63.10	4.801	9.52	5.52	---	--	59.98	4.605	12.89	7.54	A	1.895	51.56	4.090	22.18	13.40	---	--	45.00	3.793	30.29	19.45	A	1.822	43.19	3.552	31.48	19.72	---	1.756	35.29	3.112	41.09	27.61	---	1.709	29.33	3.362	52.50	45.86	---	1.722	28.42	4.027	56.88	61.41	A
Density g/cm ³	Th(NO ₃) ₄		HNO ₃		Solid Phase ^b																																																												
	mass %	mol/kg	mass %	mol/kg																																																													
2.134	70.00	5.551	3.73	2.25	---																																																												
2.046	63.10	4.801	9.52	5.52	---																																																												
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1.709	29.33	3.362	52.50	45.86	---																																																												
1.722	28.42	4.027	56.88	61.41	A																																																												
AUXILIARY INFORMATION																																																																	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Samples of investigated composition were equilibrated in a glass vessel at 25°C using a magnetic stirrer. Equilibrium was attained in 5 to 6 hours. Analysis for the content of the components was carried out by the volumetric method. Nitric acid was titrated potentiometrically using potassium hydroxide and ammonium oxalate; thorium was determined by EDTA titration with xylenol orange as the indicator (1).	SOURCE AND PURITY OF MATERIALS: 1. Thorium nitrate of the "purum" grade was twice crystallized. 2. Nitric acid was obtained from potassium nitrate. Sulfuric acid was C. P. grade. ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Precision ±0.05K. REFERENCES: 1. Tchernikov, Yu. A.; Lukianov, V. F.; Kozlova, A. V. <i>Zavod. Lab.</i> 1960, 26, 921. (in Russian).																																																																

COMPONENTS:			ORIGINAL MEASUREMENTS:		
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]			Kurnakova, A. G.; Nikolaev, A. V.		
(2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0]			<i>Zh. Neorg. Khim.</i> <u>1958</u> , 3, 1028-1036.		
(3) Water; H_2O ; [7732-18-5]			<i>Russ. J. Inorg. Chem.</i> <u>1958</u> , 3, 298.		
VARIABLES:			PREPARED BY:		
Composition at 293 K			L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES:					
The $\text{Th}(\text{NO}_3)_4$ - $\text{Al}(\text{NO}_3)_3$ - H_2O system at 20°C					
Composition of saturated solutions ^a					
Density	$\text{Th}(\text{NO}_3)_4$		$\text{Al}(\text{NO}_3)_3$		Solid Phase ^b
g/cm^3	mass %	mol/kg	mass %	mol/kg	
1.400	--	--	40.63	3.213	A
--	11.28	0.4239	33.29	2.820	A
1.550	29.13	1.1264	22.88	2.328	A
1.731	43.42	2.208	15.62	1.790	A+B
1.915	64.06	3.713	--	--	B
					B
^a Molalities calculated by the compilers.					
^b Solid phases: A = $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, B = $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$.					
AUXILIARY INFORMATION: Nothing specified.					
Solubility and specific gravity at 20°C of saturated solutions of the system:					
$\text{Al}(\text{NO}_3)_3$ - $\text{Th}(\text{NO}_3)_4$ - H_2O					
Specific gravity					

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Copper nitrate; $\text{Cu}(\text{NO}_3)_2$; [3251-23-8] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Kurnakova, A. G.; Nikolaev, A. V. <i>Zh. Neorg. Khim.</i> <u>1958</u> , 3, 1028-1036. <i>Russ. J. Inorg. Chem.</i> , <u>1958</u> , 3, 298.
VARIABLES: Composition at 298 and 293 K	PREPARED BY: L. Fuks; S. Siekierski

EXPERIMENTAL VALUES:

The $\text{Th}(\text{NO}_3)_4$ - $\text{Cu}(\text{NO}_3)_2$ - HNO_3 - H_2O system at 25°C^a

Composition of saturated solutions

Density g/cm ³	$\text{Cu}(\text{NO}_3)_2$ mass %	$\text{Th}(\text{NO}_3)_4$ mass %	Solid Phase ^b
1.709	56.47	--	A
1.725	53.64	5.36	A
1.778	51.01	9.02	A
1.798	48.56	11.65	A+B
1.785	46.35	14.27	B
1.772	40.42	19.36	B
1.787	29.06	29.27	B
1.823	20.21	39.51	B+C
1.874	14.55	46.00	C
1.896	4.60	56.84	C
1.931	--	64.06	C

^aThe compilers assume that the initial solution contained 1.5N HNO_3 .

^bSolid phases: A = $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, B = $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$,
C = $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$.

(Continued on the next page)

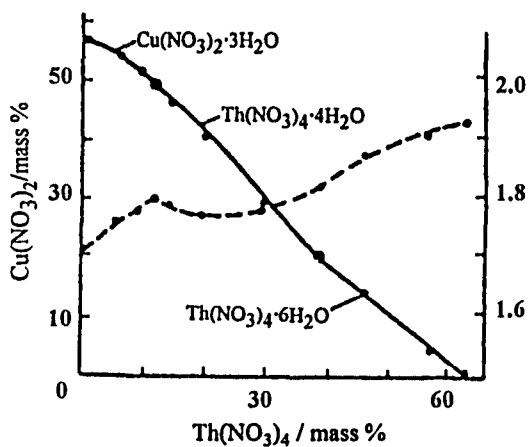
AUXILIARY INFORMATION: Nothing specified

Solubility and specific gravity of saturated solutions at 25°C of the system:

$\text{Cu}(\text{NO}_3)_2$ - $\text{Th}(\text{NO}_3)_4$ - HNO_3 - H_2O

1.5 mol/dm³ HNO_3 .

Specific gravity



COMPONENTS:

- (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]
 (2) Ferric nitrate; $\text{Fe}(\text{NO}_3)_3$; [10421-48-4]
 (3) Nitric acid; HNO_3 ; [7697-37-2]
 (4) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kurnakova, A. G.; Nikolaev, A. V.
Zh. Neog. Khim., 1958, 3, 1028 - 1036.

Russ. J. Inorg. Chem., 1958, 3, 298.

EXPERIMENTAL VALUES: (Continued)

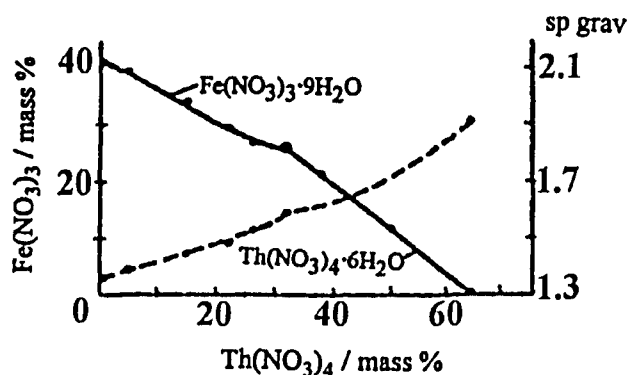
The $\text{Th}(\text{NO}_3)_4$ - $\text{Fe}(\text{NO}_3)_3$ - HNO_3 - Water system at 20°C^a

Composition of saturated solutions

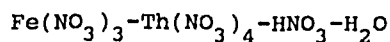
Density g/cm ³	$\text{Fe}(\text{NO}_3)_3$ mass %	$\text{Th}(\text{NO}_3)_4$ mass %	Solid _b Phase
1.366	40.93	--	A
1.388	39.45	4.26	A
1.444	33.95	14.44	A
1.492	29.58	21.66	A
1.532	26.89	25.99	A
1.586	26.33	31.90	A+B
--	21.22	38.01	B
--	11.82	49.88	B
1.915	--	64.06	B

^aThe compilers assume the initial solution was 1.5 mol/dm³ HNO_3 .

^bSolid phases: A = $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, B = $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$.



Solubility and specific gravity of saturated solutions at 20°C of the system:



1.5 mol/dm³ HNO_3 .

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Uranyl nitrate; $\text{UO}_2(\text{NO}_3)_2$; [15905-86-9] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]					ORIGINAL MEASUREMENTS: Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A. <i>Izv. Sib. Otdel. Akad. Nauk SSSR</i> 1966, 129 - 131.				
VARIABLES: Composition at 298K					PREPARED BY: L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES: The $\text{Th}(\text{NO}_3)_4 - \text{UO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C ^a Composition of Saturated Solutions ^b									
Density ³ g/cm ³	$\text{UO}_2(\text{NO}_3)_2$ mass % mol/kg		$\text{Th}(\text{NO}_3)_4$ mass % mol/kg		HNO_3 mass % mol/kg		Solid Phase ^c		
1.725	47.22	2.684	2.33	0.109	5.80	2.06	A		
1.726	42.56	2.459	8.11	0.385	5.40	1.95			
1.738	37.93	2.190	12.36	0.586	5.75	2.08			
1.771	28.39	1.645	22.42	1.066	5.40	1.96			
1.794	23.94	1.481	29.80	1.514	5.25	2.03			
1.839	16.70	1.019	36.50	1.828	5.20	1.98	B		
1.884	13.59	0.939	44.38	2.517	5.30	2.29	"		
1.962	10.10	0.761	51.14	3.162	5.07	2.39	B+C		
1.929	5.15	0.376	54.85	3.283	5.20	2.37	C		
1.886	2.30	0.180	60.00	3.848	5.22	2.55			
2.129	--	--	67.40	5.032	4.70	2.67			
^a The compilers assume the initial concentration of HNO_3 was 1.5M. ^b Molalities, mol/kg, calculated by the compilers. ^c Solid phases: A = $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$; B = $\text{UO}_2(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$; C = $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$									
AUXILIARY INFORMATION									
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Samples of the composition being studied were equilibrated in glass vessels at 25°C. Equilibrium was attained in 5 to 6 hours. Analysis of the components was carried out by the volumetric method. The nitric acid was titrated potentiometrically with potassium hydroxide, in the presence of added ammonium oxalate. The thorium, by EDTA with xylenol orange (1), and uranium with ammonium vanadate and barium diphenylamine sulfonate (2).					SOURCE AND PURITY OF MATERIALS: 1. Thorium and uranyl nitrates of "purum" grade twice crystallized. 2. Nitric acid obtained from KNO_3 and H_2SO_4 of C.P. purity. ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision $\pm 0.05\text{K}$. REFERENCES: 1. Tchernikov, Yu. A.; Lukianov, V. F.; Kozlova, A. V. <i>Zavod. Lab.</i> 1960, 26, 921. (In Russian). 2. Markov, V. K.; Vinogradov, A.V.; Elinson, S. V.; Klygin, A. E.; Moiseev, I. V. <i>Uranium - Methods of Determination.</i> (Russian), Moscow, 1960, page 161.				

COMPONENTS:				ORIGINAL MEASUREMENTS:			
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]				Phillips, J. F.; Huber, H. D.			
(2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0]				Report, 1968, BNWL-240.			
(3) Nitric acid; HNO_3 ; [7697-37-2]							
(4) Water; H_2O ; [7732-18-5]							
VARIABLES:				PREPARED BY:			
Composition at 298K and 323K				A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:							
The $\text{Th}(\text{NO}_3)_4$ - $\text{Al}(\text{NO}_3)_3$ - HNO_3 - H_2O System at 25°C and 50°C							
Composition of Saturated Solutions ^a							
	$\text{Al}(\text{NO}_3)_3$		$\text{Th}(\text{NO}_3)_4$		HNO_3		
$t/^\circ\text{C}$	mol/dm ³	g/dm ³	mol/dm ³	g/dm ³	mol/dm ³	g/dm ³	
25	0.30	64	1.94	931	2.77	175	
	0.30	64	1.49	715	6.40	400	
	0.30	64	0.93	446	9.83	619	
	0.60	130	1.74	835	2.60	160	
	0.60	130	1.47	706	5.03	317	
	0.60	130	1.19	571	6.40	403	
	0.90	190	1.50	720	2.70	170	
	0.90	190	1.43	686	3.10	195	
	0.90	190	1.29	619	3.60	227	
	0.90	190	0.67	322	5.76	363	
(continued on the next page)							
AUXILIARY INFORMATION							
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. A calculated amount of solid aluminum nitrate, nitric acid, and the approximate amount of thorium nitrate required to saturate the solution were added to 50 mL flask. Distilled water was added to about 45 mL, and the solution shaken overnight at a constant temperature. Enough thorium nitrate and/or distilled water was added to bring the volume up to 50 mL while leaving a small amount of the thorium nitrate undissolved. Thorium concentration was measured by x-ray fluorescence until the concentration of thorium no longer increased. Nitric acid was determined by titration with sodium hydroxide after buffering with potassium oxalate. Aluminum determined gravimetrically by converting nitrate to oxide at 400°C.				Nothing specified.			
				ESTIMATED ERROR:			
				Nothing specified.			
				REFERENCES:			
				None.			

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Various organics (3) Water; H_2O ; [7732-18-5]	EVALUATOR: S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
CRITICAL EVALUATION: <p>Data for the solubility of thorium in organic systems includes values in alcohols (1,6,16-19), esters (6,17,19), ethers (1-6,17,19), tributyl phosphate (1,8-12,14,20-22), ketones (1,2,6,16-19), other phosphates (1,7,13), trioctylamine (15) and nitromethane (23). In some investigations, inert diluents such as isoparaffins (9), dodecane (20), kerosine (10) and xylene (13) are included as part of the overall system. The evaluation of these studies is complicated by the presence of water and these diluents. An exception are the solubility data for systems with tri-n-butylphosphate.</p> <p><u>The System $\text{Th}(\text{NO}_3)_4$ - Organics</u></p> <p>The most comprehensive data on the solubility of $\text{Th}(\text{NO}_3)_4$ in organic materials were published by Templeton and Hall (2,17-19) for measurements at 298.15 K. Additional data were published by Yaffe (6) for selected alcohols at 293.15 K, and Katzin et al. (1) in systems with added diluents. Water from the dissolution of thorium nitrate hydrates was present in all the studies. The hydrate was either the tetrahydrate or hexahydrate of thorium nitrate.</p> <p>The studies by Templeton and Hall indicate that the solubility of thorium nitrate decreases with an increase in the number of carbon atoms for ketones, ethers, alcohols and esters. The solubility in chlorinated hydrocarbons such as carbon tetrachloride and chlorobenzene is <0.1 g/100 mL. A similar low solubility of <0.1 g/100 mL was also observed for hydrocarbons such as benzene, toluene, petroleum ether and turpentine, and for nitrogen-containing organics, including aniline, nitrobenzene and piperidine. Solubilities were considerably higher, on the order of 0.5 - 3 mol/kg for ketones, ethers, esters and alcohols. The effect of the number of carbon atoms is strikingly demonstrated in that the solubility is 3.02 mol/kg for diethyl ether, and falls to 0.003 mol/kg for isoamyl ether.</p> <p>It is not at all clear that equilibrium was attained in every case in the</p>	

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Various organics (4) Water; H_2O ; [7732-18-5]	EVALUATOR: S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
CRITICAL EVALUATION: <p>studies by Templeton and Hall, and by Yaffe (6). Another problem was the observation that a reaction occurred in some of the systems (6), as evidenced by a discoloration attributed to decomposition of the solid. Templeton and Hall (2) found examples of solvent decomposition in the case of gas evolution for the ketone propiophenone. In addition, they noted that some esters, a ketone and ethers solidified or became very viscous when mixed at 25°C with $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$.</p> <p>Katzin et al. (1) were primarily interested in obtaining information on the coordination number of Th in organic solvents. Their data contain values for the solubility of water as well as $\text{Th}(\text{NO}_3)_4$ in the organic solvent. They used a commercial grade of reagent hydrated thorium nitrate salt. The composition of this salt was checked by ignition to ThO_2; water was determined by Karl Fischer titration. The organic materials were all reagent grade, or otherwise highest quality solvents. Their procedure involved preparation of mixtures of the organic material plus a diluent such as carbon tetrachloride or hexane, by weight. A portion of this mixture was shaken with excess thorium nitrate. Saturated aqueous thorium nitrate was added where necessary to ensure that an aqueous phase was always present in the mixture.</p> <p>The thorium nitrate content in tributyl phosphate found by Katzin, et al. (1), 1.4880 mol/kg, agrees reasonably well with 1.54 mol/kg found by Wendlandt and Bryant (14), and within 0.05 mol/kg and exactly 1.49 mol/kg measured by Healy and McKay (8) at 299.5 K. The solubility of thorium nitrate in ethyl ether found by Katzin, et al. (1) was 1.610 mol/kg at 298 K, comparing with 1.56 mol/kg reported by Templeton and Hall (2,19).</p> <p>Selected solubility values from Katzin, et al. (1) are summarized in Table 27. The solubility data are recommended as a guide to the expected solubility of thorium nitrate in the organic solvents tabulated, when the system includes a saturated aqueous phase which contains thorium nitrate.</p> <p style="text-align: right;">(continued on the next page)</p>	

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]	EVALUATOR: S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
CRITICAL EVALUATION: <p>The System $\text{Th}(\text{NO}_3)_4$ - Tributyl Phosphate</p> <hr/> <p>Data for the binary system $\text{Th}(\text{NO}_3)_4$ - $(\text{C}_4\text{H}_9\text{O})_3\text{PO}$ were obtained from two sources for this evaluation (1,8); however, all values for temperatures above 25°C are from Healy and McKay (8). Their data show a ratio of water/nitrate = 0.06 at 26.4°C, but do not otherwise indicate the water content in the TBA phase.</p> <p>The experimental values in Table 28 were fitted to the solubility equation, and the results of the fit are given in Table 29 in terms of the values for the coefficients a, b, c and d. Recommended solubilities calculated from the solubility equation with these coefficients are given at intervals of 10 T/K in Table 30.</p> <p>The System $\text{Th}(\text{NO}_3)_4$-Tributyl Phosphate-Nitric Acid</p> <hr/> <p>Data for this system are the subject of six publications (9-11,20-22). According to Nikolaev et al. (11), at 298 K, the saturating phases are the tetrahydrate, $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, and the pentahydrate, $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$. Analysis of the organic phases indicated that extraction rays can be divided into three portions: predominant extraction of thorium, in which the water and nitric acid contents are constant and the ray is linear; coextraction of $\text{Th}(\text{NO}_3)_4$ and HNO_3; and predominant extraction of HNO_3. At low acidity, the stable solid was the tetrahydrate. A portion of the phase diagram was constructed using data from Ferraro et. al (24), for the $\text{Th}(\text{NO}_3)_4$-HNO_3-H_2O system, and included in the phase diagram in (11).</p>	

COMPONENTS:

- (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$;
[13823-29-5]
- (2) Tri-n-butyl phosphate (TBP);
 $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]

EVALUATOR:

S. L. Phillips
Camatx/Basic Data
Orinda, CA 94563 USA

CRITICAL EVALUATION:

Table 28. Solubility of thorium nitrate in TBP, $(\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO}$

$t/^{\circ}\text{C}$	T/K	$\text{Th}(\text{NO}_3)_4$	H_2O	Ref.
		mol/kg	mass %	
0	273.15	1.43	---	8
25.0	298.15	1.49	0.58	1
26.4	299.55	1.49	0.06	8
39.0	312.15	1.56	---	8
50.0	323.15	1.60	---	8
71.0	344.15	1.71	---	8
90.0	363.15	1.80	---	8
103.0	376.15	1.86	---	8
118.0	391.15	1.87	---	8
130.0	403.15	1.87	---	8

COMPONENTS:		EVALUATOR:	
(1) Thorium nitrate; $\text{Th}_2(\text{NO}_3)_4$; [13823-29-5]		S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA	
(2) Tributyl phosphate; $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]			

CRITICAL EVALUATION:		
Table 29. Coefficients for the solubility equation		
Coefficient	Value	σ
a	-311.948	0.004
b	8670.79	1.47
c	53.698	0.00073
d	- 0.08023	0.0000125

Table 30. Smoothed values of the solubility of thorium nitrate in TBP, calculated from the solubility equation			
	$\text{Th}(\text{NO}_3)_4$		$\text{Th}(\text{NO}_3)_4$
T/K	mol/kg	T/K	mol/kg
273	1.43	373	1.84
283	1.44	383	1.86
293	1.47	393	1.87
303	1.51	403	1.87
313	1.55	413	1.87
323	1.61	423	1.83
333	1.66		
343	1.71		
353	1.76		
363	1.80		

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Various organics (3) Water; H_2O ; [7732-18-5]	EVALUATOR: S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
CRITICAL EVALUATION: <p style="text-align: center;">REFERENCES</p> (1) Katzin, L. I.; Ferarro, J. R.; Wendlandt, W. W.; McBeth, R. L. <i>J. Am. Chem. Soc.</i> <u>1956</u> , 78, 5139. (2) Templeton, C. C.; Hall, N. F. <i>J. Phys. Colloid Chem.</i> <u>1950</u> , 54, 954. (3) Misciattelli, P. <i>Gazz. Chim. Ital.</i> <u>1930</u> , 60, 833. (4) Vdovenko, V. M.; Statsevich, V. P.; Suglovov, D. N. <i>Radiokhim.</i> <u>1972</u> , 14, 136. <i>Sov. Radiochem.</i> , <u>1972</u> , 14, 138. (5) Wells, R. C. J. <i>Washington Acad. Sci.</i> <u>1930</u> , 20, 146. (6) Yaffe, L. <i>Can. J. Res.</i> <u>1949</u> , 27B, 638. (7) Gresky, A. T.; Mansfield, R. G., in CF-60-7-108 Report, <u>1960</u> , p. 46. (8) Healy, T. V.; McKay, H. A. C. <i>Trans. Faraday Soc.</i> <u>1956</u> , 52, 633. (9) Renard, E. V.; Pyatibratov, Yu. P.; Neumoev, N. V.; Chizhov, A. A.; Kulikov, I. A.; Gol'dfarb, Yu. Ya.; Sirotkina, I. G.; Semenova, T. I. <i>Zh. Strukt. Khim.</i> <u>1988</u> , 30, 774. <i>Sov. Radiochem.</i> , <u>1988</u> , 734 (Eng.) (10) McKay, H. A. C. <i>Intl. Conf. Peaceful Uses of Atomic Energy</i> , <u>1956</u> , 7, 314 (Geneva). (11) Nikolaev, A. V.; Afanas'ev, Yu. A.; Ryabinin, A. I. <i>Dokl. Akad. Nauk SSSR</i> <u>1963</u> , 152, 806 (Eng.). (12) Schulz, W. W.; Voiland, E. E. Report HW-32417 <u>1954</u> . (13) Ukraintsev, E. V. <i>Radiokhim.</i> <u>1965</u> , 6, 641. <i>Sov. Radiochem.</i> , <u>1965</u> , 7, 641. (14) Wendlandt, W. W.; Bryant, J. M. <i>J. Phys. Colloid Chem.</i> <u>1956</u> , 60, 1145. (15) Verstegen, J. M. P. <i>J. Inorg. Nucl. Chem.</i> <u>1964</u> , 26, 1589. (16) Marcus, Y.; Kertes, A. S. <i>Ion Exchange and Solvent Extraction of Metal Complexes</i> , J. Wiley & Sons, London (<u>1969</u>). (17) Templeton, C. C.; Hall, N. F. <i>J. Phys. Colloid Chem.</i> <u>1947</u> , 51, 1441. (18) Templeton, C. C. Atomic Energy Commission Document, AECU-1721, <u>1950</u> . (19) Templeton, C. C.; Hall, N. F. <i>Can. J. Res.</i> <u>1950</u> , 28B, 156. (20) Nakashima, T.; Zimmer, E.; Merz, E. <i>Solvent Extr. Ion Exch.</i> <u>1984</u> , 2, 635. (21) Nikolaev, A. V.; Ryabinin, A. I.; Afans'ev, Yu. A. <i>Radiokhim.</i> , <u>1966</u> , 8, 421. <i>Sov. Radiochem.</i> , <u>1966</u> , 390 (Eng). (22) Nikolaev, A. V.; Ryabinin, A. I.; Afans'ev, Yu. A. <i>Radiokhim.</i> , <u>1970</u> , 326. <i>Sov. Radiochem.</i> , <u>1970</u> , 296 (Eng). (23) Warner, R. K. <i>Australian J. Appl. Sci.</i> , <u>1953</u> , 4, 427. (24) Ferraro, J. R.; Katzin, L. I.; Gibson, G. J. <i>Am. Chem. Soc.</i> , <u>1954</u> , 76, 909.	

COMPONENTS:		ORIGINAL MEASUREMENTS:		
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]		Healy, T. V.; McKay, H. A. C.		
(2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]		Trans. Faraday Soc. 1956, 52, 633-642.		
VARIABLES:		PREPARED BY:		
Temperature: 273 to 403 K		L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES:				
The $\text{Th}(\text{NO}_3)_4 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{H}_2\text{O}$ System				
Composition of Saturated Solutions				
$t/^\circ\text{C}$	$\text{Th}(\text{NO}_3)_4$	Mole Ratio ^a		Solvation
	mol/kg	TBP/nitrate	water/nitrate	number ^b
0.0	1.43	2.63	--	--
26.4	1.49	2.53	0.06	2
39.0	1.56	2.41	--	--
50.0	1.60	2.34	--	--
71.0	1.71	2.20	--	--
90.0	1.80	2.09	--	--
103.0	1.86	2.01	--	--
118.0	1.87	2.01	--	--
130.0	1.87	2.01	--	--
^a Hardwick, W. H.; Swift, E. H.; Todd, R., unpublished data.				
^b From TBP dilution data.				
AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:		
Solubility determinations were made by shaking the anhydrous solid nitrate with TBP for several days in a thermostat, and then analyzing the TBP phase.		1. Thorium nitrate was of A. R. grade.		
Analysis for water was carried out by Karl Fischer titration. The method for analysis of thorium was not described.		2. The TBP was purified as described in Reference (1).		
		ESTIMATED ERROR:		
		Temperature: $\pm 1\text{K}$.		
		REFERENCES:		
		1. Alcock, K.; Grimley, S. S.; Healy, T. V.; Kennedy, J.; McKay, H. A. C.;		
		Trans. Faraday Soc. 1956, 52, 39 - 47.		

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Schulz, W. W.; Voiland, E. E. Report, HW-32417, 1954.
VARIABLES: Composition at 299 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: The solubility of thorium nitrate in water-saturated TBP was reported as 250 g/dm^3 of thorium.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Single batch of pure TBP in contact with an aqueous solution containing thorium nitrate was made. After equilibration, the organic phase was analyzed.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCE: None.

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Tri-n-butyl phosphate; $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Water, H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Wendlandt, W. W.; Bryant, J. M. <i>J. Phys. Colloid Chem.</i> 1956, 60, 1145 - 1146.
VARIABLES: One temperature: About 299K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ in tri-n-butyl phosphate, $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$, is reported to be 42.4 and 42.6 g of the anhydrous thorium nitrate per 100 g of solution. The compilers compute these values to be 1.53 and 1.55 mol/kg of the mixture consisting of the tri-n-butyl phosphate and water.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: <p>Twenty-five grams of the hydrated salt were added to 20 mL of the tri-n-butyl phosphate, and then equilibrated by shaking for 48 to 72 hours at room temperature. At the end of this time, three phases were present: a solid hydrated phase, an aqueous phase containing a saturated solution of metal nitrate salt, and an organic phase containing the dissolved metal salt. The organic phase was separated, centrifuged, and analyzed for the metal salt content.</p> <p>The metal ion concentration after reextraction in the phosphate/benzene and water system, was determined by a standard procedure (1,2).</p>	SOURCE AND PURITY OF MATERIALS: <p>$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ was of reagent grade quality.</p> <p>Tri-n-butyl phosphate was a commercial product, and was not purified.</p> ESTIMATED ERROR: <p>Solubility: nothing specified, but probably 0.15 mass % (compilers).</p> <p>Temperature: $\pm 1\text{K}$</p> REFERENCES: <ol style="list-style-type: none"> 1. Scott, W. W. <i>Standard Methods of Chemical Analysis</i>, Vol. 1, Van Nostrand, Inc., N.Y. 1946. 2. Lundell, G.E.F.; Bright, H.A.; Hoffman, J. I. <i>"Applied Inorganic Chemistry"</i>, J. Wiley & Sons, N.Y. 1953.

COMPONENTS:				ORIGINAL MEASUREMENTS:				
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]				Nikolaev, A. V.; Afanas'ev, Yu. A.; Ryabinin, A. I.				
(2) Nitric acid; HNO_3 ; [7697-37-2]				Dokl. Akad. Nauk SSSR, 1963, 152, 806 - 808 (Eng.).				
(3) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]								
(4) Water; H_2O ; [7732-18-5]								
VARIABLES:				PREPARED BY:				
Composition at 298 K				L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES:								
The $\text{Th}(\text{NO}_3)_4 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{HNO}_3 - \text{H}_2\text{O}$ System								
Composition of the Equilibrium Phases								
	Aqueous Phase			Organic Phase				
	$\text{Th}(\text{NO}_3)_4$	HNO_3	Density	$\text{Th}(\text{NO}_3)_4$	HNO_3	H_2O	TBP ^a	Density ^b
Ray	mol/dm ³		g/cm ³	mol/dm ³		mol/dm ³		g/cm ³
I	2.56	1.24	1.960	1.25	0.25	--	2.9	1.410
	2.12	1.24	1.821	1.19	1.24	--	3.1	1.396
	1.02	1.20	1.422	1.04	0.26	--	3.1	1.352
	0.35	0.74	1.150	0.76	0.26	--	3.1	1.248
	0.28	0.38	1.113	0.60	0.25	--	3.1	1.197
	0.27	0.27	1.106	0.51	0.19	--	3.2	1.163
II	2.44	3.11	1.978	1.26	0.64	--	3.0	1.447
	2.11	3.16	1.853	1.24	0.52	--	2.9	1.397
	0.57	3.16	1.317	1.02	0.44	--	2.9	1.346
	0.31	2.57	1.202	0.89	0.56	--	3.0	1.321
	0.21	1.82	1.136	0.72	0.61	--	3.1	1.239
	0.16	0.65	1.085	0.39	0.46	--	3.2	1.141
III	1.63	4.57	1.740	1.09	0.58	0.50	3.0	1.361
	1.15	4.57	1.581	1.08	0.70	0.60	3.0	1.373
	0.65	4.52	1.397	1.02	0.67	0.51	3.0	1.350
	0.30	4.46	1.258	0.90	0.76	0.49	3.1	1.317
	0.12	3.60	1.173	0.73	0.96	0.68	3.1	1.254
	0.07	2.11	1.113	0.44	1.51	1.32	3.2	1.162
(continued on the next page)								
AUXILIARY INFORMATION								
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:				
The extractions were carried out in graduated tubes. Thorium determined by titration with Trilon B, using xylenol orange indicator. Nitric acid measured by potentiometric titration with KOH in the presence of ammonium oxalate. Solid phase identified as $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ by Schreinemakers method of residues (1).				Th(NO ₃) ₄ , HNO ₃ : nothing specified.				
				TBP: twice distilled under vacuum prior to use.				
				ESTIMATED ERROR:				
				Solubility: nothing specified. Temperature: Precision ±0.05K.				
				REFERENCES:				
				1. Schreinemakers, F. A. H. Z. physik. Chem., 1893, 11, 81.				

COMPONENTS:				ORIGINAL MEASUREMENTS:		
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]				Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A.		
(2) Nitric acid; HNO_3 ; [7697-37-2]				Radiokhim., 1966, 8, 421-426.		
(3) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]				Sov. Radiochem., 1966, 390-394.		
(4) Water; H_2O ; [7732-18-5]						
VARIABLES:				PREPARED BY:		
Composition at 298 K				S. L. Phillips		
EXPERIMENTAL VALUES:						
The $\text{Th}(\text{NO}_3)_4 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{HNO}_3 - \text{H}_2\text{O}$ System						
Composition of the Equilibrium Phases						
	Aqueous Phase			Distribution Coefficient		Organic Phase
	$\text{Th}(\text{NO}_3)_4$	HNO_3	Density	Th	H	Density
Radian	mol/dm ³		g/cm ³			g/cm ³
I	2.56	1.24	1.960	0.49	0.21	1.410
	2.12	1.24	1.821	0.56	0.20	1.396
	1.02	1.20	1.422	1.02	0.22	1.352
	0.35	0.74	1.150	2.17	0.35	1.248
	0.28	0.38	1.113	2.14	0.64	1.197
	0.27	0.27	1.106	1.91	0.67	1.163
II	2.44	3.11	1.978	0.51	0.20	1.447
	2.11	3.16	1.853	0.59	0.16	1.397
	0.57	3.16	1.317	1.78	0.14	1.346
	0.31	2.57	1.202	2.82	0.22	1.321
	0.21	1.82	1.136	3.49	0.33	1.239
III	1.63	4.57	1.740	0.66	0.13	1.361
	1.15	4.57	1.581	0.94	0.15	1.357
	0.65	4.52	1.397	1.57	0.15	1.350
	0.30	4.46	1.258	3.03	0.17	1.317
	0.12	3.60	1.173	6.07	0.27	1.254
	0.07	2.11	1.113	6.05	0.72	1.162
(continued on the next page)						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:		
Nothing specified.				$\text{Th}(\text{NO}_3)_4$, HNO_3 : nothing specified.		
				TBP: nothing specified.		
				ESTIMATED ERROR:		
				Solubility: nothing specified.		
				Temperature: nothing specified.		
				REFERENCES:		

COMPONENTS:				ORIGINAL MEASUREMENTS:		
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]				Nikolaev; A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A.		
(2) Nitric acid; HNO_3 ; [7697-37-2]				Radiokhim., 1966, 8, 421-426.		
(3) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]				Sov. Radiochem., 1966, 390-394.		
(4) Water; H_2O ; [7732-18-5]						

EXPERIMENTAL VALUES: (Continued)						
The $\text{Th}(\text{NO}_3)_4 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{HNO}_3 - \text{H}_2\text{O} - \text{System}$						
Composition of the Equilibrium Phases						
	Aqueous Phase			Distribution Coefficient		Organic Phase
	$\text{Th}(\text{NO}_3)_4$	HNO_3	Density	Th	H	Density
Radian	mol/dm ³		g/cm ³			g/cm ³
IV	1.77	6.60	1.806	0.61	0.24	1.389
	1.00	6.87	1.563	1.02	0.18	1.362
	0.43	6.87	1.362	2.21	0.17	1.330
	0.17	6.26	1.250	4.79	0.20	1.296
	0.05	4.24	1.150	10.7	0.31	1.218
V	1.48	9.07	1.763	0.68	0.25	1.374
	0.66	9.11	1.493	1.33	0.21	1.336
	0.36	9.17	1.393	2.30	0.21	1.307
	0.26	8.88	1.357	3.10	0.21	1.298
	0.048	7.56	1.248	12.6	0.26	1.234
VI	1.13	11.50	1.700	0.79	0.27	1.360
	0.59	11.86	1.541	1.32	0.25	1.313
	0.22	11.30	1.394	3.18	0.24	1.276
	0.14	11.10	1.365	4.80	0.25	1.266
	0.038	9.96	1.305	13.9	0.27	1.222
VII	0.85	14.4	1.662	1.0	0.32	1.363
	0.59	14.4	1.576	1.32	0.29	1.340
	0.23	14.4	1.458	2.84	0.27	1.288
	0.052	13.5	1.381	9.85	0.27	1.238
VIII	0.99	15.6	1.704	0.90	0.37	1.399
	0.82	15.5	1.644	1.05	0.34	1.380
	0.61	15.8	1.586	1.29	0.31	1.352
	0.12	15.1	1.432	4.89	0.29	1.268

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Tri-n-butyl phosphate; $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A. <i>Radiokhim.</i> <u>1970</u> , 12, 326 - 335. <i>Sov. Radiochem.</i> <u>1970</u> , 296 - 302.																																																										
VARIABLES: Composition at 298 K	PREPARED BY: S. L. Phillips																																																										
EXPERIMENTAL VALUES: The $\text{Th}(\text{NO}_3)_4 - (\text{C}_4\text{H}_9\text{O})_3\text{PO} - \text{HNO}_3 - \text{H}_2\text{O}$ system at 25°C <table><tr><th>HNO_3 mol/dm³</th><th>$\text{Th}(\text{NO}_3)_4$ in aqueous phase mol/dm³</th><th>Partition Coefficient</th></tr><tr><td rowspan="5">0.5</td><td>0.2</td><td>1.9</td></tr><tr><td>0.5</td><td>1.6</td></tr><tr><td>0.8</td><td>1.0</td></tr><tr><td>1.0</td><td>1.2</td></tr><tr><td>1.5</td><td>0.7</td></tr><tr><td rowspan="5">2.0</td><td>0.2</td><td>---</td></tr><tr><td>0.5</td><td>1.8</td></tr><tr><td>0.8</td><td>1.0</td></tr><tr><td>1.0</td><td>1.3</td></tr><tr><td>1.5</td><td>0.75</td></tr><tr><td rowspan="5">3.0</td><td>0.2</td><td>---</td></tr><tr><td>0.5</td><td>1.95</td></tr><tr><td>0.8</td><td>1.0</td></tr><tr><td>1.0</td><td>1.4</td></tr><tr><td>1.5</td><td>0.75</td></tr><tr><td rowspan="5">4.0</td><td>0.2</td><td>---</td></tr><tr><td>0.5</td><td>1.9</td></tr><tr><td>0.8</td><td>1.35</td></tr><tr><td>1.0</td><td>1.0</td></tr><tr><td>1.5</td><td>0.73</td></tr><tr><td rowspan="5">5.0</td><td>0.2</td><td>4.5</td></tr><tr><td>0.5</td><td>2.0</td></tr><tr><td>0.8</td><td>1.3</td></tr><tr><td>1.0</td><td>1.0</td></tr><tr><td>1.5</td><td>0.71</td></tr></table> <p>(continued on the next page)</p>		HNO_3 mol/dm ³	$\text{Th}(\text{NO}_3)_4$ in aqueous phase mol/dm ³	Partition Coefficient	0.5	0.2	1.9	0.5	1.6	0.8	1.0	1.0	1.2	1.5	0.7	2.0	0.2	---	0.5	1.8	0.8	1.0	1.0	1.3	1.5	0.75	3.0	0.2	---	0.5	1.95	0.8	1.0	1.0	1.4	1.5	0.75	4.0	0.2	---	0.5	1.9	0.8	1.35	1.0	1.0	1.5	0.73	5.0	0.2	4.5	0.5	2.0	0.8	1.3	1.0	1.0	1.5	0.71
HNO_3 mol/dm ³	$\text{Th}(\text{NO}_3)_4$ in aqueous phase mol/dm ³	Partition Coefficient																																																									
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AUXILIARY INFORMATION																																																											
METHOD/APPARATUS/PROCEDURE: No information given.	SOURCE AND PURITY OF MATERIALS: No information given.																																																										
	ESTIMATED ERROR: Nothing specified.																																																										
	REFERENCES: None.																																																										

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A.
(2) Tri-n-butyl phosphate; $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]	<i>Radiokhim.</i> 1970, 12, 326 - 335.
(3) Nitric acid; HNO_3 ; [7697-37-2]	<i>Sov. Radiochem.</i> , 1970, 296-302.
(4) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{Th}(\text{NO}_3)_4 - (\text{C}_4\text{H}_9\text{O})_3\text{PO} - \text{HNO}_3 - \text{H}_2\text{O}$ system at 25°C

HNO_3 mol/dm ³	$\text{Th}(\text{NO}_3)_4$ in aqueous phase mol/dm ³	Partition Coefficient
6.0	0.2	3.3
	0.5	1.9
	0.8	1.25
	1.0	1.0
	1.5	0.7
8.0	0.2	3.7
	0.5	1.7
	0.8	1.1
	1.0	1.0
	1.5	0.70
11.0	0.2	3.4
	0.5	1.55
	0.8	1.05
	1.0	0.85

The $\text{Th}(\text{NO}_3)_4 - (\text{C}_4\text{H}_9\text{O})_3\text{PO} - \text{H}_2\text{O}$ system at 25°C

HNO_3 mol/dm ³	$\text{Th}(\text{NO}_3)_4$ in aqueous phase mol/dm ³	Partition Coefficient
1.5	0.15	3.3
	0.2	2.9
	0.3	2.5
	0.5	1.75
	0.7	1.47
	0.8	1.22
	1.0	1.0
	1.2	0.88
	1.2	0.74

COMPONENTS:	ORIGINAL MEASUREMENTS:																																																																						
(1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5]	Renard, E. V.; Pyatibratov, Yu. P.; Neumoev, N. V.; Chizhov, A. A.; Kulikov, I. A.; Gol'dfarb, Yu. Ya.; Sirotkina, I. G.; Semenova, T.I.																																																																						
(2) Nitric acid; HNO ₃ ; [7697-37-2]	Zh. Strukt. Khim. 1988, 30, 774 - 787.																																																																						
(3) Tri-n-butyl phosphate (TBP); C ₁₂ H ₂₇ O ₄ P; [126-73-8]	Sov. Radiochem., 1988, 734-787.																																																																						
(4) Various isoparaffinic diluents																																																																							
VARIABLES: Temperature: 297 K	PREPARED BY: S. L. Phillips																																																																						
EXPERIMENTAL VALUES:																																																																							
Effect of kind of isoparaffinic diluent on extraction of Th(IV) and Pu(IV) from 3.0 mol/dm ³ HNO ₃ into a 30 vol. % solution of TBP, 24±1°C																																																																							
<table><tr><td></td><td colspan="7">Composition and Properties of Diluent^a</td><td colspan="2">Concentration, in homogeneous extract</td></tr><tr><td>Paraffin</td><td>nP</td><td>iP</td><td>Ar</td><td>bp</td><td>dens.</td><td>visc.</td><td>mp</td><td>Th</td><td>HNO₃</td></tr><tr><td></td><td>%</td><td>%</td><td>%</td><td>°C</td><td>g/cm³</td><td>cP</td><td>°C</td><td>g/dm³</td><td>mol/dm³</td></tr><tr><td>nC₆</td><td>100</td><td>---</td><td>---</td><td>68.7</td><td>0.655</td><td>0.292</td><td>-95.3</td><td>(55)</td><td>0.24</td></tr><tr><td>nC₇</td><td>100</td><td>---</td><td>----</td><td>98.4</td><td>0.680</td><td>0.390</td><td>-90.6</td><td>(49)</td><td>0.23</td></tr><tr><td>nC₈</td><td>100</td><td>---</td><td>----</td><td>125.7</td><td>0.698</td><td>0.514</td><td>-56.8</td><td>(52)</td><td>0.24</td></tr><tr><td>nC₁₀</td><td>100</td><td>--</td><td>----</td><td>174.1</td><td>0.726</td><td>0.854</td><td>-29.7</td><td>46</td><td>0.28</td></tr></table>			Composition and Properties of Diluent ^a							Concentration, in homogeneous extract		Paraffin	nP	iP	Ar	bp	dens.	visc.	mp	Th	HNO ₃		%	%	%	°C	g/cm ³	cP	°C	g/dm ³	mol/dm ³	nC ₆	100	---	---	68.7	0.655	0.292	-95.3	(55)	0.24	nC ₇	100	---	----	98.4	0.680	0.390	-90.6	(49)	0.23	nC ₈	100	---	----	125.7	0.698	0.514	-56.8	(52)	0.24	nC ₁₀	100	--	----	174.1	0.726	0.854	-29.7	46	0.28
	Composition and Properties of Diluent ^a							Concentration, in homogeneous extract																																																															
Paraffin	nP	iP	Ar	bp	dens.	visc.	mp	Th	HNO ₃																																																														
	%	%	%	°C	g/cm ³	cP	°C	g/dm ³	mol/dm ³																																																														
nC ₆	100	---	---	68.7	0.655	0.292	-95.3	(55)	0.24																																																														
nC ₇	100	---	----	98.4	0.680	0.390	-90.6	(49)	0.23																																																														
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(continued on the next page)																																																																							
AUXILIARY INFORMATION																																																																							
METHOD/APPARATUS/PROCEDURE: Studies were carried out at room temperature (22-25°C) with 3 mol/dm ³ HNO ₃ in equilibrium aqueous phase. A 1 mL aliquot of the extractant equilibrated to given concentration of acid, was placed in a separatory funnel. A 1 mL solution of HNO ₃ with about 100 g/L of Th was added. The mixture was shaken for 1 min and left standing for 20-30 min, or more. The appearance of the third phase in the thorium system was controlled visually. After the third phase appeared, the aqueous phase was separated, and the two organic phases transferred to centrifuge tubes. Traces of entrapped aqueous phase was always observed. Using a 30 vol. % solution of TBP in the same diluent which had been preequilibrated with 3 mol/dm ³ HNO ₃ , the third phase was eliminated by back titration. The end point was a single phase.	SOURCE AND PURITY OF MATERIALS: The isoparaffins were synthesized from paraffinic materials using a catalytic hydroisomerization pilot plant. The isoparaffins were separated, purified and dried. Their structure and properties were obtained by: gas-liquid chromatography; IR spectrometry, and PMR (1). The Th(NO ₃) ₄ , HNO ₃ , TBP were C. P.																																																																						
	ESTIMATED ERROR: Temperature: precision ±3 K.																																																																						
	REFERENCES: 1. Rybak, B. M. Analysis of Petroleum and Products, Goskhimizdat, Moscow (1962). In Russian.																																																																						

COMPONENTS:								ORIGINAL MEASUREMENTS:	
(1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5]								Renard, E. V.; Pyatibratov, Yu. P.; Neumoev, N. V.; Chizhov, A. A.; Kulikov, I. A.; Gol'dfarb, Yu. Ya.; Sirotkina, I. G.; Semenova, T. I.	
(2) Nitric acid; HNO ₃ ; [7697-37-2]								Zh. Strukt. Khim. 1988, 30, 774 - 787.	
(3) Tri-n-butyl phosphate (TBP); C ₁₂ H ₂₇ O ₄ P; [126-73-8]								Sov. Radiochem., 1988, 734-787.	
(4) Various isoparaffinic diluents									
EXPERIMENTAL VALUES: (Continued)									
Paraffin	Composition and Properties of the Diluent ^a							Concentration in homogeneous extract	
	nP %	iP %	Ar %	bp °C	dens. g/cm ³	visc. cp	mp °C	Th g/dm ³	HNO ₃ mol/dm ³
nC ₁₂	100	---	---	216.3	0.745	1.365	- 9.6	31	0.44
nC ₁₄	100	---	----	253.5	0.759	1.889	5.9	15	0.52
iC ₈	---	100	----	--	0.692	--	--	(53)	0.24
iC ₁₀ ,mix.	---	100	<1.3	175-180	0.736	1.25	--	(59)	0.30
iC ₁₁ ,mix.	---	100	<1.3	196-201	0.751	1.30	(-97)-53	40	0.38
iC ₁₂ ,mix.	---	100	<1.3	210-216	0.760	1.56	(-94)-35	35	0.39
iC ₁₃ ,mix.	---	100	<1.3	270.5	0.782	--	(-73)-29	25	0.56
iC ₁₄ ,mix.	---	100	<1.3	253.6	0.764	2.17	-16	28	0.50
iC ₁₅ ,mix.	---	100	<1.3	270.5	0.782	--	--	25	0.56
i-RED1	55	45	0.6	190-300	0.754	--	-21	31	0.45
ip,natur.	16	83	1.0	250-270	--	--	--	28	0.42
iRED2	30	69	1.0	190-300	--	--	--	32	0.38
nC ₁₁ +C ₁₂									
fr. RED1	100	--	--	203-214	--	--	--	32	0.38
nC ₁₄ +C ₁₅									
fr. RED1	100	--	--	260	--	--	--	36	0.36
iC ₁₁ +C ₁₂									
fr. iRED	---	100	--	180-213	--	--	--	40	0.37
iC ₁₃									
fr. iRED	---	100	--	210-230	--	--	--	35	0.41

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(Continued on the next page)

(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Renard, E. V.; Pyatibratov, Yu. P.; Neumoev, N. V.; Chizhov, A. A.; Kulikov, I. A.; Gol'dfarb, Yu. Ya.; Sirotkina, I. G.; Semenova, T. I.
(2) Nitric acid; HNO_3 ; [7697-37-2]	<i>Zh. Strukt. Khim.</i> <u>1988</u> , 30, 774 - 787
(3) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]	<i>Sov. Radiochem.</i> , <u>1988</u> , 734-787.
(4) Various isoparaffinic diluents	

EXPERIMENTAL VALUES: (Continued)

Paraffin	Composition and Properties of the Diluent ^a							Concentration in homogeneous extract	
	nP %	iP %	Ar %	bp °C	dens. g/cm ³	visc. cp	mp °C	Th g/cm ³	HNO_3 mol/dm ³
$\text{iC}_{13}+\text{C}_{14}$									
fr. iRED	---	100	--	230-240	--	--	--	36	0.44
$\text{iC}_{14}+\text{C}_{15}$	---	100	--	240-260	--	--	--	30	0.48
RED1	100	--	--	--	754	2.02	-4.0	22	0.49
$\text{iC}_{12}+\text{nC}_{12}$	50	50	--	--	--	--	--	35	--
$\text{iC}_{12}+\text{mC}_{12}$	25	75	--	--	--	--	--	32	--
$\text{iC}_{12}+\text{nC}_{12}$	75	25	--	--	--	--	--	30	--
$\text{iC}_{10}+\text{nC}_{10}$	50	50	--	--	--	--	--	43	--
$\text{iC}_{10}+\text{nC}_{14}$	50	50	--	--	--	--	--	37	--
$\text{iC}_{14}+\text{nC}_{14}$	50	50	--	--	--	--	--	25	--

^aNotation: nP, normal paraffin; iP, isoparaffin; Ar, aromatic; bp, boiling point; dens., density; visc., viscosity; mp, melting point; cp, centipoise; mix., mixture; natur., natural; fr., from.

COMMENTS AND/OR ADDITIONAL DATA:

Solid phases not identified.

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (4) Kerosine; [8008-20-6] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: McKay, H. A. C. <i>International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1956, 7, 314 - 317.</i>
VARIABLES: Various concentrations.	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The limits of solubility of $\text{Th}(\text{NO}_3)_4$ in the TBP/kerosine system are presented in the source document only in the form of a diagram.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
REFERENCES: None.	ESTIMATED ERROR: Nothing specified.

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (4) Dodecane; $\text{C}_{12}\text{H}_{26}$; [112-40-3] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Nakashima, T.; Zimmer, E.; Merz, E. <i>Solvent Extr. Ion Exch.</i> 1984, 2, 635 - 658.
VARIABLES: $T/K = 298$	PREPARED BY: S. L. Phillips
EXPERIMENTAL VALUES: <p>The solubility data are given in the form of a mathematical equation which describes the distribution ratio, K, for the reaction</p> $\text{Th}^{++++} + 4\text{NO}_3^- + 3\text{TBP} = \text{Th}(\text{NO}_3)_4 \cdot (\text{TBP})_3$ $K = [\text{Th}(\text{NO}_3)_4 \cdot (\text{TBP})_3] / [\text{Th}^{++++}] [\text{NO}_3^-]^4 [\text{TBP}]^3$ $\log K = C_1/I + C_2 + C_3I + C_4I \log T + C_5/I^{1/2}$ $C_1 = 0.0534 \pm 0.11$ $C_2 = 0.6882 \pm 0.76$ $C_3 = 1.108 \pm 0.31$ $C_4 = 0.2756 \pm 0.55$ <p>In the equation, I is the ionic strength in the aqueous phase.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: <p>The aqueous solution of 20 - 100 mL containing thorium and nitric acid was shaken with 30 vol.% TBP-dodecane diluent in a thermostatic cell at 25°C for 15 min. The volume ratio of aqueous to organic phases was 1.0. Samples of both phases were analyzed immediately after phase separation. Thorium was determined by titration with diethylenetriaminepentaacetic acid (DTPA) at pH2, using xylenol orange as the indicator. Nitric acid titrated with standard 0.01 mol/dm³ NaOH, in the presence of potassium oxalate.</p>	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Solubility: nothing specified. Temperature: Precision $\pm 0.1\text{K}$. REFERENCES: None.

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Di-2-phenylbutane phosphonate; (DSBPP); $\text{C}_{20}\text{H}_{27}\text{O}_3\text{P}$; (3) 2-Phenylbutane; $\text{C}_{10}\text{H}_{14}$; [135-98-8] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Gresky, A. T.; Mansfield, R. G. in, Report, CF-60-7-108, 46 (1960).
VARIABLES: One temperature: room (compilers)	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: The solubility of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ in 1.12 mol/dm^3 of the phosphonate DSBPP, $(\text{CH}_3\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2\text{O})_2\text{P}(\text{H})\text{O}$, in 2-phenylbutane, $\text{CH}_3\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_3$ is reported to be 358 mol/dm^3 . COMMENTS AND/OR ADDITIONAL DATA: A small amount of crystallization occurred after standing a few weeks; resolution was effected by warming. Assuming an organic volume increase of 10%, the solubility value corresponds to a complex with composition $\text{Th}(\text{NO}_3)_4 \cdot 2.8(\text{DSBPP})$.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Isothermal method used. The organic phase of 1.12 mol/dm^3 DSBPP in sec-butylbenzene was equilibrated with crystalline $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$ to effect thorium saturation of the organic reagent. After centrifugation, the thorium content in the organic phase was determined. No other details were given.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES: None.

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Diisoamyl methyl phosphonate (DAMP); $\text{C}_{11}\text{H}_{24}\text{O}_3\text{P}$ (3) p-Xylene; C_8H_{10} ; [106-42-3] (4) Water, H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Ukraintsev, E. V. <i>Radiokhim.</i> 1965, 7, 641 - 648. <i>Sov. Radiochem.</i> , 1967, 7, 641-647.																																										
VARIABLES: Composition and temperature	PREPARED BY: A. Sozanski; S. Siekierski																																										
EXPERIMENTAL VALUES: The solubility of $\text{Th}(\text{NO}_3)_4$ in the system comprised of the organics $\text{C}_{11}\text{H}_{24}\text{O}_3\text{P}$ and C_8H_{10} , as a function temperature and composition is given in the following table.																																											
<table><tr><th colspan="2">DAMP in xylene</th><th colspan="4">$\text{Th}(\text{NO}_3)_4$, mol/dm³</th></tr><tr><th colspan="2"></th><th colspan="4">T/K</th></tr><tr><th>Vol %</th><th>mol/dm³</th><th>295</th><th>325</th><th>346</th><th>363</th></tr><tr><td>5</td><td>0.20</td><td>0.081</td><td>0.0985</td><td>0.099</td><td>---</td></tr><tr><td>10</td><td>0.40</td><td>0.150</td><td>0.184</td><td>0.199</td><td>0.212</td></tr><tr><td>20</td><td>0.80</td><td>0.262</td><td>0.324</td><td>0.352</td><td>0.382</td></tr><tr><td>100</td><td>4.00</td><td>1.210</td><td>1.520</td><td>1.680</td><td>1.830</td></tr></table>		DAMP in xylene		$\text{Th}(\text{NO}_3)_4$, mol/dm ³						T/K				Vol %	mol/dm ³	295	325	346	363	5	0.20	0.081	0.0985	0.099	---	10	0.40	0.150	0.184	0.199	0.212	20	0.80	0.262	0.324	0.352	0.382	100	4.00	1.210	1.520	1.680	1.830
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100	4.00	1.210	1.520	1.680	1.830																																						
AUXILIARY INFORMATION																																											
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic solvent with DAMP was mixed with thorium nitrate tetrahydrate for 150 hours. When a mixture of DAMP and p-xylene was used, equilibrium attained after 3 hours. Thorium was determined in the organic phase by precipitation with oxalate.		SOURCE AND PURITY OF MATERIALS: 1. $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, was twice crystallized. 2. Diisoamyl methyl phosphonate was redistilled at 130°C at 7 torr, and then washed with 5% solution of Na_2CO_3 , and finally water.																																									
		ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision $\pm 1\text{K}$ at 20°C, $\pm 3\text{K}$ at 90°C.																																									
		REFERENCES: None.																																									

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Aluminum nitrate; $\text{Al}(\text{NO}_3)_3$; [13473-90-0] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Various organic phosphates (5) m-Xylene; C_8H_{10} ; [108-38-3] (6) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Mikhlin, E. B.; Berezkina, V. V.; Mikhailichenko, A. I. <i>Radiokhim.</i> 1984, 26, 440 - 445. Translated from: <i>Sov. Radiochem.</i> 1985, 421 - 426.																																							
VARIABLES: $T/K = 273$ to 353	PREPARED BY: S. L. Phillips																																							
EXPERIMENTAL VALUES: Maximum concentrations of thorium in the organic phase, 0.3 and 0.6 mol/dm ³ , respectively, achieved when the extractant is 1 and 2 mol/dm ³ in tri-n-butylphosphate (TBP). The stoichiometry of the thorium in the extracted phase is indicated to be $\text{Th}(\text{NO}_3)_4 \cdot 3\text{TBP}$. The data are given in the form of the following table: <table><tr><th rowspan="2">Extractant</th><th colspan="4">Distribution coefficients (D) of thorium Concentration of HNO_3, mol/dm³</th></tr><tr><th>0.5</th><th>1.0</th><th>2.0</th><th>5.0</th></tr><tr><td>Tributyl phosphate, 100%</td><td>4.5</td><td>12</td><td>18</td><td>27</td></tr><tr><td>Diisooctylmethylphosphonate, 100%</td><td>17.0</td><td>120</td><td>290</td><td>460</td></tr><tr><td>Diisooctylmethylphosphonate, 50% in TBP</td><td>35.0</td><td>150</td><td>230</td><td>270</td></tr><tr><td>Diisooctylmethylphosphonate, 20% in TBP</td><td>23.0</td><td>105</td><td>260</td><td>340</td></tr><tr><td>Petroleum sulfonates, 2M in m-xylene</td><td>10.5</td><td>38</td><td>140</td><td>305</td></tr><tr><td>Triisobutyl phosphate, 100%</td><td>3.6</td><td>5</td><td>5</td><td>7</td></tr></table> Comment: source document gives the distribution coefficient, β , instead of D, which appears to be a typographical error (compiler).		Extractant	Distribution coefficients (D) of thorium Concentration of HNO_3 , mol/dm ³				0.5	1.0	2.0	5.0	Tributyl phosphate, 100%	4.5	12	18	27	Diisooctylmethylphosphonate, 100%	17.0	120	290	460	Diisooctylmethylphosphonate, 50% in TBP	35.0	150	230	270	Diisooctylmethylphosphonate, 20% in TBP	23.0	105	260	340	Petroleum sulfonates, 2M in m-xylene	10.5	38	140	305	Triisobutyl phosphate, 100%	3.6	5	5	7
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METHOD/APPARATUS/PROCEDURE: The distribution of $\text{Th}(\text{NO}_3)_4$ was studied at 25°C by mixing components for 10 min; m-xylene used as diluent. 1.67 mol/dm ³ $\text{Al}(\text{NO}_3)_3$ served as a salting out agent. The effect of temperature from 20 - 80°C was studied using thermostatically controlled separatory funnels. The thorium content in the aqueous and the organic phases was measured by xylenol orange indicator, or by a photometric method with arsenazo III as the colorimetric agent (1,2).	SOURCE AND PURITY OF MATERIALS: Tri-n-butyl phosphate, diisooctylmethyl phosphate, petroleum sulfoxides with 10.1% sulfoxide sulfur and 360 average molecular weight, trialkylbenzylammonium nitrate, m-xylene, $\text{Th}(\text{NO}_3)_4$ and $\text{Al}(\text{NO}_3)_3$: source and purity were not specified. ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision $\pm 0.5 - 1\text{K}$. REFERENCES: 1. Zarubina, Yu.S.; Merisov, Yu. I.; Petrova, E.I. <i>Tsvet. Metall.</i> 1975, 3, 44-46. 2. Kondrat'eva, T.M.; Merisov, Yu.I.; Petrova, E. I. <i>Zavod. Lab.</i> 1975, 10, 1183-1185.																																							

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Water; H_2O ; [7732-18-5]					ORIGINAL MEASUREMENTS: Misciattelli; P. <i>Gazz. Chim. Ital.</i> 1930, 60, 833 - 838.																																																																																																																																									
VARIABLES: Composition: $T/\text{K} = 273.15$ and 293.15K					PREPARED BY: L. Fuks; S. Siekierski																																																																																																																																									
EXPERIMENTAL VALUES: The $\text{Th}(\text{NO}_3)_4 - \text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3 - \text{H}_2\text{O}$ System Composition of Saturated Solutions $T/\text{K} = 273\text{K}$ <table><tr><th rowspan="3">SP^b</th><th colspan="4">Water Phase^a</th><th colspan="4">Ether phase^a</th></tr><tr><th>Ether</th><th>H_2O</th><th colspan="2">$\text{Th}(\text{NO}_3)_4$</th><th>Ether</th><th>H_2O</th><th colspan="2">$\text{Th}(\text{NO}_3)_4$</th></tr><tr><th>mass %</th><th>mass%</th><th>mass %</th><th>mol/kg</th><th>mass %</th><th>mass %</th><th>mass %</th><th>mol/kg</th></tr><tr><td>A</td><td>--</td><td>35.00</td><td>65.00</td><td>3.869</td><td>--</td><td>--</td><td>--</td><td>--</td></tr><tr><td>B</td><td>4.50</td><td>28.50</td><td>67.00</td><td>4.229</td><td>41.36</td><td>13.99</td><td>44.65</td><td>1.680</td></tr><tr><td>B</td><td>5.21</td><td>28.89</td><td>65.90</td><td>4.026</td><td>41.27</td><td>12.78</td><td>45.95</td><td>1.771</td></tr><tr><td>B</td><td>--</td><td>--</td><td>--</td><td>--</td><td>54.50</td><td>10.50</td><td>35.00</td><td>1.122</td></tr><tr><td>C</td><td>--</td><td>--</td><td>--</td><td>--</td><td>94.20</td><td>--</td><td>5.80</td><td>0.128</td></tr></table> $T/\text{K} = 293\text{K}$ <table><tr><td>A</td><td>--</td><td>35.00</td><td>65.00</td><td>3.869</td><td>--</td><td>--</td><td>--</td><td>--</td></tr><tr><td>B</td><td>1.92</td><td>32.50</td><td>65.53</td><td>3.960</td><td>54.10</td><td>8.40</td><td>37.50</td><td>1.250</td></tr><tr><td>B</td><td>--</td><td>--</td><td>--</td><td>--</td><td>62.47</td><td>7.33</td><td>30.30</td><td>0.905</td></tr><tr><td>B</td><td>--</td><td>--</td><td>--</td><td>--</td><td>72.50</td><td>5.00</td><td>22.50</td><td>0.605</td></tr><tr><td>C</td><td>--</td><td>--</td><td>--</td><td>--</td><td>88.58</td><td>2.19</td><td>9.22</td><td>0.212</td></tr><tr><td>C</td><td>--</td><td>--</td><td>--</td><td>--</td><td>92.54</td><td>0.50</td><td>6.96</td><td>0.156</td></tr><tr><td>C</td><td>--</td><td>--</td><td>--</td><td>--</td><td>98.10^c</td><td>--</td><td>1.90</td><td>0.040</td></tr></table>										SP ^b	Water Phase ^a				Ether phase ^a				Ether	H_2O	$\text{Th}(\text{NO}_3)_4$		Ether	H_2O	$\text{Th}(\text{NO}_3)_4$		mass %	mass%	mass %	mol/kg	mass %	mass %	mass %	mol/kg	A	--	35.00	65.00	3.869	--	--	--	--	B	4.50	28.50	67.00	4.229	41.36	13.99	44.65	1.680	B	5.21	28.89	65.90	4.026	41.27	12.78	45.95	1.771	B	--	--	--	--	54.50	10.50	35.00	1.122	C	--	--	--	--	94.20	--	5.80	0.128	A	--	35.00	65.00	3.869	--	--	--	--	B	1.92	32.50	65.53	3.960	54.10	8.40	37.50	1.250	B	--	--	--	--	62.47	7.33	30.30	0.905	B	--	--	--	--	72.50	5.00	22.50	0.605	C	--	--	--	--	88.58	2.19	9.22	0.212	C	--	--	--	--	92.54	0.50	6.96	0.156	C	--	--	--	--	98.10 ^c	--	1.90	0.040
SP ^b	Water Phase ^a				Ether phase ^a																																																																																																																																									
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^a Mol/kg, of the mixture consisting of water and ether (compilers). ^b Solid phase: A = $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$; B = $\text{Th}(\text{NO}_3)_4 \cdot \text{H}_2\text{O}$; C = $\text{Th}(\text{NO}_3)_4$. ^c Value corrected from original apparently erroneous 88.01% (compilers).																																																																																																																																														
AUXILIARY INFORMATION																																																																																																																																														
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Thorium, diethyl ether and water were shaken for 20 days in a thermostatted funnel, then the phases were separated, filtered and analyzed. Special attention was directed to the ether phase, because of the volatility. Weighed samples of liquid phases were evaporated and calcined in platinum crucible to form ThO_2 . Ether was determined gasometrically, after converting to CO_2 , using CaCl_2 . Water content in the solid phase was taken as the difference of the mass of the sample and of thorium nitrate content evaluated as ThO_2 .					SOURCE AND PURITY OF MATERIALS: $\text{Th}(\text{NO}_3)_4$ was purified by precipitation, crystallization, and drying at 110°C for several days in order to obtain the anhydrous salt. The salt was analyzed for ThO_2 and N_2O_5 content. ESTIMATED ERROR: Nothing specified. REFERENCES: None.																																																																																																																																									

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Various alcohols (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F. <i>J. Phys. Colloid Chem.</i> 1947, 51, 1441 - 1449.
VARIABLES: One temperature: 298 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: The solubility of $\text{Th}(\text{NO}_3)_4$ in various alcohols is reported as grams of the anhydrous salt in 100 g of solution. The compilers have also converted this quantity to units of molality, mol/kg.	
<div>Alcohol</div> <div>Methyl alcohol; CH_4O; [67-56-1]</div> <div>Ethyl alcohol; $\text{C}_2\text{H}_6\text{O}$; [64-17-5]</div> <div>Ethyl alcohol; 95%; $\text{C}_2\text{H}_6\text{O}$; [64-17-5]</div> <div>Propyl alcohol; $\text{C}_3\text{H}_8\text{O}$; [71-23-8]</div> <div>Isopropyl alcohol; $\text{C}_3\text{H}_8\text{O}$; [67-63-0]</div> <div>Allyl alcohol; $\text{C}_3\text{H}_6\text{O}$; [107-18-6]</div> <div>Butyl alcohol; $\text{C}_4\text{H}_{10}\text{O}$; [71-36-3]</div> <div>Isobutyl alcohol; $\text{C}_4\text{H}_{10}\text{O}$; [78-92-2]</div>	<div><div>$\text{Th}(\text{NO}_3)_4$</div><div><div>mass %</div><div>mol/kg (compilers)</div></div><div>65.73.99</div><div>55.62.61</div><div>56.02.65</div><div>47.01.85</div><div>44.41.66</div><div>45.81.76</div><div>44.61.68</div><div>39.91.38</div></div>
(continued on the next page)	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The appropriate weight of hydrated salt and the solvent were mixed in a test tube. The contents were equilibrated by end-over-end agitation for a five day period. The contents were allowed to settle, and a portion pipetted for weighing. The solvent was removed by evaporation or burning. The residue was ignited, and thorium measured as ThO_2 .	SOURCE AND PURITY OF MATERIALS: 1. $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ was Baker's C.P. analyzed. 2. All organic solvents were of Eastman "practical" grade.
	ESTIMATED ERROR: Solubility: Gravimetric errors, $\pm 0.2\%$ for solvents with a boiling point (b.p.) over 100°C; $\pm 0.45\%$ for solvents with b.p. from 80°C to 100°C. Temperature: ± 0.05 K.
	REFERENCES: None.

COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Templeton, C. C.; Hall, N. F.	
(2) Various alcohols	<i>J. Phys. Colloid Chem.</i> 1947, 51, 1441 - 1449.	
(3) Water; H_2O ; [7732-18-5]		
EXPERIMENTAL VALUES: (Continued)		
Alcohol	$\text{Th}(\text{NO}_3)_4^a$	
	mass %	mol/kg (compilers)
3-Methyl-1-butanol; $\text{C}_5\text{H}_{12}\text{O}$; [123-51-3] ^b (isoamyl alcohol)	37.8	1.27
Hexyl alcohol; $\text{C}_6\text{H}_{14}\text{O}$; [111-27-3]	33.4	1.04
Cyclohexanol; $\text{C}_6\text{H}_{12}\text{O}$; [108-93-0]	35.9	1.17
1,6-Hexanediol; $\text{C}_6\text{H}_{14}\text{O}_2$; [629-11-8] ^c (hexamethylene glycol)	13.5	0.33
Benzyl alcohol; $\text{C}_7\text{H}_8\text{O}$; [100-51-6]	20.9	0.55
m-Cresol; $\text{C}_7\text{H}_8\text{O}$; [108-39-4]	0.10 ^d	0.18
Glycerol; $\text{C}_3\text{H}_8\text{O}_3$; [56-81-5] ^c	46.5	1.75
Ethylene chlorohydrin; $\text{C}_2\text{H}_5\text{ClO}$; [107-07-3]	44.4	1.66
Ethylene glycol; $\text{C}_2\text{H}_6\text{O}_2$; [107-21-1]	44.4	1.66
Diethylene glycol; $\text{C}_4\text{H}_{10}\text{O}_3$; [111-46-6]	47.3	---
^a Molalities calculated by the compilers.		
^b Agitated over 20 days at 25°C. Solubility became constant after 4 days.		
^c Very viscous solution.		
^d ThO_2 content, per 100 mL of solution.		
(Continued on the next page)		

COMPONENTS:

(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]

(2) Various esters

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Templeton, C. C.; Hall, N. F.

J. Phys. Colloid Chem. 1947, *51*, 1441 - 1449.

EXPERIMENTAL VALUES: (Continued)

The solubility of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ in various esters is reported in units of grams of the anhydrous salt in 100 g of solution. The compilers have converted this unit to mol/kg.

Ester	$\text{Th}(\text{NO}_3)_4$ ^{a,b}	
	mass %	mol/kg (compilers)
Ethyl formate; $\text{C}_3\text{H}_6\text{O}_2$; [109-94-4]	32.5	1.00
Methyl acetate; $\text{C}_3\text{H}_6\text{O}_2$; [79-20-9]	50.0	2.08
Diethyl carbonate; $\text{C}_4\text{H}_{10}\text{O}_3$; [105-58-8]	8.9	0.20
Ethyl propionate; $\text{C}_5\text{H}_{10}\text{O}_2$; [105-37-3]	67.1	4.25
Ethyl acrylate; $\text{C}_5\text{H}_8\text{O}_2$; [140-88-5]	12.6	0.30
Ethyl butyrate; $\text{C}_6\text{H}_{12}\text{O}_2$; [105-54-4]	56.9	2.75
Ethyl caproate; $\text{C}_8\text{H}_{16}\text{O}_2$; [123-66-0]	28.6	0.83
Methyl salicylate; $\text{C}_8\text{H}_8\text{O}_3$; [119-36-8]	2.4	0.05
Ethyl benzoate; $\text{C}_9\text{H}_{10}\text{O}_2$; [93-89-0]	6.3	0.14
Ethyl acetate; $\text{C}_4\text{H}_8\text{O}_2$; [141-78-6]	43.4	1.60
Ethyl phenylacetate; $\text{C}_{10}\text{H}_{12}\text{O}_2$; [101-97-3]	18.4	0.47

^aHighest observed value reported. True equilibrium was not obtained.

^bMolalities calculated by the compilers.

(Continued on the next page)

COMPONENTS:

(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]

(2) Various ethers

(3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Templeton, C. C.; Hall, N. F.

J. Phys. Colloid Chem. 1947, 51, 1441 - 1449.

EXPERIMENTAL VALUES: (Continued)

The solubility of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ in various ethers is reported in units of grams of the anhydrous salt in 100 g of solution. The compilers have converted this unit to molality, mol/kg.

Ether	$\text{Th}(\text{NO}_3)_4$	
	mass %	mol/kg (compilers)
Ethylene glycol monomethyl ether ^a (methyl cellosolve); $\text{C}_3\text{H}_8\text{O}_2$; [109-86-4]	59.2	3.02
Diethyl ether ^a ; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]	42.8	1.56
Ethylene glycol monoethyl ether ^a (ethyl cellosolve); $\text{C}_4\text{H}_{10}\text{O}_2$; [110-80-5]	54.6	2.50
Diethylene glycol ^a ; $\text{C}_4\text{H}_{10}\text{O}_3$ [111-46-6]	47.3	1.87
Dioxane ^a (1,4-dioxane); $\text{C}_4\text{H}_8\text{O}_2$; [123-91-1]	42.9	1.57
Dibutyl ether ^b ; $\text{C}_8\text{H}_{18}\text{O}$; [142-96-1]	2.69	0.0576
	0.53	0.0111
	0.33	0.0069
Isoamyl ether ^b ; $\text{C}_{10}\text{H}_{22}\text{O}$; [544-01-4]	1.12	0.0236
	0.14	0.0029
	0.14	0.0029

^aHighest observed value is reported. A true equilibrium is not obtained. The solution becomes unmanageably viscous.

^bValues determined 1, 2 and 4 days after cessation of agitation.

(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Templeton, C. C.; Hall, N. F.
(2) Various ketones	<i>J. Phys. Colloid Chem.</i> 1947, 51, 1441 - 1449.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The solubility of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ in various ketones is reported in units of grams of the anhydrous salt in 100 g of solution. The compilers have converted this to units of molality, mol/kg.

Ketone	$\text{Th}(\text{NO}_3)_4$	
	mass %	mol/kg (compilers)
Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1] (2-propanone) ⁶	59.3	3.04
4-Methyl-2-pentanone; $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1]	42.20	1.52
2-Butanone; $\text{C}_4\text{H}_8\text{O}$; [78-93-3]	55.7	2.62
Cyclohexanone; $\text{C}_6\text{H}_{10}\text{O}$; [108-94-1] ^a	28.5	0.83
Diisopropyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [565-80-0]	20.8	0.55
2-Heptanone; $\text{C}_7\text{H}_{14}\text{O}$; [110-43-0]	36.68	1.21
Methyl hexyl ketone; $\text{C}_8\text{H}_{16}\text{O}$; [111-13-7]	31.06	---
Propiophenone; $\text{C}_9\text{H}_{10}\text{O}$; [93-55-0]	18.9	0.49
Acetophenone; $\text{C}_8\text{H}_8\text{O}$; [96-86-2]	37.06	1.23

^aHigh observed value was reported. True equilibrium was not attained because the solution became unmanageably viscous, or the solution solidified.

(Continued on the next page)

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Various hydrocarbons, halogenated organics, other organics (3) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F. <i>J. Phys. Colloid Chem.</i> 1947, 51, 1441 - 1449.	
EXPERIMENTAL VALUES: (Continued) The solubility of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ in various hydrocarbons is given in units of grams of equivalent ThO_2 per 100 mL of solution. The compilers have converted this unit to equivalent grams of $\text{Th}(\text{NO}_3)_4$ per 100 mL of solution.			
Organic	Thorium in solution g/(100 mL)		
	ThO_2	$\text{Th}(\text{NO}_3)_4$	
Methylene chloride; CH_2Cl_2 ; [75-09-2]	0.00	0.00	
Carbon tetrachloride; CCl_4 ; [56-23-5]	0.05	0.09	
Ethylene dichloride; $\text{C}_2\text{H}_2\text{Cl}_2$; [540-59-0]	0.05	0.09	
Methyl chloroform; $\text{C}_2\text{H}_3\text{Cl}_3$; [71-55-6]	0.01	0.02	
Trichloroethylene; C_2HCl_3 ; [79-01-6]	0.02	0.04	
Ethyl bromide; $\text{C}_2\text{H}_5\text{Br}$; [74-96-4]	0.02	0.04	
Chlorobenzene; $\text{C}_6\text{H}_5\text{Cl}$; [108-90-7]	0.03	0.05	
p-Chlorotoluene; $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_3$; [106-43-4]	0.00	0.00	
Bromobenzene; $\text{C}_6\text{H}_5\text{Br}$; [108-86-1]	0.00	0.00	
Ethylene chlorohydrin; $\text{C}_2\text{H}_5\text{ClO}$; [107-07-3]	44.4	---	
Chloroform; CHCl_3 ; [67-66-3]	0.01	0.01	
Aniline; $\text{C}_6\text{H}_7\text{N}$; [62-53-3]	0.04	0.07	
o-Toluidine; $\text{C}_7\text{H}_9\text{N}$; [95-53-4]	0.09	0.20	
Dimethylaniline; $\text{C}_8\text{H}_{11}\text{N}$; [121-69-7]	0.07	0.10	
Nitrobenzene; $\text{C}_6\text{H}_5\text{NO}_2$; [98-95-3]	0.02	0.04	
Toluene; C_7H_8 ; [108-88-3]	0.02	0.04	
Piperidine; $\text{C}_5\text{H}_{11}\text{N}$; [110-89-4]	0.01	0.02	
Isoquinoline; $\text{C}_9\text{H}_7\text{N}$; [119-65-3] ^a	---	10.5 g/(100 g)	
Petroleum ether; [8032-32-4]	0.03	0.05	
Turpentine;	0.04	0.07	
2-Pentene; C_5H_{10} ; [109-68-2]	0.00	0.00	
Benzene; C_6H_6 ; [71-43-2]	0.00	0.00	
Tetrahydronaphthalene; $\text{C}_{10}\text{H}_{12}$; [119-64-2]	0.00	0.00	

^aMass % = 10.5. The highest observed value is reported. True equilibrium is not established because the solution solidifies.

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Various ethers (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Yaffe, L. <i>Can. J. Res.</i> <u>1949</u> , 27B, 638 - 645.														
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski														
EXPERIMENTAL VALUES: <p>Solubility is expressed as grams of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ per 100 cm^3 of the solvent ether.</p> <table> <thead> <tr> <th data-bbox="216 682 911 723">Ether</th><th data-bbox="938 641 1130 723">$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)</th></tr> </thead> <tbody> <tr> <td data-bbox="216 764 911 815">Ethylene glycol ethyl ether; $\text{C}_4\text{H}_{10}\text{O}_2$; [110-20-5] (ethyl cellosolve)</td><td data-bbox="1007 764 1061 784">6.8</td></tr> <tr> <td data-bbox="216 835 581 866">Dimethyldioxane; $\text{C}_6\text{H}_{12}\text{O}_2$;</td><td data-bbox="993 835 1061 856">30.0</td></tr> <tr> <td data-bbox="216 887 677 917">Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]</td><td data-bbox="993 887 1061 907">17.0</td></tr> <tr> <td data-bbox="216 958 691 989">Ethyl hexyl cellosolve; $\text{C}_{10}\text{H}_{22}\text{O}_2$;</td><td data-bbox="1007 958 1061 979">6.9</td></tr> <tr> <td data-bbox="216 1030 636 1060">Dibutyl cellosolve; $\text{C}_{10}\text{H}_{22}\text{O}_2$;</td><td data-bbox="1007 1030 1061 1050">6.4</td></tr> <tr> <td data-bbox="216 1101 746 1132">Dibutyl carbitol; $\text{C}_9\text{H}_{20}\text{O}_3$; [112-73-2]</td><td data-bbox="1007 1101 1061 1122">8.8</td></tr> </tbody> </table> <p style="text-align: right;">(continued on the next page)</p>		Ether	$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)	Ethylene glycol ethyl ether; $\text{C}_4\text{H}_{10}\text{O}_2$; [110-20-5] (ethyl cellosolve)	6.8	Dimethyldioxane; $\text{C}_6\text{H}_{12}\text{O}_2$;	30.0	Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]	17.0	Ethyl hexyl cellosolve; $\text{C}_{10}\text{H}_{22}\text{O}_2$;	6.9	Dibutyl cellosolve; $\text{C}_{10}\text{H}_{22}\text{O}_2$;	6.4	Dibutyl carbitol; $\text{C}_9\text{H}_{20}\text{O}_3$; [112-73-2]	8.8
Ether	$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)														
Ethylene glycol ethyl ether; $\text{C}_4\text{H}_{10}\text{O}_2$; [110-20-5] (ethyl cellosolve)	6.8														
Dimethyldioxane; $\text{C}_6\text{H}_{12}\text{O}_2$;	30.0														
Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]	17.0														
Ethyl hexyl cellosolve; $\text{C}_{10}\text{H}_{22}\text{O}_2$;	6.9														
Dibutyl cellosolve; $\text{C}_{10}\text{H}_{22}\text{O}_2$;	6.4														
Dibutyl carbitol; $\text{C}_9\text{H}_{20}\text{O}_3$; [112-73-2]	8.8														
AUXILIARY INFORMATION															
METHOD/APPARATUS/PROCEDURE: <p>The isothermal method was used. A 25 cm^3 portion of the solvent and a few grams of the $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ were placed in a sealed centrifuge tube and agitated in water bath which was thermostatically controlled at 20°C. Additional solid was added until saturation was obtained. The minimum time for saturation to occur was taken to be 24 hours. The solution was centrifuged before analysis to remove any solid that might have been present in the form of a suspension. To analyze for thorium, an aliquot of the solvent layer was pipetted into a receptacle, the solvent evaporated, and the residue ignited to ThO_2.</p>	SOURCE AND PURITY OF MATERIALS: <ol style="list-style-type: none"> 1. $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, Baker's C.P. analyzed. The maximum impurities were <0.1% of rare earths. 2. The organic solvent was of "practical" grade, or better. ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision $\pm 0.05\text{K}$. REFERENCES:														

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Yaffe, L. <i>Can. J. Res.</i> 1949, 27B, 638 - 645.
(2) Various ethers	
(3) Water; H_2O ; [7732-18-5]	
EXPERIMENTAL VALUES: (Continued)	
Ether	$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)
Pentyl ether; $\text{C}_{10}\text{H}_{22}\text{O}$; [693-65-2]	0.02
Hexyl ether; $\text{C}_{12}\text{H}_{26}\text{O}$; [112-58-3]	0.084
Dichloroisopropyl ether; $\text{C}_6\text{H}_{12}\text{Cl}_2\text{O}$;	0.40
Isoamyl ether; $\text{C}_{10}\text{H}_{22}\text{O}$; [544-01-4]	<0.1
Amylphenol ether; $\text{C}_{11}\text{H}_{16}\text{O}$;	"
p-tert-Amyl methyl ether; $\text{C}_2\text{H}_5\text{C}(\text{CH}_3)_2\text{OCH}_3$; [994-05-8]	"
β-Bromoethyl ethyl ether; $\text{BrCH}_2\text{CH}_2\text{OC}_2\text{H}_5$; [592-55-2]	"
Γ-Bromopropyl phenyl ether; $\text{C}_6\text{H}_5\text{O}(\text{CH}_2)_3\text{Br}$; [588-63-6]	"
Methyl phenyl ether; $\text{C}_6\text{H}_5\text{OCH}_3$; [100-66-3]	"
o-Chloroisopropyl ether; $[\text{ClCH}_2\text{CH}(\text{CH}_3)]_2\text{O}$; [108-60-1]	"
m-Cresyl methyl ether; $\text{CH}_3\text{C}_6\text{H}_4\text{OCH}_3$; [100-84-5]	"
o-Cresyl methyl ether;	"
p-Cresyl methyl ether;	"
B,B'-Dichloroisopropyl ether; $(\text{ClCH}_2\text{CH}_2)_2\text{O}$; [111-44-4]	"
B,B'-Dichloroethyl ether; $(\text{ClCH}_2\text{CH}_2\text{Cl})_2\text{O}$; [111-44-4]	"
Γ,Γ-dichloroisopropyl ether;	"
1-8 Epoxy p-menthane;	"
Eugenol methyl ether; $\text{H}_2\text{C}=\text{CHCH}_2\text{C}_6\text{H}_3(\text{OCH}_3)_2$; [93-15-2]	"
Resorcinol dimethyl ether; $\text{C}_6\text{H}_4(\text{OCH}_3)_2$; [151-10-0]	"
(Continued on the next page)	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Yaffe, L.
(2) Various alcohols	<i>Can. J. Res.</i> <u>1949</u> , 27B, 638 - 645.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)	
Alcohol	$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)
Triethylene glycol dichloride; $\text{C}_6\text{H}_{12}\text{Cl}_2\text{O}_2$; [112-26-5]	8.2
Dibutoxytetraethylene glycol; $\text{C}_{16}\text{H}_{34}\text{O}_5$; [112-98-1]	75.9
Isobutyl carbinol; $\text{C}_5\text{H}_{12}\text{O}$; [123-51-3]	30.0
Diethylcarbinol; $\text{C}_5\text{H}_{12}\text{O}$; [584-02-1]	9.1
Amyl alcohol; $\text{C}_5\text{H}_{12}\text{O}$; [71-41-0]	7.3
2-Ethyl-1-butyl alcohol; $\text{C}_6\text{H}_{14}\text{O}$; [97-95-0]	9.0
Capryl alcohol; $\text{C}_8\text{H}_{18}\text{O}$; [111-87-5]	8.1
β,γ -Dibromopropyl alcohol; $\text{C}_3\text{H}_6\text{Br}_2\text{O}$; [93-13-6]	4.8
Undecanol; $\text{C}_{11}\text{H}_{24}\text{O}$; [112-42-5]	5.5
Tetradecanol; $\text{C}_{14}\text{H}_{30}\text{O}$; [112-72-1]	0.37

(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Yaffe, L.
(2) Various ketones, esters, nitrate	Can. J. Res. <u>1949</u> , 27B, 638 - 645.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)	
Solubility is expressed as grams of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ per 100 cm^3 of the organic solvent.	
Ketone or Ester	$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)
Methyl isobutyl ketone; $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1]	26.0
Methyl amyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [110-43-0]	17.0
Diisopropyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [565-80-0]	6.6
85% Methyl ethyl ketone; $\text{C}_4\text{H}_8\text{O}$; [78-93-3] and 15% Xylene; C_8H_{10} ; [1330-20-7]	75.0
Ethyl acetylglycollate; $\text{C}_6\text{H}_{10}\text{O}_4$;	30.0
Butyl acetate; $\text{C}_6\text{H}_{12}\text{O}_2$; [123-86-4]	6.5
Isopropyl acetate; $\text{C}_5\text{H}_{10}\text{O}_2$; [108-21-4]	20.0
Amyl formate; $\text{C}_6\text{H}_{12}\text{O}_2$; [638-49-3]	30.0
Butyl propionate; $\text{C}_7\text{H}_{14}\text{O}_2$; [540-42-1]	27.5
Isoamyl acetate; $\text{C}_7\text{H}_{14}\text{O}_2$; [123-92-2]	18.0
Isobutyl acetate; $\text{C}_6\text{H}_{12}\text{O}_2$; [110-19-0]	16.0
Isoamyl oxalate;	<0.1
Benzyl butyrate; $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{C}_6\text{H}_5$; [103-37-7]	"
Butyl cellosolve oleate;	"
Ethyl laurate; $\text{CH}_3(\text{CH}_2)_{10}\text{COOCH}_2\text{CH}_3$; [106-33-2]	"
Ethyl myristate; $\text{CH}_3(\text{CH}_2)_{12}\text{COOC}_2\text{H}_5$; [124-06-1]	"
Linalyl acetate; $\text{CH}_3\text{COOC}(\text{CH}=\text{CH}_2)(\text{CH}_3)\text{CH}_2\text{CH}_2=\text{C}(\text{CH}_3)_2$; [115-95-7]	"
Phenylethyl benzoate; $\text{C}_6\text{H}_5\text{COOCH}_2\text{CH}_2\text{C}_6\text{H}_5$; [94-47-3]	"
Isopropyl benzoate; $\text{C}_6\text{H}_5\text{COOCH}(\text{CH}_3)_2$; [939-48-0]	"
Butyl nitrate; $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{ONO}_2$; [928-45-0]	"

(Continued on the next page)

COMPONENTS;	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Yaffe, L.
(2) Various esters and other organics	<i>Can. J. Res.</i> 1949, 27B, 638 - 645.
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)	
Ester or Organic	$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)
Amyl acetate; $\text{C}_7\text{H}_{14}\text{O}_2$; [628-63-7]	9.2
N-butyl sebacate; $\text{C}_{18}\text{H}_{34}\text{O}_4$; [109-43-3]	2.1
Vinyl acetate; $\text{C}_4\text{H}_6\text{O}_2$; [108-05-4]	2.5
Amyl butyrate; $\text{C}_9\text{H}_{18}\text{O}_2$; [540-18-1]	4.3
Isoamyl formate; $\text{C}_6\text{H}_{12}\text{O}_2$; [35073-27-9]	20.0
Amyl valerianate; $\text{C}_{10}\text{H}_{20}\text{O}_2$; [2173-56-0]	4.2
Butyl oxalate; $\text{C}_{10}\text{H}_{18}\text{O}_4$; [2050-60-4]	0.03
Isoamyl caproate; $\text{C}_{11}\text{H}_{22}\text{O}_2$; [2198-61-0]	2.4
Diphenyl mono(p-tert-butylphenyl) phosphate	<0.1
Di(p-tert-butyl phenyl) monophenyl phosphate	<0.1
Di(o-chlorophenyl) monophenyl phosphate	<0.1
Nitromethane; CH_3NO_2 ; [75-52-5]	0.04
Triglycol dichloride; $\text{C}_6\text{H}_{12}\text{Cl}_2\text{O}_2$; [112-26-5]	8.2
Tetrabutyl urea; $\text{C}_{17}\text{H}_{36}\text{N}_2$; [4559-86-8]	6.0
Butyl aldehyde; $\text{C}_4\text{H}_8\text{O}$; [123-72-8]	0.49

(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Various substituted hydrocarbons (3) Water; H_2O ; [7732-18-5]	Yaffe, L. <i>Can. J. Res.</i> <u>1949</u> , 27B, 638 - 645.
EXPERIMENTAL VALUES: (Continued)	
Substituted Hydrocarbon	$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)
Isoamyl bromide; $\text{C}_5\text{H}_{11}\text{Br}$; [107-82-4]	<0.1
m-Chloroethylbenzene; $\text{C}_8\text{H}_9\text{Cl}$; [622-24-2] (2-Chloroethyl)benzene	"
x-Dichloro-x-diethylbenzene	"
Benzyl chloride; $\text{C}_7\text{H}_7\text{Cl}$; [100-44-7]	"
Carbon tetrachloride; CCl_4 ; [56-23-5]	"
1-Chloro-1-nitropropane	"
2-Chloro-2-nitropropane; $\text{C}_3\text{H}_8\text{ClNO}_2$; [594-71-8]	"
1-Chloro-1-nitroethane	"
Chloroform; CHCl_3 ; [67-66-3]	"
o-Dichlorobenzene; $\text{C}_6\text{H}_4\text{Cl}_2$; [95-50-1]	"
1,1-Dichloro-1-nitropropane;	"
Ethylene dibromide; $\text{C}_2\text{H}_4\text{Br}_2$; [106-93-4]	"
Ethylene Iodide; $\text{ICH}_2\text{CH}_2\text{I}$; [624-73-7]	"
Tetrabromomethane; CBr_4 ; [558-13-4]	"
1,1,2,2-Tetrachloroethane; $\text{Cl}_2\text{CHCHCl}_2$; [79-34-5]	"
Trichloroethylene; $\text{ClCH}=\text{CCl}_2$; [79-01-6]	"
Diethylamine; $\text{C}_4\text{H}_{11}\text{N}$; [109-89-7]	"
Diethyleneamine; $\text{C}_4\text{H}_{10}\text{N}_2$; [110-85-0]	"
Hydroxyethylethylenediamine; $\text{H}_2\text{NCH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{OH}$; [111-41-1]	"
Triptentylamine; $(\text{C}_5\text{H}_{11})_3\text{N}$; [621-77-2]	"
Triethanolamine; $\text{C}_6\text{H}_{15}\text{O}_3\text{N}$; [102-71-6]	"
Piperidine; $\text{C}_5\text{H}_{11}\text{N}$; [110-89-4]	"
(Continued on the next page)	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Yaffe, L.
(2) Various hydrocarbons and substituted hydrocarbons;	<i>Can. J. Res.</i> <u>1949</u> , 27B, 638 - 645.
(3) Water; H_2O ; [7732-18-5]	
EXPERIMENTAL VALUES: (Continued)	
Hydrocarbon and unsubstituted hydrocarbon	$\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ g/(100 cm^3)
Quinoline; $\text{C}_9\text{H}_7\text{N}$; [91-22-5]	<0.1
β-Hydroxy-o-toluidine; $\text{H}_2\text{NC}_6\text{H}_3(\text{CH}_3)\text{OH}$; [2835-99-6]	"
2-Bromopyridine; $\text{C}_5\text{H}_4\text{BrN}$; [109-04-6]	"
Diamylphenol;	"
2-Chloro-4,6-di-tert-amylphenol;	"
x-Triisopropyltoluene;	"
1-Pentene; C_5H_{10} ; [109-67-1]	"
Benzene; C_6H_6 ; [71-43-2]	"
p-Isopropyltoluene; $\text{C}_{10}\text{H}_{14}$; [99-87-6]	"
Linalool; $\text{C}_{10}\text{H}_{17}\text{O}$; [78-70-6]	"
Isopentane; C_5H_{12} ; [78-78-4]	"
Petroleum ether; [8032-32-4]	"
Toluene; C_7H_8 ; [108-88-3]	"
Turpentine;	"
Xylene; C_8H_{10} ; [1330-20-7]	"

COMPONENTS: (1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5] (2) Mixtures of rare earth nitrates (3) Various alcohols (4) Water; H ₂ O; [7732-18-5]	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F. <i>J. Phys. Colloid Chem.</i> <u>1950</u> , <i>54</i> , 954 - 957.																	
VARIABLES: One temperature: Room temperature One composition of thorium and rare earth nitrates	PREPARED BY: L. Fuks; S. Siekierski																	
EXPERIMENTAL VALUES: The solubility of Th(NO ₃) ₄ in various alcohols is reported as the mass of Th(NO ₃) ₄ ·4H ₂ O/100 g solution. The organic phase is in equilibrium with the solid phase which consists of a mixture of thorium and rare earth nitrates. The mixed rare earth nitrates had the following relative composition (percentage as metal in an oxalate sample). La, 7.0; Pr, 5.7; Nd, 12.5; Sm, 3.0; Eu, 0.05; Gd, 1.5; Tb, 0.2; Dy, 1.0; Ho, 0.3; Er, 0.5; Tm, 0.1; Yb, 0.5; Y, 10.0; Ce, 0.0. <table><tr><td rowspan="2">Alcohol</td><td colspan="2">Th(NO₃)₄</td></tr><tr><td>mass %</td><td>mol/kg (compilers)</td></tr><tr><td>Methyl alcohol; CH₄O; [67-56-1]</td><td>36.0</td><td>1.17</td></tr><tr><td>Propyl alcohol; C₃H₈O; [71-23-8]</td><td>39.6</td><td>1.37</td></tr><tr><td>Isoamyl alcohol; C₅H₁₁O; [123-51-3]</td><td>36.1</td><td>1.18</td></tr><tr><td>Hexyl alcohol; C₆H₁₄O; [111-27-3]</td><td>32.7</td><td>1.01</td></tr></table> (Continued on the next page)		Alcohol	Th(NO ₃) ₄		mass %	mol/kg (compilers)	Methyl alcohol; CH ₄ O; [67-56-1]	36.0	1.17	Propyl alcohol; C ₃ H ₈ O; [71-23-8]	39.6	1.37	Isoamyl alcohol; C ₅ H ₁₁ O; [123-51-3]	36.1	1.18	Hexyl alcohol; C ₆ H ₁₄ O; [111-27-3]	32.7	1.01
Alcohol	Th(NO ₃) ₄																	
	mass %	mol/kg (compilers)																
Methyl alcohol; CH ₄ O; [67-56-1]	36.0	1.17																
Propyl alcohol; C ₃ H ₈ O; [71-23-8]	39.6	1.37																
Isoamyl alcohol; C ₅ H ₁₁ O; [123-51-3]	36.1	1.18																
Hexyl alcohol; C ₆ H ₁₄ O; [111-27-3]	32.7	1.01																
AUXILIARY INFORMATION																		
METHOD/APPARATUS/PROCEDURE: A suitable volume of solvent was mixed with an appropriate amount of thorium nitrate tetrahydrate and the rare earth nitrates in a test tube. The sample was then rotated at 30 rpm at room temperature for 5 days. Saturation was ensured by the presence of distinct white lumps in the final solid phase. The solution was then filtered and the metals content determined by weighing about 1 mL of solution into a tared platinum crucible, followed by burning off the solvent and igniting the oxides. Thorium was separated from the rare earths, and determined by the iodate method.	SOURCE AND PURITY OF MATERIALS: 1. Th(NO ₃) ₄ ·4H ₂ O was chemically pure, J. T. Baker Chemical Co. 2. All solvents were "practical" grade. ESTIMATED ERROR: Nothing specified. REFERENCES: None.																	

COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Templeton, C. C.; Hall, N. F. <i>J. Phys. Colloid Chem.</i> 1950, 54, 954 - 957.	
(2) Mixtures of rare earth nitrates		
(3) Various ketones and ester		
(4) Water; H_2O ; [7732-18-5]		
EXPERIMENTAL VALUES: (Continued)		
The solubility of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ in various ketones is reported in units of mass of the anhydrous salt in 100 g of solution. The organic phase is in equilibrium with the solid phase which consists of a mixture of thorium and the rare earth nitrates. The mixed rare earth nitrates had the following composition (percentage as metal in an oxalate sample).		
La, 7.0; Pr, 5.7; Nd, 12.5; Sm, 3.0; Eu, 0.05; Gd, 1.5; Tb, 0.2; Dy, 1.0; Ho, 0.3; Er, 0.5; Tm, 0.1; Yb, 0.5; Y, 10.0; Ce, 0.0.		
	$\text{Th}(\text{NO}_3)_4$	
Ketones/Ester	mass %	mol/kg (compilers)
Acetone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1]	45.7	1.75
Methyl ethyl ketone; $\text{C}_4\text{H}_8\text{O}$; [78-93-3] (2-butanone)	46.0	1.77
Methyl isobutyl ketone; $\text{C}_6\text{H}_{16}\text{O}$; [108-10-1]	38.5	1.30
Methyl amyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [110-43-0]	35.1	1.13
Methyl hexyl ketone; $\text{C}_8\text{H}_{18}\text{O}$; [111-13-7]	30.2	--
Ethyl butyrate; $\text{C}_3\text{H}_7\text{COOC}_2\text{H}_5$; [105-54-4]	30.5	--

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) 1-Hexanol; $\text{C}_6\text{H}_{14}\text{O}$; [111-27-3] (3) 2-Octanone; $\text{C}_8\text{H}_{16}\text{O}$; [111-13-7] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Templeton, C. C. Atomic Energy Commission Document, AECU-1721, 1950.																	
VARIABLES: One temperature: 298 K	PREPARED BY: A. Sozanski; S. Siekierski																	
EXPERIMENTAL VALUES: The solubility of $\text{Th}(\text{NO}_3)_4$ is reported as the mass of the anhydrous $\text{Th}(\text{NO}_3)_4$ in 100 g of solution at 25°C. The solubility in units of molality, mol/kg, is defined as moles of anhydrous $\text{Th}(\text{NO}_3)_4$ per kg of a mixture consisting of the organic constituent, plus water.																		
<table><tr><th rowspan="2">Organic solvent</th><th rowspan="2">Solvent purity</th><th rowspan="2">Number of hydrated waters</th><th colspan="2">$\text{Th}(\text{NO}_3)_4$</th></tr><tr><th>mass %</th><th>mol/kg</th></tr><tr><td>1-Hexanol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$</td><td>---</td><td>4.3 5.0</td><td>33.5 32.8</td><td>1.05 1.02</td></tr><tr><td>2-Octanone, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COCH}_3$</td><td>2^a 3^b 3^b</td><td>4.3 4.3 5.0</td><td>31.3 30.7 32.3</td><td>0.949 0.923 0.994</td></tr></table>	Organic solvent	Solvent purity	Number of hydrated waters	$\text{Th}(\text{NO}_3)_4$		mass %	mol/kg	1-Hexanol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	---	4.3 5.0	33.5 32.8	1.05 1.02	2-Octanone, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COCH}_3$	2 ^a 3 ^b 3 ^b	4.3 4.3 5.0	31.3 30.7 32.3	0.949 0.923 0.994	
Organic solvent				Solvent purity	Number of hydrated waters	$\text{Th}(\text{NO}_3)_4$												
	mass %	mol/kg																
1-Hexanol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	---	4.3 5.0	33.5 32.8	1.05 1.02														
2-Octanone, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COCH}_3$	2 ^a 3 ^b 3 ^b	4.3 4.3 5.0	31.3 30.7 32.3	0.949 0.923 0.994														
^a Practical grade. ^b Practical grade subjected two NaHSO_3 precipitations, and one middle fraction distillation.																		
AUXILIARY INFORMATION																		
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. All of the solutions were agitated by rotating end-over-end at 30 rpm for a period of at least 5 days. No additional information was given.	SOURCE AND PURITY OF MATERIALS: 1. $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, General Chemical Co., Baker and Adamson. The number of water molecules in the hydrate of two preparations was 4.3 and 5.0. 2. 1-Hexanol, Eastman Kodak Co., was twice distilled, the middle fraction was retained. Solvent distilled from magnesium; final water content was 0.0024%. ESTIMATED ERROR: Solubility: nothing specified. The result is the average of two or determinations. Temperature: precision $\pm 0.05\text{K}$. REFERENCES: None.																	

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Various oxygenated organics (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F. <i>Can. J. Res.</i> <u>1950</u> , 28B, 156 - 160.																							
VARIABLES: $T/K = 298$	PREPARED BY: L. Fuks; S. Siekierski																							
EXPERIMENTAL VALUES: Solubility of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ is reported as the mass of the anhydrous $\text{Th}(\text{NO}_3)_4$ in 100 g of solution at 25°C . The solubility in units of molality, mol/kg, is defined as moles of anhydrous $\text{Th}(\text{NO}_3)_4$ per kg of a mixture consisting of the organic constituent plus water. <table><tr><th rowspan="2">Organic</th><th colspan="2">$\text{Th}(\text{NO}_3)_4$</th></tr><tr><th>mass %</th><th>mol/kg</th></tr><tr><td>Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]</td><td>42.8</td><td>---</td></tr><tr><td>Isoamyl alcohol; $\text{C}_6\text{H}_{14}\text{O}$; [123-51-3]</td><td>37.8</td><td>1.27</td></tr><tr><td>Methyl hexyl ketone; $\text{C}_8\text{H}_{16}\text{O}$; [111-13-7]</td><td>31.06</td><td>0.94</td></tr><tr><td>Methyl amyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [110-43-0]</td><td>36.7</td><td>---</td></tr><tr><td>Methyl isobutyl ketone; $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1]</td><td>42.2</td><td>---</td></tr><tr><td>Diisopropyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [565-80-0]</td><td>20.8</td><td>---</td></tr></table>		Organic	$\text{Th}(\text{NO}_3)_4$		mass %	mol/kg	Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]	42.8	---	Isoamyl alcohol; $\text{C}_6\text{H}_{14}\text{O}$; [123-51-3]	37.8	1.27	Methyl hexyl ketone; $\text{C}_8\text{H}_{16}\text{O}$; [111-13-7]	31.06	0.94	Methyl amyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [110-43-0]	36.7	---	Methyl isobutyl ketone; $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1]	42.2	---	Diisopropyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [565-80-0]	20.8	---
Organic	$\text{Th}(\text{NO}_3)_4$																							
	mass %	mol/kg																						
Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]	42.8	---																						
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Diisopropyl ketone; $\text{C}_7\text{H}_{14}\text{O}$; [565-80-0]	20.8	---																						
AUXILIARY INFORMATION																								
METHOD/APPARATUS/PROCEDURE: A suitable volume of the solvent was mixed in a test tube with an appropriate amount of the thorium. The sample was then rotated at 30 rpm for a period of 5 days. Saturation was ensured by the presence of some distinct white lumps in the final solid phase. The solution was then filtered, and the solubility determined by weighing the solution in a covered platinum crucible which was ignited directly to ThO_2 . The variation in solubility versus the time were examined by the agitation beginning immediately after mixing and lasting for about 20 days.	SOURCE AND PURITY OF MATERIALS: 1. Thorium nitrate tetrahydrate was probably a chemically pure grade (compilers). 2. Practical grade solvents were used. ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision $\pm 0.05\text{K}$. REFERENCES:																							

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Nitromethane; CH_3NO_2 ; [75-52-5] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Warner, R. K. <i>Australian J. Appl. Sci.</i> <u>1953</u> , 4, 427-443.
VARIABLES: $T/K = 293$	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The system consisting of nitromethane and water saturated with solid $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ was reported to contain 0.0133 g of the anhydrous salt per 1 g of the water-rich phase. The compilers compute this value as 0.0281 mol/kg in the nitromethane-rich phase, and 3.78 mol/kg in the water-rich phase.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: <p>The isothermal method was used. The solubility data of thorium nitrate tetrahydrate were obtained by equilibration of an undersaturated solution, and also by crystallization from a supersaturated solution, close agreement being recorded in each case. The thorium nitrate concentration was determined by evaporation of weighed aliquots followed by ignition to ThO_2.</p>	SOURCE AND PURITY OF MATERIALS: 1. $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$ of "pure" grade, free of sulfate and rare earths. Ignition of the material gave 47.67% of ThO_2 (theoretical is 47.83%). 2. The nitromethane was distilled twice before use.
	ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision $\pm 0.1\text{K}$
	REFERENCES: No references.

COMPONENTS: (1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5] (2) Isobutyl alcohol; C ₄ H ₁₀ O; [78-92-2] (3) Carbon tetrachloride; CCl ₄ ; [56-23-5] (4) Water; H ₂ O; [7732-18-5]	ORIGINAL MEASUREMENTS: Katzin, L. I.; Ferraro, J. R.; Wendlandt, W. W.; McBeth, R. L. <i>J. Am. Chem. Soc.</i> <u>1956</u> , <i>78</i> , 5139 - 5144.			
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski; P. Persoff			
EXPERIMENTAL VALUES: The Th(NO ₃) ₄ - CH ₃ CH ₂ CH(OH)CH ₃ - CCl ₄ - H ₂ O System Composition of organic layers in equilibrium with saturated Th(NO ₃) ₄				
CCl ₄ ^a	C ₄ H ₁₀ O ^b	Th(NO ₃) ₄ ^c		H ₂ O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	49.53	2.044	15.75
28.5	71.5	38.67	1.313	11.45
49.8	50.2	27.76	0.8005	7.53
57.0	43.0	23.83	0.6517	6.18
57.0	43.0	22.13	0.5920	5.95
66.7	33.3	17.02	0.4273	4.66
66.7	33.3	16.83	0.4215	4.42
80.0	20.0	8.03	0.182	2.03
91.0	9.0	1.61	0.034	0.42
^a Inert diluent. ^b Initial concentration of 2-butanol in CCl ₄ . ^c Mol/kg, of the mixture of 2-butanol, CCl ₄ and H ₂ O (compilers). (Continued on the next page)				
AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A portion of the organic mixture, the components 2 and 3, was shaken for 6 to 7 hours with excess Th(NO ₃) ₄ . The CCl ₄ served as an inert diluent. Where necessary, saturated aqueous thorium nitrate was added to ensure the presence of an excess aqueous phase. The mixtures were allowed to settle, and the organic layer was centrifuged. Samples were taken for analysis. Water was determined by Karl Fischer titration, and thorium analyzed by the modified fluoride indicator titration technique (1). Correction was made to the water content for the solubility of water in the absence of the salt.		SOURCE AND PURITY OF MATERIALS: 1. Thorium nitrate was a commercial reagent hydrated salt. Composition was checked by ignition to ThO ₂ , and by Karl Fischer H ₂ O titration. 2. Organic solvents, reagent grade. ESTIMATED ERROR: Solubility: nothing specified. Error in thorium determination of 0.5 to 1% (compilers). Temperature: precision ±2 K. REFERENCES: 1. Banerjee, G. <i>Z. anal. Chem.</i> <u>1955</u> , <i>146</i> , 417.		

COMPONENTS:

(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]

(2) Isobutyl alcohol; $\text{C}_4\text{H}_{10}\text{O}$; [78-92-2]

(3) 4-Methyl-2-pentanone (hexone); $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1]

(4) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7]

(5) Carbon tetrachloride; CCl_4 ; [56-23-5]

(6) Heptane; C_7H_{16} ; [142-82-5]

(7) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Katzin, L. I.; Ferarro, J. R.; Wendlandt, W. W.; McBeth, R. L.

J. Am. Chem. Soc. **1956**, *78*, 5139 - 5144.

EXPERIMENTAL VALUES: (Continued)

The $\text{Th}(\text{NO}_3)_4$ - $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ - $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$ - H_2O System

Composition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

C_7H_{16} ^a	$\text{C}_4\text{H}_{10}\text{O}$ ^b	$\text{Th}(\text{NO}_3)_4$ ^c		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	48.80	1.985	15.20
10.2	89.8	42.93	1.567	13.42
22.3	77.7	38.05	1.279	11.00
28.6	71.4	34.64	1.104	10.20
36.2	63.8	phase separation		

The $\text{Th}(\text{NO}_3)_4$ - $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{COCH}_3$ - CCl_4 - H_2O System

Composition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4 ^a	$\text{C}_6\text{H}_{12}\text{O}$ ^b	$\text{Th}(\text{NO}_3)_4$ ^c		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	46.90	1.840	12.15
0.0	100.0	45.98	1.773	11.90
16.5	83.5	38.22	0.9902	9.46
28.3	71.7	32.06	0.9830	7.88
39.7	60.3	24.18	0.6643	6.03
39.7	60.3	23.48	0.6392	5.66
56.8	43.2	8.81	0.201	2.24
66.5	33.5	2.32	0.0495	1.27
74.8	25.2	0.43	0.0090	0.53
79.9	20.1	0.00	0.00	0.36

The $\text{Th}(\text{NO}_3)_4$ - $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ - CCl_4 - H_2O System

Composition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4 ^a	$\text{C}_4\text{H}_{10}\text{O}$ ^b	$\text{Th}(\text{NO}_3)_4$ ^c		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	43.59	1.610	12.38
29.3	76.7	30.50	0.914	7.75
46.3	53.7	6.62	0.148	1.66
63.7	36.3	1.12	0.0235	0.38

^aInert diluent. ^bInitial concentration of organic in the inert diluent.

^bMol/kg of the mixture of the organics and H_2O (compilers).

(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Katzin, L. I.; Ferraro, J. R.; Wendlandt, W. W.; McBeth, R. L.
(2) Ethylene glycol diethyl ether; $\text{C}_6\text{H}_{14}\text{O}_2$; [629-14-1]	<i>J. Am. Chem. Soc.</i> 1956 , <i>78</i> , 5139 - 5144.
(3) Ethylene glycol dibutyl ether; $\text{C}_{10}\text{H}_{22}\text{O}_2$;	
(4) Diethylene glycol diethyl ether; $\text{C}_8\text{H}_{18}\text{O}_3$; [112-36-7]	
(5) Diethylene glycol dibutyl ether; $\text{C}_{12}\text{H}_{26}\text{O}_3$; [112-73-2]	
(6) Carbon tetrachloride; CCl_4 ; [56-23-5]	
(7) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{Th}(\text{NO}_3)_4$ - $\text{C}_2\text{H}_5\text{OCH}_2\text{CH}_2\text{OC}_2\text{H}_5$ - CCl_4 - H_2O SystemComposition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4^a	$\text{C}_6\text{H}_{14}\text{O}_2^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	57.73	2.845	16.30
17.6	82.4	50.15	2.096	13.50

The $\text{Th}(\text{NO}_3)_4$ - $\text{C}_4\text{H}_9\text{OCH}_2\text{CH}_2\text{OC}_4\text{H}_9$ - CCl_4 - H_2O systemComposition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4^a	$\text{C}_{10}\text{H}_{22}\text{O}_2^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	29.46	0.8700	5.75
15.9	84.1	18.33	0.4675	3.69
22.2	77.8	14.13	0.3428	2.81
38.8	61.2	5.17	0.114	1.22
57.3	42.7	1.45	0.0306	0.40

The $\text{Th}(\text{NO}_3)_4$ - $\text{C}_2\text{H}_5\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OC}_2\text{H}_5$ - CCl_4 - H_2O SystemComposition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4^a	$\text{C}_8\text{H}_{18}\text{O}_3^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	57.49	2.817	16.12
14.8	85.2	52.47	2.295	14.15

The $\text{Th}(\text{NO}_3)_4$ - $\text{C}_4\text{H}_9\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OC}_4\text{H}_9$ - CCl_4 - H_2O SystemComposition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4^a	$\text{C}_{12}\text{H}_{26}\text{O}_3^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	44.79	1.690	8.90
31.1	68.9	31.97	0.9789	6.42
56.1	43.9	16.70	0.4176	3.18
73.1	26.9	1.99	0.0423	0.47

^aInert diluent. ^bInitial concentration of the organic material in CCl_4 .^cMol/kg, of mixture of organic material in CCl_4 and H_2O (compilers)
(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Katzin, L. I.; Ferraro, J. R.; Wendlandt, W. W.; McBeth, R. L.
(2) Tri-n-butyl phosphate; $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]	J. Am. Chem. Soc. <u>1956</u> , 78, 5139 - 5144.
(3) Dibutyl butyl phosphonate (DBP); $\text{C}_8\text{H}_{18}\text{O}_3\text{P}$; [78-46-6]	
(4) Tributyl phosphite; $\text{C}_{12}\text{H}_{27}\text{O}_3\text{P}$; [102-85-2]	
(5) Carbon tetrachloride; CCl_4 ; [56-23-5]	
(6) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{Th}(\text{NO}_3)_4$ - $(\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO}$ - CCl_4 - H_2O SystemComposition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4^a	$\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.0	100.0	41.67	1.4880	0.58
15.4	84.6	37.96	1.2750	0.49
40.8	59.2	29.53	0.8729	0.45
61.6	38.4	21.64	0.5753	0.38
79.2	20.8	12.41	0.2951	0.15
93.4	6.60	3.96	0.0859	0.04

The $\text{Th}(\text{NO}_3)_4$ - DBP - CCl_4 - H_2O SystemComposition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4^a	$\text{C}_8\text{H}_{18}\text{O}_3\text{P}^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.00	100.00	45.07	1.7090	1.00
15.60	84.40	40.78	1.4340	0.79
61.80	58.20	32.05	0.9825	0.63
62.50	37.50	23.29	0.6324	0.38
79.50	20.50	14.25	0.3462	0.24
93.72	6.28	4.94	0.1080	0.13

The $\text{Th}(\text{NO}_3)_4$ - $(\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{P}$ - CCl_4 - H_2O SystemComposition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

CCl_4^a	$\text{C}_{12}\text{H}_{27}\text{O}_3\text{P}^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
0.00	100.00	49.61	2.0510	7.06
15.90	84.10	45.59	1.7450	6.02
16.40	83.60	44.47	1.6680	6.06
47.80	57.20	36.14	1.1790	4.76
63.50	36.50	26.38	0.7464	3.09
80.10	19.90	14.51	0.3536	1.60
80.20	19.80	15.63	0.3859	1.85
3.84	6.16	5.09	0.1120	0.46

^aInert diluent.^bInitial concentration of organic component in CCl_4 .^cMol/kg, of the mixture of organic component, CCl_4 and H_2O (compilers).

(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Katzin, L. I.; Ferraro, J. R.;
(2) Isobutyl alcohol; $\text{C}_4\text{H}_{10}\text{O}$; [78-92-2]	Wendlandt, W. W.; McBeth, R. L.
(3) Methylisobutyl ketone; $\text{C}_6\text{H}_{12}\text{O}$; [108-10-1]	<i>J. Am. Chem. Soc.</i> <u>1956</u> , 78, 5139 - 5144.
(4) Tri-n-butyl phosphate; $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]	
(5) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{Th}(\text{NO}_3)_4 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3 - \text{H}_2\text{O}$ System

Composition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

$\text{C}_4\text{H}_{10}\text{O}^a$	$\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
21.3	78.7	42.8	1.56	3.00
35.3	64.7	42.5	1.54	5.10
45.0	55.0	43.1	1.58	6.70
55.2	44.8	43.0	1.57	8.32
71.2	28.8	43.4	1.60	11.08

The $\text{Th}(\text{NO}_3)_4 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{COCH}_3 - \text{H}_2\text{O}$ System

Composition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$

$\text{C}_6\text{H}_{12}\text{O}^a$	$\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
mass %	mass %	mass %	mol/kg	mass %
15.0	85.0	41.0	1.45	1.29
21.6	78.4	41.3	1.47	1.87
35.5	64.5	40.3	1.41	3.06
45.3	54.7	40.9	1.44	4.16
55.2	44.8	40.8	1.44	5.27
71.3	28.7	42.4	1.53	7.51
80.4	19.6	43.3	1.59	8.85

^aNon-inert (reactive) diluent.

^bInitial concentration of 2-butanol and methylisobutyl ketone.

^cMolalities calculated by the compilers as mol/kg of the organics, and water.

(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Katzin, L. I.; Ferraro, J. R.; Wendlandt, W. W.; McBeth, R. L.
(2) Tri-n-butyl phosphate; $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]	<i>J. Am. Chem. Soc.</i> <u>1956</u> , 78, 5139 - 5144.
(3) Dibutyl butyl phosphonate (DBP); $\text{C}_8\text{H}_{18}\text{O}_3\text{P}$; [78-46-6]	
(4) Tetrachloromethane; CCl_4 ; [56-23-5]	
(5) Tributyl phosphite; $\text{C}_{12}\text{H}_{27}\text{O}_3\text{P}$; [102-85-2]	
(6) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)					
The $\text{Th}(\text{NO}_3)_4 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{PO} - \text{CCl}_4 - \text{H}_2\text{O}$ System					
Composition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$					
	CCl_4^a	$\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
$t/^\circ\text{C}$	mass %	mass %	mass %	mol/kg	mass %
2	46.8	53.2	26.81	0.7630	0.37
45	46.5	53.5	28.65	0.8364	0.53
The $\text{Th}(\text{NO}_3)_4 - \text{DBP} - \text{CCl}_4 - \text{H}_2\text{O}$ System					
Composition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$					
	CCl_4^a	$\text{C}_8\text{H}_{18}\text{O}_3\text{P}^b$	$\text{Th}(\text{NO}_3)_4^c$		H_2O
$t/^\circ\text{C}$	mass %	mass %	mass %	mol/kg	mass %
2	47.3	52.7	27.30	0.78	0.42
45	47.4	52.6	31.20	0.94	0.50
The $\text{Th}(\text{NO}_3)_4 - (\text{CH}_3(\text{CH}_2)_3\text{O})_3\text{P} - \text{CCl}_4 - \text{H}_2\text{O}$ System					
Composition of organic layers in equilibrium with saturated $\text{Th}(\text{NO}_3)_4$					
	CCl_4^a	$\text{C}_{12}\text{H}_{27}\text{O}_3\text{P}^b$	$\text{Th}(\text{NO}_3)_4$		H_2O
$t/^\circ\text{C}$	mass %	mass %	mass %	mol/kg	mass %
2	48.0	52.0	31.94	0.9776	3.38
45	48.6	51.4	33.87	1.0670	4.05

^aInert diluent. ^bInitial concentration of organic in CCl_4 .

^cMol/kg, of the mixture of the organics, CCl_4 and H_2O (compilers).

COMPONENTS: (1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5] (2) Tri-n-octylamine nitrate; C ₂₄ H ₅₂ N ₂ O ₃ ; [1116-76-3] (3) Chloroform; CHCl ₃ ; [67-66-3] (4) Water, H ₂ O; [7732-18-5]	ORIGINAL MEASUREMENTS: Verstegen, J. M. P. J. J. Inorg. Nucl. Chem. 1964, 26, 1589 - 1599.												
VARIABLES: Composition at 294K	PREPARED BY: A. Sozanski; S. Siekierski												
EXPERIMENTAL VALUES: The Th(NO ₃) ₄ - (C ₈ H ₁₇) ₃ N.HNO ₃ - CHCl ₃ - H ₂ O System at 294K Composition of saturated solutions <table><tr><td>Th(NO₃)₄^a mol/dm³</td><td>(C₈H₁₇)₃N.HNO₃ mol/dm³</td><td>H₂O mol/dm³</td></tr><tr><td>0.0370</td><td>0.100</td><td>0.046</td></tr><tr><td>0.0190</td><td>0.050</td><td>0.044</td></tr><tr><td>0.0094</td><td>0.025</td><td>0.043</td></tr></table> <p>^aThe values of the thorium nitrate in the pure diluent have been subtracted from those in the amine nitrate phase.</p> <p>(Continued on the next page)</p>		Th(NO ₃) ₄ ^a mol/dm ³	(C ₈ H ₁₇) ₃ N.HNO ₃ mol/dm ³	H ₂ O mol/dm ³	0.0370	0.100	0.046	0.0190	0.050	0.044	0.0094	0.025	0.043
Th(NO ₃) ₄ ^a mol/dm ³	(C ₈ H ₁₇) ₃ N.HNO ₃ mol/dm ³	H ₂ O mol/dm ³											
0.0370	0.100	0.046											
0.0190	0.050	0.044											
0.0094	0.025	0.043											
AUXILIARY INFORMATION													
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phases were prepared by shaking 0.10 mol/dm ³ amine solution with empirically determined amounts of aqueous HNO ₃ and centrifugating (1,2). Pure diluents were added to bring the amine nitrate concentration to the desired value. Finely ground hydrated thorium nitrate was shaken for at least 12 hours with the solvent, replaced by fresh solid, and shaken for an additional 6 hours. Final separation of solid and liquid phase was by centrifugation. The metal was extracted back from the saturated organic phase by means of 0.5 mol/dm ³ HNO ₃ . Thorium determined with thoron, and water by the Karl Fischer reagent.	SOURCE AND PURITY OF MATERIALS: 1. Thorium nitrate, hydrate, BDH, "AR" grade. 2. The (C ₈ H ₁₇) ₃ N was purified as described in Reference (3). ESTIMATED ERROR: Solubility: Nothing specified. The concentration of amine nitrate ±2% to the desired value. Temperature: precision ±2K. REFERENCES: 1. Verstegen, J.M.P.J. Trans. Faraday Soc. 1962, 58, 1878. 2. Verstegen, J.M.P.J. J. Inorg. Nucl. Chem. 1964, 26, 1085. 3. Verstegen, J.M.P.J.; Katelaar, J.A.A. Trans. Faraday Soc. 1961, 57, 1527.												

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Verstegen, J. M. P. J.
(2) Tri-n-octylamine nitrate; $\text{C}_{24}\text{H}_{52}\text{N}_2\text{O}_3$; [1116-76-3]	<i>J. Inorg. Nucl. Chem.</i> 1964 , <i>26</i> , 1589 - 1599.
(3) Dodecane; $\text{C}_{12}\text{H}_{26}$; [112-40-3]	
(4) 1-Octanol; $\text{C}_8\text{H}_{18}\text{O}$; [111-87-5]	
(5) Nitrobenzene; $\text{C}_6\text{H}_5\text{NO}_2$; [98-95-3]	
(6) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The $\text{Th}(\text{NO}_3)_4 - (\text{C}_8\text{H}_{17})_3\text{N.HNO}_3 - \text{CH}_3(\text{CH}_2)_{10}\text{CH}_3 - \text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{OH} - \text{H}_2\text{O}$ System, at 294K^a

Composition of saturated solutions

$\text{Th}(\text{NO}_3)_4$ ^{b,c} mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N.HNO}_3$ mol/dm ³	H_2O ^c mol/dm ³
0.0042	0.100	0.026
0.0045	0.050	0.028
0.0052	0.025	0.029

^aModified dodecane (6 vol% 1-octanol) as the diluent.

^bThe values of the thorium nitrate solubility in the pure diluent have been subtracted from those in the amine nitrate phase.

^cConcentration measured in the light part of the organic phase.

The $\text{Th}(\text{NO}_3)_4 - (\text{C}_8\text{H}_{17})_3\text{N.NO}_3 - \text{C}_6\text{H}_5\text{NO}_2 - \text{H}_2\text{O}$ System at 294K

Composition of saturated solutions

$\text{Th}(\text{NO}_3)_4$ ^a mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N.HNO}_3$ mol/dm ³	H_2O mol/dm ³
0.049	0.100	0.017
0.023	0.050	0.014
0.014	0.025	0.014

The solubility of hydrated $\text{Th}(\text{NO}_3)_4$ in the $\text{C}_6\text{H}_5\text{NO}_2 - \text{H}_2\text{O}$ system is reported to be 0.00020 mol/dm³, at 294K.

^aThe values of the thorium nitrate solubility in the pure diluent have been subtracted from those in the amine nitrate phase.

(Continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Verstegen, J. M. P. J.
(2) Tri-n-octylamine nitrate; $\text{C}_{24}\text{H}_{52}\text{N}_2\text{O}_3$; [1116-76-3]	<i>J. Inorg. Nucl. Chem.</i> 1964, 26, 1589 - 1599.
(3) Benzene; C_6H_6 ; [71-43-2]	
(4) Chloroform; CHCl_3 ; [67-66-3]	
(5) 1,2-Dichlorobenzene; $\text{C}_6\text{H}_4\text{Cl}_2$; [95-50-1]	
(6) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

1. The $\text{Th}(\text{NO}_3)_4 - (\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3 - \text{C}_6\text{H}_6 - \text{H}_2\text{O}$ System at 294 K

Composition of saturated solutions

$\text{Th}(\text{NO}_3)_4^a$ mol/dm ³	$(\text{C}_8\text{H}_{17})_3\text{N} \cdot \text{HNO}_3$ mol/dm ³	H_2O mol/dm ³
0.0060 ^b	0.100	0.021 ^b
0.0055 ^b	0.050	0.021 ^b
0.0057	0.025	0.024

^aThe values of the thorium nitrate solution in the pure diluent have been subtracted from those in the amine nitrate phase.

^bConcentration measured in the light part of the organic phase.

2. The solubility of hydrated $\text{Th}(\text{NO}_3)_4$ in the system $\text{CHCl}_3 - \text{H}_2\text{O}$ is reported to be 0.00000070 mol/dm³ at 294K.

3. The solubility of hydrated $\text{Th}(\text{NO}_3)_4$ in the systems $\text{C}_6\text{H}_4\text{Cl}_2 - \text{H}_2\text{O}$ and $\text{C}_6\text{H}_6 - \text{H}_2\text{O}$ at 294K was reported to be as follows:

The $\text{Th}(\text{NO}_3)_4 - \text{C}_6\text{H}_4\text{Cl}_2 - \text{H}_2\text{O}$ System
 1×10^{-5} mol/dm³

The $\text{Th}(\text{NO}_3)_4 - \text{C}_6\text{H}_6 - \text{H}_2\text{O}$ System
 7×10^{-5} mol/dm³

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Ethanol; $\text{C}_2\text{H}_6\text{O}$; [64-17-5] (3) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (4) 2-Propanone; $\text{C}_3\text{H}_6\text{O}$; [67-64-1]	ORIGINAL MEASUREMENTS: Marcus, Y.; Kertes, A. S. <i>Ion Exchange and Solvent Extraction of Metal Complexes</i> , J. Wiley & Sons, London, 1969.								
VARIABLES: Temperature: Room temperature	PREPARED BY: L. Fuks; S. Siekierski								
EXPERIMENTAL VALUES: <p>The solubility of $\text{Th}(\text{NO}_3)_4$ in the three organic components is given in the following table.</p> <table> <tr> <th>Component</th><th>$\text{Th}(\text{NO}_3)_4$, mol/kg</th></tr> <tr> <td>$\text{C}_2\text{H}_5\text{OH}$</td><td>2.65</td></tr> <tr> <td>$\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$</td><td>1.56</td></tr> <tr> <td>CH_3COCH_3</td><td>3.03</td></tr> </table>		Component	$\text{Th}(\text{NO}_3)_4$, mol/kg	$\text{C}_2\text{H}_5\text{OH}$	2.65	$\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$	1.56	CH_3COCH_3	3.03
Component	$\text{Th}(\text{NO}_3)_4$, mol/kg								
$\text{C}_2\text{H}_5\text{OH}$	2.65								
$\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$	1.56								
CH_3COCH_3	3.03								
AUXILIARY INFORMATION									
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.								
ESTIMATED ERROR: Nothing specified.	REFERENCES: None.								

COMPONENTS: (1) Thorium nitrate; Th(NO ₃) ₄ ; [13823-29-5] (2) Diethyl ether; C ₄ H ₁₀ O; [60-29-7] (3) Cyclohexane; C ₆ H ₁₂ ; [110-82-7] (4) Water; H ₂ O; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Statsevich, V. P.; Suglovov; D. N. Radiokhim. 1972, 14, 136 - 140. Sov. Radiochem., 1972, 14, 138.																																								
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski																																								
EXPERIMENTAL VALUES: Solubility of Th(NO ₃) ₄ ·5H ₂ O in the mixture CH ₃ CH ₂ OCH ₂ CH ₃ - CH ₂ (CH ₂) ₄ CH ₂ at 298K. The concentrations, g/dm ³ , of both ether and thorium nitrate were calculated by the compilers. <table><tr><th colspan="2">CH₃CH₂OCH₂CH₃</th><th colspan="2">Th(NO₃)₄</th></tr><tr><th>mol/dm³</th><th>g/dm³</th><th>mol/dm³</th><th>g/dm³</th></tr><tr><td>1.57</td><td>116</td><td>0.00065</td><td>0.31</td></tr><tr><td>2.04</td><td>151</td><td>0.00190</td><td>0.912</td></tr><tr><td>2.14</td><td>159</td><td>0.00174</td><td>0.835</td></tr><tr><td>2.57</td><td>190</td><td>0.00364</td><td>1.75</td></tr><tr><td>4.79</td><td>355</td><td>0.436</td><td>20.9</td></tr><tr><td>5.55</td><td>411</td><td>0.0760</td><td>36.5</td></tr><tr><td>6.45</td><td>478</td><td>0.158</td><td>75.8</td></tr><tr><td>7.25</td><td>537</td><td>0.246</td><td>118.0</td></tr></table>		CH ₃ CH ₂ OCH ₂ CH ₃		Th(NO ₃) ₄		mol/dm ³	g/dm ³	mol/dm ³	g/dm ³	1.57	116	0.00065	0.31	2.04	151	0.00190	0.912	2.14	159	0.00174	0.835	2.57	190	0.00364	1.75	4.79	355	0.436	20.9	5.55	411	0.0760	36.5	6.45	478	0.158	75.8	7.25	537	0.246	118.0
CH ₃ CH ₂ OCH ₂ CH ₃		Th(NO ₃) ₄																																							
mol/dm ³	g/dm ³	mol/dm ³	g/dm ³																																						
1.57	116	0.00065	0.31																																						
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6.45	478	0.158	75.8																																						
7.25	537	0.246	118.0																																						
(Continued on the next page)																																									
AUXILIARY INFORMATION																																									
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of the Th(NO ₃) ₄ ·5H ₂ O, ether, and cyclohexane were placed in a sealed ampoule, and shaken for 7 to 8 hours at 25°C. The mixture was allowed to settle. The thorium content was determined by gravimetric analysis. The Th(NO ₃) ₄ ·5H ₂ O in the inert diluent (cyclohexane) was considered to be virtually insoluble.	SOURCE AND PURITY OF MATERIALS: 1. Th(NO ₃) ₄ ·5H ₂ O nothing given. 2. The ether was purified as described in Reference (1), and was distilled once more prior to use. 3. Cyclohexane and other diluents were purified before use (1). ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision ±0.05K. REFERENCES: 1. Vaisberger, A; Proskauer, E.; Riddik, D.; Tups, E. Organicheskie Rastvoriteli. Moskva, 1958.																																								

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5]	Vdovenko; V. M.; Statsevich, V.P.; Suglov; D. N.
(2) Diethyl ether; $\text{C}_2\text{H}_5\text{O}$; [60-29-7]	<i>Radiokhim.</i> 1972, 14, 136 - 140.
(3) Chloroform; CHCl_3 ; [67-66-3]	<i>Sov. Radiochem.</i> , 1972, 14, 138.
(4) Carbon tetrachloride; CCl_4 ; [56-23-5]	
(5) 1-Chlorobutane; $\text{C}_4\text{H}_9\text{Cl}$; [109-69-3]	
(6) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The solubility of $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$ in the mixture $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3 - \text{CHCl}_3$ is given at 298K. The concentrations, g/dm^3 , of both ether and thorium nitrate were calculated by the compilers.

$\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$		$\text{Th}(\text{NO}_3)_4$	
mol/dm ³	g/dm ³	mol/dm ³	g/dm ³
2.40	178	0.00182	0.874
3.80	282	0.00892	4.28
4.57	339	0.0148	7.10
5.43	402	0.0316	15.2
6.60	489	0.0676	32.5
9.12	676	0.263	126.0

Solubility of $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$ in the mixture $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3 - \text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{Cl}$ at 298K is given in the following table. The concentrations, g/dm^3 , were calculated by the compilers.

$\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$		$\text{Th}(\text{NO}_3)_4$	
mol/dm ³	g/dm ³	mol/dm ³	g/dm ³
1.38	102	0.00085	0.41
1.70	126	0.00170	0.816
2.88	213	0.0100	4.80
5.31	394	0.0776	37.3
6.92	513	1.190	91.2

Solubility of $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$ in the mixture $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3 - \text{CCl}_4$ at 298K. The concentrations, g/dm^3 , of both ether and thorium nitrate were calculated by the compilers.

$\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$		$\text{Th}(\text{NO}_3)_4$	
mol/dm ³	g/dm ³	mol/dm ³	g/dm ³
1.91	142	0.00100	1.480
2.24	166	0.00204	0.797
3.02	224	0.00562	2.70
4.21	312	0.0155	7.44
6.84	507	0.0955	45.8
7.95	589	0.195	93.6

(Continued on the next page)

COMPONENTS: (1) Thorium nitrate; $\text{Th}(\text{NO}_3)_4$; [13823-29-5] (2) Diethyl ether; $\text{C}_4\text{H}_{10}\text{O}$; [60-29-7] (3) Benzene; C_6H_6 ; [71-43-2] (4) Chlorobenzene; $\text{C}_6\text{H}_5\text{Cl}$; [108-90-7] (5) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Statsevich, V. P.; Suglov, D. N. <i>Radiokhim.</i> <u>1972</u> , 14, 136 - 140. <i>Sov. Radiochem.</i> , <u>1972</u> , 14, 138.
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EXPERIMENTAL VALUES: (Continued)

Solubility of $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$ in the mixture $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ - C_6H_6 at 298K. The concentrations, g/dm^3 , of both ether and benzene were calculated by the compilers.

$\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$		$\text{Th}(\text{NO}_3)_4$	
mol/dm ³	g/dm ³	mol/dm ³	g/dm ³
1.98	147	0.00562	2.70
2.37	176	0.000871	4.18
2.88	213	0.0135	6.48
2.82	209	0.0186	8.93
4.85	359	0.0987	47.4
4.85	359	0.105	50.4
5.37	398	0.126	60.5
6.24	463	0.234	112.0
6.24	463	0.251	120.0
7.29	540	0.380	182.0

Solubility of $\text{Th}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$ in the mixture $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ - $\text{C}_6\text{H}_5\text{Cl}$ at 298K. The concentrations, g/dm^3 , of both ether and thorium nitrate were calculated by the compilers.

$\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$		$\text{Th}(\text{NO}_3)_4$	
mol/dm ³	g/dm ³	mol/dm ³	g/dm ³
1.70	126	0.00126	0.605
1.88	139	0.00178	0.855
3.55	263	0.0120	5.76
4.36	323	0.0364	17.5
5.82	431	0.0832	39.9
7.25	537	0.120	57.6
7.66	568	0.229	110

COMPONENTS: (1) Plutonium nitrates (2) Neptunium nitrates (3) Americium nitrates	EVALUATOR: S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
CRITICAL EVALUATION: <p style="text-align: center;">INTRODUCTION</p> <p>The published solubility data in this section cover the ternary systems (Pu, Np) nitrates - nitric acid - water (1-4), ternary systems with $\text{PuO}_2(\text{NO}_3)_2$ nitrate - metal nitrates - water (5); quaternary systems which consist of (Pu, Np) nitrates - metal nitrates - nitric acid - water (6); and (Pu, Np, Am) - organic systems (7-12). In general, the solid phase composition is either unknown, or is uranyl nitrate hexahydrate. In the evaluator's opinion, there are insufficient data for a critical evaluation resulting in recommended solubilities.</p> <p>There are studies which support the existence of the two Pu(VI) phases $\text{PuO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ and $\text{PuO}_2(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$ (13). Both crystalline hydrates lose water when left in a desiccator containing NaOH, to form the dihydrate $\text{PuO}_2(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$, or the anhydrous $\text{PuO}_2(\text{NO}_3)_2$ (13). However, the hydrates can decompose due to the radioactivity of plutonium.</p> <p style="text-align: center;">BINARY SYSTEMS</p> <p>There are no solubility data for binary systems composed of Pu, Np, Am nitrates and water. An estimate can be made of the solubility of $\text{PuO}_2(\text{NO}_3)_2$ in water by fitting data from Krevinskaia et al. in Table 31 to the equation $\log \text{Pu} = A + B [\text{HNO}_3]$, and extrapolating to zero nitric acid concentration. The extrapolated solubility is 336 g/kg Pu.</p> <p style="text-align: center;">TERNARY SYSTEMS</p> <p>The solubility of $\text{PuO}_2(\text{NO}_3)_2$ apparently decreases with increasing HNO_3 concentration (2). The solubility of NpO_2NO_3 increased from 2.5 g/L in 0.5 mol/dm³ HNO_3, to 8 g/L in 1 mol/dm³ HNO_3 and to 50 g/L in 5 mol/dm³ (4). In the $\text{Np}(\text{NO}_3)_4$-HNO_3-H_2O system, LaChapelle et al. (4) reported a solubility of 80 g/L in 4 mol/dm³ HNO_3, with an increase to 300 g/L 5M HNO_3. The only value for $\text{NpO}_2(\text{NO}_3)_2$ is 38 g/L in 0.2 mol/dm³ HNO_3 (4). Feldman reported a solubility of $\text{Pu}(\text{NO}_3)_4$ in 1.8 mol/dm³ HNO_3 at 25°C of 2.1-2.5 mol/dm³ (1). Vogler et al. (3) published solubility data for mixtures of $\text{Pu}(\text{NO}_3)_4$ and $\text{PuO}_2(\text{NO}_3)_2$. The initial solution contained hexavalent plutonium, but this was unstable and formed some of the tetravalent plutonium on standing. Their measurements therefore included both oxidation states.</p>	

COMPONENTS: (1) Plutonium nitrates (2) Neptunium nitrates (3) Americium nitrates	EVALUATOR: S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
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CRITICAL EVALUATION:

QUATERNARY SYSTEMS

Pu(NO₃)₄ solubility in metal-nitric acid-water systems was reported by Anderson for the following nitrates (6): K₂Pu(NO₃)₆, Rb₂Pu(NO₃)₆, Cs₂Pu(NO₃)₆, and Tl₂Pu(NO₃)₆. Presumably, these were the solid phases under equilibrium conditions. The results are given in units of Pu per g/L of the mother liquor at 301 K in Table 32 and Table 33. Analytical data for the precipitates are compared with calculated %Pu in Table 33.

ACTINIDES-ORGANICS SYSTEMS

Solubility data are given for the following plutonium systems:

Hydrous System	Solubility g/L, 25°C	Ref.
Pu(NO ₃) ₄		
+ ethanol	25	8
+ 1.5N nitric acid + butex	5.6	7
+ 0.1N nitric acid + butex	1.1	7 ^a
+ kerosine	0.7	8 ^b
+ TBP	---	8 ^b
+ TBP + kerosine	---	8 ^{a,b}
+ nitric acid + dibutyl phosphate	---	10 ^b
+ pyridine + nitric acid	2	6
+ quinoline + nitric acid	0.5	6
PuO ₂ (NO ₃) ₂		
+ nitric acid + butex	0.67, 0.54	7 ^c

^aAromatic-free. ^bSolubility is a function of the concentration of conditioning nitric acid. ^cAfter 2 days and 10 days of agitation, respectively, in 0.1M HNO₃.

COMPONENTS:

(1) Plutonium nitrates

(2) Neptunium nitrates

(3) Americium nitrates

EVALUATOR:

S. L. Phillips

Camatx/Basic Data

Orinda, CA 94563 USA

CRITICAL EVALUATION:

Table 31. Solubility of Pu in nitric acid solutions at 298 K
(2). Value at 0 mol/dm³ HNO₃ is extrapolated.

HNO₃, mol/dm³

0

2

4

6

Pu, g/kg solution

336.0

164.9

160.9

137.6

Table 32. Solubility of Pu(NO₃)₄ in monovalent metal nitrates at 301 K (6).

Metal Nitrate

CsNO₃

RbNO₃

KNO₃

TlNO₃

Free HNO₃
mol/dm³

6.5

12

12

12

Pu solubility
g/L

3.4

4.6

18 (274 K)

26

Table 33. Analytical data for precipitates formed in the system Pu(NO₃)₄-HNO₃-metal nitrates (6).

Precipitate Formula

Cs₂Pu(NO₃)₆

Rb₂Pu(NO₃)₆

Tl₂Pu(NO₃)₆

K₂Pu(NO₃)₆^a

Plutonium
Found, %

26.8

31.8

24.2

29.7

Calculated, %

27.26

30.6

23.4

34.7

^aContaminated with free KNO₃.

COMPONENTS: (1) Plutonium nitrates (2) Neptunium nitrates (3) Americium nitrates	EVALUATOR: S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA
CRITICAL EVALUATION: (Continued) <p style="text-align: center;">REFERENCES</p> <ol style="list-style-type: none"> 1. Feldman, B. C., Report HW-31000, <u>1955</u>. 2. Krevinskaia, M. Ye.; Nikol'skii, V. D.; Pozharskii, B. G.; Zastenker, Ye. Ye. <i>Radiokhim.</i>, <u>1959</u>, 1, 562-566. <i>Sov. Radiochem.</i>, <u>1960</u>, 1, 253. 3. Vogler, S.; Grosvenor, D. E.; Lewitz, N. M. Report ANL-7917, <u>1972</u>. 4. LaChapelle, T. J.; Magnusson, L. B.; Hindman, J. C., Paper 15.6 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (<u>1949</u>), 1097-1110. 5. Cunningham, B. B., "The Actinide Elements," (Seaborg, G. T.; Katz, J. J., eds.), Nat. Nucl. Energy Ser., Div. IV, Vol. 14A, McGraw-Hill Book Co., New York (<u>1954</u>), p. 414. 6. Anderson, H. H., Paper 6.220 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (<u>1949</u>). 7. Dawson, J. K., Report AERE C/M 92, <u>1950</u>. 8. Dawson, J. K.; Elliott, R. M., Report AERE C/M 113, <u>1951</u>. 9. Bogdanov, F. A.; Belyaeva, T. B.; Sokhina, L. P.; Solovkin, A. S. <i>Radiokhim.</i>, <u>1979</u>, 21, 920. <i>Sov. Radiochem.</i>, <u>1979</u>, 21, 786. 10. Sokhina, L. P.; Rovnyi, S. I.; Goncharuk, L. V.; Bogdanov, F. A. <i>Radiokhim.</i>, <u>1988</u>, 30, 418. <i>Sov. Radiochem.</i>, 1988, 30, 394. 11. Fedorov, Yu. S.; Zil'berman, B. Ya. <i>Radiokhim.</i>, <u>1988</u>, 30, 572. <i>Sov. Radiochem.</i>, <u>1989</u>, 546. 12. Renard, E. V.; Pyatibratov, Yu. P.; Neumoev, N. V.; Chizhov, A. A.; Kulikov, I. A.; Gol'dfarb, Yu. Ya.; Sirotkina, I. G.; Semenova, T. I. <i>Zh. Strukt. Khim.</i>, <u>1988</u>, 30, 774. <i>Sov. Radiochem.</i>, <u>1989</u>, 734. 13. "The Chemistry of the Actinides," 2nd ed., Vol. 1, Katz, J. J.; Seaborg, G. T.; Morss, L. R., eds., Chapman and Hall, New York (<u>1986</u>), p. 766. 	

COMPONENTS: (1) Plutonyl nitrate; $\text{PuO}_2(\text{NO}_3)_2$; [22853-0-5] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Feldman, B. C. Report HW-31000, <u>1955</u>
VARIABLES: One temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The approximate solubility of plutonyl nitrate in about 1.8 mol/dm ³ HNO_3 solution at 25° is reported to be 2.1 mol/L.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Plutonyl nitrate; $\text{PuO}_2(\text{NO}_3)_2$; [22853-0-5] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Krevinskaia, M.Ye.; Nikol'skii, V.D.; Pozharskii, B.G.; Zastenker, Ye.Ye. <i>Radiokhim.</i> , 1959, 1, 562-566. <i>Sov. Radiochem.</i> , 1960, 1, 253-257.																																																							
VARIABLES: Nitric acid concentration at 298 K		PREPARED BY: A. Sozanski; S. Siekierski																																																							
EXPERIMENTAL VALUES: $\text{PuO}_2(\text{NO}_3)_2 - \text{HNO}_3 - \text{H}_2\text{O}$ System at 25°C <div><div>HNO_3 mol/dm³</div><div><div>Pu, g/kg Solution</div><table><tr><td></td><td>Radiometric</td><td>Gravimetric</td></tr><tr><td>2</td><td>272.6</td><td>271.0</td></tr><tr><td>4</td><td>163.0</td><td>164.9</td></tr><tr><td>6</td><td>157.5</td><td>160.9</td></tr><tr><td>8</td><td>136.9</td><td>137.6</td></tr></table></div></div>					Radiometric	Gravimetric	2	272.6	271.0	4	163.0	164.9	6	157.5	160.9	8	136.9	137.6																																							
	Radiometric	Gravimetric																																																							
2	272.6	271.0																																																							
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6	157.5	160.9																																																							
8	136.9	137.6																																																							
Solubility of $\text{PuO}_2(\text{NO}_3)_2$ in 12.91 mol/dm ³ HNO_3 by Radiometric Method ^a Solubility, 1 kg Solution ^c <table><tr><td rowspan="2">Days Equilibrated</td><td colspan="2">g Pu</td><td colspan="2">moles $\text{PuO}_2(\text{NO}_3)_2$</td></tr><tr><td>mean</td><td>σ</td><td>mean</td><td>σ</td></tr><tr><td>1</td><td>118.2</td><td>2.2</td><td>0.484</td><td>0.009</td></tr><tr><td>3</td><td>109.1</td><td>2.0</td><td>0.447</td><td>0.008</td></tr><tr><td>4</td><td>104.0</td><td>2.3</td><td>0.462</td><td>0.010</td></tr><tr><td>6</td><td>98.5</td><td>1.0</td><td>0.404</td><td>0.004</td></tr><tr><td>10</td><td>89.5</td><td>1.4</td><td>0.367</td><td>0.006</td></tr><tr><td>14</td><td>66.0</td><td>1.5</td><td>0.270</td><td>0.006</td></tr><tr><td>16</td><td>65.2</td><td>0.6</td><td>0.267</td><td>0.002</td></tr><tr><td>18^b</td><td>66.1</td><td>0.9</td><td>0.271</td><td>0.004</td></tr><tr><td>21^b</td><td>65.4</td><td>1.1</td><td>0.268</td><td>0.005</td></tr></table>				Days Equilibrated	g Pu		moles $\text{PuO}_2(\text{NO}_3)_2$		mean	σ	mean	σ	1	118.2	2.2	0.484	0.009	3	109.1	2.0	0.447	0.008	4	104.0	2.3	0.462	0.010	6	98.5	1.0	0.404	0.004	10	89.5	1.4	0.367	0.006	14	66.0	1.5	0.270	0.006	16	65.2	0.6	0.267	0.002	18 ^b	66.1	0.9	0.271	0.004	21 ^b	65.4	1.1	0.268	0.005
Days Equilibrated	g Pu		moles $\text{PuO}_2(\text{NO}_3)_2$																																																						
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1	118.2	2.2	0.484	0.009																																																					
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4	104.0	2.3	0.462	0.010																																																					
6	98.5	1.0	0.404	0.004																																																					
10	89.5	1.4	0.367	0.006																																																					
14	66.0	1.5	0.270	0.006																																																					
16	65.2	0.6	0.267	0.002																																																					
18 ^b	66.1	0.9	0.271	0.004																																																					
21 ^b	65.4	1.1	0.268	0.005																																																					
^a The equilibrium solid phase is $\text{PuO}_2(\text{NO}_3)_2 \cdot \text{HNO}_3 \cdot n\text{H}_2\text{O}$. ^b Solubility after 21 days determined by the gravimetric method was 70 g/kg Pu in solution, or 0.287 mol/kg. ^c Calculated by the compilers.																																																									
AUXILIARY INFORMATION																																																									
METHOD/APPARATUS/PROCEDURE: Solubility dependence on the HNO_3 concentration was evaluated after 40 hours equilibrium of each sample. The plutonium solubility was determined by both radiochemical and gravimetric procedures. The valence state was checked spectrophotometrically. The plutonium content in the solid phase was determined gravimetrically. The nitrate by Devarda's method. Each solubility is the average of three separate experiments.		SOURCE AND PURITY OF MATERIALS: $\text{PuO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ obtained by the concentration of nitric acid solutions of PuO_2^{++} over P_2O_5 at room temperature. Analyzed 47.4% Pu (theor. 47.51%), NO_3^- , 24.4%. ESTIMATED ERROR: Temp: ± 0.2 K. REFERENCES:																																																							

COMPONENTS: (1) Plutonyl nitrate; $\text{PuO}_2(\text{NO}_3)_2$; [22853-0-5] (2) Ammonium nitrate; NH_4NO_3 ; [6484-52-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Cunningham, B. B. "The Actinide Elements," (Seaborg, G.T.; Katz, J.J., eds.) Nat. Nucl. Energy Ser., Div. IV, Vol. 14A, McGraw-Hill Book Co., New York (1954), p. 414.
VARIABLES: One temperature	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The concentration of plutonium in the aqueous phase in equilibrium with the solid phase as obtained by evaporation as described below was about 500 g/L.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: The solid phase was obtained by evaporation of an aqueous solution of Pu(IV) nitrate containing some ammonium nitrate. The solid phase may have been a double salt of Pu(IV) nitrate and ammonium nitrate.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Plutonyl nitrate; $\text{PuO}_2(\text{NO}_3)_2$; [22853-0-5] (2) Diethylene glycol dibutyl ether (Butex); $\text{C}_{12}\text{H}_{26}\text{O}_3$; [112-73-2] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Dawson, J. K. Report AERE C/M 92, 1950.
VARIABLES: One temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{PuO}_2(\text{NO}_3)_2^a$ in diethylene glycol diethyl ether (butex) conditioned to 0.10 mol/L HNO_3, was reported as 0.67 and 0.54 g of plutonium per liter of solution, after 2 and 10 days equilibration time, respectively.</p> <p>^aThe number of water molecules in both the initial and the final equilibrium solid hydrates were not specified (compilers).</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The plutonium (VI) nitrate samples were prepared by bromate oxidation of plutonium (IV) solution, and removal of excess bromate by the addition of barium nitrate. Butex, conditioned to the required acidity, was added. The glass stoppered container was placed in a metal container to exclude light, and this, in turn, was suspended in a thermostat. The tubes were shaken by hand from time to time during the course of the experiments, and were centrifuged immediately prior to pipetting out aliquots for counting. The counting was done in an argon proportional chamber with 35% geometry, or in an electroscope, Type 1096 (1).	SOURCE AND PURITY OF CHEMICALS: Nothing specified. ESTIMATED ERROR: Soly: Not better than $\pm 5\%$. (Authors) Temp: Nothing specified. REFERENCES: 1. Mandelberg, C. J. AERE C/R 582 Report.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Feldman, B. C. Report HW 31000, <u>1955</u> .
VARIABLES: One temperature: 298 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The solubility of plutonium(IV) nitrate in approximately 1.8 mol/dm^3 HNO_3 at 25°C was reported to be about 2.1-2.5 mol/L.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Potassium nitrate; KNO_3 ; [7757-79-1] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Anderson, H. H. Paper 6.220, in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949).
VARIABLES: $T/K = 274$ and 301	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of dipotassium plutonium(IV) hexanitrate, $\text{K}_2\text{Pu}(\text{NO}_3)_6$, at 1°C was reported to be about 18 g of plutonium per liter of the mother liquor with the composition given in the PROCEDURE.</p> <p>The solubility of this salt at 28°C was supposed to be at least 50 g of plutonium per liter of the solution with the composition given in the PROCEDURE.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A 17.5 mg weight of potassium nitrate and 8.4 mg of plutonium(IV) as the nitrate were mixed in 0.150 mL of $12 \text{ mol/dm}^3 \text{ HNO}_3$ and cooled to 1°C . Slow horizontal rotations of the solution in a centrifuge cone tended to give equilibrium in solubility. The crystals were filtered at 1°C on a sintered pyrex dish, dried at room temperature, and analyzed (1).	SOURCE AND PURITY OF MATERIALS: $\text{K}_2\text{Pu}(\text{NO}_3)_6$, 29.7% of plutonium, found, was probably contaminated with free KNO_3 ; probably 86% of $\text{K}_2\text{Pu}(\text{NO}_3)_6$ and 14% of KNO_3 . ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Anderson, H. H. Report ANL-4062.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Rubidium nitrate; RbNO_3 ; [13126-12-0] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Anderson, H. H. Paper 6.220 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949).
VARIABLES: $T/K = 301$	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of dirubidium plutonium(IV) hexanitrate, $\text{Rb}_2\text{Pu}(\text{NO}_3)_6$, at 28°C was reported to be 4.6 g/L of plutonium in the mother liquor with the composition described in the PROCEDURE.</p>	
AUXILIARY INFORMATION	
METHOD/Apparatus/PROCEDURE: The isothermal method was used. A 11.2 mg portion of rubidium nitrate and 8.4 mg of plutonium(IV) as the nitrate were mixed in 0.22 mL of 12 mol/dm ³ HNO_3 at 28°C . Slow horizontal rotations of the solution in a cone shaped centrifuge tube tended to give equilibrium solubility. The crystals were filtered by suction on a sintered pyrex dish, dried at 0.3 mm Hg pressure, heated under a heat lamp at 125°C for 20 minutes, and analyzed (1).	SOURCE AND PURITY OF MATERIALS: $\text{Rb}_2\text{Pu}(\text{NO}_3)_6$ was found to contain 31.8 mass % of plutonium (calc. 30.6 mass %). ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Anderson, H.H. Report ANL-4062.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Cesium nitrate; CsNO_3 ; [7789-18-6] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Anderson, H. H. Paper 6.220 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949).
VARIABLES: One temperature: 301 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of dicesium plutonium(IV) hexanitrate, $\text{Cs}_2\text{Pu}(\text{NO}_3)_6$, at 28°C was reported to be about 3.4 g of the plutonium per liter of the mother liquor with the composition given in the PROCEDURE.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: <p>The isothermal method was used. A 9.5 mg portion of cesium nitrate and 5.6 mg of plutonium(IV) as nitrate were mixed in 0.122 mL of 6.5 mol/dm³ nitric acid. Slow horizontal rotations of the solution in a centrifuge cone tended to given equilibrium in solubility. The crystals were filtered by suction on a sintered pyrex dish, and dried under vacuum at room temperature before chemical analysis (1).</p>	SOURCE AND PURITY OF MATERIALS: <p>$\text{Cs}_2\text{Pu}(\text{NO}_3)_6$ was found to contain 26.6 mass % of plutonium and 31.0 mass % cesium (calc. 27.27 mass % and 30.5 mass %, respectively).</p> ESTIMATED ERROR: <p>Nothing specified.</p> REFERENCES: <p>1. Anderson, H. H. Report ANL-4062.</p>

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Thallium nitrate; TlNO_3 ; [10102-45-1] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Anderson, H. H. Paper 6.220 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949).
VARIABLES: One temperature: 301 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of dithallium(I) plutonium(IV) nitrate, $\text{Tl}_2\text{Pu}(\text{NO}_3)_6$, at 28°C was reported to be about 26 g of plutonium per liter of the mother liquor with the composition given in the PROCEDURE.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A 12.5 mg portion of thallous nitrate and 4.2 mg of plutonium(IV) were mixed in 0.100 mL of 12 mol/dm ³ HNO_3 acid. Slow horizontal rotations of the solution in a centrifuge cone tended to given equilibrium in solubility. The crystals were filtered by suction on a sintered pyrex dish, washed with one drop of 95% ethyl alcohol, dried under vacuum at room temperature, heated for 15 minutes at 130°C, and then analyzed (1).	SOURCE AND PURITY OF MATERIALS: $\text{Tl}_2\text{Pu}(\text{NO}_3)_6$ was found to contain 24.2 mass % of plutonium (calc. 23.4 mass %). ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Anderson, H. H. Report ANL-4062.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Ethanol; $\text{C}_2\text{H}_5\text{OH}$; [64-17-5] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Dawson, J. K.; Elliott, R. M. AERE Report C/M 113, 1951.
VARIABLES: $T/K = 298$	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{Pu}(\text{NO}_3)_4$ in ethyl alcohol, $\text{CH}_3\text{CH}_2\text{OH}$, at 25°C is reported to be 25 g/L.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: <p>The isothermal method was used. The solubility was measured in a small stoppered tube which was immersed in a thermostat at 25°C and slowly rotated so that the solution was continuously stirred by centrifugal action. Equilibrium between crystals and supernatant was attained fairly quickly, but the observations were extended over several days. The amount of solvent used was about 200 micro liters, and aliquots pipetted for the radiation counting were usually 4 microliters. The aliquots were transferred to a dish-shaped platinum tray, evaporated under an infrared lamp, and counted in a modified electroscope.</p>	SOURCE AND PURITY OF MATERIALS: <p>Pale-green plutonium nitrate of unknown degree of hydration was prepared by vacuum evaporation at room temperature from a strong solution of $\text{Pu}(\text{IV})$ in HNO_3. Ethanol was not purified.³</p> ESTIMATED ERROR: <p>The total inaccuracy of the results is about $\pm 5\%$ on the basis of pipetting small aliquots of concentrated solutions, and of the radiation counting, with errors $< 1\%$. Further errors of unknown magnitude are likely to arise from traces of impurities in the Pu solution, and from the conditioning process.</p> REFERENCES:

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Kerosine; [8008-20-6] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Dawson, J. K.; Elliott, R. M. AERE Report C/M 113, 1951.
VARIABLES: $T/K = 298$	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{Pu}(\text{NO}_3)_4$ in aromatic-free kerosine conditioned with $1.0 \text{ mol/dm}^3 \text{ HNO}_3$ is reported to be 0.7 g/L at 25°C. The organic solvent consists of kerosine and an unknown amount of water, resulting from the hydrated salt dissolution, and from the nitric acid conditioning.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: <p>The isothermal method was used. The solubilities were measured in small stoppered tubes which were immersed in a thermostat at 25°C, and slowly rotated so that the solution was continuously stirred by centrifugal action. Equilibrium was attained fairly quickly, but the observations were extended over several days. The amount of solvent used was about 200 microliters and aliquots pipetted out for the radiation counting were usually 4 microliters. The aliquots were transferred to dish-shaped platinum trays, evaporated under infrared lamps, and counted in a modified electroscope.</p>	SOURCE AND PURITY OF MATERIALS: <p>Pale-green plutonium nitrate of unknown degree of hydration was prepared by vacuum evaporation at room temperature of a strong solution of $\text{Pu}(\text{IV})$ in nitric acid. kerosine was conditioned with 1.0 mol/dm^3 nitric acid by shaking and filtering.</p> ESTIMATED ERROR: <p>The total inaccuracy of the results is about $\pm 5\%$ on the basis of pipetting small aliquots of concentrated solutions, and of the radiation counting, with errors $< 1\%$. Further errors of unknown magnitude are likely to arise from traces of impurities in the plutonium solution, and from the conditioning procedure.</p> REFERENCES:

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Dawson, J. K.; Elliott, R. M. AERE Report C/M 113, Harwell, 1951.												
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski												
EXPERIMENTAL VALUES: <p>The solubility of $\text{Pu}(\text{NO}_3)_4$ in $(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{O})_3\text{PO}$ (TBP) as a function of conditioning acidity at 25°C^a is given as:</p> <table> <tr> <th>Conditioning Acidity₃ mol/dm³</th><th>$\text{Pu}(\text{NO}_3)_4$ g/L</th></tr> <tr><td>0.1</td><td>32.4</td></tr> <tr><td>0.75</td><td>48.9</td></tr> <tr><td>1.0</td><td>74.6</td></tr> <tr><td>3.0</td><td>30.8</td></tr> <tr><td>5.0</td><td>29.0</td></tr> </table> <p>^aThe solvent consists of TBP and an unknown amount of water resulting from the dissolution of hydrated plutonium nitrate and from the nitric acid.</p>		Conditioning Acidity ₃ mol/dm ³	$\text{Pu}(\text{NO}_3)_4$ g/L	0.1	32.4	0.75	48.9	1.0	74.6	3.0	30.8	5.0	29.0
Conditioning Acidity ₃ mol/dm ³	$\text{Pu}(\text{NO}_3)_4$ g/L												
0.1	32.4												
0.75	48.9												
1.0	74.6												
3.0	30.8												
5.0	29.0												
AUXILIARY INFORMATION													
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The solubilities were measured in small stoppered tubes which were immersed in a thermostat at 25°C , and slowly rotated so that the solution was continuously stirred by centrifugal action. Equilibrium between crystals and supernatant was attained fairly quickly, but the observations were extended over several days. The amount of solvent used was about 200 microliters, and aliquots pipetted out for the radiation counting were usually 4 microliters. The aliquots were transferred to dish-shaped platinum trays, evaporated under an infrared lamp, and counted in a modified electroscope.	SOURCE AND PURITY OF MATERIALS: Pale-green plutonium nitrate of unknown degree of hydration was prepared by vacuum evaporation at room temperature from a strong solution of $\text{Pu}(\text{IV})$ in nitric acid. TBP was washed several times with NaOH solutions and water, followed by redistillation. The TBP was conditioned to the required acidity with nitric acid, and centrifuged if necessary.												
REFERENCES:	ESTIMATED ERROR: The total inaccuracy of the results is about $\pm 5\%$ on the basis of pipetting small aliquots of concentrated solutions, and of the radiation counting, with errors of $<1\%$. Additional errors of unknown magnitude are likely to arise from traces of impurities in the plutonium solution, and from the conditioning procedure.												

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Di-n-butyl phosphate (DBPA); $\text{C}_8\text{H}_{19}\text{O}_4\text{P}$; [107-66-4] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Sokhina, L. P.; Rovnyi, S. I.; Goncharuk, L. V.; Bogdanov, F. A. <i>Radiokhim.</i> , <u>1988</u> , 30, 418-420. <i>Sov. Radiochem.</i> , <u>1982</u> , 30, 394-396.
VARIABLES: $T/K = 293 \text{ to } 373$	PREPARED BY: S. L. Phillips
EXPERIMENTAL VALUES: The solubility of $\text{Pu}(\text{NO}_3)_2(\text{DBPA})_2$ in nitric acid solutions as a function of temperature is given by the equation $S, \text{ mg/L} = \exp [AT + (B + DT + ET^2) C]$ where: $A = 0.0383 \pm 0.004$, $B = 0.37 \pm 0.03$, $D = (0.52 \pm 0.13) \times 10^{-2}$, $E = (0.34 \pm 0.11) \times 10^{-4}$, $T = \text{temperature, } t/^{\circ}\text{C}$, $C = \text{HNO}_3, \text{ mol/dm}^3$.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Plutonium in a nitric acid solution stabilized in +4 state with hydrogen peroxide at $60 \pm 5^{\circ}\text{C}$ in a 3 mol/dm^3 nitric acid solution. Plutonium DBPA precipitates were prepared by pouring together fixed volumes of aqueous nitric acid solutions of Pu and DBPA. The resulting precipitates were separated from the mother liquor by centrifuging, and washed two or three times with 0.1 mol/dm^3 nitric acid. Solubility was determined (1). The plutonium content was measured radiometrically; DBPA was determined spectrophotometrically according to phosphorus.	SOURCE AND PURITY OF MATERIALS: Nothing specified for $\text{Pu}(\text{NO}_3)_4$. The valence state was monitored spectrophotometrically. DBPA was synthesized from phosphoric anhydride and n-butyl alcohol. It was purified (2). ESTIMATED ERROR: Soly: Error did not exceed $\pm 15\%$. Temp: $\pm 5^{\circ}\text{C}$. REFERENCES: 1. Solovkin, A. S. <i>Radiochim.</i> , <u>1982</u> , 24, 56. 2. Hardy, C. J.; Scargill, D. <i>J. Inorg. Nucl. Chem.</i> , <u>1958</u> , 10, 323.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Fedorov, Yu. S.; Zil'berman, B. Ya. <i>Radiokhim.</i> , 1988, 30, 572-576. <i>Sov. Radiochem.</i> , 1989, 546-550.
VARIABLES: Nitric acid concentration at 293 K	PREPARED BY: S. L. Phillips
EXPERIMENTAL VALUES: <p>The distribution of $\text{PuO}_2(\text{NO}_3)_2$ between HNO_3 solutions and a 30% solution of TBP in CCl_4 in the presence of solid $\text{UO}_2(\text{NO}_3)_2$ is given in the form of a figure.</p> <p>The distribution of $\text{Pu}(\text{NO}_3)_4$ between HNO_3 solutions and a 30% solution of TBP in CCl_4 in the presence of solid $\text{UO}_2(\text{NO}_3)_2$ is given in the form of a figure.</p> <p>COMMENT AND/OR ADDITIONAL DATA:</p> <p>Plutonyl nitrate has a structure similar to that of uranyl nitrate.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The initial concentration of ^{239}Pu was 0.0002 mol/dm ³ . Content of Pu was determined radiometrically. No further details given, but the procedure probably followed that used in prior study (1).	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Fedorov, Yu.S.; Zil'berman, B.Ya. <i>Radiokhim.</i> , 1986, 28, 37.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Kerosine; [8008-20-6] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Dawson, J. K.; Elliott, R. M. AERE Report C/M 113, 1951.								
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski								
EXPERIMENTAL VALUES: The solubility of $\text{Pu}(\text{NO}_3)_4$ in 30% TBP in aromatic-free kerosine as a function of conditioning acid at 25°C^a is: <table data-bbox="480 643 905 858"> <thead> <tr> <th>Conditioning Acidity mol/dm^3</th><th>$\text{Pu}(\text{NO}_3)_4$ g/L</th></tr> </thead> <tbody> <tr> <td>0.1</td><td>11.9</td></tr> <tr> <td>1.0</td><td>27.9</td></tr> <tr> <td>5.0</td><td>9.9</td></tr> </tbody> </table> <p>^aThe solvent consists of TBP, aromatic-free kerosine and an unknown amount of water resulting from the dissolution of hydrated plutonium nitrate, and from the nitric acid conditioning.</p>		Conditioning Acidity mol/dm^3	$\text{Pu}(\text{NO}_3)_4$ g/L	0.1	11.9	1.0	27.9	5.0	9.9
Conditioning Acidity mol/dm^3	$\text{Pu}(\text{NO}_3)_4$ g/L								
0.1	11.9								
1.0	27.9								
5.0	9.9								
AUXILIARY INFORMATION									
METHOD/APPARATUS/PROCEDURE: The solubilities were measured in small stoppered tubes which were immersed in a thermostat at 25°C , and slowly rotated so that the solution was continuously stirred by centrifugal action. Equilibrium was attained fairly quickly between the supernatant solution and crystals, but observations were extended over several days. The amount of solvent used was about 200 microliters, and aliquots pipetted out for the radiation counting were usually 4 microliters. The aliquots were transferred for dish-shaped platinum trays, evaporated under infrared lamp, and counted in a modified electroscope.	SOURCE AND PURITY OF MATERIALS: Pale-green plutonium nitrate of unknown degree of hydration was prepared by vacuum evaporation at room temperature from a strong solution of $\text{Pu}(\text{IV})$ in nitric acid. TBP was washed several times with NaOH solution and water, prior to redistillation. The aromatic-free kerosine solutions of TBP were conditioned to required acidity by shaking with aqueous nitric acid solution and rotated if necessary.								
REFERENCES:	ESTIMATED ERROR: The total inaccuracy of the results is about $\pm 5\%$ on the basis of pipetting small aliquots of concentrated solutions, and of the radiation counting, with errors of $< 1\%$. Other errors of unknown magnitude are related to impurities in the various solutions, and from the conditioning procedure.								

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Plutonium nitrate; Pu(NO ₃) ₄ ; [13823-27-3]	Renard, E. V.; Pyatibratov, Yu. P.; Neumoev, N. V.; Chizhov, A. A.; Kulikov, I. A.; Gol'dfarb, Yu. Ya.; Sirotkina, I. G.; Semenova, T.I.
(2) Nitric acid; HNO ₃ ; [7697-37-2]	Zh. Strukt. Khim., 1988, 30, 774 - 787.
(3) Tri-n-butyl phosphate (TBP); C ₁₂ H ₂₇ O ₄ P; [126-73-8]	Sov. Radiochem., 1989, 734-787.
(4) Various isoparaffinic diluents	
VARIABLES:	PREPARED BY:
T/K = 297	S. L. Phillips
EXPERIMENTAL VALUES:	
Effect of kind of isoparaffinic diluent on extraction of Pu(IV) from 3.0 mol/dm ³ HNO ₃ into a 30 vol. % solution of TBP, 24±1°C	
	Concentration, in homogeneous extract

COMPONENTS:								ORIGINAL MEASUREMENTS:	
(1) Plutonium nitrate; Pu(NO ₃) ₄ ; [13823-27-3]								Renard, E. V.; Pyatibratov, Yu. P.; Neumoev, N. V.; Chizhov, A. A.; Kulikov, I. A. Gol'dfarb, Yu. Ya.; Sirotkina, I. G.; Semenova, T. I.	
(2) Nitric acid; HNO ₃ ; [7697-37-2]								Zh. Strukt. Khim., 1988, 30, 774 - 787.	
(3) Tri-n-butyl phosphate (TBP); C ₁₂ H ₂₇ O ₄ P; [126-73-8]								Sov. Radiochem., 1989, 734-787.	
(4) Various isoparaffinic diluents									
EXPERIMENTAL VALUES: (Continued)									
Paraffin	Composition and Properties of the Diluent ^a							Concentration, in homogeneous extract	
	nP %	iP %	Ar %	bp °C	dens. g/cm ³	visc. cp	mp °C	Pu g/dm ³	HNO ₃ mol/dm ³
nC ₁₂	100	---	---	216.3	0.745	1.365	- 9.6	55	0.44
nC ₁₄	100	---	---	253.5	0.759	1.889	5.9	28	0.52
iC ₁₀ ,mix.	---	100	<1.3	175-180	0.736	1.25	--	108	0.30
iC ₁₁ ,mix.	---	100	<1.3	196-201	0.751	1.30	(-97)-53	79	0.38
iC ₁₂ ,mix.	---	100	<1.3	210-216	0.760	1.56	(-94)-35	61	0.39
iC ₁₃ ,mix.	---	100	<1.3	270.5	0.782	--	(-73)-29	39	0.56
iC ₁₄ ,mix.	---	100	<1.3	253.6	0.764	2.17	-16	42	0.50
iC ₁₅ ,mix.	---	100	<1.3	270.5	0.782	--	--	39	0.56
i-RED1	55	45	0.6	190-300	0.754	--	-21	43	0.45
iC ₁₄ +C ₁₂									
fr. iRED	---	100	--	180-213	--	--	--	94	0.37

(Continued on the next page)

(Continued on the next page)

(1) Plutonium nitrate, $\text{Pu}(\text{NO}_3)_4$; [13823-27-3]	Renard, E. V.; Pyatibratov, Yu. P.; Neumoev, N. V.; Chizhov, A. A.; Kulikov, I. A.; Gol'dfarb, Yu. Ya.; Sirotkina, I. G.; Semenova, T. I.
(2) Nitric acid; HNO_3 ; [7697-37-2]	<i>Zh. Strukt. Khim.</i> , 1988 , <i>30</i> , 774 - 787
(3) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8]	<i>Sov. Radiochem.</i> , 1989 , 734-787.
(4) Various isoparaffinic diluents	

EXPERIMENTAL VALUES: (Continued)

Paraffin	Composition and Properties of the Diluent ^a							Concentration, in homogeneous extract	
	nP	iP	Ar	bp	dens.	visc.	mp	Pu	HNO_3
	%	%	%	°C	g/cm^3	cp	°C	g/cm^3	mol/dm^3
$\text{iC}_{13}+\text{C}_{14}$									
fr. iRED	---	100	--	230-240	--	--	--	67	0.44
$\text{iC}_{14}+\text{C}_{15}$	---	100	--	240-260	--	--	--	55	0.48
RED1	100	--	--	--	754	2.02	-4.0	<35	0.49

^aNotation: nP, normal paraffin; iP, isoparaffin; Ar, aromatic; bp, boiling point; dens., density; visc., viscosity; mp, melting point; cp, centipoise; mix., mixture; natur., natural; fr., from.

COMMENTS AND/OR ADDITIONAL DATA:

Solid phases not identified.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Diethylene glycol dibutyl ether; (Butex); $\text{C}_{12}\text{H}_{26}\text{O}_3$; [112-73-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Dawson, J. K. AERE C/M 92 Report, Harwell, <u>1950</u> .
VARIABLES: Time of equilibration	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of $\text{Pu}(\text{NO}_3)_4$ in $\text{C}_4\text{H}_9\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OC}_4\text{H}_9$ at 35°C conditioned to $0.1 \text{ mol/dm}^3 \text{ HNO}_3$ at 25°C was reported to be 1.1 g of plutonium per liter of solution. The solubility was also reported to be 1.5, 0.76 and 0.71 g of plutonium per liter of solution after 10, 15 and 23 days of equilibration at 25°C.</p> <p>The solubility of plutonium(IV) at 25°C in butex conditioned with $1.5 \text{ mol/dm}^3 \text{ HNO}_3$ was reported to be 5.6 g plutonium per liter of solution.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The plutonium(IV) nitrate samples containing 1 to 5 mg of plutonium were prepared by evaporation to dryness plutonium(IV) solutions on a high vacuum line. Butex adjusted to the required acidity was added. The glass stoppered container was placed in a metal container to exclude light and this, in turn, was suspended in a thermostat. The tubes were shaken by hand from time to time during the course of the experiments, and were centrifuged immediately prior to pipetting out aliquots for counting. The counting was done in an argon proportional chamber with 35% geometry, or in an electroscope, Type 1096 (1).	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Solubility: The results are probably no better than $\pm 5\%$ (authors). Temperature: Nothing specified. REFERENCES: 1. Mandelberg, C. J. AERE C/R 582 Report.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Pyridine nitrate; $\text{C}_5\text{H}_6\text{N}_2\text{O}_3$; [110-86-1] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Anderson, H. H. Paper 6.220 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949).
VARIABLES: One temperature: 301 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of dipyridine plutonium(IV) hexanitrate 14(?) hydrate, $(\text{C}_5\text{H}_5\text{NH})_2\text{Pu}(\text{NO}_3)_6 \cdot 14(?)\text{H}_2\text{O}$, was reported to be approximately 2 g per liter of the mother liquor of the composition given in the PROCEDURE.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A 71 mg weighed amount of pyridinium nitrate and 5.6 mg of plutonium(IV) as nitrate were mixed in 0.140 mL of $2.5 \text{ mol/dm}^3 \text{ HNO}_3$. Slow rotations of the solution in a centrifuge cone tended to give equilibrium in solubility. The crystals were filtered by suction under vacuum on a sintered pyrex dish, dried in vacuum at room temperature, dried under a heat lamp, and analyzed (1).	SOURCE AND PURITY OF MATERIALS: $(\text{C}_5\text{H}_5\text{NH})_2\text{Pu}(\text{NO}_3)_6 \cdot 14(?)\text{H}_2\text{O}$ was found to contain 23.4 mass % of plutonium (calc. 23.4 mass %). The crystals melted without decomposition at 110°C . ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Anderson, H. H. Report ANL-4062.

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Quinoline nitrate; $\text{C}_9\text{H}_8\text{N}_2\text{O}_3$; [91-22-5] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Anderson, H. H. Paper 6.220 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949).
VARIABLES: One temperature: 301 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of diquinoline plutonium(IV) hexanitrate, $(\text{C}_9\text{H}_7\text{NH})_2\text{Pu}(\text{NO}_3)_6$, at 28°C was reported to be 0.50 g/L of plutonium of the mother liquor with the composition given in the PROCEDURE.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. A 80 mg weighed amount of quinoline nitrate, and 5.6 mg of plutonium(IV) as nitrate were mixed in nitric acid to give 0.175 mL of solution which was 3.7 mol/dm ³ in HNO_3 . Slow rotations of the solution in a centrifuge cone tended to give equilibrium in solubility. The crystals were filtered by suction on a sintered pyrex dish, washed with several drops of 95% ethanol, dried under vacuum at room temperature, and analyzed (1).	SOURCE AND PURITY OF CHEMICALS: $(\text{C}_9\text{H}_7\text{NH})_2\text{Pu}(\text{NO}_3)_6$ was found to contain 27.2 mass % of plutonium (calc. 27.4 mass %).
	ESTIMATED ERROR: Nothing specified.
	REFERENCES: 1. Anderson, H. H. Report ANL-4062.

COMPONENTS: (1) Plutonium nitrate; Pu(NO ₃) ₃ ; (2) Di-n-butyl hydrogen phosphate (DBHP); C ₈ H ₁₉ O ₄ P; [107-66-4] (3) Nitric acid; HNO ₃ ; [7697-37-2] (4) Water; H ₂ O; [7732-18-5]		ORIGINAL MEASUREMENTS: Bogdanov, F. A.; Belyaeva, T. B.; Sokhina, L. P.; Solovkin, A. S. Radiokhim., 1979, 21, 920-922. Sov. Radiochem., 1979, 21, 786.			
VARIABLES: T/K = 293 to 296		PREPARED BY: S. L. Phillips			
EXPERIMENTAL VALUES: The Pu(NO ₃) ₃ - DBHP - HNO ₃ - H ₂ O System Table 1. The molar ratio of DBHP (HA) to Pu in precipitates as a function of HNO ₃ concentration.					
Volume of initial solutions before mixing, mL		Concentration in decantates, g/L		Molar ratio DBHP/Pu	
Pu(III)	DBHP	Pu(III)	DBHP	Initial Solution	Precipitate
HA = 2.8 g/L, Pu = 0.75 g/L, 0.2 mol/dm ³ HNO ₃					
3.0	1.5	0.034	0.51	2.12	3.03
1.0	3.0	0.0040	1.66	12.6	2.73
1.0	5.0	0.0029	2.12	21.0	2.66
1.0	6.0	0.0033	2.07	25.2	3.40
1.0	8.0	0.0025	2.30	33.6	2.63
HA = 5.50 g/L, Pu = 0.50 g/L, 1.5 mol/dm ³ HNO ₃					
10	0.8	0.40	0.24	1.00	3.02
10	2.4	0.31	0.56	3.00	6.20
10	4.8	0.16	0.88	6.00	5.83
10	7.2	0.10	1.28	8.98	6.09
10	9.6	0.03	1.44	11.9	6.22
HA = 5.25 g/L, Pu = 0.50 g/L, 3.0 mol/dm ³ HNO ₃					
10	0.8	0.43	0.34	1.00	3.40
10	2.5	0.32	0.64	3.19	6.00
10	5.0	0.22	1.14	6.00	6.55
10	7.5	0.19	1.73	8.86	6.02
10	10.1	0.14	2.02	11.9	6.33
(Continued on the next page)					
AUXILIARY INFORMATION					
METHOD/APPARATUS/PROCEDURE: The valence state of Pu(III) was monitored spectrophotometrically. PuA ₃ or Pu ₂ .3HA were precipitated from nitric acid solutions by mixing the solution of Pu(NO ₃) ₃ in HNO ₃ , and DBHP solutions.			SOURCE AND PURITY OF MATERIALS: 1. Di-n-butyl hydrogen phosphate, 98.8% purity. 2. Pu(III) nitrate prepared by H ₂ O ₂ reduction of Pu(IV) with hydrazine nitrate in 6M HNO ₃ or reduction with hydrazine nitrate in 0.5-4.0M HNO ₃ for 5-6 hr at 70-80°C.		
REFERENCES:			ESTIMATED ERROR: Nothing specified.		

COMPONENTS:		ORIGINAL MEASUREMENTS:	
(1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_3$;		Bogdanov, F. A.; Belyaeva, T. B.; Sokhina, L. P.; Solovkin, A. S.	
(2) Di-n-butyl hydrogen phosphate (DBHP); $\text{C}_8\text{H}_{19}\text{O}_4\text{P}$; [107-66-4]		Radiokhim., 1979, 21, 920-922.	
(3) Nitric acid; HNO_3 ; [7697-37-2]		Sov. Radiochem., 1979, 21, 786.	
(4) Water; H_2O ; [7732-18-5]			

EXPERIMENTAL VALUES: (Continued)

Table 2. The molar ratio of DBHP (HA) to Pu in precipitates as a function of HNO_3 concentration.

Volume of initial solutions before mixing, mL		Concentration in decantates, g/L		Molar ratio DBHP/Pu	
Pu(III)	DBHP	Pu(III)	DBHP	Initial Solution	Precipitate
HA = 7.30 g/L, Pu = 0.50 g/L, 4.5 mol/dm ³ HNO_3					
10	0.6	0.44	0.36	1.06	3.60
10	1.9	0.35	0.80	3.18	6.12
10	3.8	0.29	1.64	6.38	6.14
HA = 3.00 g/L, Pu = 1.51 g/L, 6.0 mol/dm ³ HNO_3					
1.0	1.0	0.54	0.43	2.25	5.61
1.0	4.0	0.25	2.12	9.00	6.19
0.5	4.0	0.11	2.36	18.00	6.20
0.5	7.0	0.077	2.66	31.5	5.71
0.5	8.0	0.056	2.64	36.0	6.18

COMMENT AND/OR ADDITIONAL DATA:

In 1.5 - 4.5 HNO_3 solutions with the ratio DBHP/Pu > 3, and in a 6 mol/dm³ solution of HNO_3 with the ratio = 2-36, a precipitate formed with the ratio of DBHP/Pu in the precipitate close to 6. The composition of the precipitate could be represented by the formula $\text{PuA}_3 \cdot 3\text{HA}$. The precipitate with the formula PuA_3 was a loose light-violet powder; the $\text{PuA}_3 \cdot 3\text{HA}$ was a resinous material.

COMPONENTS: (1) Plutonium nitrate; Pu(NO ₃) ₄ ; [13823-27-3] (2) Plutonyl nitrate; PuO ₂ (NO ₃) ₂ ; [22853-0-5] (3) Nitric acid; HNO ₃ ; [7697-37-2] (4) Water; H ₂ O; [7732-18-5]	ORIGINAL MEASUREMENTS: Vogler, S.; Grosvenor, D. E.; Lewitz, N. M. Report, 1972, ANL-7917.																																																				
VARIABLES: Composition and temperature	PREPARED BY: A. Sozanski; S. Siekierski																																																				
EXPERIMENTAL VALUES: The UO ₂ (NO ₃) ₂ - Pu(NO ₃) ₄ ^a - HNO ₃ - H ₂ O System Composition of Saturated Solutions ^b <table><tr><td></td><td>U</td><td>Pu</td><td>HNO₃</td></tr><tr><td>t/°C</td><td>mol/dm³</td><td>mol/dm³</td><td>mol/dm³</td></tr><tr><td>1.5</td><td>0.70</td><td>0.70</td><td>3.4</td></tr><tr><td>3.2</td><td>1.28</td><td>0.34</td><td>2.0</td></tr><tr><td>5.3</td><td>0.98</td><td>0.42</td><td>3.4</td></tr><tr><td>10.2</td><td>1.12</td><td>0.28</td><td>3.4</td></tr><tr><td>12.6^c</td><td>1.4</td><td>0</td><td>3.4</td></tr><tr><td>13.2</td><td>1.6</td><td>0.2</td><td>2.0</td></tr><tr><td>15.3</td><td>1.28</td><td>0.34</td><td>3.4</td></tr><tr><td>15.9</td><td>1.6</td><td>0.3</td><td>2.0</td></tr><tr><td>17.6</td><td>1.12</td><td>0.28</td><td>4.8</td></tr><tr><td>18.0</td><td>1.6</td><td>0.4</td><td>2.0</td></tr><tr><td>20.8</td><td>1.28</td><td>0.34</td><td>4.8</td></tr></table> ^a See Comments, next page. ^b Solid phase = UO ₂ (NO ₃) ₂ ·6H ₂ O. ^c Extrapolated from Dillon's data (1). (Continued on the next page)			U	Pu	HNO ₃	t/°C	mol/dm ³	mol/dm ³	mol/dm ³	1.5	0.70	0.70	3.4	3.2	1.28	0.34	2.0	5.3	0.98	0.42	3.4	10.2	1.12	0.28	3.4	12.6 ^c	1.4	0	3.4	13.2	1.6	0.2	2.0	15.3	1.28	0.34	3.4	15.9	1.6	0.3	2.0	17.6	1.12	0.28	4.8	18.0	1.6	0.4	2.0	20.8	1.28	0.34	4.8
	U	Pu	HNO ₃																																																		
t/°C	mol/dm ³	mol/dm ³	mol/dm ³																																																		
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AUXILIARY INFORMATION																																																					
METHOD/APPARATUS/PROCEDURE: Synthetic method used. Test solution prepared from stock solutions of 2.52 mol/dm ³ uranyl nitrate, 1.5 mol/dm ³ plutonium nitrate, 16 mol/dm ³ nitric acid. The test solution was heated to approximately 5°C above the temperature of first crystallization, and the solution was allowed to cool slowly at a steady rate while stirring. The change in solution temperature as a function of time was recorded. Onset of crystallization resulted in a decrease in the rate of temperature change because of the heat evolved during the process of crystallization. The crystallization point was taken as the intersection of the two lines drawn through the cooling-curve segments.	SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Solubility: Crystallization point determined 2 or 3 times for each solution. Temperature: Precision ±1K, above 10°C, ±1.5K, below 10°C. REFERENCES: 1. Dillon, I. ANL, Private Communication, 1950.																																																				

COMPONENTS: (1) Plutonium nitrate; $\text{Pu}(\text{NO}_3)_4$; [13823-27-3] (2) Plutonyl nitrate; $\text{PuO}_2(\text{NO}_3)_2$; [22583-0-5] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Vogler, S.; Grosvenor, D. E.; Lewitz, N. M. <i>Report, 1972, ANL-7917.</i>
EXPERIMENTAL VALUES: (Continued) <p>About 30% of plutonium in the stock solution was present as hexavalent plutonyl ions (and the remainder apparently as the tetravalent plutonium, compilers). Preliminary tests in which crystallization points were determined from cooling curves of uranyl nitrate solutions demonstrated good agreement in the experimental results with published data of uranyl nitrate solutions. Upon standing, hexavalent plutonium was reduced to the tetravalent oxidation state. The crystallization experiments were repeated on the same solutions after they had stood for three months. Essentially, the same crystallization temperatures were obtained.</p> <p>The analyses confirmed that the solid was uranyl nitrate, even for the solution with a Pu/U ration of one. Plutonium does not crystallize from solution.</p> <p>The replacement of uranyl ions with plutonium increases the total metal solubility.</p>	

COMPONENTS: (1) Neptunyl nitrate; $\text{NpO}_2(\text{NO}_3)_2$; [66320-31-8] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: LaChapelle, T. J.; Magnusson, L. B.; Hindman, J. C. Paper 15.6 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949), 1097-1110.
VARIABLES: One acid concentration	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The solubility of neptunyl nitrate in $0.2 \text{ mol/dm}^3 \text{ HNO}_3$ was reported to be greater than 38 g/L. The initial solid was neptunyl nitrate of unknown water content.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Neptunyl nitrate solution was obtained by dissolving neptunyl hydroxide in nitric acid. No other information was given. ESTIMATED ERROR: Nothing specified. REFERENCES:

COMPONENTS: (1) Neptunyl nitrate; NpO_2NO_3 ; [17118-09-1] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: LaChapelle, T. J.; Magnusson, L. B. Hindman, J. C. Paper 15.6 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949), 1097-1110.
VARIABLES: Three acid concentrations	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of neptunium(V) in $0.5 \text{ mol/dm}^3 \text{ HNO}_3$ was reported to be at least 2.5 g/L. The solubility exceeds 8 g/L in $1 \text{ mol/dm}^3 \text{ HNO}_3$, and is greater than 50 g/L in $5 \text{ mol/dm}^3 \text{ HNO}_3$.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF CHEMICALS: Neptunium(V) nitrate solution was obtained by heating a neptunium(V) solution in nitric acid at 30°C for several minutes or by dissolution of neptunium(V) hydroxide in nitric acid. No additional information was given.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS: (1) Neptunium nitrate; $\text{Np}(\text{NO}_3)_4$; [25933-53-3] (2) Nitric acid; HNO_3 ; [7697-37-2] (3) Water; H_2O ; [7732-18-5]	EVALUATOR: LaChapelle, T.J.; Magnusson, L.B.; Hindman, J.C. Paper 15.6 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York (1949), 1097-1110.
VARIABLES: Two acid concentrations	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: <p>The solubility of neptunium(IV) nitrate in approximately 5 mol/dm³ HNO_3 was reported to be at least 300 g/L. The solubility in 4 mol/dm³ nitric acid was greater than 80 g/L.</p> <p>The initial solid was neptunium(IV) nitrate hydrate of unknown water content.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: Nothing specified.	SOURCE AND PURITY OF MATERIALS: Neptunium(IV) nitrate solution was obtained by dissolving $\text{Np}(\text{IV})$ hydroxide in nitric acid at temperatures below 30°C. No additional information was given. ESTIMATED ERROR: Nothing specified. REFERENCES:

COMPONENTS: (1) Neptunyl nitrate; $\text{NpO}_2(\text{NO}_3)_2$; [66320-31-8] (2) Tri-n-butyl phosphate (TBP); $\text{C}_{12}\text{H}_{27}\text{O}_4\text{P}$; [126-73-8] (3) Nitric acid; HNO_3 ; [7697-37-2] (4) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Fedorov, Yu. S.; Zil'berman, B. Ya. <i>Radiokhim.</i> , 1988, 30, 572-576. <i>Sov. Radiochem.</i> , 1989, 546-550.
VARIABLES: $T/K = 293$	PREPARED BY: S. L. Phillips
EXPERIMENTAL VALUES: The distribution of $\text{NpO}_2(\text{NO}_3)_2$ between HNO_3 solutions and a 30% solution of TBP in CCl_4 in the presence of solid $\text{UO}_2(\text{NO}_3)_2$ is given in the form of a figure. The distribution of NpO_2NO_3 between HNO_3 solutions and a 30% solution of TBP in CCl_4 in the presence of solid $\text{UO}_2(\text{NO}_3)_2$ is given in the form of a figure. The distribution of $\text{Np}(\text{NO}_3)_4$ between HNO_3 solutions and a 30% solution of TBP in CCl_4 in the presence of solid $\text{UO}_2(\text{NO}_3)_2$ is given in the form of a figure. COMMENTS AND/OR ADDITIONAL DATA: The saturating solid phase was $\text{UO}_2(\text{NO}_3)_2$.	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: The initial concentration of ^{237}Np was 0.0002 mol/dm ³ . Content of Np was determined radiometrically. No further details given, but the procedure probably followed that used in prior study (1).	SOURCE AND PURITY OF MATERIALS: Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES: 1. Fedorov, Yu. S.; Zil'berman, B. Ya. <i>Radiokhim.</i> , 1986, 28, 37.

COMPONENTS: (1) Americium nitrate; Am(NO ₃) ₃ ; [25933-53-3] (2) Di-n-butyl hydrogen phosphate (DBHP); C ₈ H ₁₉ PO ₄ ; [107-66-4] (3) Nitric acid; HNO ₃ ; [7697-37-2] (4) Water; H ₂ O; [7732-18-5]	ORIGINAL MEASUREMENTS: Bogdanov, F. A.; Belyaeva, T. B.; Sokhina, L. P.; Solovkin, A. S. Radiokhim., 1979, 21, 920-922. Sov. Radiochem., 1979, 21, 786.																								
VARIABLES: T/K = 293-296	PREPARED BY: S. L. Phillips																								
EXPERIMENTAL VALUES: The Am(NO ₃) ₃ - DBHP - HNO ₃ - H ₂ O System Table 1. The molar ratio of DBHP (HA) to Am in precipitates formed by mixing 3.0 mol/L HNO ₃ of DBHP and Am(III)																									
<table><tr><th rowspan="2">Molar ratio of DBHP to Am in initial solutions</th><th colspan="2">Concentration in decantates</th><th rowspan="2">Molar ratio DBHP/Am in precipitates</th></tr><tr><th>DBHP g/L</th><th>Am(III) mg/L</th></tr><tr><td>1.4</td><td>0.063</td><td>0.75</td><td>3.2</td></tr><tr><td>3.5</td><td>0.42</td><td>0.002</td><td>2.8</td></tr><tr><td>6.0</td><td>1.76</td><td>0.001</td><td>3.2</td></tr><tr><td>10.5</td><td>3.41</td><td>0.001</td><td>3.1</td></tr></table>				Molar ratio of DBHP to Am in initial solutions	Concentration in decantates		Molar ratio DBHP/Am in precipitates	DBHP g/L	Am(III) mg/L	1.4	0.063	0.75	3.2	3.5	0.42	0.002	2.8	6.0	1.76	0.001	3.2	10.5	3.41	0.001	3.1
Molar ratio of DBHP to Am in initial solutions	Concentration in decantates		Molar ratio DBHP/Am in precipitates																						
	DBHP g/L	Am(III) mg/L																							
1.4	0.063	0.75	3.2																						
3.5	0.42	0.002	2.8																						
6.0	1.76	0.001	3.2																						
10.5	3.41	0.001	3.1																						
Table 2. The solubility of AmA ₃ at room temperature, 20-23°C, as a function of HNO ₃ concentration																									
<table><tr><th>HNO₃ mol/dm³</th><th>AmA₃ mg/L</th></tr><tr><td>0.01</td><td>24</td></tr><tr><td>1.0</td><td>30</td></tr><tr><td>3.0</td><td>53</td></tr><tr><td>6.0</td><td>87</td></tr><tr><td>11.6</td><td>200</td></tr></table>				HNO ₃ mol/dm ³	AmA ₃ mg/L	0.01	24	1.0	30	3.0	53	6.0	87	11.6	200										
HNO ₃ mol/dm ³	AmA ₃ mg/L																								
0.01	24																								
1.0	30																								
3.0	53																								
6.0	87																								
11.6	200																								
AUXILIARY INFORMATION																									
METHOD/APPARATUS/PROCEDURE: Americium(III) di-n-butyl phosphate was obtained by mixing solutions of DBHP (6.4 g/L) and Am(III) (2.10 g/L) in a 3.0 mol/L HNO ₃ solution. The resulting precipitate was a light pink amorphous powder.		SOURCE AND PURITY OF MATERIALS: 1. Di-n-butyl hydrogen phosphate, 98.8% purity. 2. Am(III) nitrate, nothing specified.																							
REFERENCES:		ESTIMATED ERROR: Nothing specified.																							

SYSTEM INDEX

Page numbers preceded by E refer to evaluation text whereas those not preceded by E refer to compiled tables. Salts and esters are listed under their Chemical Abstracts index name e.g. potassium nitrate appears as nitric acid, potassium salt and ethyl acetate appears as acetic acid, ethyl ester.

Citronellal

see 5[R]-3,7-dimethyl-6-octenal

Hexyl ether

see 1,1'-oxybis-hexane

Linalool

see 3,7-dimethyl-1,6-octadien-3-ol

Linalyl acetate

see 3,7-dimethyl-1,6-octadien-3-ol acetate

Neptunium, bis(nitrato-O)dioxo-, (T-4)-, (multicomponent)

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+ tetradecane isomers	336
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+ acetic acid, methyl ester	E259-E261, 287

Nitric acid, thorium salt (aqueous)

+ acetic acid, 1-methylethyl ester	E259-E261, 294
+ acetic acid, 2-methylpropyl ester	E259-E261, 294
+ acetic acid, pentyl ester	E259-E261, 295
+ acetophenone	E259-E261, 289
+ isoamyl ether	E259-E261, 288
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+ benzenamine	E259-E261, 290
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+ benzeneacetic acid, ethyl ester	E259-E261, 287
+ benzoic acid, ethyl ester	E259-E261, 287
+ benzoic acid, 1-methylethyl ester	E259-E261, 294
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+ 1,2-bis(2-chloroethoxy)ethane	E259-E261, 295
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+ bromoethane	E259-E261, 290
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+ 1-bromo-3-methylbutane	E259-E261, 296
+ (3-bromopropoxy)benzene	E259-E261, 292
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+ dichloroethene	E259-E261, 290
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+ 1,1-dichloro-1-nitropropane	E259-E261, 296
+ di(<i>o</i> -chlorophenyl) monophenyl phosphate	E259-E261, 295
+ diethylamine	E259-E261, 296
+ diethyl carbitol	E259-E261, 297
+ diethyleneamine	E259-E261, 296
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Nitric acid, thorium salt (aqueous)	
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+ ethylene glycol monomethyl ether	E259-E261, 288
+ formic acid, ethyl ester	E259-E261, 287
+ formic acid, pentyl ester	E259-E261, 294
+ 2-heptanone	E259-E261, 289, 294, 299, 301
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