# INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

ANALYTICAL CHEMISTRY DIVISION COMMISSION ON SOLUBILITY DATA

# SOLUBILITY DATA SERIES

.

# Volume 55

# **ACTINIDE NITRATES**

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# SOLUBILITY DATA SERIES

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# Volume 55

# **ACTINIDE NITRATES**

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Introduction to the Solubility of Solids in Liquids Preface 1. Uranyl nitrate - aqueous systems 1.1 Evaluation 1.2 Compilations for binary systems	vi × 1 27
1. Uranyl nitrate - aqueous systems 1.1 Evaluation	1
1.1 Evaluation	
1.2 Compilations for binary systems	27
	2. I
1.3 Compilations for ternary systems	37
1.4 Compilations for multicomponent systems	100
2. Uranyl nitrate - nonaqueous systems	
2.1 Evaluation of systems with organic components	121
2.2 Compilations for systems in alcohols	131
2.3 Compilations for systems in esters	140
2.4 Compilations for systems in ketones and aldehydes	146
2.5 Compilations for systems in ethers	161
2.6 Compilations for systems in other organic solvents	201
2.7 Compilations for systems with phosphates	213
3. Thorium nitrate - aqueous systems	
3.1 Evaluation	225
3.2 Compilations for binary system	240
3.3 Compilations for ternary systems	248
3.4 Compilations for multicomponent systems	254
4. Thorium nitrate - nonaqueous systems	
4.1 Evaluation for systems with organic components	259
4.2 Compilations for systems with phosphorus	266
4.3 Compilations for systems with organics	283
5. Plutonium, neptunium, americium - aqueous systems	
5.1 Evaluation	316
5.2 Compilations	320
System Index	350
Registry Number Index	358
Author Index	362

# 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 18column 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 nu

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<sup>3</sup> 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  $t/^{\circ}C$ ,  $t/^{\circ}F$  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 then 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):

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

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

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

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

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

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

$$x_{1} = \frac{v_{+2}x_{01}}{v_{+2} - (v_{2} - 1)x_{+2}} \qquad x_{2} = \frac{x_{+2}}{v_{+2} - (v_{2} - 1)x_{+2}}$$
[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):

$$w_1 = g_1 / \sum_{s=1}^{c} g_s$$
 [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,  $x_{s,1}$ :

$$x_{s,1} = m_1 / \sum_{s=1}^{c'} m_s = x_1 / \sum_{s=1}^{c'} x_s$$
[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,  $x_{v,1}$ :

$$x_{\nu,1} = x_1 / \sum_{s=1}^{p} x_s$$
 [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,  $m_1$ :

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

SI base units: mol kg<sup>-1</sup>. 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),  $m_1^{(3)}$ :

$$m_1^{(3)} = m_1 \overline{M} / M_3$$
<sup>[10]</sup>

SI base units: mol kg<sup>-1</sup>. Here, the average molar mass of the solvent is

$$\overline{M} = x_{\nu,2}M_2 + (1 - x_{\nu,2})M_3$$
<sup>[11]</sup>

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  $V, c_1$ :

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

SI base units: mol m<sup>-3</sup>. 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,  $\rho_1$ :

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

SI base units: kg m<sup>-3</sup>.

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

$$r_{n,12} = n_1 / n_2 \tag{14}$$

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

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

$$I_m = \frac{1}{2} \sum_{i} m_i z_i^2, \quad I_c = \frac{1}{2} \sum_{i} c_i z_i^2$$
 [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  $z_+$ ,  $z_-$ ,

$$I_m = |z_{+}z_{-}| vm_i, \quad I_c = |z_{+}z_{-}| vc_i$$
[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 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, p:

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

SI base units: kg m<sup>-3</sup>. 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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January, 1994

 $\boldsymbol{x_i}$ W<sub>i</sub> m<sub>i</sub>  $c_i$  $x_i =$  $\boldsymbol{x_i}$  $\overline{1 + \frac{1}{m_i M_c} + \sum_{j \neq i}^{c-1} \frac{m_j}{m_i}}$ c-1  $1 + \frac{M_i}{M_c}$ c-1  $1 + \frac{1}{M_c} \left( \frac{\rho}{c_i} - \frac{\rho}{c_i} \right)$ wj  $w_i =$  $c_i M_i$ Wi  $\overline{\epsilon} \left[ 1 + \sum_{j \neq i}^{c-1} m_j M_j \right]$  $1+\frac{1}{m_iM_i}$ ρ M  $m_i =$  $m_i$ c-1 c-1 c-1 w,  $-M_i$ М 1+1  $c_i =$  $\frac{\rho w_i}{M_i}$ C,  $+\sum_{i=1}^{c-1}M_{j}m_{j}+M_{i}$ c-1 M  $M_i + M_j$ m i+i

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

 $\rho$  - 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 pentahdyrate 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.

Thanks are given to Mark Salomon and Jack W. Lorimer for their reviews and comments of the draft copies of this volume.

S. Siekierski Warsaw, Poland

S. L. Phillips Orinda, California U.S.A.

COMPONENTS:			
(1)	Uranyl	nitrate;	U02(N03)2;
	[15905	-86-9]	2 7 2
}			

(2) Water; H<sub>2</sub>O; [7732-18-5]

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

CRITICAL EVALUATION:

THE BINARY SYSTEM

#### INTRODUCTION

Measurements of the solubility of  $UO_2(NO_3)_2$  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 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
U02(N03)2.6H20	Uranium nitrate hexahydrate	[13520-83-7]
uo <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O	Uranium nitrate trihydrate	[20651-50-7]
UO2(NO3)2.2H2O	Uranium nitrate dihydrate	[16071-05-9]
U02(N03)2.H20	Uranium nitrate monohydrate	
U02(N03)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  $-35^{\circ}C$  (238 K), and which decomposes at  $-20^{\circ}C$  (253 K). In the binary system  $UO_2(NO_3)_2 - H_2O$ , 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

COMPONENTS:			EVALUATOR:		
(1) Uranyl nitrate [15905-86-9]	e; UO <sub>2</sub> (NO <sub>3</sub> )2	;	S. Siekiers Warsaw, Pol and		
(2) Water; H <sub>2</sub> O; [7	732-18-5]		S. L. Phill Orinda, Cal		S.A.
CRITICAL EVALUATIO	N: (Contir	nued)		<u></u>	
Table 1. Summary					
		•	temperature	range 253	K to 334 K,
conside	ered for fit	ting to E	lq 1.		
	olubility			Solubility	
T/K	mol/kg	Ref.	T/K	mol/kg	Ref.
253.15	2.105	12	*298.15	3.213	25
255.05	1.921	3	*298.15	3.217	8
261.05 261.65	2.119 2.182	3 8	*298.15 *298.15	3.219 3.22	25 21
*267.65	2.387	8	*298.15	3.22	30
268.95	2.099	8	*298.15	2 222	28,29,35
*270.95	2.414	3	298.15	3.223 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 *278.65	2.67 2.594	21 8	305.05 305.65	3.728 4.00	24 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
*285.45 287	2.846 1.25	3 1	*316.75 *318.35	4.551 4.734	8 3
207	1.25	T	.210.23	4.734	2
287.15	2.94	24	*323.15	5.218	25
*288.15	2.839	8	*323.15	5.27	22
*288.15 *288.15	2.84 2.85	21 30	*324.95 *327.65	5.329 5.993	3 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 <sup>C</sup>	8.50	24
*293.15	3.03	21	333.15 <sup>C</sup>	9.27	24
*293.55	3.08	24	333.4 <sup>0</sup> 334.15 <sup>0</sup>	9.250	3
294.25 296.35	3.175 3.31	8 24	334.15	8.64	24
<sup>a</sup> Mean tempe		~ .			
b <sub>Temperatur</sub> error in C	e according hem. Zentr.	to Ref. <u>1910</u> , <i>11</i>	(8). There m , 1527.	ust be a t	pographical
C <sub>Metastable</sub>	equilibriu	m.			
<sup>d</sup> Temperatur (3). The c	e of the co orrespondin	ngruent m g molalit	elting point y was calcula	of the her ated by the	kahydrate e evaluators.
				-	

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COMPONENTS:

(1) Uranyl nitrate; U [15905-86-9]	0 <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;
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(2) Water; H<sub>2</sub>O; [7732-18-5]

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

CRITICAL EVALUATION: (Continued)

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  $UO_2(NO_3)_2 - HNO_3 - H_2O$ . This means that the eutectic temperature for the hexahydrate and ice must exceed 253.8 K. EVALUATION PROCEDURE

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  $UO_2(NO_3)_2 - HNO_3 - H_2O$  were also used in the analysis. These data were fitted initially to the general solubility equation, Eq 1, with d = 0.

 $Y = \ln (m/m_0) - (m/m_0 - 1) = a + b/T + c \ln (T) + d (T)$ (1) In Eq 1, m is the solubility of the solute in units of mol/kg, at the temperature T/K; m<sub>0</sub> 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.

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,  $\sigma_{\rm Y}$ , and the value of Grubbs parameter k (15) at the 0.05 significance level exceeded  $k_{0.05}\sigma_{\rm Y}$ . 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  $k_{0.05}\sigma_{\rm Y}$ .

SOLUBILITY IN THE SYSTEM UO2(NO3)2.6H20 - H20

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

COMPONENTS:	EVALUATOR:
 (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	S. Siekierski Warsaw, Poland and
(2) Water; H <sub>2</sub> O; [7732-18-5]	S. L. Phillips Orinda, California U.S.A.

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  $UO_2(NO_3)_2$  at 298.2 K in the  $UO_2(NO_3)_2.6D_2O - D_2O$  system is 2.720 mol/kg (37). This value is considerably lower than in ordinary

### COMPONENTS:

(1)	Uranyl nitrate; [15905-86-9]	<sup>UO</sup> 2 <sup>(NO</sup> 3)2;

(2) Water; H<sub>2</sub>O; [7732-18-5]

## EVALUATOR:

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

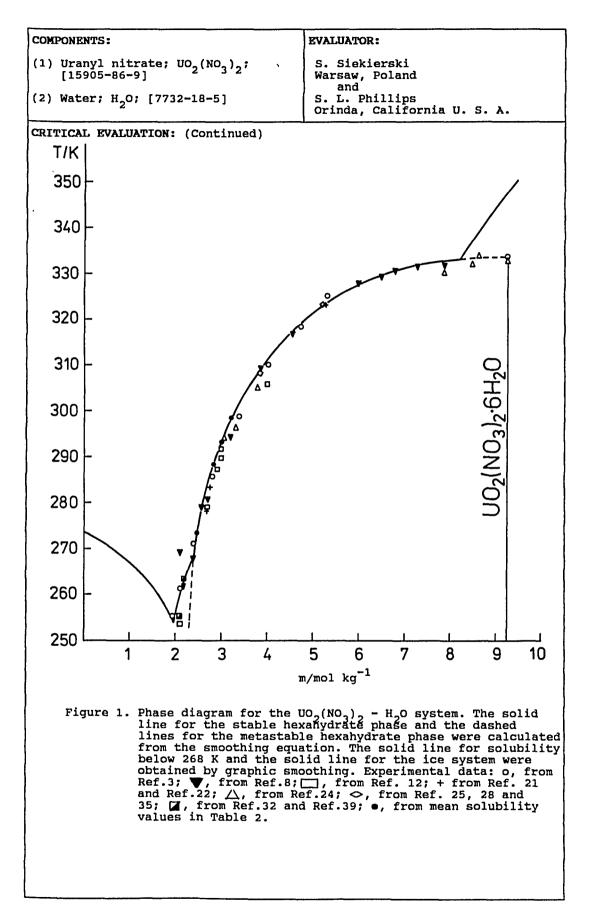
#### CRITICAL EVALUATION: (Continued)

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 an 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.

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.

The remaining data were fitted to Eq 1, and the values from Vasil'ev (3)

mitmotes II					
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]			S. Siekierski Warsaw, Poland		
H <sub>2</sub> 0; [7732	-18-5]	S. L.	Phillips	rnia U. H	S. A.
ALUATION:	(Continued)				
2. Invaria	nt points in	the UO <sub>2</sub> (NO	<sub>3</sub> ) <sub>2</sub> - н <sub>2</sub> о	binary :	system.
Invaria	nt point	T/K	mo	lality	Ref.
		<u></u>	ma	ol/kg	12
enrecric		>253.8	-		21
		255.1	1.	921	3
		331.8 333	-		8,10 17
hexahydrat	e congruent	333.4	9	9.251 <sup>a</sup>	3
trihydrate dihydrate	to transition	386.2	14	1.02	14,17
trihydrate	congruent	394.7	18	3.50 <sup>a</sup>	3
dihydrate	congruent				3
		457.2			14,17 10
<sup>a</sup> Theore	tical value.				
3. Mean so measure	lubilities o ments.	f UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	.6H <sub>2</sub> 0 in v	vater fro	om repeat
	m	σm	t <sub>0.05</sub> σ <sub>m</sub>		
	mol/kg	mol/kg		Ref.	
5 <sup>a</sup>	2.491	0.0075	0.021	3,21,29 28	5,
3	2.843	0.0035	0.015	8,21,3	D
5	3.011	0.0010	0.028	8,9,16 19,21	,
10	3.229	0.0048	0.011	5,8,21 23,25, 30,34	
denotes th	e mean value	of solubil:	ity; σ <sub>m</sub> is	the	
andard dev	iation of th	e mean; t <sub>o.</sub>	05 is the	Student	's
t statistic at the 0.05 significance level.					
				в.з к.	
	H <sub>2</sub> O; [7732 ALUATION: 2. Invaria Invaria eutectic hexahydrat trihydrate hexahydrat trihydrate dihydrate dihydrate 3. Mean so measure mber of a points 5 <sup>a</sup> 10 denotes th andard dev	H <sub>2</sub> O; [7732-18-5] ALUATION: (Continued) 2. Invariant points in Invariant point eutectic hexahydrate to trihydrate transition hexahydrate congruent trihydrate congruent dihydrate congruent dihydrate congruent aTheoretical value. 3. Mean solubilities o measurements. m mber of a points mol/kg 5 <sup>a</sup> 2.491 3 2.843 5 3.011 10 3.229 denotes the mean value andard deviation of th	$H_2O; [7732-18-5]$ an S. L. OrindaVALUATION: (Continued)2. Invariant points in the $UO_2(NO$ Invariant point $T/K$ eutectic $<253.2$ $>253.8$ $255.1$ hexahydrate to trihydrate transition331.8 $333$ hexahydrate congruent $333.4$ trihydrate transitiontrihydrate congruent $394.7$ $457.2$ $460$ a Theoretical value. $452.5$ $457.2$ $460$ 3. Mean solubilities of $UO_2(NO_3)_2$ measurements.m $\sigma_m$ $m$ $10$ 10 $3.229$ 0.001010 $3.229$ 10 $3.229$ 10 $3.229$ 10 $3.229$ 10 $3.229$ 10 $3.229$ 10 $3.229$ 10 $3.229$ 10 $3.229$ 10 $3.229$ 101	$H_2O; [7732-18-5]$ and S. L. Phillips Orinda, Califor Orinda, Califor Model Science Orinda, Califor Model Science Science Orinda, Califor Model Science Science Orinda, Califor Model Science Orinda, Califor Model Science Orinda, Califor Model Science Orinda, Califor Model Science Orinda, Califor Model Science Science Orinda, Califor Model Science Science Orinda, Califor Model Science Orinda, Califor Model Science Science Science Orinda, Califor Model Science 	$H_2O; [7732-18-5]$ and S. L. Phillips Orinda, California U. 1ALUATION: (Continued)2. Invariant points in the $UO_2(NO_3)_2 - H_2O$ binary for a point point $T/K$ molalityInvariant point $T/K$ molalityeutectic $\sim 253.2$ $\sim$ $\sim 255.1$ $1.921$ hexahydrate to $331.8$ $$ trihydrate transition $333.4$ $9.251^a$ trihydrate transition $386.2$ $14.02$ trihydrate congruent $394.7$ $18.50^a$ dihydrate congruent $394.7$ $2.77$ $a$ $a$ $2.643$ $0.002(NO_3)_2.6H_2O$ in water from the measurements. $a$ $2.843$ $0.0035$ $0.021$ $3.2843$ $0.0035$ $0.015$ $8.21.30$ $5$ $3.011$ $0.0010$ $0.028$ $8.9.16$ $19.21$ $10$ $3.229$ $0.0048$ $0.011$ $5.8.21.30$ $30.34$ denotes the mean value of solubility; $\sigma_m$ is the transition of the mean; $t_{0.$



COMPONENTS:		EVALUATOR:
	(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	S. Siekierski Warsaw, Poland and
	(2) Water; H <sub>2</sub> O; [7732-18-5]	S. L. Phillips Orinda, California U. S. A.

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,  $\sigma_v$ , 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 298.2K. Standard deviations in the solubility values obtained from this fit,  $\sigma_{\rm m}$ , 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

COMPONENTS:	EVALUATOR:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	S. Siekierski Warsaw, Poland and
(2) Water; H <sub>2</sub> O; [7732-18-5]	S. L. Phillips Orinda, California U. S. A.

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.

Results for the analyses with Eq 1 on the solubility of  $UO_2(NO_3)_2$  in the  $UO_2(NO_3)_2.6H_2O - H_2O$  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  $\sigma_m$  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  $\sigma_m$ , so that the overall uncertainty in the recommended values is equal to the imprecision from the fit. This was found to increase from  $\pm 0.008$  mol/kg at 273.2 K, through  $\pm 0.012$  mol/kg at 298.2 K to  $\pm 0.05$  mol/kg at 328.2 K.

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 Th(NO<sub>3</sub>)<sub>4</sub> - H<sub>2</sub>O system in this work. Additional experimental data are needed on the solubility of UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> below 270K, to confirm the

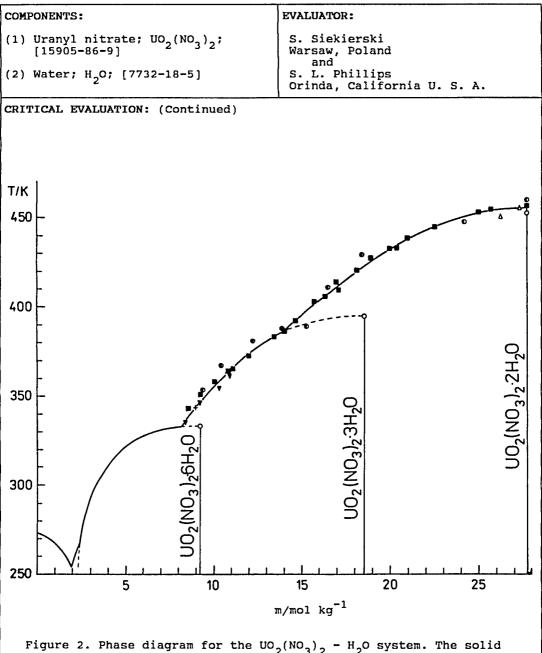


Figure 2. Phase diagram for the UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> - H<sub>2</sub>O system. The solid lines represent stable phases and dashes lines are for metastable phases. These were calculated from smoothing equation. Solid line for solubility below 268 K and the solid line for the ice system were obtained by graphical smoothing. Experimental data: o, Ref. 3; ▼, Ref. 8; ●, Ref. 10; ■, Ref. 14, 17; +, Ref. 21,22; △, 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.

			EVALUATOR:	
l) Uranyl nit [15905-86-	rate; UO <sub>2</sub> (NO <sub>3</sub> 9]	)2;	S. Siekierski Warsaw, Poland	
?) Water; H <sub>2</sub> O	; [7732-18-5]		and S. L. Phillips Orinda, Californ	nia U. S. A.
ITICAL EVALU	ATION: (Contin	nued)		
Table 4.	Values of the	parameters	and the standard	1
	deviations for	r the smoot	hing equation, Ed	11.
	Parameter			andard Lation
	a	964.61	B mol/kg 0	.0149
	b	-23711.09	mol/(kg K) 4	.57
	С	-172.09	4 mol/kg 0	.00261
	d	0.31	B <b>7</b> 0.	.0000489
	mo	9.25	mol/kg 0	.0149 <sup>a</sup>
	<sup>a</sup> Standard er	ror of the (	estimate.	
	002(N03)2.6H20	D, obtained		
	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> 0 Solul	D, obtained	with Eq 1 <sup>a</sup> . Solui	oility
	002(N03)2.6H20	D, obtained	with Eq 1 <sup>a</sup> .	
	$\frac{UO_2(NO_3)_2.6H_2}{SOlul}$	D, obtained bility mol/kg 2.17	with Eq 1 <sup>a</sup> . Solut $\frac{T/K}{298.15}$	mol/kg 3.21
	UO2(NO3)2.6H2 Solul T/K	D, obtained Dility mol/kg	with Eq 1 <sup>a</sup> . Solul <u>T/K</u>	mol/kg
	UO2(NO3)2.6H2 Solul T/K 258.15 263.15 268.15 268.15 273.15	D, obtained bility mol/kg 2.17 2.28 2.39 2.49	with Eq 1 <sup>a</sup> . Solul <u>T/K</u> 298.15 303.15 308.15 313.15	mol/kg 3.21 3.44 3.71 4.07
	UO2(NO3)2.6H2 Solul T/K 258.15 263.15 268.15 273.15 278.15	D, obtained bility mol/kg 2.17 2.28 2.39	with Eq 1 <sup>a</sup> . Solul <u>T/K</u> 298.15 303.15 308.15	mol/kg  3.21 3.44 3.71
	UO2(NO3)2.6H2 Solul T/K 258.15 263.15 268.15 273.15 278.15 283.15	D, obtained bility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73	with Eq 1 <sup>a</sup> . Solul T/K 298.15 303.15 308.15 313.15 318.15 323.15	mol/kg  3.21 3.44 3.71 4.07 4.53 5.17
	UO2(NO3)2.6H2 Solul T/K 258.15 263.15 268.15 273.15 278.15	D, obtained Dility mol/kg  2.17 2.28 2.39 2.49 2.61	with Eq 1 <sup>a</sup> . Solul <u>T/K</u> 298.15 303.15 308.15 313.15 318.15	mol/kg  3.21 3.44 3.71 4.07 4.53
	UO2(NO3)2.6H2 Solul T/K 258.15 263.15 268.15 273.15 278.15 283.15 288.15 293.15	D, obtained bility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73 2.87 3.03	with Eq 1 <sup>a</sup> . Solul <u>T/K</u> 298.15 303.15 308.15 313.15 318.15 323.15 328.15 328.15 332.15	bility mol/kg 3.21 3.44 3.71 4.07 4.53 5.17 6.17 9.25 <sup>b</sup>
	UO2(NO3)2.6H2 Solul T/K 258.15 263.15 268.15 273.15 278.15 283.15 288.15 293.15	D, obtained pility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73 2.87 3.03 cated solid	with Eq 1 <sup>a</sup> . Solul <u>T/K</u> 298.15 303.15 308.15 313.15 318.15 323.15 328.15 328.15 322.15	bility mol/kg 3.21 3.44 3.71 4.07 4.53 5.17 6.17 9.25 <sup>b</sup> with more th
	UO2(NO3)2.6H2 Solul 7/K 258.15 263.15 268.15 273.15 273.15 278.15 283.15 283.15 293.15	D, obtained Dility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73 2.87 3.03 Cated solid the temperat	with Eq 1 <sup>a</sup> . Solul 7/K 298.15 303.15 308.15 313.15 318.15 323.15 328.15 328.15 322.15 may be a hydrate	bility mol/kg 3.21 3.44 3.71 4.07 4.53 5.17 6.17 9.25 <sup>b</sup> with more th
	UO2(NO3)2.6H2 Solul T/K 258.15 263.15 268.15 273.15 278.15 283.15 288.15 293.15	D, obtained Dility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73 2.87 3.03 Cated solid the temperat	with Eq 1 <sup>a</sup> . Solul 7/K 298.15 303.15 308.15 313.15 318.15 323.15 328.15 328.15 322.15 may be a hydrate	bility mol/kg 3.21 3.44 3.71 4.07 4.53 5.17 6.17 9.25 <sup>b</sup> with more th
	UO2(NO3)2.6H2 Solul 7/K 258.15 263.15 268.15 273.15 273.15 278.15 283.15 283.15 293.15	D, obtained Dility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73 2.87 3.03 Cated solid the temperat	with Eq 1 <sup>a</sup> . Solul 7/K 298.15 303.15 308.15 313.15 318.15 323.15 328.15 328.15 322.15 may be a hydrate	bility mol/kg 3.21 3.44 3.71 4.07 4.53 5.17 6.17 9.25 <sup>b</sup> with more th
	UO2(NO3)2.6H2 Solul 7/K 258.15 263.15 268.15 273.15 273.15 278.15 283.15 283.15 293.15	D, obtained Dility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73 2.87 3.03 Cated solid the temperat	with Eq 1 <sup>a</sup> . Solul 7/K 298.15 303.15 308.15 313.15 318.15 323.15 328.15 328.15 322.15 may be a hydrate	bility mol/kg 3.21 3.44 3.71 4.07 4.53 5.17 6.17 9.25 <sup>b</sup> with more th
	UO2(NO3)2.6H2 Solul 7/K 258.15 263.15 268.15 273.15 273.15 278.15 283.15 283.15 293.15	D, obtained Dility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73 2.87 3.03 Cated solid the temperat	with Eq 1 <sup>a</sup> . Solul 7/K 298.15 303.15 308.15 313.15 318.15 323.15 328.15 328.15 322.15 may be a hydrate	bility mol/kg 3.21 3.44 3.71 4.07 4.53 5.17 6.17 9.25 <sup>b</sup> with more th
	UO2(NO3)2.6H2 Solul 7/K 258.15 263.15 268.15 273.15 273.15 278.15 283.15 283.15 293.15	D, obtained Dility mol/kg 2.17 2.28 2.39 2.49 2.61 2.73 2.87 3.03 Cated solid the temperat	with Eq 1 <sup>a</sup> . Solul 7/K 298.15 303.15 308.15 313.15 318.15 323.15 328.15 328.15 322.15 may be a hydrate	bility mol/kg 3.21 3.44 3.71 4.07 4.53 5.17 6.17 9.25 <sup>b</sup> with more th

COMPONENTS: (1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (2) Water; H<sub>2</sub>O; [7732-18-5] EVALUATOR: S. Siekierski, Warsaw, Poland and S. L. Phillips, Orinda, California

CRITICAL EVALUATION: (Continued) existence and exact composition of a high hydrate phase.

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/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  $UO_2(NO_3)_2 - HNO_3 - H_2O$  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  $\pm 0.05$  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.

## SOLUBILITIES IN THE SYSTEM UO (NO3) 2.3H 0 - H 0

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).

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

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	EVALUATOR: S. Siekierski Warsaw, Poland and
(2) Water; H <sub>2</sub> O; [7732-18-5]	S. L. Phillips Orinda, California U. S. A.

CRITICAL EVALUATION: (Continued) 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.

The results of the analyses for the solubility of  $UO_2(NO_3)_2$  in the system  $UO_2(NO_3)_2.3H_2O - H_2O$  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  $\sigma_m$  is the standard deviation in the solubility. The overall uncertainty calculated in this manner was found to be about  $\pm 0.1$  mol/kg at 338.2 K,  $\pm 0.15$  mol/kg at 363.2 K, and  $\pm 0.3$  mol/kg at 383.2 K.

# SOLUBILITIES IN THE SYSTEM UO2(NO3)2.2H20 - H20

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

				EVALUATOR	•	
(1) Urany [1590	1 nitrat 5-86-9]	e; UO <sub>2</sub> (1	<sup>NO</sup> 3) <sub>2</sub> ;	S. Sieki Warsaw, and		
(2) Water	2) Water; H <sub>2</sub> O; [7732-18-5]			S. L. Ph	illips California	U. S. A
CRITICAL	EVALUATI	ON: (Cor	ntinued)			
Tabl	.e 6. Sol UO <sub>2</sub>	ubility (NO3)2.	data for UC 3H <sub>2</sub> 0 - H <sub>2</sub> 0.	$O_2(NO_3)_2$ in	the system	
	So	lubility	1		Solubility	ł
	<i>Т/</i> К	mol/kg	Ref.	T/K	mol/kg	
3	35.2	8.415	8	363.7	10.81	14,17
3	43.2	8.617	14,17	365.2	11.08	14,17
د د	43.2	8.998	22	367	10.5	10
3	43.2 43.2 45.6 50.4	9.260	14,17	363.7 365.2 367 373.2 381	12.02	14,17 10
	53		10			
2	64 1 1	0 10	0	386.2 <sup>a</sup>	13.46 14.02	14,17
3	58.2 1	0.10	14,17	*388	13.9	10
3	61.7 1	0.91	8	*388 *389b *394.7 <sup>C</sup>	15.3	10
3	63.2 1	0.82	22	*394.7	18.50	3
a	The trih	ydrate –	> dihydrat	e transitio:	n point (14	4,17).
	Metastab					
С	Congruen molality	t meltir was cal	ng point of lculated by	the trihydr the evaluat	ate (3). Th ors.	ne corre
*	molality Not used e 7. Par	was cal in fitt ameters	lculated by	the evaluat d deviation	ors.	
* Tabl	molality Not used e 7. Par	was cal in fitt ameters tem UO <sub>2</sub> (	lculated by ting. and standar	the evaluat d deviation - H <sub>2</sub> 0.	ors.	
* Tabl	molality Not used e 7. Par sys Paramete	was cal in fitt ameters tem UO <sub>2</sub> ( r	lculated by ting. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value	the evaluat d deviation - H <sub>2</sub> O. er D	ors. s for Eq 1, Standard eviation	
* Tabl	molality Not used e 7. Par sys	was cal in fitt ameters tem UO <sub>2</sub> ( r	lculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/	the evaluat d deviation - H <sub>2</sub> O. er D	ors. s for Eq 1, Standard	
* Tabl	molality Not used e 7. Par sys Paramete a b c	was call in fitt ameters tem $UO_2($ r 121	Iculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ (k-65.227 mol/(k-65.227 mol/	the evaluat d deviation - H <sub>2</sub> O. er D /kg 	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212	
* Tabl	molality Not used e 7. Par sys Paramete a b c d	was call in fitt ameters tem $UO_2($ r 121	lculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 148.7 mol/(k -65.227 mol/ 0.09145	the evaluat d deviation - H <sub>2</sub> O. r D (kg K) (kg	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346	
* Tabl	molality Not used e 7. Par sys Paramete a b c d m o	was cal in fitt ameters tem UO <sub>2</sub> ( r 	lculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/(k -65.227 mol/(k 0.09145 18.50 mol/k	the evaluat d deviation - H <sub>2</sub> O. er D /kg	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212	
* Tabl	molality Not used e 7. Par sys Paramete a b c d m o <sup>a</sup> Standar	was cal in fitt ameters tem UO <sub>2</sub> ( r -12] d error	lculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/(k 65.227 mol/(k 65.227 mol/k 18.50 mol/k of the esti	the evaluat d deviation - H <sub>2</sub> O. er  (kg  (kg  (kg  (kg  (kg  (kg  (kg ) (kg) (kg) (kg) (kg) (kg) (kg) (kg) (kg	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346 0.0124	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d mo <sup>a</sup> Standar e 8. Rec sys	was cal in fitt ameters tem UO <sub>2</sub> ( r -121 d error	lculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 48.7 mol/(k -65.227 mol/ 0.09145 18.50 mol/kt of the esti ained with	the evaluat d deviation - H <sub>2</sub> O. er - D 	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346 0.0124 0.0124 0.0124 0.0003, 2.3H	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d m o a Standar e 8. Rec sys S	was cal in fitt ameters tem UO <sub>2</sub> ( r 	lculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 48.7 mol/(k -65.227 mol/ 0.09145 18.50 mol/k of the esti a solubilititicained with Ey	the evaluat d deviation - H <sub>2</sub> O. er D /kg kg kg kg mate. es in the U Eq 1. Sol	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.000346 0.0124 0.0124 0.0124 0.000346 0.0124	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d mo <sup>a</sup> Standar e 8. Rec sys	was cal in fitt ameters tem UO <sub>2</sub> ( r 	lculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 48.7 mol/(k -65.227 mol/ 0.09145 18.50 mol/kt of the esti ained with	the evaluat d deviation - H <sub>2</sub> O. er - D 	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346 0.0124 0.0124 0.0124 0.0003, 2.3H	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d m o a Standar e 8. Rec sys S <u>T/K</u> 338.	was cal in fitt ameters tem UO <sub>2</sub> ( r -121 d error ommended tem, obt olubilit	lculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 48.7 mol/(k -65.227 mol/ 0.09145 18.50 mol/k of the esti ained with cy mol/kg 8.54	the evaluat d deviation - $H_2O$ . er $\frac{D}{Kg}$ ig K) kg ig mate. es in the U Eq 1. Sol $\frac{T/K}{368.15}$	ors. s for Eq 1, Standard eviation $\overline{0.0124}$ 4.49 0.00212 0.0000346 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.000346 0.0124 0.0124 0.0124 0.000346 0.0124 0.0124 0.0124 0.000346 0.0124 0.0124 0.0124 0.000346 0.0124 0.0124 0.0124 0.000346 0.0124 0.0124 0.0124 0.000346 0.0124 0.0124 0.0124 0.000346 0.0124 0.0124 0.0124 0.0124 0.0124 0.000346 0.0124	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d mo a standar e 8. Rec sys S T/K 338. 343.	was cal in fitt ameters tem UO <sub>2</sub> ( r -121 d error ommended tem, obt olubilit	Iculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/(k 65.227 mol/(k 65.227 mol/(k 65.227 mol/k 0.09145 18.50 mol/k of the esti ained with y mol/kg 8.54 8.93	the evaluat d deviation $-H_2O$ . er $\frac{D}{kg}$ $\frac{C}{kg}$	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346 $0.0124^{a}$ $0.0124^{a}$ $0.0124^{a}$ $0.0124^{a}$ $0.0124^{a}$ $0.0124^{a}$	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d m o a Standar e 8. Rec sys S <u>T/K</u> 338. 343. 348.	was cal in fitt ameters tem UO <sub>2</sub> ( r -121 d error ommended tem, obt olubilit	Iculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 48.7 mol/(k -65.227 mol/ 0.09145 18.50 mol/kt of the esti ained with -y mol/kg 8.54 8.93 9.33	the evaluat d deviation = H <sub>2</sub> O. er $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{K}$ $\frac{1}{T/K}$ $\frac{1}{368.15}$ $\frac{1}{373.15}$ 378.15	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 1.2 11.2 11.8 12.5	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d m o a standar e 8. Rec sys S T/K 338. 343. 348. 353.	was cal in fitt ameters tem UO <sub>2</sub> ( r -12] d error ommended tem, obt olubilit	Iculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 48.7 mol/(k -65.227 mol/ 0.09145 18.50 mol/k of the esti ained with -y mol/kg 8.54 8.93 9.33 9.74	the evaluat d deviation = H <sub>2</sub> O. er $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{K}$ $\frac{1}{T/K}$ $\frac{1}{368.15}$ $\frac{1}{373.15}$ $\frac{1}{378.15}$ $\frac{1}{383.15}$	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 1.2 11.2 11.8 12.5	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d m o a Standar e 8. Rec sys S <u>T/K</u> 338. 343. 348.	was cal in fitt ameters tem UO <sub>2</sub> ( r 	Iculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 48.7 mol/(k -65.227 mol/ 0.09145 18.50 mol/kt of the esti ained with -y mol/kg 8.54 8.93 9.33	the evaluat d deviation = H <sub>2</sub> O. er $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{Kg}$ $\frac{1}{K}$ $\frac{1}{T/K}$ $\frac{1}{368.15}$ $\frac{1}{373.15}$ 378.15	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346 0.0124 0.0124 0.0124 0.0124 0.0124 1.2 11.2 11.8 12.5 13.3 <sub>a</sub>	, for th
* Tabl	molality Not used e 7. Par sys Paramete a b c d m o a standar e 8. Rec sys S T/K 338. 343. 348. 353. 358. 363.	was cal in fitt ameters tem UO <sub>2</sub> ( r -121 d error ommended tem, obt olubilit	Iculated by ing. and standar (NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O Paramete Value 384.618 mol/ 48.7 mol/(k 65.227 mol/ 0.09145 18.50 mol/k of the esti a solubiliti cained with Fy mol/kg 8.54 8.93 9.33 9.74 10.2	the evaluat d deviation = H <sub>2</sub> O. er $\frac{1}{2}$ G $\frac{1}{2}$ G	ors. s for Eq 1, Standard eviation 0.0124 4.49 0.00212 0.0000346 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 0.0124 1.2 11.2 11.8 12.5	, for th

COMPONENTS:

# (1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9]

(2) Water; H\_O; [7732-18-5]

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

#### CRITICAL EVALUATION: (Continued)

outlier and was rejected. No outlier was found in the second fitting. The results of the analyses for the solubility of UO2(NO3)2 in the system UO<sub>2</sub>(NO<sub>2</sub>)<sub>2</sub>.2H<sub>2</sub>O - H<sub>2</sub>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  $\sigma_{
m m}$  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  $\pm 0.15$  mol/kg at 388.2 K,  $\pm 0.25$  at 423.2 K, and ±0.5 mol/kg at 448.2 K.

#### THE SYSTEM ICE - UO, (NO,)

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.

386.15 <sup>a</sup> 14.02         14,17         433.15         20.41         14,17           393.15         14.67         14,17         439.65         21.00         14,17	) Uranyl nitrate; [15905-86-9]		1		
2) Water; H <sub>2</sub> 0; [7732-18-5] RTTICAL EVALUATION: (Continued) Table 9. Solubility data for UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> in the system UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> O - H <sub>2</sub> O Solubility T/K mol/kg Ref. T/K mol/kg Ref. Table 10. Parameters and standard deviations for Eq 1, for the system UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> :2H <sub>2</sub> O - H <sub>2</sub> O. Parameter Parameter Parameter Parameter Not used in fitting to Eq 1. Table 10. Parameters and standard deviations for Eq 1, for the system UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> :2H <sub>2</sub> O - H <sub>2</sub> O. Parameter Parameter Parameter Not used in fitting to Eq 1. Table 10. Parameters and standard deviations for Eq 1, for the system UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> :2H <sub>2</sub> O - H <sub>2</sub> O. Parameter Parameter Not used in fitting to Eq 1. Table 10. Parameter Standard Deviation Table 11. Recommended solubilities in the UO <sub>2</sub> (NO <sub>2</sub> ) <sub>0</sub> :2H <sub>2</sub> O - H.	-	uo <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Warsaw, P		
Table 9. Solubility data for $UO_2(NO_3)_2$ in the system $UO_2(NO_3)_2 \cdot 2H_2O - H_2O$ Solubility       Solubility $\overline{T/K}$ $\overline{mol/kg}$ Ref. $\overline{T/K}$ $\overline{mol/kg}$ Ref. $\overline{386.15^a}$ $\overline{14.02}$ $14.17$ $433.15$ $\overline{20.41}$ $14.17$ $39.15$ $14.67$ $14.17$ $433.15$ $\overline{20.41}$ $14.17$ $403.15$ $15.76$ $14.17$ $445.15$ $22.64$ $14.17$ $410.15$ $17.09$ $14.17$ $445.15$ $24.2$ $14.17$ $410.15$ $17.09$ $14.17$ $445.15$ $24.9$ $14.17$ $413.15$ $16.32$ $14.17$ $445.15$ $25.98$ $14.17$ $412.15$ $10$ $*452.5^b$ $27.75$ $14.17$ $427.65$ $19.02$ $14.17$ $*454.15$ $25.98$ $14.17$ $427.65$ $19.02$ $14.17$ $*454.15$ $25.98$ $14.17$ $427.65$ $19.02$ $14.17$ $*457.15^d$ $27.78$ $14.17$ $427.15$ $18.4$ $10$ $*457.15^d$ <td>) Water; H<sub>2</sub>0; [773</td> <td>2-18-5]</td> <td>S. L. Phi</td> <td>llips alifornia</td> <td>U.S.A.</td>	) Water; H <sub>2</sub> 0; [773	2-18-5]	S. L. Phi	llips alifornia	U.S.A.
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	TTICAL EVALUATION:	(Continued)	<sup>1</sup>		
$\frac{T/K}{386.15^{a}} \frac{14.02}{14.02} \frac{14.17}{14.17} \frac{433.15}{433.15} \frac{20.41}{20.41} \frac{14.17}{14.17} \frac{433.15}{393.15} \frac{20.41}{14.07} \frac{14.17}{14.17} \frac{433.15}{393.15} \frac{20.41}{14.17} \frac{14.17}{490.65} \frac{14.00}{14.17} \frac{14.17}{445.15} \frac{14.00}{22.64} \frac{14.17}{14.17} \frac{445.15}{445.15} \frac{22.64}{22.64} \frac{14.17}{14.17} \frac{14.17}{445.15} \frac{14.17}{24.2} \frac{10}{10} \frac{14.17}{11.15} \frac{16.5}{16.32} \frac{10}{14.17} \frac{14.52.5^{b}}{451.2} \frac{27.75}{27.75} \frac{14.17}{14.17} \frac{14.135}{12.20.15} \frac{17.09}{14.17} \frac{14.17}{455.15} \frac{14.52}{27.73} \frac{24}{24} \frac{14.17}{422.15} \frac{14.17}{100} \frac{14.17}{455.5} \frac{14.52}{27.73} \frac{24}{24} \frac{14.12}{422.15} \frac{19.02}{14.17} \frac{14.17}{455.5} \frac{14.52}{27.73} \frac{24}{24} \frac{14.22}{15} \frac{15.4}{10} \frac{10}{14.17} \frac{14.55}{457.5} \frac{12.77}{27.3} \frac{14.17}{10} \frac{14.22}{432.15} \frac{14.17}{20.00} \frac{14.17}{14.17} \frac{14.55}{460.15} \frac{27.77}{27.7} \frac{10}{10} \frac{14.17}{432.15} \frac{14.17}{20.00} \frac{14.17}{14.17} \frac{14.52}{440.15} \frac{27.78}{27.73} \frac{14.17}{27.7} \frac{14.27}{432.15} \frac{14.17}{20.00} \frac{14.17}{14.17} \frac{14.57}{4460.15} \frac{27.77}{27.7} \frac{16}{10} \frac{14.17}{432.15} \frac{16.2}{20.00} \frac{14.17}{14.17} \frac{14.17}{4460.15} \frac{14.17}{27.78} \frac{14.17}{14.17} \frac{14.17}{432.15} \frac{14.17}{20.00} \frac{14.17}{14.17} 1$	Table 9. Solubi UO <sub>2</sub> (NO	lity data for U <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> O - H <sub>2</sub> O	$O_2(NO_3)_2$ in t	he system	
$\frac{386.15^{a}}{393.15} \frac{14.02}{14.67} \frac{14,17}{14,17} \frac{433.15}{433.15} \frac{20.41}{20.01} \frac{14,17}{14,17} \frac{1433.15}{439.65} \frac{20.41}{21.00} \frac{14,17}{14,17} \frac{1433.15}{403.15} \frac{20.41}{14.17} \frac{144.17}{406.15} \frac{14.67}{16.32} \frac{14,17}{14,17} \frac{445.15}{448.15} \frac{22.64}{24.2} \frac{10}{10} \frac{141.17}{10.15} \frac{16.5}{17.09} \frac{14,17}{14,17} \frac{445.15}{448.15} \frac{24.2}{24.2} \frac{10}{14,17} \frac{141.35}{448.15} \frac{17.01}{24.2} \frac{14,17}{14.35} \frac{14.67}{17.01} \frac{14,17}{14,17} \frac{445.15}{4454.15} \frac{25.98}{27.75} \frac{14,17}{14.17} \frac{1420.15}{420.15} \frac{18.18}{18.14} \frac{14,17}{10} \frac{1455.5^{b}}{27.73} \frac{24}{24} \frac{14.27}{420.15} \frac{18.4}{10} \frac{10}{14.17} \frac{1455.15}{27.78} \frac{27.3}{14.17} \frac{24}{429.15} \frac{24.99}{14.17} \frac{14.17}{432.15} \frac{20.00}{20.00} \frac{14,17}{14.17} \frac{1460.15}{27.77} \frac{27.78}{14.17} \frac{14.17}{432.15} \frac{14.67}{20.00} \frac{14.17}{14.17} \frac{1460.15}{27.77} \frac{10}{10} \frac{a}{a}$ The trihydrate> dihydrate transition point (14,17). $\frac{b}{Congruent} \text{ melting point of the dihydrate (3). Molality we calculated by the evaluator.}$ $\frac{c}{The reported solubility corresponds to the temperature interval 454 - 457 K (24).$ $\frac{d}{congruent} \text{ melting point of the dihydrate (14,17).}$ *Not used in fitting to Eq 1. Table 10. Parameters and standard deviations for Eq 1, for the system $UO_2(NO_3)_2.2H_2O - H_2O.$ $\frac{Parameter}{a} \frac{576.981 \text{ mol/kg}}{0.0000144} \frac{0.0000144}{0.0000144} \frac{0.0000144}{0.0000144} \frac{0.0000144}{0.0000144} \frac{0.0000144}{0.0000144} \frac{0.0000144}{0.0000144} \frac{0.0000144}{0.0000144} \frac{0.0000144}{0.0000144} \frac{0.00000144}{0.0000144} \frac{0.0000144}{0.00000144} \frac{0.0000144}{0.00000144} \frac{0.0000144}{0.00000144} \frac{0.0000144}{0.00000144} \frac{0.0000144}{0.00000144} \frac{0.00000144}{0.00000144} \frac{0.0000014}{0.00000144} \frac{0.00000014}{0.00000144} \frac{0.0000014}{0.00$	Solub	ility		Solubilit	У
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-		T/K	mol/kg	Ref.
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	386.15 <sup>a</sup> 14.	02 14,17	433.15	20.41	14,17
$\frac{411.15}{414.35} \frac{16.5}{17.01} \frac{14,17}{14,17} \frac{452.5^{b}}{453.15} \frac{27.75}{24.99} \frac{14,17}{14,17} \frac{420.15}{420.15} \frac{18.18}{18.18} \frac{14,17}{14,17} \frac{454.15}{455.5^{c}} \frac{27.3}{27.38} \frac{14,17}{24} \frac{427.65}{422.15} \frac{18.4}{10} \frac{10}{457.15^{d}} \frac{27.78}{27.78} \frac{14,17}{10} \frac{1427.15}{432.15} \frac{20.00}{14,17} \frac{14,17}{460.15} \frac{27.77}{27.78} \frac{14,17}{10} \frac{1427.15}{432.15} \frac{20.00}{14,17} \frac{14,17}{460.15} \frac{27.77}{27.77} \frac{14}{10} \frac{14}{10} \frac{14}{17} \frac{14}{10} \frac{14}{17} \frac{14}{10} \frac{14}{17} \frac{14}{10} \frac{14}{10} \frac{14}{17} \frac{14}{10} \frac{14}{17} \frac{14}{10} \frac{14}{11} \frac{11}{11} \frac{14}{11} \frac{14}{1$	393.15 14.	67 14.17	439.65	21.00	14,17
$\frac{411.15}{414.35} \frac{16.5}{17.01} \frac{14,17}{14,17} \frac{452.5^{b}}{453.15} \frac{27.75}{24.99} \frac{14,17}{14,17} \frac{420.15}{427.65} \frac{18.18}{19.02} \frac{14,17}{14,17} \frac{455.5^{c}}{455.5^{c}} \frac{27.3}{27.78} \frac{14,17}{24} \frac{427.65}{19.02} \frac{14,17}{14,17} \frac{4455.5^{c}}{455.5^{c}} \frac{27.7}{27.78} \frac{14,17}{10} \frac{427.65}{432.15} \frac{20.00}{14,17} \frac{14,17}{4460.15} \frac{27.77}{27.78} \frac{14,17}{10} \frac{1432.15}{20.00} \frac{14,17}{14,17} \frac{460.15}{27.77} \frac{27.77}{10} \frac{10}{10} \frac{10}{10}$	403.15 15.	76 14,17	445.15	22.64	14,17
$\frac{411.15}{414.35} \frac{16.5}{17.01} \frac{14,17}{14,17} \frac{452.5^{b}}{453.15} \frac{27.75}{24.99} \frac{14,17}{14,17} \frac{420.15}{420.15} \frac{18.18}{18.18} \frac{14,17}{14,17} \frac{455.5^{c}}{455.5^{c}} \frac{27.3}{27.38} \frac{14,17}{24} \frac{427.65}{429.15} \frac{18.4}{10} \frac{10}{457.15^{d}} \frac{27.78}{27.78} \frac{14,17}{10} \frac{1427.15}{432.15} \frac{20.00}{14,17} \frac{14,17}{460.15} \frac{27.77}{27.78} \frac{14,17}{10} \frac{1427.15}{432.15} \frac{20.00}{14,17} \frac{14,17}{460.15} \frac{27.7}{27.77} \frac{14}{10} \frac{14}{10} \frac{14}{17} \frac{14}{10} \frac{14}{10} \frac{14}{17} \frac{14}{10} \frac{14}{11} \frac{11}{11} \frac{14}{11} \frac{14}$	406.15 16.	32 14,17	448.15	24.2	10
$\frac{411.15}{414.35} \frac{16.5}{17.01} \frac{14,17}{14,17} \frac{452.5^{b}}{453.15} \frac{27.75}{24.99} \frac{14,17}{14,17} \frac{420.15}{427.65} \frac{18.18}{19.02} \frac{14,17}{14,17} \frac{455.5^{c}}{455.5^{c}} \frac{27.3}{27.78} \frac{14,17}{24} \frac{427.65}{19.02} \frac{14,17}{14,17} \frac{4455.5^{c}}{455.5^{c}} \frac{27.7}{27.78} \frac{14,17}{10} \frac{427.65}{432.15} \frac{20.00}{14,17} \frac{14,17}{4460.15} \frac{27.77}{27.78} \frac{14,17}{10} \frac{1432.15}{20.00} \frac{14,17}{14,17} \frac{460.15}{27.77} \frac{27.77}{10} \frac{10}{10} \frac{10}{10}$	410.15 17.	09 14,17	451	26.3	24
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			ber -b		· · ·
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	411.15 16.	5 10			
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	414.35 17.	UL 14,17	*453.15	24.99	
432.15 20.00 14,17 *460.15 27.7 10 <sup>a</sup> The trihydrate> dihydrate transition point (14,17). <sup>b</sup> Congruent melting point of the dihydrate (3). Molality we calculated by the evaluator. <sup>C</sup> The reported solubility corresponds to the temperature interval 454 - 457 K (24). <sup>d</sup> Congruent 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 $UO_2(NO_3)_2 \cdot 2H_2O - H_2O$ . Parameter Value Deviation <u>a</u> <u>576.981 mol/kg</u> <u>0.00606</u> b -20478.6 mol/(kg K) 2.56 c -95.3630 mol/kg 0.00100 d 0.11359 0.0000144 m <sub>O</sub> 27.75 mol/kg 0.00606 <sup>a</sup> <sup>a</sup> Standard error of the estimate. Table 11. Recommended solubilities in the $UO_2(NO_2)_2 \cdot 2H_2O - H_2O$	420.15 18.	18 14,17	*454.15	25.98	
432.15 20.00 14,17 *460.15 27.7 10 <sup>a</sup> The trihydrate> dihydrate transition point (14,17). <sup>b</sup> Congruent melting point of the dihydrate (3). Molality we calculated by the evaluator. <sup>C</sup> The reported solubility corresponds to the temperature interval 454 - 457 K (24). <sup>d</sup> Congruent 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 $UO_2(NO_3)_2 \cdot 2H_2O - H_2O$ . Parameter Value Deviation <u>a</u> <u>576.981 mol/kg</u> <u>0.00606</u> b -20478.6 mol/(kg K) 2.56 c -95.3630 mol/kg 0.00100 d 0.11359 0.0000144 m <sub>O</sub> 27.75 mol/kg 0.00606 <sup>a</sup> <sup>a</sup> Standard error of the estimate. Table 11. Recommended solubilities in the $UO_2(NO_2)_2 \cdot 2H_2O - H_2O$	427.65 19.	02 14,17	*455.5	27.3	
<ul> <li><sup>a</sup>The trihydrate&gt; dihydrate transition point (14,17).</li> <li><sup>b</sup>Congruent melting point of the dihydrate (3). Molality was calculated by the evaluator.</li> <li><sup>c</sup>The reported solubility corresponds to the temperature interval 454 - 457 K (24).</li> <li><sup>d</sup>Congruent melting point of the dihydrate (14,17).</li> <li>*Not used in fitting to Eq 1.</li> <li>Table 10. Parameters and standard deviations for Eq 1, for the system UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.2H<sub>2</sub>O - H<sub>2</sub>O.</li> <li>Parameter Value Deviation</li> <li><sup>a</sup> 576.981 mol/kg 0.00606</li> <li><sup>b</sup> -20478.6 mol/(kg K) 2.56</li> <li><sup>c</sup> 0.00606</li> <li><sup>c</sup> 0.11359 0.0000144</li> <li><sup>a</sup> 35tandard error of the estimate.</li> </ul>	*429.15 18.	4 10	*457.15	27.78	
<ul> <li><sup>b</sup>Congruent melting point of the dihydrate (3). Molality was calculated by the evaluator.</li> <li><sup>C</sup>The reported solubility corresponds to the temperature interval 454 - 457 K (24).</li> <li><sup>d</sup>Congruent melting point of the dihydrate (14,17).</li> <li>*Not used in fitting to Eq 1.</li> <li>Table 10. Parameters and standard deviations for Eq 1, for the system UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.2H<sub>2</sub>O - H<sub>2</sub>O.</li> <li>Parameter Value Deviation</li> <li><sup>a</sup> 576.981 mol/kg 0.00606</li> <li><sup>b</sup> -20478.6 mol/(kg K) 2.56</li> <li><sup>c</sup> -95.3630 mol/kg 0.00100</li> <li><sup>d</sup> 0.11359 0.0000144</li> <li><sup>a</sup> Standard error of the estimate.</li> </ul>	432.15 20.	00 14,17	<b>#46U.15</b>	21.1	TO
calculated by the evaluator. <sup>C</sup> The reported solubility corresponds to the temperature interval 454 - 457 K (24). <sup>d</sup> Congruent 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 UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> O - H <sub>2</sub> O. Parameter Standard Parameter Value Deviation a 576.981 mol/kg 0.000006 b -20478.6 mol/(kg K) 2.56 c -95.3630 mol/kg 0.00100 d 0.11359 0.0000144 m <sub>o</sub> 27.75 mol/kg 0.00606 <sup>a</sup> Standard error of the estimate. Table 11. Recommended solubilities in the UO <sub>2</sub> (NO <sub>2</sub> ) <sub>2</sub> .2H <sub>2</sub> O - H <sub>2</sub> O	<sup>a</sup> The trihydr	ate> dihydra	te transition	point (14	,17).
Parameter       Value       Deviation         a $576.981 \text{ mol/kg}$ $0.00606$ b $-20478.6 \text{ mol/(kg K)}$ $2.56$ c $-95.3630 \text{ mol/kg}$ $0.00100$ d $0.11359$ $0.0000144$ mo $27.75 \text{ mol/kg}$ $0.00606^{a}$ a $354$ and ard error of the estimate.         Table 11. Recommended solubilities in the U0 <sub>2</sub> (N0 <sub>2</sub> ) <sub>2</sub> .2H <sub>2</sub> O - H <sub>2</sub>	calculated <sup>C</sup> The reporte interval 45	by the evaluato d solubility co 4 - 457 K (24).	r. rresponds to <sup>.</sup>	the temper	
b -20478.6 mol/(kg K) 2.56 c -95.3630 mol/kg 0.00100 d 0.11359 0.0000144 m <sub>0</sub> 27.75 mol/kg 0.00606 <sup>a</sup> <sup>a</sup> Standard error of the estimate. Table 11. Recommended solubilities in the $UO_2(NO_2)_2.2H_2O - H_2$	calculated <sup>C</sup> The reporte interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param	by the evaluator d solubility co 4 - 457 K (24). elting point of fitting to Eq eters and standa	r. rresponds to the dihydrata 1. ard deviation:	the temper. e (14,17).	ature
c -95.3630 mol/kg 0.00100 d 0.11359 0.0000144 m <sub>0</sub> 27.75 mol/kg 0.00606 <sup>a</sup> <sup>a</sup> Standard error of the estimate. Table 11. Recommended solubilities in the $UO_{2}(NO_{2})_{2}.2H_{2}O - H_{2}O$	calculated <sup>C</sup> The reporte interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste	by the evaluator d solubility con- 4 - 457  K (24). elting point of fitting to Eq eters and standar m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> Param	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> 0. eter	the temper (14,17). for Eq 1 Standard	ature
c -95.3630 mol/kg 0.00100 d 0.11359 0.0000144 m <sub>0</sub> 27.75 mol/kg 0.00606 <sup>a</sup> <sup>a</sup> Standard error of the estimate. Table 11. Recommended solubilities in the $UO_2(NO_2)_2.2H_2O - H_2$	calculated <sup>C</sup> The reporte interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter	by the evaluator d solubility con- 4 - 457 K (24). elting point of fitting to Eq eters and stands m $UO_2(NO_3)_2.2H_2$ Parama Val 576.981	r. rresponds to the dihydrat 1. ard deviation 0 - H <sub>2</sub> 0. eter ue mol/kg	the temper (14,17). for Eq 1 Standard Deviation	ature
d 0.11359 0.0000144 $m_0$ 27.75 mol/kg 0.00606 <sup>a</sup> <sup>a</sup> Standard error of the estimate. Table 11. Recommended solubilities in the UO <sub>2</sub> (NO <sub>2</sub> ) <sub>2</sub> .2H <sub>2</sub> O - H <sub>2</sub>	calculated <sup>C</sup> The reporte interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste <u>Parameter</u> <u>a</u>	by the evaluator d solubility co 4 - 457 K (24). elting point of fitting to Eq eters and stand m $UO_2(NO_3)_2.2H_2$ Parama Val 576.981 -20478.6 m	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> O. eter ue mol/kg ol/(kg K)	the temper (14,17). for Eq 1 Standard Deviation 0.00606	ature
<sup>a</sup> Standard error of the estimate. Table 11. Recommended solubilities in the $UO_2(NO_2)_2.2H_2O - H_2$	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste <u>Parameter</u> a b c	by the evaluator d solubility co 4 - 457 K (24). elting point of fitting to Eq eters and standar m $UO_2(NO_3)_2.2H_2$ Parama Val 576.981 -20478.6 m -95.363	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> O. eter ue mol/kg ol/(kg K) 0 mol/kg	the temper (14,17). for Eq 1 Standard Deviation 0.00606 2.56 0.00100	ature , for the
Table 11. Recommended solubilities in the UO2(NO2)2.2H2O - H2	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter a b c d	by the evaluator d solubility co 4 - 457 K (24). elting point of fitting to Eq eters and standa m $UO_2(NO_3)_2 \cdot 2H_2$ Param Val 576.981 -20478.6 m -95.363 0.113	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> O. eter ue mol/kg ol/(kg K) 0 mol/kg 59	the temper (14,17). for Eq 1 Standard Deviation 0.00606 2.56 0.00100 0.000014	ature , for the
Table 11. Recommended solubilities in the $UO_2(NO_3)_2.2H_2O - H_2$ system, obtained with Eq 1.	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter a b c d	by the evaluator d solubility co 4 - 457 K (24). elting point of fitting to Eq eters and standa m $UO_2(NO_3)_2 \cdot 2H_2$ Param Val 576.981 -20478.6 m -95.363 0.113	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> O. eter ue mol/kg ol/(kg K) 0 mol/kg 59	the temper (14,17). for Eq 1 Standard Deviation 0.00606 2.56 0.00100 0.000014	ature , for the
	calculated <sup>C</sup> The reporte interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste <u>Parameter</u> a b c d m o	by the evaluator d solubility co 4 - 457 K (24). elting point of fitting to Eq eters and stand m $UO_2(NO_3)_2.2H_2$ Parama Val 576.981 -20478.6 m -95.363 0.113 27.75 m	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> O. eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/kg	the temper (14,17). for Eq 1 Standard Deviation 0.00606 2.56 0.00100 0.000014	ature , for the
Solubility Solubility	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter <u>a</u> b c d mo <sup>a</sup> Standard e Table 11. Recom	by the evaluator d solubility co 4 - 457 K (24). elting point of fitting to Eq eters and standa m $UO_2(NO_3)_2.2H_2$ Param Val 576.981 -20478.6 m -95.363 0.113 27.75 m rror of the est mended solubili	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> O. eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/kg imate. ties in the U	the temperative (14,17).	ature , for the 4
T/K mol/kg T/K mol/kg	calculated <sup>C</sup> The reporterinterval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter a b c d mo <sup>a</sup> Standard e Table 11. Recom	by the evaluator d solubility col 4 - 457 K (24). elting point of fitting to Eq eters and standa m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> Param Val 576.981 -20478.6 m -95.363 0.113 27.75 m rror of the est mended solubili m, obtained wit	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> 0. eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/kg imate. ties in the Un h Eq 1.	the temper (14,17). for Eq 1 Standard Deviation 0.00606 2.56 0.00100 0.000014 0.00606 0.00606 0.000014 0.00606	ature , for the 4
388,15 14.2 423.15 19.2	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste <u>Parameter</u> <u>a</u> b c d mo <sup>a</sup> Standard e Table 11. Recom syste Sol	by the evaluator d solubility col 4 - 457 K (24). elting point of fitting to Eq eters and standd m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> Parama Val 576.981 -20478.6 m -95.363 0.113 27.75 m rror of the est mended solubilit m, obtained with ubility	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> O. eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/kg imate. ties in the Un h Eq 1. So	the temper (14,17). (14	ature , for the 4 H <sub>2</sub> O - H <sub>2</sub> O
	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter a b c d mo <sup>a</sup> Standard e Sol <u>T/K</u>	by the evaluator d solubility col 4 - 457 K (24). elting point of fitting to Eq eters and standar m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> Parame Val 576.981 -20478.6 m -95.363 0.113 27.75 m rror of the est mended solubili m, obtained with ubility mol/kg	r. rresponds to the dihydratule 1. ard deviations $D - H_2O$ . eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/kg imate. ties in the U h Eq 1. So T/K	the temper (14,17). (14	ature , for the 4 H <sub>2</sub> 0 - H <sub>2</sub> 0
	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter <u>a</u> b c d mo <sup>a</sup> Standard e Sol <u>T/K</u> <u>388.15</u>	by the evaluator d solubility cold 4 - 457 K (24). elting point of fitting to Eq eters and standar m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> Parame Valt 576.981 -20478.6 mm -95.363 0.113 27.75 mm eters of the est mended solubilities mol/kg 14.2	r. rresponds to $T$ the dihydrate 1. ard deviations $D - H_2O$ . eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/kg imate. ties in the U h Eq 1. So T/K 423.15	the temper (14,17). (14,17). (14,17). (14,17). (15,17). (14	ature , for the 4 H <sub>2</sub> 0 - H <sub>2</sub> 0
	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter <u>a</u> b c d mo <sup>a</sup> Standard e Table 11. Recom syste Sol <u>T/K</u> <u>388.15</u> 393.15	by the evaluator d solubility col 4 - 457 K (24). elting point of fitting to Eq eters and standar m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> Param Val 576.981 -20478.6 m -95.363 0.113 27.75 m rror of the est mended solubili m, obtained with ubility <u>mol/kg</u> <u>14.2</u> 14.7	r. rresponds to the dihydrate 1. ard deviations 0 - H <sub>2</sub> 0. eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/kg imate. ties in the Un h Eq 1. So T/K 423.15 428.15	the temper (14,17). (14	ature , for the 4 H <sub>2</sub> 0 - H <sub>2</sub> 0
	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter <u>a</u> b C d mo <sup>a</sup> Standard e Table 11. Recom syste Sol <u>T/K</u> <u>388.15</u> 393.15 398.15	by the evaluator d solubility col 4 - 457 K (24). elting point of fitting to Eq eters and standar m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> Param Val 576.981 -20478.6 m -95.363 0.113 27.75 m rror of the est mended solubili m, obtained with ubility 14.2 14.7 15.3	r. rresponds to the dihydrate 1. ard deviations 0 - $H_2O$ . eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/kg imate. ties in the Un h Eq 1. So T/K 423.15 423.15 433.15	the temper (14,17). (14	ature , for the 4 H <sub>2</sub> 0 - H <sub>2</sub> 0
	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter <u>a</u> b c d mo <sup>a</sup> Standard e Table 11. Recom syste Sol <u>T/K</u> <u>388.15</u> 393.15 398.15 403.15	by the evaluator d solubility col 4 - 457 K (24). elting point of fitting to Eq eters and standd m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> Parama Val 576.981 -20478.6 mm -95.363 0.113 27.75 mm rror of the est mended solubility mol/kg 14.2 14.7 15.3 15.9	r. rresponds to $T$ the dihydrate 1. ard deviation: $0 - H_2 0$ . eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/(kg K) 0 mol/kg imate. ties in the Un h Eq 1. So T/K 423.15 428.15 438.15	the temper (14,17). (14	ature , for the 4 H <sub>2</sub> 0 - H <sub>2</sub> 0
413.15 17.0 448.15 24.1 418.15 17.7	calculated <sup>C</sup> The reporte- interval 45 <sup>d</sup> Congruent m *Not used in Table 10. Param syste Parameter <u>a</u> b c d mo <sup>a</sup> Standard e Table 11. Recom syste Sol <u>T/K</u> <u>388.15</u> 393.15 393.15 398.15 403.15 408.15	by the evaluator d solubility col 4 - 457 K (24). elting point of fitting to Eq eters and standar m $UO_2(NO_3)_2.2H_2$ Parama Val 576.981 -20478.6 mm -95.363 0.113 27.75 mm rror of the est mended solubility mol/kg 14.2 14.7 15.3 15.9 16.4	r. rresponds to $T$ the dihydrate 1. ard deviations $0 - H_2 0$ . eter ue mol/kg ol/(kg K) 0 mol/kg 59 ol/(kg K) 0 mol/kg 59 ol/kg imate. ties in the Un h Eq 1. So T/K 423.15 433.15 433.15 443.15	the temper (14,17). (14	ature , for the 4 H <sub>2</sub> 0 - H <sub>2</sub> 0

COMPONENTS:	EVALUATOR:		
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>;   [15905-86-9]</pre>	S. Siekierski Warsaw, Polan		
(2) Water; H <sub>2</sub> O; [7732-18-5]	and S. L. Phillip Orinda, Calif		Α.
CRITICAL EVALUATION: (Continued)			
Table 12. Invariant points i computed from data	in the system UO <sub>2</sub> (NO a fitting.	3) <sub>2</sub> - H <sub>2</sub> O	
Invariant Point		Т/К	mol/kg
Eutectic between ice and	$1 UO_2(NO_3)_2 \cdot nH_2O^a(?)$	254	1.95
n hydrate> hexahydra	te transition (?)	268	2.45
hexahydrate> trihydr	ate transition	333.0	
hexahydrate congruent		332.9	9.251 <sup>b</sup>
trihydrate> dihydrat	e transition	386	
trihydrate congruent		398	18.50 <sup>b</sup>
dihydrate congruent		455	27.75 <sup>b</sup>
<sup>a</sup> n > 6, see the evaluati hexahydrate system.	on of solubilities	in the	
<sup>b</sup> Theoretical value at th	e congruent melting	point:	
6 mole $H_2^0 = (6)(18.015)$	(4) = 108.09  g, 0.10	809 kg	
molality: 1 mole/0.1080	9 = 9.25 mol/kg		
$3 \text{ mole } H_2 O = (3)(18.015)$	54) = 54.046 g, 0.05	4046 kg	
molality: 1 mole/0.0540	046 = 18.50 mol/kg		
COMMENT AND/OR ADDITIONAL DA	<b>ATA</b> :		
The heat of solution of anhy in water at 25°C is -81.6 kJ	drous uranyl nitrat //mol (45).	e, UO <sub>2</sub> (NO <sub>3</sub>	)2,

CONDONENIES -		
COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub>	(NO ) •	EVALUATOR: S. Siekierski
[15905-86-9]	2(1103)2'	Warsaw, Poland and
(2) Water; H <sub>2</sub> O; [7732-1	.8-5]	S. L. Phillips Orinda, California U.S.A.
		orinda, carrornia 0.3.A.
CRITICAL EVALUATION: (C	Continued)	
Table 13		for water freezing as a uranyl nitrate. The is ice.
. 0 .	UO2(NO3)	2
t/ <sup>o</sup> c	mol/kg	Ref.
-0.2 -0.3	0.0402 0.217	3 8
-1	0.218	8 12 <sup>a</sup>
-1.0 -1.6	0.22 0.3082	21 3
-2.1	0.3536	3
-2.9 -2.9	0.5264 0.5320	3 8
-4.4	0.7800	3 12 <sup>a</sup>
-5	0.7780	
-5.4 -5.4	0.846 0.8392	21 8
-6.0	0.9005	3
-7.3 -7.9	1.067 1.223	8 3
-11.2	1.505	3
-14.4 -18.0	1.692 1.918	21 8
-20	2.105	8 12
evaluat Recommen	or assumes ice ided values for	ecified in source publication, is the solid phase. water freezing as a function ed on fitting above data to Eq 1.
	<i>Т/</i> К	mol/kg <sup>b</sup>
	251.02	9.251
	253.15 258.15	2.436 1.436
	263.15	1.511
	266.15 268.15	1.221 0.8396
	270.15	0.4556 0.1429
<sup>b</sup> Standard	deviation, 0.	

```
COMPONENTS:

(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>;

[15905-86-9]

(2) Nitric acid; HNO<sub>3</sub>; [7697-37-2]

(3) Water; H<sub>2</sub>O; [7732-18-5]
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EVALUATOR:
S. Siekierski
Warsaw, Poland
and
S. L. Phillips
Orinda, California U.S.A.
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THE TERNARY AND QUATERNARY SYSTEMS

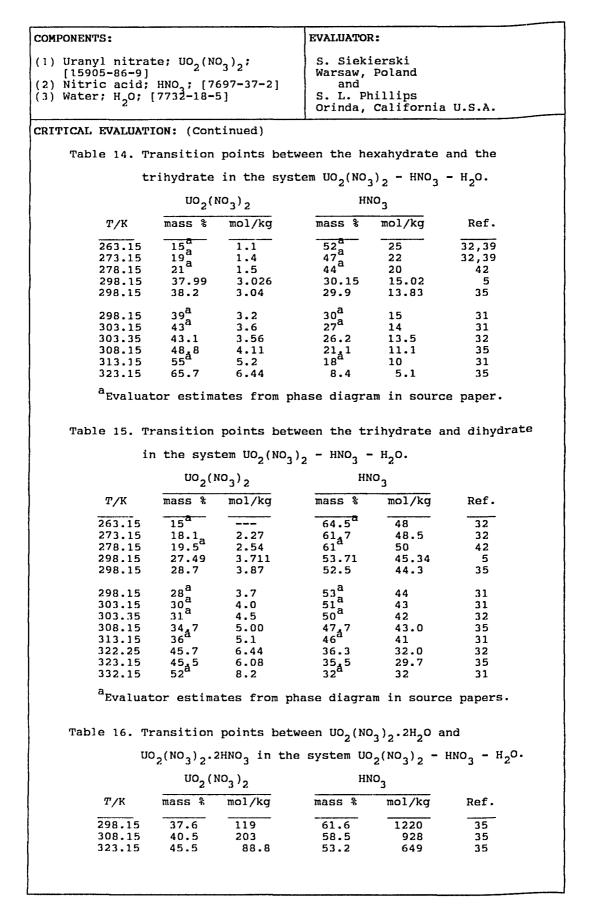
### SYSTEMS WITH NITRIC ACID

The system  $UO_2(NO_3)_2 - HNO_3 - H_2O$  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
UO2(NO3)2.6H2O	Uranium nitrate hexahydrate
UO2(NO3)2.3H2O	Uranium nitrate trihydrate
UO2(NO3)2.2H2O	Uranium nitrate dihydrate
UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .3HNO <sub>3</sub>	Uranium nitrate trinitric acid
UO2(NO3)2.2HNO3	Uranium nitrate dinitric acid
UO2(NO3)2.N2O4.H2O	Uranium nitrate dinitrogen tetroxide monohy

At concentrations of  $\text{HNO}_3$  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  $\text{HNO}_3$  molecules (32). When the  $\text{HNO}_3$ concentration exceeds 55 mass % (depending on temperature) and at medium nitrate concentrations, the solid phase at equilibrium consists of the adduct with two  $\text{HNO}_3$  molecules (35). According to Lacher, et al. (31), nitric acid decomposes in the acid-rich region, and the solid phase under equilibrium conditions is  $\text{UO}_2(\text{NO}_3)_2 \cdot \text{N}_2\text{O}_4$ .H<sub>2</sub>O. According to Deigele (42), when T/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	<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (2) Nitric acid; HNO<sub>3</sub>; [7697-37-2] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.

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).

The  $UO_2(NO_3)_2 - HNO_3 - H_2O$  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  $UO_2(NO_3)_2$ .3HNO<sub>3</sub> branch. In view of the very low water content in the region under consideration, the latter assignment seems to be more plausible.

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  $UO_2(NO_3)_2.2HNO_3$ , depicted in Figure 3, are based solely on the data in Yakimov and Mishin (35).

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

COMPONENTS:	EVALUATOR:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (2) Nitric acid; HNO<sub>3</sub>; [7697-86- (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	S. Siekierski Warsaw, Poland -9] and S. L. Phillips Orinda, California U.S.A.

CRITICAL EVALUATION: (Continued) 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.

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.

Studies of the  $UO_2(NO_3)_2 - HNO_3 - H_2O$  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 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.

#### SYSTEMS WITH ALKALI METALS, AMMONIUM AND THALLIUM NITRATES

Ternary systems with  $MeNO_3$ , Me = Li, Na, K, Rb, Cs,  $NH_4$  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

COMPONENTS:	EVALUATOR:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (2) Alkali Metal and Other Cations (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.

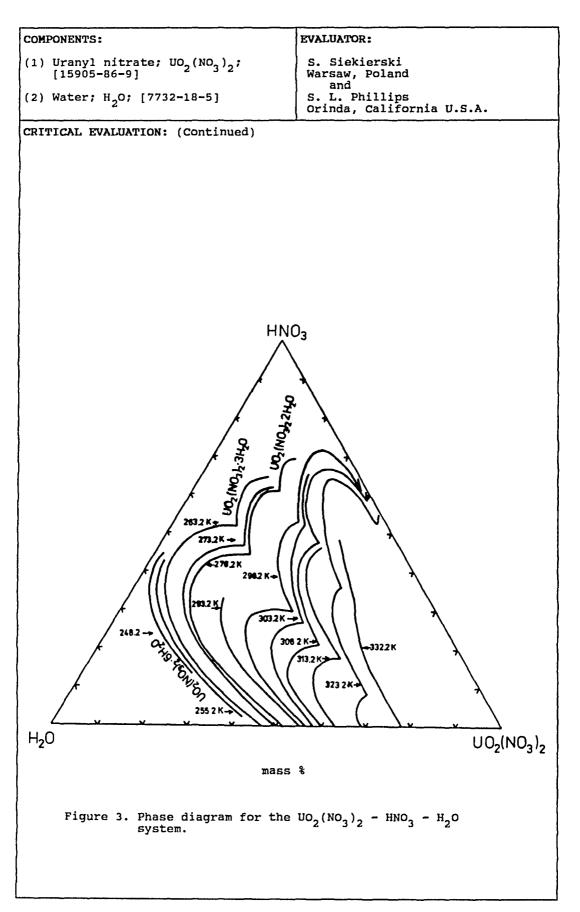
the trihydrate, with the latter stable for temperatures above the hexahydrate ---> trihydrate transition point. For the Rb, Cs and NH<sub>4</sub> nitrate double salts with uranyl nitrate, these are also the stable phases. Rimbach (2) notes a double salt exists also for potassium nitrate as the second component, but his findings have not been verified by Perova (21,22). Solubility isotherms at 298.2 K for the system with KNO<sub>3</sub> (2,5,21) are in very good agreement. Similarly, there is good agreement for the NH<sub>4</sub>NO<sub>3</sub> system at 298.1 - 298.2 K (2,6).

#### SYSTEMS WITH ALKALINE EARTH METALS AND TRANSITION METAL NITRATES

Solubility data for the ternary systems  $UO_2(NO_3)_2 - Me(NO_3)_2 - H_2O$ , where Me = Cu, Be, Mg, Ca, Sr, Zn, 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,  $UO_2(NO_3)_2.6H_2O$ . There has been no report of a double salt as the solid phase at equilibrium.

## QUATERNARY SYSTEMS WITH TWO SATURATING COMPONENTS

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  $Al(NO_3)_3$ , a trihydrate has also been reported as the equilibrium solid (33,44). Nikolaev et al. (38) mention that when high concentrations of  $Th(NO_3)_4$  are present, the solid at equilibrium is uranyl nitrate tetrahydrate,  $UO_2(NO_3)_2.4H_2O$ . 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.



COMPONENTS: EVALUATOR: (1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>2</sub>)<sub>2</sub>; S. Siekierski [15905-86-9] Warsaw, Poland and S. L. Phillips (2) Water; H\_O; [7732-18-5] Orinda, California U.S.A. CRITICAL EVALUATION: (Continued) REFERENCES 1. De Conninck, Oe. Compt. Rend., 1900, 131, 1219. 2. Rimbach, E. Ber., 1904, 37, 461. 3. Vasil'ev, A. M. Zh. Russ. Fiz. Khim. Obshchestva, 1910, 42, 570. Chem. Zentr., 1910, 81, 1527. 4. Germann, F. E. E. J. Am. Chem. Soc., 1922, 44, 1466. 5. Colani, A. Bull. Soc. Chim. Fr., 1926, 39, 1243. 6. Colani, A. Compt. Rend., 1927, 185, 1475. 7. Colani, A. Bull. Soc. Chim. Fr., 1928, 43, 194. 8. Guempel, O. Bull. Soc. Chim. Belg., 1929, 38, 443. 9. Misciattelli, P. Gazz. Chim. Ital., 1930, 60, 839. 10. Benrath, A. Z. Anorg. Allg. Chem., 1942, 249, 245. 11. Lane, J. A. Plutonium Project Handbook, Rev. Ed., CL-697, Chapt. 2, "Physical and Chemical Properties," May 1945. 12. Harmon, M. K. "Freezing Point Data for UNH - H20 - HNO2," Hanford Works, General Electric Co., HW-8309, December 1947. 13. Harmon, M. K.; Cooper, V. R. Report HW-10137, 1948. 14. Marshall, W. L.; Gill, J. S. Oak Ridge National Laboratory Report ORNL-607, <u>1949</u>, 38. 15. Grubbs, F. E. Ann. Math. Stat., 1950, 21, 27. 16. De Keyser, W. L.; Cypres, R.; Herrmann, M. Bull. Centre Phys. Nucl. Univ. Libre de Bruxelles, 1950, No. 17. 17. Marshall, W. L.; Gill, J. S.; Secoy, C. H. J. Am. Chem. Soc., 1951, 73, 1867. 18. Katzin, L. I.; Sullivan, J. C. J. Phys. Colloid Chem., <u>1951</u>, 55, 346. 19. Warner, R. K. Australian J. Appl. Sci., 1953, 4, 581. 20. Report HW-31000, 1955. Perova, A. P. Zh. Neorg. Khim., <u>1956</u>, 1, 323. Russ J. Inorg. Chem., <u>1956</u>, 1, 140. (Eng. trans.)
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COMPONENTS: EVALUATOR: S. Siekierski (1) Uranyl nitrate; UO2(NO3)2; Warsaw, Poland [15905-86-9] and S. L. Phillips Orinda, California U.S.A. (2) Water; H<sub>2</sub>O; [7732-18-5] CRITICAL EVALUATION: Kurnakova, A. G.; Nikolaev, A. V. Zh. Neorg. Khim., <u>1958</u>, 3, 1028. Russ. J. Inorg. Chem., <u>1958</u>, 3, 298. (Eng. trans.)
 Yakimov, M. A.; Nosova, N. F. Zh. Neorg. Khim., <u>1960</u>, 5, 720. Russ. J. Inorg. Chem., <u>1960</u>, 5, 346. (Eng. trans.)
 Yakimov, M. A.; Nosova, N. F. Zh. Neorg. Khim., <u>1961</u>, 6, 208. Russ. J. Inorg. Chem., <u>1961</u>, 6, 103. (Eng. trans.)
 Yakimov, M. A.; Nosova, N. F. Vestn. Leningr. Univ., <u>1962</u>, 4, 106. 31. Lacher, J. R.; Ensley, K.; Park, J. D. Inorg. Chem., <u>1962</u>, 1, 944. 32. Gaunt, J.; Bastien, I. J.; Adelman, M. Can. J. Chem., 1963, 41, 527. 33. Thibodeau, R. D.; Adelman, M. Can. J. Chem., 1963, 41, 531. 34. Yakimov, M. A.; Nosova, N. F.; Degtyarev, A. Ya.; Tsyan-Tsi, Yui Radiokhim., <u>1963</u>, 5, 73. Sov. Radiochem., <u>1963</u>, 60. (Eng. trans.) Yakimov, M. A.; Mishin, V. Ya. Radiokhim., <u>1964</u>, 6, 454.
 Sov. Radiochem., <u>1964</u>, 437. (Eng. trans.)
 Davis, W.; Lawson, P. S.; De Bruin, H. J.; Mrochek, J. J. Phys. Chem., 1965, 69, 1904. 37. Vdovenko, V. M.; Legin, E. K. Radiokhim., <u>1966</u>, 8, 317.(Eng. trans.) 38. Nikolaev, A. V.; Ryabinin A. I.; Afanasiev, Iu. A. Izv. Sib. Otdel. Akad. Nauk SSSR, 1966, 129. 39. Christensen, H. Th.; Holmberg, K. E. Nukleonik, 1968, 11, 165. 40. Cordfunke, E. H. P. J. Inorg. Nucl. Chem., 1972, 34, 531. 41. Efimova, V. S.; Gromov, B. V. At. Energ., <u>1973</u>, 35, 57. 42. Deigele, E. Thesis, Munich 1983, INIS-mf-9277. 43. Vogler, S.; Grosvenor, D. E.; Lewitz, N. M. Report ANL-7917, 1972. 44. Medkov, B. K.; Petrov, M. R.; Roslyakova, O. N. Radiokhim., <u>1988</u>, 30, 272. Sov. Radiochem., <u>1988</u>, 30, 253. (Eng. trans.) 45. Kanevskii, E. A.; Zarubin, A. I.; Rengevich, V. B.; Pavlovskaya,G.R. Radiokhim., <u>1974</u>, 16, 410. sov. Radiochem., <u>1975</u>, 16, 407. (Eng. trans.)

26

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	ODICINAL WENCHDEWENDC.
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>2</sub> ) <sub>2</sub> ;	ORIGINAL MEASUREMENTS:
[15905-86-9]	De Conninck, Oe.
(2) Water; H <sub>2</sub> O; [7732-18-5]	Compt. Rend., <u>1900</u> , <i>131</i> , 1219 - 1220.
VARIABLES:	PREPARED BY:
Temperature: About 287 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
The solubility of uranyl nitrat	e 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 and 14.2 <sup>0</sup> C.	2.9 <sup>°</sup> C, 13.2 <sup>°</sup> C, 13.7 <sup>°</sup> C, 14 <sup>°</sup> C,
	this solubility as 1.25 mol/kg.
AUXILIARY	INFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	Uranyl nitrate, presumably the
	hexahydrate, UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O
	(compilers) was exposed for several
	days to a stream of dry air, and
	then dried for four hours at 85 <sup>0</sup> C
	to 90 <sup>0</sup> C.
	Distilled water was used as the solvent.
	ESTIMATED ERROR:
	Nothing specified.
	Nothing specified. REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Vasil'ev, A. M.
[15905-86-9] 2 3 2 (2) Water; H <sub>2</sub> O; [7732-18-5]	Zh. Russ. Fiz. Khim. Obied., <u>1910</u> , 42, 570 - 581.
VARIABLES:	PREPARED BY:
Temperature: 271 to 345 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
Solubility of $UO_2(NO_3)_2$ in $H_2O$	as a function of temperature <sup>a,b</sup>
t/ <sup>o</sup> c υο <sub>2</sub> (Νο <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> Ο	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> Solid Phase
mass %	mass % mol/kg
	10.83 0.3082 A
	12.23 0.3536 A
	17.18 0.5264 A
	23.51 0.7800 A
	26.19 0.9005 A
	32.52 1.223 A
-11.2 47.45	37.23 1.505 A
-18.1 54.90	43.08 1.921 B
	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 <sub>d</sub> 82.96	65.10 4.734 B
71.8 <sup>d</sup> 86.32	67.74 5.329 B
<sup>C</sup> Solid phases: $A = ice; B = UO_2$	ties calculated by the compilers. $(NO_3)_2.6H_2O.$ in Ref. (1). According to Ref. (2),
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified in Ref. (1).	$UO_2(NO_3)_2.6H_2O$ with a m.p. of
	$60.2^{\circ}$ C was used.
	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES: 1. Vasil'ev, A. Chem. Zentr. <u>1910</u> , <i>81</i> , 1527.
	<ol> <li>Guempel, O. Bull. Soc. Chim. Belg. <u>1929</u>, 38, 443.</li> </ol>

COMPONENTS:	ORIGINAL MEASUREMENTS:	
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>;</pre>	Guempel, O.	
[15905-86-9]	Bull. Soc. Chim. Belg. <u>1929</u> , 38,	
(2) Water; H <sub>2</sub> O; [7732-18-5]	443 - 477.	
VARIABLES:	PREPARED BY:	
Temperature: 273 to 362 K	L. Fuks; S. Siekierski	

Solubi	lity of UO <sub>2</sub> ()	10 <sub>3</sub> ) <sub>2</sub> in H <sub>2</sub> O a	as a function of t	emperature <sup>a</sup>
t/°c	U0 <sub>2</sub> (N	10 <sub>3</sub> ) <sub>2</sub>	Method	Solid <sub>c</sub> Phase
	mass %	mol/kg		
-0.3	7.87	0.217	Cryoscopic	A
-2.9	17.33	0.5320	11	A
-5.4	24.85	0.8392	"	A
-7.3	29.60	1.067	11	A
-18.0	43.04	1.918	17	A
-11.5	46.25	2.182	Synthetic	В
-5.5	48.47	2.387	- 11	в
-4.2	45.27 50.55 <sup>b</sup>	2.099	17	В
5.5		2.594		В
7.6	51.27	2.702	10	В
15.0	52.80	2.839	11	В
20.0	54.40b	3.028	Analytical	В
21.1	55.58	3.175	11	В
25.0	55.90	3.217	11 11	В
36.1	60.28	3.851	11	B
43.6	64.20	4.551	11	В
54.5	70.25	5.993	n	B
56.1	71.95	6.510		B
57.4 58.2	72.76 74.13	6.779 7.272	11	B B
58.6	75.65	7.884	tt	B+C
62.0	76 03	0 415	11	0
72.4	76.83 78.50	8.415 9.266	tt	C C
80.9	80.20	10.28	11	c
88.5	81.13	10.91	11	c
a <sub>Molalit</sub>	cies calculat	ed by compile	ers.	
			to Vasil'ev (1).	
c <sub>Solid</sub>	ohases: A = i	ce, $B = UO_{-}(N)$	$(0_3)_2.6H_20, C = 00$	$(NO_)$ , $xH_O$ , $x<6$
		AUXILIARY IN		2, 3,5 5,
METHOD/APPAR	ATUS/PROCEDUF	(E:	SOURCE AND PURITY	OF MATERIALS:
The uranyl n were determin			Nothing specified	•
<sup>U</sup> <sub>3</sub> 0 <sub>8</sub> .		(	ESTIMATED ERROR:	
			Nothing specified	
1			REFERENCES:	
			1. Vasil'ev, A. C 81, 1527.	hem. Zentr. <u>1910</u> ,
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COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Benrath, A.	
(2) Water; H <sub>2</sub> O; [7732-18-5]	Z. Anorg. Allg. Chem., <u>1942</u> , 249, 245 - 250.	
VARIABLES:	PREPARED BY:	
Temperature: 353 to 460 K	A. Sozanski; S. Siekierski	
EXPERIMENTAL VALUES:	I	
Solubility of $UO_2(NO_3)_2$ in $H_2O_3$	as a function of temperature <sup>a</sup>	
t/ <sup>o</sup> c	002(N03)2	
ma	ss % mol/kg	
80 7	9 9.5	
94 8	0.6 10.5	
	2.9 12.3 4.6 13.9	
	5.8 15.3	
	6.7 16.5 7.9 18.4	
175 9	0.5 24.2	
187 9:	1.6 27.7	
COMMENTS AND/OR ADDITIONAL DATA: The hexa> trihydrate transit. Decomposition of uranyl nitrate w In the source paper, the solubil is given.	was observed at 180 <sup>0</sup> C.	
AUXILIARY INFORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF CHEMICALS:	
The synthetic method was used. The temperature of crystallization was determined visually. Details were given in Ref. (1).	Nothing specified.	
	ESTIMATED ERROR:	
	Nothing specified.	
	REFERENCES:	
	<ol> <li>Benrath, A.; Gjedebo, F.;</li> <li>Schiffers, B.; Wunderlich, H.</li> </ol>	
	Z. Anorg. Allg. Chem. <u>1937</u> , 231, 285.	

COMPONENTS:		ORIGINAL MI	EASUREMENTS:	
	10 ) •	Lane, J. A		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]		1		
(2) Water; H <sub>2</sub> O; [7732-18-5]		Ed., CL-69	Plutonium Project Handbook, Rev. Ed., CL-697, Chapt. 2, "Physical and Chemical Properties",May 1945.	
VARIABLES:		PREPARED BY	<i>t</i> :	
Temperature: 333 to 417 I	K	L. Fuks; S.	. Siekierski	
EXPERIMENTAL VALUES:		1	<u></u>	
Solubility of UO2	$(NO_3)_2$ in $H_2C$	as a funct	ion of temperature <sup>a</sup>	
t/°c			Solid <sub>b</sub>	
	mass %		Phase	
	mass *	mo1/kg		
60	79.0	9.57	Α	
64.5	79.5	9.87	A	
71.9	79.2	9.68	А	
78.9	80.6	10.5	Α	
80.5	82.0	11.6	A	
92.2	82.8	12.2	A	
101.1	85.6	15.1	Α	
105.5	86.0	15.6	A	
144.2	89.3	21.2	В	
	AUXILIARY I	NFORMATION		
METHOD/APPARATUS/PROCEDU	RE:	SOURCE AND	PURITY OF MATERIALS:	
Nothing specified.		Nothing sp	pecified.	
		ESTIMATED 1	ERROR:	
		Nothing s	specified.	
		REFERENCES		
			all, W. L.; Gill, J. S.; , C. H.	
		J. Am. 1867.	. Chem. Soc. <u>1951</u> , 73,	
		2. Guempe	el, O.	
		Bu11	Soc. Chim. Belg. <u>1929</u> ,	

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; (15905-86-9)	ORIGINAL MEASUREMENTS: Marshall, W. L.; Gill, J. S.
[15905-88-9] (2) Water; H <sub>2</sub> O; [7732-18-5]	Report <u>1949</u> , ORNL-607, Oak Ridge National Laboratory, 38 - 44.
VARIABLES: Temperature: 343 to 457 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
Solubility of $UO_2(NO_3)_2$ in $H_2O_3$	as a function of temperature <sup>a</sup>
$t/^{\circ}c$ $UO_2(NO_3)_2$	Solid <sub>b</sub> Phase
	lol/kg
	.617 A 2.260 A
	.10 A
90.5 80.98 10 92 81.37 11 100 82 57 12	.81 Ad
	.02 A
110 84.14 13	.46 A
113 84.67 14	.02 A+B
112 84.67 14	.02 ATD
120 85.25 14	.67 B
130 86.16 15	.80 B
133 86.54 16	.32 B
	.09 Be
	.01 B <sup>-</sup> .18 B
	.02 B
	.00 B
160 88.94 20	.41 B
166.5 89.22 21	.00 B
172 89.92 22	.64 B
	.99 B
	.69 Bf .78 B <sup>f</sup>
<sup>a</sup> Molalities calculated by the compi	lers.
<sup>b</sup> Solid phases: $A = UO_2(NO_3)_2.3H_2O$ ,	
<sup>C</sup> 87.08% UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> (theor. 87.95%).	$d_{87.05\% UO_{3}(NO_{3})_{3}}$ (theor. 87.95%).
$e_{90.58\%}$ UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> (theor. 91.63%).	
AUXILIARY I	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
runs made in a long-necked 200 cm <sup>3</sup>	1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, chemically pure.
The flask was connected to a standard	
taper joint unit having gas analysis	
and vacuum line takeoff. Sample was withdrawn with pipets through the	dehydration of hexahydrate.
side arm. A partial vacuum was placed on molten uranyl nitrate	ESTIMATED ERROR:
hydrate at the working temperature to remove water, and the liquid was	Solubility: less than 0.2%.
vigorously stirred until crystals formed. After 40 to 45 min. of	Temperature: Precision $\pm 0.1$ K.
further stirring, samples of clear solution were taken. Analysis of	
uranium was made by straight oxidation at $900^{\circ}$ C to $U_3O_8$ , or by	REFERENCES:
precipitation of ammonium diuranate	
followed by oxidation to U <sub>3</sub> O <sub>8</sub> . 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, and NO.	1
<u> </u>	1

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9]</pre>	De Keyser, W. L.; Cypres, R.; Herrmann, M.
(2) Water; H <sub>2</sub> O; [7732-18-5]	Bull. Centre Phys. Nucl. Univ. Libre de Bruxelles No. 17, <u>1950</u> .
VARIABLES:	PREPARED BY:
Temperature: 293 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	L
The solubility of UO2(NO3)2.6H20	in water is reported to be
54.09 g of anhydrous salt per 10	) g of solution, at 20 <sup>0</sup> C. The
corresponding molality value cal	culated by the compilers is
2.990 mol/kg.	
AUXILIARY I	
AUXILIARY I METHOD/APPARATUS/PROCEDURE:	NFORMATION SOURCE AND PURITY OF MATERIALS:
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm <sup>3</sup> of water and mixed for 30 minutes at 30 to 40 <sup>°</sup> 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	SOURCE AND PURITY OF MATERIALS: Nothing specified for the solid uranyl nitrate hexahydrate. The
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm 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 aliquot was pipetted for weighing. The sample was gried at	SOURCE AND PURITY OF MATERIALS: Nothing specified for the solid uranyl nitrate hexahydrate. The amount of crystallization water was 21.30% (theor. 21.52%).
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm <sup>3</sup> of water and mixed for 30 minutes at 30 to 40 <sup>°</sup> 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 <sup>3</sup> aliquot was pipetted for	SOURCE AND PURITY OF MATERIALS: Nothing specified for the solid uranyl nitrate hexahydrate. The amount of crystallization water was
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl niţrate hexahydrate was placed in 20 cm 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 sqlution had settled (15 min), a 10 cm aliquot was pipetted for weighing. The sample was dried at 120 °C and calcined at 900 °C in a	SOURCE AND PURITY OF MATERIALS: Nothing specified for the solid uranyl nitrate hexahydrate. The amount of crystallization water was 21.30% (theor. 21.52%).
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl niţrate hexahydrate was placed in 20 cm <sup>3</sup> of water and mixed for 30 minutes at 30 to 40 <sup>°</sup> 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 <sup>3</sup> aliquot was pipetted for weighing. The sample was dried at 120 <sup>°</sup> C and calcined at 900 <sup>°</sup> C in a platinum crucible to constant weight	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
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl niţrate hexahydrate was placed in 20 cm <sup>3</sup> of water and mixed for 30 minutes at 30 to 40 <sup>°</sup> 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 <sup>3</sup> aliquot was pipetted for weighing. The sample was dried at 120 <sup>°</sup> C and calcined at 900 <sup>°</sup> C in a platinum crucible to constant weight	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

		ODICINAL MEACUDEMENTS.	
COMPONENTS:		ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]		Marshall, W. L.; Gill, J. S.; Secoy, C. H.	
(2) Water; H <sub>2</sub> O; [7732-18-5]		J. Am. Chem. Soc., <u>1951</u> , 73, 1867 - 1869.	
VARIABLES:		PREPARED BY:	
Temperature: 343 to 457	к	L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:			
Solubility of UO <sub>2</sub> (	$NO_3)_2$ in $H_2O$	as a function of temperature <sup>a</sup>	
t∕°c	<sup>UO</sup> 2 <sup>(NO</sup> 3	) <sub>2</sub> Solid Phase	
	mass % (c	mol/kg ompilers)	
70	77.25	8.617 A	
77.2	78.49	9.260 A	
85		10.10 A	
90.5		10.80 A	
92 100		11.08 A 12.02 A	
110		13.46 A	
113 <sup>b</sup>	84.67	14.02 A+B	
120	85.25	14.67 B	
130		15.76 B	
133		16.32 B	
137		17.09 B	
141.2 147		17.10 B 18.18 B	
154.5		19.02 B	
159		20.00 B	
160	88.94	20.41 B	
165.5		21.00 B	
172		22.64 B	
180		24.99 B 25.98 B	
181 184 <sup>c</sup>		27.78 B	
<sup>a</sup> The initial solid			
<sup>b</sup> Intersecting poin	t for incongr	uent melting point of trihydrate.	
<sup>C</sup> True melting poin	t of the dihy	drate.	
<sup>d</sup> Solid phases: A =	U02(N03)2.3H	$_{2}^{O}; B = UO_{2}(NO_{3})_{2}.2H_{2}O.$	
	AUXILIARY I	NFORMATION	
METHOD/APPARATUS/PROCEDU		SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O,Mallinckrodt C.P.	
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		2. Dihydrate prepared by the	
		ESTIMATED ERROR:	
	in. Duplicate	Soly: Results of 5 separate runs.	
as of the solid phase we and the uranium content	re removed, determined by	Temp: Precision $\pm 0.1^{\circ}$ C.	
ignition at 900°C to for U <sub>3</sub> 0 <sub>8</sub> .	m the Oxide,	REFERENCES:	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Warner, R. K.
(2) Water; H <sub>2</sub> O; [7732-18-5]	Australian J. Appl. Sci., <u>1953</u> , 4, 581-589.
VARIABLES:	PREPARED BY:
One temperature: 293 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	<u>1</u>
The solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O i be 0.540 g of the anhydrous salt p The corresponding molality was cal 2.98 mol/kg.	er g of the solution.
AUXILIARY IN	FORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. Excess uranyl nitrate hexahydrate was	"AR" grade UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O.
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 evapora-	ESTIMATED ERROR: Soly: Repeat determinations of the solubility were made until agreement within 0.2 mass %. Temp: Precision ±0.05 K. REFERENCES:
tion of the weighed aliquots, followed by ignition to U <sub>3</sub> 0 <sub>8</sub> .	

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>;</pre>	Nethaway, M. O.; Lang, G. P.
[15905-86-9]	Report <u>1958</u> , MCW-1412
(2) Water; H <sub>2</sub> O; [7732-18-5]	(Elliot, B., ed.)
VARIABLES:	PREPARED BY:
Temperature: 287 to 457 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES: Solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> in H <sub>2</sub> C t/ <sup>O</sup> C	) as a function of temperature <sup>a,b</sup> UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>

	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

<sup>a</sup>Molalities calculated by the compilers.

<sup>b</sup>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 I	AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF CHEMICALS:				
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.	Mallinckrodt UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O was (purified). Uraynyl 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 MEA	CIIDEMENTIC •	
	rrate: IIO (NO	۱.	Colani, A.		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]					
(2) Nitric aci	Ld; HNO <sub>3</sub> ; [769	97-37-2]	Bull. Soc. Chim. Fr., <u>1926</u> , 39, 1243 - 1245.		
(3) Water; H <sub>2</sub> (	<b>;</b> [7732-18-5]	]			
VARIABLES:			PREPARED BY:		
Composition at	298 K		A. Sozanski;	S. Siekierski	
EXPERIMENTAL V	/ALUES:		l		
	The system	UO2(NO3)2 ·	- нио <sub>3</sub> - н <sub>2</sub> о	at 25 <sup>0</sup> C	
	Composi	ition of Sat	turated Solut	ions <sup>a</sup>	
HNC	D <sub>3</sub>	U0 <sub>2</sub> (1	NO <sub>3</sub> ) <sub>2</sub>	Solid Phase	
mass %	mol/kg	mass %	mol/kg		
$\begin{array}{cccccccc} 0 & 0 & 56.08 \\ 12.35 & 4.144 & 40.36 \\ 25.14 & 8.951 & 30.29 \\ 28.67 & 10.92 & 29.65 \\ 29.84 & 12.18 & 31.27 \\ 30.43 & 14.70 & 36.72 \\ 30.15 & 15.02 & 37.99 \\ 32.31 & 16.32 & 36.28 \\ 46.12 & 27.41 & 27.18 \\ 50.43 & 33.66 & 25.79 \\ 53.20 & 42.15 & 26.77 \\ 53.71 & 45.34 & 27.49 \\ 55.24 & 50.04 & 27.24 \\ 60.38 & 60.00 & 23.65 \\ 66.71 & 96.24 & 22.29 \\ 68.83 & 125.8 & 22.49 \\ \end{array}$			$D; B = UO_2(NO)$	$ \begin{array}{c} A\\ A\\ A\\ A\\ A\\ A\\ A\\ A\\ A+B\\ B\\ B\\ B\\ B\\ B\\ B\\ B\\ B\\ B+C\\ C\\ C$	
	C = U(	$D_2(NO_3)_2.2H_2$	2 <sup>0.</sup>	······································	
		UXILIARY I	NFORMATION		
METHOD/APPARAI	TUS/PROCEDURE:	:	SOURCE AND P	URITY OF MATERIALS:	
The isothermal mixture of wat			Nothing spe	cified.	
saturated with nitrate hexahy	n uranyl nitra	ate. Uranyl	ESTIMATED ER	ROR:	
nitric acid co at high concer acid, the init	oncentrations ntrations of t	, whereas the nitric	Nothing specified.		
uranium nitrat	e dehydrated	in a	REFERENCES:		
vacuum. Solid Schreinemakers	s method (1).	No	1. Schreinem	akers, F. A. H.	
additional information is given.			Z. physik	. Chem., <u>1893</u> , 11, 81.	

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			ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]			Harmon, M. K.		
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]			"Freezing Point Data for UNH-H O- HNO3," Hanford Works, General		
(3) Water; H	2 <sup>0;</sup> [7732-	-18-5]	Electric Co., HW-8309, Dec. 17, 1947.		
VARIABLES:			PREPARED BY	ť:	
Temperature:	253 to 33	18 K	A. Sozanski	i; S. Siekie	erski
EXPERIMENTAL	VALUES:				
		$= UO_2(NO_3)_2 - HN_2$			
	Com	position of satu	rated soluti	ions <sup>a,b</sup>	
			00 <sub>2</sub> (N0 <sub>3</sub> ) <sub>2</sub>		10 <sub>3</sub>
t∕°c	mass %	g/dm <sup>3</sup>	mol/kg	g/dm <sup>3</sup>	mol/kg
-20 - 5	57.78 29.90		2.105	0 0	0
- 1	10.1		0.7780 0.218	0	0 0
5.7	65.35	1110.1	2.671	ő	0
	68.8	1217.1	2.98	ō	õ
18.3	68.8	1215.4	2.98	Ō	Ō
32.5	78.0	1461.2	4.00	0	0
20.7	F.4. 01	240 24	1 055	15 10	0 0774
-20.7 - 6.5	54.91 32.2	849.84	1.955 0.876	15.13 17.72	0.2774
- 2.2	10.0	370.5 107.52	0.220	18.18	0.3339 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
	0,,,0			20104	00000
-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	170 5	2 262
-22.5	33.3	461.09	1.10	178.5 188.67	
-16.5	8.6	107.54	0.22	177.3	3.5895 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					-
		equilibrium solie		specified.	
MOIAl	itles cald	culated by the c			
	<b>.</b>	AUXILIARY I	<u>,</u>		
	c method v	vas used. The		PURITY OF M	IATERIALS:
approximatel	y given pr	repared to an redetermined	-	specified.	
were measure	d. In all	freezing points cases, cooling			
point wherev	er possibl	and the setting le was measured	ESTIMATED F	RROR :	
Crystal form	as the true freezing temperature. Crystal formation was observed			cified.	
closely with light source	and the t	emperature at			
which crysta	is were fi	rst noted was point for those			
solutions who			REFERENCES:		
exhibited no					
			1		

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Report <u>1955</u> , HW-31000.
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition and temperature	L. Fuks; S. Siekierski

The solubility of uranyl nitrate hexahydrate in water was determined as a function of temperature from about  $-25^{\circ}C$  to about  $45^{\circ}C$  at varying nitric acid concentrations of the range 1 to 10 M. The data are presented in the form of  $t/^{\circ}C$  vs. M, molarity. The diagram is based on data reported in Refs. (1-3). A solution of 60 mass %, about 13M, HNO<sub>3</sub> saturated with respect to uranyl nitrate at  $25^{\circ}C$  is reported to contain 23.5 mass % of  $UO_2(NO_3)_2.6H_2O$ , which is equivalent to 2.17 mol/kg of the anhydrous salt (compilers).

AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:			
Nothing specified.	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; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]				Hart, R. G	.; Morr	is, G. O.	
(2) Nitric	-	NO_: [769	7-37-21	Prog. Nucl Vol. 2, (Bi			
(3) Water;		5		J. M.; Hym 1958, 544	an, H. I	H., eds.)	London
			····				
VARIABLES:				PREPARED BY			
Compositic		_	2	A. Sozanski	; S. Si	ekierski	
EXPERIMENT	'AL VALUE						
		_		$NO_3 - H_2O$ Sy	stem		
HNO3	_	U	Solid <sub>a</sub> Phase	HNO3	-	U	Solid Phase
mol/dm <sup>3</sup>	t∕°c	g/cm <sup>3</sup>		mol/dm <sup>3</sup>	t∕°c	g/cm <sup>3</sup>	
0	-16	400	A	3	-26	200	A
0 0	-11 - 8	350 300	A A	3 3	-20 -16	150 100	A A
õ	- 6	250	Ä	3	- 8	250	В
0	- 4	200	Α	3	5	300	в
0	- 2	150	A	3	14	350	В
0 0	- 1 3	100 500	A B	3 3	21 31	400 500	B B
1	-19	350	A	4	-32	150	А
1 1	-17 -13	300 250	A A	4 4	-27 - 5	100 200	A B
1	-10	200	A	4	- 5	250	B
ī	- 7	150	A	4	15	300	B
1	- 6	100	Α	4	21	350	В
1 1	- 2 18	400 500	B B	4 4	27 34	400 500	B B
2	-22	250	A	5	-39	100	в
2	-18	200	A	5	- 5	150	B
2 2	-14 -12	150 100	А А	5 5	7 15	200 250	B B
2	- 9	300	B	5	21	300	B
2	5	350	В	5	26	350	В
2	14	400	В	5	30	400	В
2	27	500	В	5	35	500	В
				(Con	tinued (	on the ne	ext page
		λ	UXILIARY I	NFORMATION			
METHOD/APP	ARATUS/P	ROCEDURE :		SOURCE AND	PURITY (	OF MATERI	ALS:
The synthe Equilibriu higher and	m was ap	proached	from both	Nothing s	pecifie	đ.	
nigher and	TOWEL C	.emperatur	65.	ESTIMATED ERROR: Soly: The results represent the mean of two temperatures observed for the first formation and the final			
				di: Temp.: Pi		ance of c n <u>+</u> 2K.	rystals
				REFERENCES:			

COMPONENTS	5:			ORIGINAL ME	ASUREME	NTS:	
(1) Uranyl	nitrate	; UO_(NO_	).;	Hart, R. G.; Morris, G. O.			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]			Prog. Nucl.				
(2) Nitric	acid; H	NO <sub>3</sub> ; [769	7-37-2]	Vol. 2, (Br J. M.; Hyma	ruce, F	. R.; Fle	stcher,
(3) Water;	H <sub>2</sub> 0; [7	732-18-5]		<u>1958</u> , 544 -		-	
VARIABLES:				PREPARED BY			
Compositic	on and te	mperature		A. Sozanski	S. Si	ekierski	
EXPERIMENT	AL VALUE	S: (Conti	nued)				
		The UO2	$(NO_3)_2 - HI$	NO <sub>3</sub> — Н <sub>2</sub> О Sys	stem		
HNO <sub>3</sub>		U	Solid <sub>a</sub> Phase	ниоз		U	Solid <sub>a</sub> Phase
mol/dm <sup>3</sup>	t∕°c	g/cm <sup>3</sup>		mol/dm <sup>3</sup>	t∕⁰c	g/cm <sup>3</sup>	
6	-18	100 150	B B	9 9	5 8	100 150	B B
6	12 19	200 250	B	- 9 9	15 18	200	в
6	23	300	В	9	20	250 300	B B
6	27 30	350 400	B B	9 9	22 24	350 400	B B
6	36	500	В	9			
7	3 9	100 150	B B	10 10	3 6	100 150	B B
7	15 20	200 250	B B	10 10	12 15	200 250	B B
7	24	300	в	10	17	300	в
777	27 29	350 400	B B	10 10	24 29	350 400	B B
8	5 10	100 150	B B				
8	17	200	В				
8 8	20 23	250 300	B B				
8 8	25 27	350 400	B B				
<sup>a</sup> solid p	hase: A :	= ice; B :	= UO <sub>2</sub> (NO <sub>2</sub> ),	2.6H <sub>2</sub> O (compi	lers).		
		ADDITIONA		<u> </u>			
Uranyl n	itrate s	olutions	have a grea	at tendency t	o super	rcool, ar	nd on
the crys	tallizat	ns nave b ion tempe	een cooled rature, wit	to a tempera thout the for	mation	of cryst	als.
							{
							(
}							

42		

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Gaunt, J.; Bastien, I. J.; Adelman, M.		
<pre>(2) Nitric acid; HNO<sub>3</sub>; [7697-37-2] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	Can. J. Chem., <u>1963</u> , 41, 527 - 530.		
VARIABLES:	PREPARED BY:		
Composition and temperature	A. Sozanski; S. Siekierski		

The  $UO_2(NO_3)_2$  -  $HNO_3$  -  $H_2O$  System

Composition of Saturated Solutions<sup>a</sup>

	υο <sub>2</sub> (νο <sub>3</sub> ) <sub>2</sub>		HN	0 <sub>3</sub>	Solid Phase <sup>b</sup>
t∕°c	mass %	mol/kg	mass %	mol/kg	1 HADG
49.1	62.0	4.78	5.1	2.5	Α
	63.1	4.75	3.2	1.5	Α
	62.5	4.94	5.4	2.7	A A A A A
	59.0	5.04	11.3	6.04	Α
	61.4	5.59	10.7	6.09	A
	56.8	4.46	10.9	5.36	λ
	60.9	5.79	12.4	7.37	В
	60.8	5.91	13.1	3.97	В
	54.6	5.39	19.7	12.2	в
	55.4	5.65	19.7	12.6	B B
	49.5	5.02	25.5	16.2	В
	48.2	4.97	27.2	17.5	В
	47.8	5.05	28.2	18.6	В
	46.3	5.13	30.8	21.3	В
	46.4	4.99	30.0	20.2	В
	45.9	5.63	33.4	25.6	В
	45.6	5.70	34.1	26.7	В
	44.4	5.69	35.8	28.7	B B B B B B B
			(Cont	tinued on th	ne next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. The uranyl nitrate solutions were	Nothing specified.
prepared by dissolving uranyl nitrate hexahydrate in nitric acid. At high	ESTIMATED ERROR:
acid concentrations, the hexahydrate was dissolved in more concentrated	Solubility: Nothing specified.
acid, and the crystals obtained were redissolved in increasing concentra-	Temperature: Precision <u>+</u> 0.2K.
tions of nitric acid and red fuming nitric acid. Each sample was	REFERENCES:
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	Report <u>1955</u> , CLE-112.
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).	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Gaunt, J.; Bastien, I. J.; Adelman, M.
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Can. J. Chem., <u>1963</u> , 41, 527 - 530.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

The $UO_2(NO_3)_2$	- HNO <sub>3</sub> - H <sub>2</sub> O System
Composition of	Saturated Solutions <sup>a</sup>

$ t/^{O}C  mass \  \  \  mass \  \  \  \  \  \  \  \  \  \  \  \  \$		U0 <sub>2</sub> (N	0 <sub>3</sub> ) <sub>2</sub>	HNO <sub>3</sub>		Solid <sub>b</sub> Phase
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	t∕°c	mass %	mol/kg	mass %	mol/kg	Fliase
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	49.1	45.7	6.44	36.3	32.0	B+C
$\begin{array}{cccccccccccccccccccccccccccccccccccc$						
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		40.7	5.52	40.6	34.5	С
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		36.5	6.22	48.6	51.8	С
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		35.9	6.24	49.5	53.8	С
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		35.0	6.99	52.3	65.4	С
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		26.0	6.28	63.5	96.0	-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		12.2	4.07		167	D
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		12.7		80.7	194	D
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		10.3	3.90	83.0	197	D
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		8.83		85.5	239	D
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	30.2	55.6	3.39	2.82	1.08	A
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		49.6	2.91	7.12	2.61	A
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		46.7	2.85	11.7	4.46	A
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		40.3	2.47		7.01	A
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		38.8	2.63	23.8	10.1	Α
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			3.24		11.5	λ
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		42.6		25.4	12.6	A
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			2.98	25.7		A
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		43.1	3.56	26.2	13.5	A+B
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		39.7	3.37	30.4	16.1	В
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		39.0	3.28	30.8	16.2	В
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		39.2	3.37	31.3	16.8	В
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		37.8	3.37	33.7	18.8	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		37.2	3.29	34.1	18.9	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		35.8	3.03	34.2	18.1	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		33.4	3.12	39.4	23.0	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		32.6	3.42	43.2	28.3	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		32.0	3.40	44.1	29.3	В
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		30.3	3.26	46.1	31.0	В
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		30.0	3.64	49.1	37.3	В
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		29.4				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		28.5	4.95	56.9	61.8	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		22.9	4.61	64.5	81.2	С
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		13.0	3.37	77.2	125	
34.81.6411.33.33A22.91.0421.36.06A14.30.66230.98.95A11.10.61042.714.7A11.50.63742.714.8A13.40.81244.716.9A13.30.79644.316.6A19.91.4946.121.5A		10.9	2.85	79.4	130	D
22.91.0421.36.06A14.30.66230.98.95A11.10.61042.714.7A11.50.63742.714.8A13.40.81244.716.9A13.30.79644.316.6A19.91.4946.121.5A	0.0	45.2				
14.30.66230.98.95A11.10.61042.714.7A11.50.63742.714.8A13.40.81244.716.9A13.30.79644.316.6A19.91.4946.121.5A						
11.10.61042.714.7A11.50.63742.714.8A13.40.81244.716.9A13.30.79644.316.6A19.91.4946.121.5A						
11.50.63742.714.8A13.40.81244.716.9A13.30.79644.316.6A19.91.4946.121.5A						
13.40.81244.716.9A13.30.79644.316.6A19.91.4946.121.5A						
13.3 0.796 44.3 16.6 A 19.9 1.49 46.1 21.5 A						
19.9 1.49 46.1 21.5 A		13.4				
(Continued on the next page)		19.9	1.49			
				(Con	tinued on the	e next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Gaunt, J.; Bastien, I. J.; Adelman, M.			
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Can. J. Chem., <u>1963</u> , 41, 527 - 530.			
(3) Water; H <sub>2</sub> O; [7732-18-5]				

# The $UO_2(NO_3)_2$ - $HNO_3$ - $H_2O$ System

Composition of Saturated Solutions<sup>a</sup>

	UO2(N	10 <sub>3</sub> ) <sub>2</sub>	нио <sub>з</sub>		Solid <sub>l</sub> Phase	
t∕°c	mass %	mol/kg	mass %	mol/kg	FIIdad	
0.0	18.6	1.34	46.2	20.8	А	
	22.2	1.78	46.1	23.1	Α	
	20.0	1.52	46.5	22.0	Α	
	18.6	1.36	46.8	21.5	Α	
	20.5	1.59	46.8	22.7	В	
	18.5	1.41	48.2	23.0	B	
	17.4	1.33	49.5	23.7	В	
	17.5	1.35	49.6	23.9	B	
	17.1	1.41	52.1	26.8	В	
	15.7	1.29	53.5	27.6	В	
	15.1	1.43	58.1	34.4	B	
	14.8	1.44	59.1	35.9	В	
	14.9	1.46	59.2	36.3	B	
	15.0	1.52	59.9	37.9	В	
	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	В	
	18.1	2.27	61.7	48.5	B+C	
	18.4	2.38	62.0	50.2	С	
	19.5	3.28	65.4	68.7	°c	
	5.81	1.51	84.4	137		
-10.0	30.0	1.31	12.0	3.28	Α	
	8.46	0.371	33.6	9.20	А	
	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	В	
	12.1	1.19	62.1	38.2	В	
	11.4	1.05	61.1	35.3	В	
	11.7	1.20	63.5	40.6	В	
	11.8	1.22	63.7	41.3	в	
	14.4	1.85	65.8	52.7	в	
	15.6	1.91	63.7	48.8	В	
	18.2	3.06	66.7	70.1	С	
	6.8	1.7	82.9	128	D	
<sup>a</sup> Mola	lities calcu	lated by the c	ompilers.			
<sup>b</sup> Soli	d phases: A	= UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H	$_{0}$ ; B = UO <sub>0</sub> (N	0,),.3H,0;		
		$= UO_2(NO_3)_2.2H$				
c,					<b>NO \</b>	
		d phase after	iiitracion ga	ve 83.5% UU2(	<sup>NO</sup> 3 <sup>1</sup> 2 <sup>a)</sup>	
11 5	& HNO <sub>3</sub> .					

COMPONEN				ORIGINAL MEASURE			
(1) Urany [1590	yl nitrate 05-86-9]	; UO2(NO3)2	;	Yakimov, M. A.; Mishin, V. Ya.			
(2) Nitri	ic acid; H	INO <sub>3</sub> ; [7697-	37-2]	Radiokhim., <u>196</u>	<u>4,</u> 6,454 ·	- 459.	
	r; H <sub>2</sub> 0; [7	~	-	Sov. Radiochem.	, <u>1964</u> , 43	7. (Eng.)	
VARIABLE	s:			PREPARED BY:			
Composit:	ion and te	emperature		A. Sozanski; S.	Siekiersk	i	
EXPERIME	NTAL VALUE	:S:					
	The UO <sub>2</sub> (	NO3)2 - HNO	<sub>3</sub> - н <sub>2</sub> о з	System at 25 <sup>0</sup> C, 3	5°C, 50°C		
		Compositio	n of Sati	urated Solutions <sup>a</sup>			
	U0 <sub>2</sub> (	NO3)2		hno <sub>3</sub>	н <sub>2</sub> 0	Solid <sub>b</sub> Phase	
t∕°c	mass %	mol/kg	mass	% mol/kg	mass %		
25	55.95 50.0 46.4	3.223 2.75 2.54	0 3. 7.	2 2.5	44.05 45.3 48.4	A AC AC	
	44.4 38.4	2.42 2.10	9.1 15.1		46.5 46.4	A A	
[	32.8	1.86	22.	4 7.93	44.8	A	
		2.45			35.7	A	
l	38.2	3.04	29.9		31.9	A+B	
	31.9 31.5	2.73 2.66	38.		29.7 30.1	B	
	29.7	2.46	38.4 39.0		30.7	B B	
1	26.7	2.68	48.0		25.3	B	
}	27.6	3.23	50.		21.7	В	
	28.4	3.73	52.3		19.3	B	
	28.7	3.87	52.		18.8	B+C	
	27.3 26.7	3.81 3.85	54.! 55.°		18.2 15.6	с <sub>с</sub>	
	24.8	3.91	59.3		16.1	c	
	23.3	4.45	63.		13.3	č	
[	22.1	4.71	66.0	0 88.0	11.9	С	
]	22.0	6.14	68.9		9.1	С	
	22.4	8.01	70.		7.1	С	
1	22.3	8.57	71.		6.6	C	
	24.4 29.5	15.5 32.6	71.0 68.3		4.0 2.3	C C	
	29.9	39.9	68.		1.9	č	
	33.7	53.5	64.	7 642	1.6 d on the no	С	
		AUX	ILIARY II	NFORMATION			
METHOD/AI	PPARATUS/F			SOURCE AND PURIT	Y OF MATER	IALS:	
		hod was use	d.	1. $UO_2(NO_3)_2.6H_2O$ , not specified.			
Experimen	nts were p	erformed as	before	2. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> , Re			
(1). Nitrate solutions were prepared by dissolving uranyl nitrate hexa- hydrate in nitric acid solutions. At			ESTIMATED ERROR:				
acid concentrations above 65 mass %, 50°C, or above 70 mass %, 25°C, anhy-							
drous uranyl nitrate was used.Equili-			}				
		hed after 4		REFERENCES:	1	<b>N P</b> -	
nours. N:	itric acid	i was determ by precipi	ined by	1. Yakimov, M. Grishin V		, N. F.;	
of ammon	ium diurar	ate, then c	alcined	Grishin, V. Zh. Neorg. K		, 3, 504-	
to U308.	Water fou	nd as diffe	rence.	2. Marketos, P. Compt. Rend.			
1				1	· · · · · · · · · · · · · · · · · · ·	•	

COMPONENT	rs:		ORIG	INAL MEASUREM	ENTS:	
(1) Urany [1590	/l nitrate; )5-86-9]	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Yak	imov, M. A.;	Mishin, V	. Ya.
•	-	10 <sub>3</sub> ; [7697-37-	-2] Rađ	iokhim., <u>196</u>	4, 6, 454	- 459.
	с; Н <sub>2</sub> 0; [77	5	Sov	. Radiochem.,	<u>1964</u> , 43	7. (Eng.)
(5) 114201	2 <sup>1</sup> 2 <sup>1</sup> 2 <sup>1</sup>	52 10 5]				
EXPERIMEN	TAL VALUES	: (Continued)	)			
	The $UO_2(N)$	10 <sub>3</sub> ) <sub>2</sub> - HNO <sub>3</sub> -	• H <sub>2</sub> O Syste	m at 25 <sup>0</sup> C, 35	°c, 50°c	
		Composition of	of Saturate	d Solutions <sup>a</sup>		
	U0 <sub>2</sub> (	NO3)2	HN	0 <sub>3</sub>	<sup>н</sup> 20	Solid <sub>b</sub> Phase
t∕°c	mass %	mol/kg	mass %	mol/kg	mass %	FlidSe
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 58.8	3.823 3.68	0 0.6	0 0.2	39.90 50.6	A AC
	57.7	3.60	1.6	0.62	40.7	Ä
	53.1	3.26	5.5	2.1	41.4	A
	47.9	2.89	10.1	3.82	42.0	A
	45.7 44.7	2.82 2.98	13.2 17.2	5.10 7.16	41.1 38.1	A A
	44.5	3.12	19.3	8.46	36.2	Ä
	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	Bc
	37.6	3.44	34.7	19.9	28.0	Б
	35.5 34.5	3.51 3.50	38.8 40.5	24.0 25.7	25.7 25.0	B B
	33.6	3.40	41.3	26.1	25.1	В
	34.0	3.85	43.6	30.9	22.4	B
	34.3	4.27	45.3	35.2	21.4	BC
	34.6	4.50	45.9	37.4	19.5	В
	34.4 34.4	4.50 4.62	46.2 46.7	37.8 39.2	19.4 18.9	B B
	34.7	5.00	47.7	43.0	17.6	B+C
	30.5	4.61	52.7	49.8	16.8	с
	28.9	4.31	54.1	50.5	17.0	с с
	26.4	4.85	59.8	68.8	13.8	С
	25.4 25.5	5.42 7.27	62.7 65.6	83.6 117	11.9 8.9	с с
	31.0	23.1	65.6	306	3.4	c
	31.0	22.5	65.5	297	3.5	č
	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	Ac
	68.1	5.52	0.6	0.3	30.6	A
	66.0 65.6	5.84 5.70	5.3 5.2	2.9 2.8	28.7 29.2	А А
	65.1	6.16	8.1	4.8	26.8	Ä

8.4

10.4 10.6

13.1

6.44

6.24 6.22 6.08

5.1

6.37

8.12

A+B

В в

В

25.9

25.9 25.9

25.6

(Continued on the next page)

65.7

63.7 63.5

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Mishin, V. Ya.		
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Radiokhim., <u>1964</u> , 6, 454 - 459. Sov. Radiochem., <u>1964</u> , 437. (Eng.)		
(2) Water; H <sub>2</sub> O; [7732-18-5]	2000 Mario Mario (2007)		

The UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> - HNO<sub>3</sub> - H<sub>2</sub>O System at 25<sup>o</sup>C, 35<sup>o</sup>C, 50<sup>o</sup>C Composition of Saturated Solutions<sup>a</sup>

	uo <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub>	hno <sub>3</sub>		<sup>н</sup> 20	Solid <sub>b</sub> Phase
t∕°c	mass %	mol/kg	mass %	mol/kg	mass %	Flidbe
50	61.1	5.99	13.0	7.97	25.9	в
	58.2	5.59	15.4	9.26	26.4	в
	51.2	5.24	24.0	15.4	24.8	Bc
	48.4	5.12	27.6	18.3	25.0	
	47.3	5.31	30.1	21.1	22.6	B B
	47.1	5.24	30.1	21.0	22.8	в
	45.8	5.26	32.1	23.1	22.1	В
	45.5	6.08	35.5	29.7	19.0	B+C
	44.8	6.05	36.4	30.7	18.8	С
	43.9	6.16	38.0	33.3	18.1	С
	43.0	6.03	38.9	34.1	18.1	0 0 0 0 0 0 0 0 0 0 0
	40.7	5.90	41.8	37.9	17.5	С
	38.7	5.88	44.6	42.4	16.7	С
	34.5	5.84	50.5	53.4	15.0	С
	29.4	7.04	60.0	89.8	10.6	С
	28.4	9.24	63.8	130	7.8	С
	28.1	10.3	65.0	149	6.9	С
	29.3	11.8	64.4	162	6.3	С
	34.0	24.7	62.5	283	3.5	С
	41.0	52.0	57.0	452	2.0	С
	44.0	69.8	54.4	540	1.6	С
	45.1	60.2	53.0	443	1.9	С
	45.5	88.8	53.2	649	1.3	C+D
	44.5	565	55.3	4390	0.2	D

<sup>a</sup>Molalities calculated by the compilers.

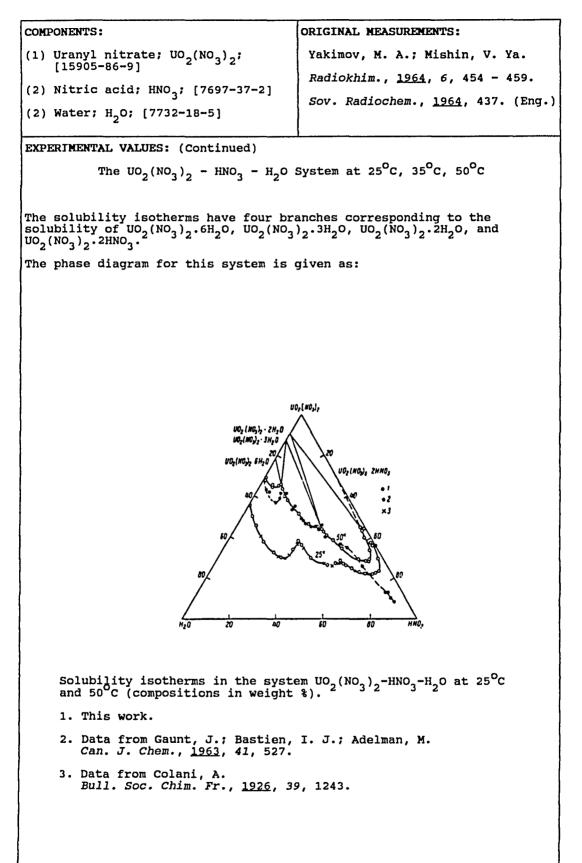
<sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2 \cdot 6H_2O$ ;  $B = UO_2(NO_3)_2 \cdot 3H_2O$ ;  $C = UO_2(NO_3)_2 \cdot 2H_2O$ ;  $D = UO_2(NO_3)_2 \cdot 2HNO_3$ .

<sup>C</sup>The sum of mass % is not equal to 100 (compilers).

COMMENTS AND/OR ADDITIONAL DATA

In the source paper, the phase diagram is given. Solubility isotherms have four branches corresponding to the solubility of  $UO_2(NO_3)_2.6H_2O$ ,  $UO_2(NO_3)_2.3H_2O$ ,  $UO_2(NO_3)_2.2H_2O$ ,  $UO_2(NO_3)_2$ .

(Continued on the next page)



COMPONENTS:			ORIGINAL ME	ASUREMENTS		
(1) Uranyl nitrat	e: 110 (NO	) :				
[15905-86-9]			Davis, W.; Lawson, P. S.; De Bruin, H. J.; Mrochek, J.			
(2) Nitric acid;	HNO <sub>3</sub> ; [769	7-37-2]	J. Phys. Ch	em., <u>1965</u> ,	<i>69</i> , 1904 - 1914.	
(3) Water; H <sub>2</sub> O; [7732-18-5]						
VARIABLES:			PREPARED BY	1		
Temperature: 298	ĸ		A. Sozanski	; S. Sieki	erski	
EXPERIMENTAL VALU	ES:		l	<u></u>		
T	he UO <sub>2</sub> (NO <sub>3</sub>	$)_2 - HNO_3$	- H <sub>2</sub> O System	at 25 <sup>0</sup> C		
			urated Solut			
Density	HN	<sup>10</sup> 3	U0 <sub>2</sub> (N	<sup>10</sup> 3)2	Solid Phase	
g/cm <sup>3</sup>	mol/dm <sup>3</sup>	mol/kg	mol/dm <sup>3</sup>	mol/kg		
1.7793	0.005	0.006	2.440	2.985	A	
1.7267 1.6587	1.320 2.478	1.653	2.144	2.684	A	
1.5957	4.368	3.130 5.813	1.804 1.444	2.279 1.922	А А	
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	В	
<sup>b</sup> Solid phase	s: A = UO <sub>2</sub>	(NO <sub>3</sub> ).6H <sub>2</sub> O	, B = UO <sub>2</sub> (NO	3) <sub>2</sub> .3H <sub>2</sub> O.		
	Α	UXILIARY II	NFORMATION	·····		
METHOD/APPARATUS/I	PROCEDURE:		SOURCE AND	PURITY OF	MATERIALS:	
The isothermal met Uranyl nitrate he:			1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O of high quality			
agitated in sealed aqueous nitric ac	d vessels	with	was recrystallized from water.			
concentration. The	e vessels	were	2. HNO3, reagent grade, N2 sparged.			
agitated for 1 to stat. The liquid p some time after ag stopped. The samp	phase was gitation h	sampled ad been	3. Water, d	istilled a	nd deionized.	
for uranium by con	nventional	methods.	ESTIMATED E	RROR :		
The solution densities were measured in duplicate using 10 mL pycnometers.			Solubility:		pecified.	
		Temperature	: Precisio	-		
			DEEEDENCES			
			REFERENCES:			

COMPONENTS:			ORIGINAL MEASUREMENTS:			
(1) Uranyl ( [15905-	nitrate; UO 86-9]	2 <sup>(NO</sup> 3)2;	Christensen, H. Th.; Holmberg, K. E.			
<pre>(2) Nitric acid; HNO<sub>3</sub>; [7697-37-2] (3) Water; H<sub>2</sub>O; [7732-18-5] VARIABLES:</pre>			Nukleon	ik, <u>1968</u> ,	<i>11</i> , 165 ·	- 170.
			PREPARED	BY:		
Composition	and tempera	ature	A. Sozar	ski; S. S	iekierski	
EXPERIMENTA	L VALUES:					
	The	$UO_2(NO_3)_2 - HN$	о, - н,с	) System		
		position of Sat				
t/ <sup>o</sup> c		NO3)2			н <sub>2</sub> 0	Solid
-, -		mol/kg				Phase
-44.7	2.9	0.12	33.9	8.51	63.2	λ+B+C
-36.7	6.6	0.25	27.5			A+C
-34.3 -31.3	8.1 11.8	0.31	26.0 22.1		65.9 66.1	A+C A+C
-29.3	13.9	0.453 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	Α
-25.0	3.63	0.151	35.4	9.21	61.0	A
-25.0	2.50	0.110	39.6		57.9	A
-25.0	2.09	0.0999	44.8	13.4	53.1	A
-23.4	28.2	1.16	10.0		61.8	A+C
-22.0 -21.3	33.6	1.43 1.58	6.8 4.7	1.8 1.3	59.6 58.8	A+C A+C
-20.1	36.5 40.7	1.82	2.4		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		58.2	A
-18.0	21.1	0.869	17.3	4.46	61.6	А
-18.0	6.29	0.260	32.3	8.35	61.4	А
-18.0	3.32	0.156	42.7	12.5	54.0	A
			(	Continued	on the ne	ext page
		AUXILIARY I	NFORMATIO	N		<u></u>
TETHOD/APPA	RATUS/PROCEI	DURE:	SOURCE A	ND PURITY	OF MATER	IALS:
		vas used. A 20 ion was placed	1.U02(NC	3 <sup>)</sup> 2 <sup>.6H</sup> 2 <sup>O</sup> ,	HNO3, A.1	R. grade
in an ultra-cryostat, and stirred while cooling. The plot of tempera- ture 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			2.H.O, purified by ion exchange and distilled twice from quartz.			
			Solv: nothing specified.			
			Temp.: P	recision	±0.0.02 to	o 0.04K.
(4 minutes,	2000 g). Ni	tric acid and were measured	REFERENC		<del> </del>	
		tion (1,2).	1. Ahrla		ta Chem. ! •	Scand.,

COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Christensen, H. Th.; Holmberg, K. E.			
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Nukleonik, <u>1968</u> , 11, 165 - 170.			
(3) Water; H <sub>2</sub> O; [7732-18-5]				

The  $UO_2(NO_3)_2$  -  $HNO_3$  -  $H_2O$  System Composition of Saturated Solutions<sup>a</sup>

t∕°c	U02(N03)2		HN	hno <sub>3</sub>		Solid Phase	
	mass %	mol/kg	mass %	mol/kg	mass %	FIIGSE	
-10.0	41.8	1.91	2.70	0.772	55.5	А	
-10.0	34.8	1.54	7.78	2.15	57.4	А	
-10.0	19.1	0.800	20.3	5.32	60.6	Α	
-10.0	5.85	0.268	38.3	11.1	55.3	Α	
-10.0	6.53	0.371	48.8	17.3	44.7	A	
0	45.7	2.24	2.46	0.754	51.8	A	
Ō	39.5	1.88	7.06	2.10	53.4		
0	24.2	1.09	19.2	5.38	56.6	А А А	
Ō	10.7	0.515	36.6	11.0	52.7	Α	
0	11.8	0.720	46.6	17.8	41.6	A	
20.0	50.3	2.75	3.34	1.14	46.4	А	
20.0	43.5	2.30	8.49	2.81	48.0	A	
20.0	30.3	1.53	19.3	6.08	50.4	A	
20.0	22.1	1.17	29.9	9.89	48.0		
20.0	21.2	1.17	33.0	11.4	45.8	A A	

<sup>a</sup>Molalities calculated by the compilers.

<sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2.6H_2O; B = HNO_3.3H_2O; C = ice.$ 

COMMENTS AND/OR ADDITIONAL DATA:

In the source paper, the phase diagram is given. The lowest eutonic point between hexahydrate and ice is at -44.7°C, and has the composition  $UO_2(NO_3)_2$ , 2.9 mass %; HNO<sub>3</sub>, 33.9 mass %, H<sub>2</sub>O, 63.2 mass %.

COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO2(NO3)	Deigele, E.			
	Thesis, Munich <u>1983</u> , INIS-mf-9277.			
(2) Nitric acid; HNO <sub>3</sub> ; [7697	2-37-2]			
(3) Water; H <sub>2</sub> O; [7732-18-5]				
VARIABLES:	PREPARED BY:			
Composition at 278 K	L. Fuks; S. Siekierski			
EXPERIMENTAL VALUES:				
The UO <sub>2</sub> (N	$(O_3)_2 - HNO_3 - H_2O$ System at 5 <sup>o</sup> C			
Compositi	on of Saturated Solutions <sup>a</sup>			
нноз	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> H <sub>2</sub> O			
mass % mol/kg	mass % mol/kg mass %			
2.26 0.851	42.68 1.967 55.05			
1.17 0.364 0.94 0.296	47.81 2.378 51.02 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 5.40 1.59	45.17 2.206 51.97 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 5.73 1.76	44.26 2.238 50.18 42.69 2.006 51.63			
5.73 1.76 6.48 1.93	42.69 2.096 51.63 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 9.37 2.81	41.77 2.033 52.14 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 $3.52615.45$ $4.361$	33.94 1.594 54.05 28.32 1.278 56.24			
15.45 4.361 16.70 4.843	28.32 1.278 56.24 28.57 1.325 54.73			
	(Continued on the next page)			
AU	XILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF CHEMICALS:			
The isothermal method was us	ed. Nothing specified.			
Uranium nitrate hexahydrate	or U <sub>3</sub> O <sub>8</sub>			
(when nitric acid exceeded 1 mol/dm ) was dissolved in ni	o tric			
lacid at room temperature, an	d then			
cooled to 5°C. The precipita	ted solid ESTIMATED ERROR:			
and the cooled solution were for 24 hours at 5°C. The ura	stirred			
content was determined by ev				
of the solution and ignition	to $U_2O_2$ . Temperature: Precision ±0.3C.			
The total content of nitrate	ions			
was measured by titration wi	th NaOH			
after removal of uranium usi	ng Dowex			
50 W-X8 ion exchanger. The H content was determined as th	e REFERENCES:			
difference.				

COMPONENTS:

(1)	Uranyl [15905	nitra -86-9]	te; UO	2 <sup>(NO</sup> 3)2;
(2)	Nitric	acid;	нNO <sub>3</sub> ;	[7697-37-2]

ORIGINAL MEASUREMENTS: Deigele, E. Thesis, Munich <u>1983</u>, INIS-mf-9277.

### EXPERIMENTAL VALUES: (Continued)

(3) Water; H<sub>2</sub>O; [7732-18-5]

The system  $UO_2(NO_3)_2 - HNO_3 - H_2O$  at 5<sup>O</sup>C Composition of saturated solutions<sup>a</sup>

mass % 18.08 17.04 17.17 21.67 20.85 25.88 22.67 19.58 21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93 36.23	mol/kg 5.152 4.851 4.838 6.103 5.841 7.301 6.392 5.487 6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	mass % 26.23 27.21 26.51 21.98 22.50 17.86 21.04 23.79 21.84 18.91 16.36 16.37 14.68 15.19 14.57	mol/kg 1.195 1.239 1.195 0.9899 1.008 0.8056 0.9486 1.066 0.9794 0.8524 0.7458 0.7458 0.7549 0.6782 0.7018	mass % 55.69 55.75 56.32 56.35 56.65 56.25 56.27 56.63 56.59 56.30 55.63 55.03 55.03 54.93	
17.04 17.17 21.67 20.85 25.88 22.67 19.58 21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	4.851 4.838 6.103 5.841 7.301 6.392 5.487 6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	27.21 26.51 21.98 22.50 17.86 21.04 23.79 21.84 18.91 16.36 16.37 14.68 15.19 14.57	1.239 1.195 0.9899 1.008 0.8056 0.9486 1.066 0.9794 0.8524 0.7458 0.7458 0.7549 0.6782	55.75 56.32 56.35 56.65 56.25 56.27 56.63 56.59 56.30 56.30 55.67 55.03 54.93	
17.17 21.67 20.85 25.88 22.67 19.58 21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	4.838 6.103 5.841 7.301 6.392 5.487 6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	26.51 21.98 22.50 17.86 21.04 23.79 21.84 18.91 16.36 16.37 14.68 15.19 14.57	1.195 0.9899 1.008 0.8056 0.9486 1.066 0.9794 0.8524 0.7458 0.7549 0.6782	56.32 56.35 56.65 56.25 56.27 56.63 56.59 56.30 56.30 55.67 55.03 54.93	
21.67 20.85 25.88 22.67 19.58 21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	6.103 5.841 7.301 6.392 5.487 6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	21.98 22.50 17.86 21.04 23.79 21.84 18.91 16.36 16.37 14.68 15.19 14.57	0.9899 1.008 0.8056 0.9486 1.066 0.9794 0.8524 0.7458 0.7549 0.6782	56.35 56.65 56.25 56.27 56.63 56.59 56.30 56.30 55.67 55.03 54.93	
20.85 25.88 22.67 19.58 21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	5.841 7.301 6.392 5.487 6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	22.50 17.86 21.04 23.79 21.84 18.91 16.36 16.37 14.68 15.19 14.57	1.008 0.8056 0.9486 1.066 0.9794 0.8524 0.7458 0.7549 0.6782	56.65 56.25 56.27 56.63 56.59 56.30 55.67 55.03 54.93	
25.88 22.67 19.58 21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	7.301 6.392 5.487 6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	17.86 21.04 23.79 21.84 18.91 16.36 16.37 14.68 15.19 14.57	0.8056 0.9486 1.066 0.9794 0.8524 0.7458 0.7458 0.7549 0.6782	56.25 56.27 56.63 56.59 56.30 55.67 55.03 54.93	
22.67 19.58 21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	6.392 5.487 6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	21.04 23.79 21.84 18.91 16.36 16.37 14.68 15.19 14.57	0.9486 1.066 0.9794 0.8524 0.7458 0.7458 0.7549 0.6782	56.27 56.63 56.59 56.30 55.67 55.03 54.93	
19.58 21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	5.487 6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	23.79 21.84 18.91 16.36 16.37 14.68 15.19 14.57	1.066 0.9794 0.8524 0.7458 0.7549 0.6782	56.63 56.59 56.30 55.67 55.03 54.93	
21.57 24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	6.049 6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	21.84 18.91 16.36 16.37 14.68 15.19 14.57	0.9794 0.8524 0.7458 0.7549 0.6782	56.59 56.30 55.67 55.03 54.93	
24.79 29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	6.988 7.974 8.248 8.780 8.633 8.862 8.951 8.664	18.91 16.36 16.37 14.68 15.19 14.57	0.8524 0.7458 0.7549 0.6782	56.30 55.67 55.03 54.93	
29.97 28.60 30.39 29.88 30.61 29.51 30.06 31.93	7.974 8.248 8.780 8.633 8.862 8.951 8.664	16.36 16.37 14.68 15.19 14.57	0.7458 0.7549 0.6782	55.67 55.03 54.93	
28.60 30.39 29.88 30.61 29.51 30.06 31.93	8.248 8.780 8.633 8.862 8.951 8.664	16.37 14.68 15.19 14.57	0.7549 0.6782	55.03 54.93	
30.39 29.88 30.61 29.51 30.06 31.93	8.780 8.633 8.862 8.951 8.664	14.68 15.19 14.57	0.6782	54.93	
29.88 30.61 29.51 30.06 31.93	8.633 8.862 8.951 8.664	15.19 14.57			
30.61 29.51 30.06 31.93	8.862 8.951 8.664	14.57	0.7010		
29.51 30.06 31.93	8.951 8.664		0.6741	54.82	
30.06 31.93	8.664	15.07	0.6901	55.42	
31.93		14.88	0.6858	55.06	
	9.331	13.76	0.6430	54.31	
	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 17.29	1.925	22.17	
67.91 66.80	72.82 66.63	17.29	2.965 2.758	14.81 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	1.455	27.00	
60.92	41.71	15.90	1.741	23.18	
63.79	57.59	18.60	2.680	17.61	
	2.122	20100		tinued on the ne	ext page)

CONDONENTE		OPTC	INAL MEASUREMENT	ς.
COMPONENTS:				
(1) Uranyl nitrat [15905-86-9]	e; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;		gele, E.	TNTC
(2) Nitric acid;	нно <sub>3</sub> ; [7697-37-2]	Thes	is, Munich <u>1983</u> ,	IN15-m1-92//.
(3) Water; H <sub>2</sub> O; [	7732-18-5]			
EXPERIMENTAL VALU	ES: (Continued)			
	The $UO_2(NO_3)_2 - HN$	ю <sub>3</sub> – н <sub>2</sub>	O system at 5 <sup>0</sup> C	
	Composition of sa			
ниоз		00 <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub>	н <sub>2</sub> 0
mass %	mol/kg n	nass %	mol/kg	mass %
61.59		9.58	2.639	18.83
63.74		18.49 18.07	2.641 1.461	17.77 31.38
50.54 55.56		6.17	1.452	28.26
57.36		5.91	1.511	26.73
63.65		8.76	2.707	17.59
		4.33	6.798	5.35
63.30		8.71	2.639	17.99
76.91	173.1 1	6.04	5.774	7.05
51.23	26.25 1	17.80	1.459	30.97
62.35		9.26	2.658	18.39
		15.51	4.418	9.918
61.83		.9.42	2.628	18.75
69.30		19.11	4.184	11.59
46.23		20.20	1.527	33.57
49.81		18.24	1.449	31.95 5.75
		.4.60 L6.16	6.444 3.847	10.67
61.01		9.76	2.608	19.22
		4.21	5.652	6.37
48.45		8.70	1.445	32.84
1		4.60	6.155	6.02
67.78		9.61	3.947	12.61
69.12		19.20	4.172	11.68
		.6.35	4.140	10.07
48.37		19.33	1.159	32.30
•		4.91	3.966	9.54
66.57		9.79	3.682	13.64
		.2.28	6.673	4.67
67.54 69.36		19.76 .8.78	3.949 4.019	12.70 11.86
45.03		21.04	1.574	33.92
66.86		.8.28	3.122	14.86
66.41		20.19	3.824	13.40
70.46		7.13	3.503	12.41
68.92		17.71	3.362	13.37
69.31	85.54 1	7.83	3.519	12.86
44.33	20.51 2	21.37	1.581	34.29
<sup>a</sup> Molalities	calculated by the	compile	rs.	

COMMENTS AND/OR ADDITIONAL DATA:

At 11 mol/dm<sup>3</sup><sub>3</sub> HNO<sub>3</sub>, equilibrium solid changes from hexa- to trihydrate; at 16 mol/dm, 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 HNO<sub>3</sub>, the equilibrium solid is the monohydrate. No evidence found for the existence of a solid in which hydrated water is replaced by HNO<sub>3</sub>. In the source paper, the triangular diagram is also given.

COMPONENTS:	ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Colani, A. Bull. Soc. Chim. Fr., <u>1928</u> , 43,				
(2) Ammonium nitrate; NH <sub>4</sub> NO <sub>3</sub> ; [6484-52-2]	Bull. Soc. Chim. Fr., <u>1928</u> , 43, 194 - 199.				
(3) Water; H <sub>2</sub> O; [7732-18-5]					
VARIABLES:	PREPARED BY:				
Temperature: 298 K	L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES:					
The $UO_2(NO_3)_2 - NH_4NO_3$	- H <sub>2</sub> O System at 25 <sup>0</sup> C				
Composition of Satu	urated Solutions <sup>a</sup>				
<sup>UO</sup> 2 <sup>(NO</sup> 3)2	NH4NO3 Solid Phase				
mass % mol/kg mass	s % mol/kg				
56.08 3.240 0	0 A				
54.53 3.221 2.1 53.23 3.343 6.3	36 1.97 A Í				
51.79 3.474 10.					
53.06 4.534 17. 54.35 5.593 20.					
52.00 5.101 22.3	13 10.69 B				
49.33 4.862 24.9 46.31 4.692 28.0	92 12.09 B				
40.81 4.227 34.6					
40.23 4.154 35.3					
30.54 2.958 43.3 23.12 2.046 48.3	26 20.63 C 21 21.01 C				
18.10 1.528 51.8	B4 21.55 C				
6.90 0.543 60.8 0 0 65.					
<sup>a</sup> Molalities calculated by the co <sup>b</sup> Solid phases: $A = UO_2(NO_3)_2 \cdot 6H_2$	-				
$C = NH_4NO_3.$					
AUXILIARY II	NFORMATION				
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:				
Nothing specified, but probably the isothermal procedure as given in (1).					
No numerical data are given in (1), but a small phase diagram was	ESTIMATED ERROR:				
presented.	Nothing specified.				
	REFERENCES: 1. Colani, A. <i>Compt. Rend.</i> <u>1927</u> , 185, 1475.				

COMPONENTS:	ORIGINAL MEASUREMENTS:
	Colani, A.
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Compt. Rend., <u>1927</u> , 185, 1475 -
(2) Ammonium nitrate; NH <sub>4</sub> NO <sub>3</sub> ; [6484-52-2]	1476.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Temperature: 298 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
The results are given only in th	e form of a small diagram in
which the concentration of $UO_2(N)$	$(0_3)_2$ is plotted against the
concentration of $NH_4NO_3$ . The fol	lowing solid phases were found:
UO2(NO3)2.6H2O, (NH4)2UO2(NO3)4.	
2 3 2 2 4 2 2 3 4	2 4 5
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal analytical method was used. No additional information is given.	Nothing specified.
TO ATAONA	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES:
	l

COMPONENTS:			ORIGINAL P	<b>IEASUREMENTS</b>	5:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]			Rimbach,	Rimbach, E.		
<ul> <li>(2) Ammonium nitrate; NH<sub>4</sub>NO<sub>3</sub>;</li> </ul>			Ber., <u>190</u>	Ber., <u>1904</u> , 37, 461 - 488.		
[6484-5	2-2]	4.037				
(3) Water;	H <sub>2</sub> 0; [7732-1	.8-5]				
VARIABLES:			PREPARED BY:			
Composition	and tempera	ture	L. Fuks; S	5. Siekiersk	i	
EXPERIMENTA	L VALUES:					
	The	• UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> -	NH <sub>4</sub> NO <sub>3</sub> - H <sub>2</sub> C	) System		
	Con	position of S	aturated Sol	lutions <sup>a</sup>		
	UO <sub>2</sub> (	NO3)2	NH	1 <sup>NO</sup> 3	Solid	
t∕°c	mass %	mol/kg		mol/kg	Phase <sup>D</sup>	
0.5	43.35	2.519	12.97	3.710	А	
13.5	47.20	3.186	15.20	5.051	A	
24.9 35.0	53.21 61.39	4.348 6.678	15.73 15.28	6.327 8.183	А А	
59.0	64.74	7.341	12.88	7.190	в	
	65.60		13.24		B	
a Molal	ities calcul	ated by the c UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H	ompilers.		_	
a Molal	ities calcul	ated by the c	ompilers.		_	
a Molal	ities calcul	ated by the c UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H	ompilers. <sub>2</sub> 0; B = UO <sub>2</sub> (		_	
<sup>a</sup> Molal <sup>b</sup> Solid	ities calcul phases: A =	ated by the c UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H	ompilers. 2 <sup>0</sup> ; B = UO <sub>2</sub> ( INFORMATION	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N	0 <sub>3</sub> .nH <sub>2</sub> 0.	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother	ities calcul phases: A = RATUS/PROCED mal analytic	ated by the c UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H AUXILIARY UURE:	ompilers. 2 <sup>0</sup> ; B = UO <sub>2</sub> ( INFORMATION SOURCE AND Pure urar		MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid <b>METHOD/APPA</b> The isother used. Weigh salt and wa investigate	ities calcul phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur	AUXILIARY AUXILIARY AUXILIARY AUXILIARY AUXILIARY AUXILIARY AUXILIARY	ompilers. 2 <sup>0; B = UO</sup> 2( INFORMATION SOURCE AND	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu	MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother used. Weigh salt and wa investigate solution wa water evapo	ities calcul phases: A = phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur s analyzed e ration, or a	AUXILIARY AUXILIARY AUXILIARY URE: al method was f the double red at the re. The sither after ifter the	ompilers. 2 <sup>0; B = U0</sup> 2( INFORMATION SOURCE AND Pure urar used. ESTIMATED	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu	MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother used. Weigh salt and wa investigate solution wa water evapo uranium pre The uranium	ities calcul phases: A = phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur s analyzed e ration, or a concentrati	AUXILIARY AUXILIARY AUXILIARY URE: al method was of the double at the e. The either after fter the ising (NH <sub>4</sub> ) <sub>2</sub> S. on was	ompilers. 20; B = UO <sub>2</sub> ( INFORMATION SOURCE AND Pure urar used. ESTIMATED Nothing s	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu ERROR: specified.	MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother used. Weigh salt and wa investigate solution wa water evapo uranium pre The uranium measured af	ities calcul phases: A = phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur s analyzed e ration, or a cipitation u concentrati ter its calc	AUXILIARY AUXILIARY AUXILIARY URE: al method was of the double at the e. The either after fter the ising (NH.).S.	ompilers. 20; B = UO <sub>2</sub> ( INFORMATION SOURCE AND Pure urar used. ESTIMATED Nothing s	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu ERROR: specified.	MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother used. Weigh salt and wa investigate solution wa water evapo uranium pre The uranium measured af	ities calcul phases: A = phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur s analyzed e ration, or a cipitation u concentrati ter its calc	AUXILIARY AUXILIARY AUXILIARY URE: al method was of the double at the e. The either after fter the ising (NH <sub>4</sub> ) <sub>2</sub> S. on was	ompilers. 20; B = UO <sub>2</sub> ( INFORMATION SOURCE AND Pure urar used. ESTIMATED Nothing s	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu ERROR: specified.	MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother used. Weigh salt and wa investigate solution wa water evapo uranium pre The uranium	ities calcul phases: A = phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur s analyzed e ration, or a cipitation u concentrati ter its calc	AUXILIARY AUXILIARY AUXILIARY URE: al method was of the double at the e. The either after fter the ising (NH <sub>4</sub> ) <sub>2</sub> S. on was	ompilers. 20; B = UO <sub>2</sub> ( INFORMATION SOURCE AND Pure urar used. ESTIMATED Nothing s	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu ERROR: specified.	MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother used. Weigh salt and wa investigate solution wa water evapo uranium pre The uranium measured af	ities calcul phases: A = phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur s analyzed e ration, or a cipitation u concentrati ter its calc	AUXILIARY AUXILIARY AUXILIARY URE: al method was of the double at the e. The either after fter the ising (NH <sub>4</sub> ) <sub>2</sub> S. on was	ompilers. 20; B = UO <sub>2</sub> ( INFORMATION SOURCE AND Pure urar used. ESTIMATED Nothing s	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu ERROR: specified.	MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother used. Weigh salt and wa investigate solution wa water evapo uranium pre The uranium measured af	ities calcul phases: A = phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur s analyzed e ration, or a cipitation u concentrati ter its calc	AUXILIARY AUXILIARY AUXILIARY URE: al method was of the double at the e. The either after fter the ising (NH <sub>4</sub> ) <sub>2</sub> S. on was	ompilers. 20; B = UO <sub>2</sub> ( INFORMATION SOURCE AND Pure urar used. ESTIMATED Nothing s	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu ERROR: specified.	MATERIALS:	
<sup>a</sup> Molal <sup>b</sup> Solid METHOD/APPA The isother used. Weigh salt and wa investigate solution wa water evapo uranium pre The uranium measured af	ities calcul phases: A = phases: A = RATUS/PROCED mal analytic ed amounts c ter were mix d temperatur s analyzed e ration, or a cipitation u concentrati ter its calc	AUXILIARY AUXILIARY AUXILIARY URE: al method was of the double at the e. The either after fter the ising (NH <sub>4</sub> ) <sub>2</sub> S. on was	ompilers. 20; B = UO <sub>2</sub> ( INFORMATION SOURCE AND Pure urar used. ESTIMATED Nothing s	(NO <sub>3</sub> ) <sub>2</sub> .2NH <sub>4</sub> N D PURITY OF nium-ammoniu ERROR: specified.	MATERIALS:	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N. F.
<pre>(2) Lithium nitrate; LiNO<sub>3</sub>; [7790-69-4] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	Zh. Neorg. Khim., <u>1961</u> , 6, 208 - 211. Russ. J. Inorg. Chem., <u>1961</u> , 6, 103. (Eng. trans.)
VARIABLES:	PREPARED BY:
Composition at 273 and 298 K	A. Sozanski; S. Siekierski

The  $UO_2(NO_3)_2$  - LiNO<sub>3</sub> - H<sub>2</sub>O System at 0°C and 25°C

Composition of Saturated Solutions<sup>a</sup>

	uo <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub>	LiN	10 <sub>3</sub>	н <sub>2</sub> 0	Solid Phase <sup>b</sup>
t∕°c	mass %	mol/kg	mass %	mol/kg	mass %	Filuse
0	0	0	34.7	7.71	65.3	А
	2.6	0.10	31.6	6.97	65.8	A
	4.2	0.16	30.6	6.81	65.2	А А А А А
	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	в
	23.2	1.02	19.2	4.83	57.6	в
	24.8	1.09	17.6	4.43	57.6	в
	29.4	1.32	14.2	3.65	56.4	в
	34.0	1.59	11.6	3.09	54.4	в
	38.6	1.81	7.2	1.9	54.2	в
	44.0	2.14	3.8	1.1	52.2	в
	49.5	2.49	0	0	50.5	В
				<i></i>		

(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 ESTIMATED ERROR: calcination to the oxide, U<sub>3</sub>O<sub>8</sub>. The lithium content in filtrate<sup>3</sup> was determined by evaporation with H<sub>2</sub>SO<sub>4</sub> as Li<sub>2</sub>SO<sub>4</sub>.

# SOURCE AND PURITY OF MATERIALS:

Nothing specified.

Solubility: Nothing specified.

Temperature: Nothing specified.

#### **REFERENCES:**

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

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

	·					
COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;				AL MEASURE mov, M. A.		N. F.
[15905-	-86-9]	2 3 2				
(2) Lithium nitrate; LiNO <sub>3</sub> ; [7790-69-4]			Zh. N	eorg. Khim	•, <u>1961</u> , e	5, 208 - 211.
			Russ.	J. Inorg.	Chem., 19	961, 6,
(3) Water; H <sub>2</sub> O; [7732-18-5]				(Eng. tran		
EXPERIMENTAL VALUES: (Continued) The $UO_2(NO_3)_2$ - LiNO <sub>3</sub> - H <sub>2</sub> O System at 0°C and 25°C						
	Com	position of S	Saturated	Solutions <sup>a</sup>		
	U0 <sub>2</sub> (	NO3)2	LiN	0 <sub>3</sub>	н <sub>2</sub> о	Solid <sub>b</sub> Phase
t∕°c	mass %	mol/kg	mass %	mol/kg	mass %	1 11436
25	0	0	46.4	12.6	53.6	A
l	2.9	0.14	45.0	12.5	52.1	A
	4.8	0.24	44.2	12.6	51.0	A
1	7.2	0.37	43.0	12.5	49.8	A
	9.4	0.49	41.8	12.4	48.8	A
	10.6 12.8	0.560	41.4	12.5	48.0	A
	14.6	0.687 0.795	39.9 38.8	12.2 12.1	47.3 46.6	A A
	15.0	0.820	38.6	12.1	46.4	Ä
	18.4	1.04	36.7	11.9	44.9	Ä
	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	в
}	22.8	1.29	32.4	10.5	44.8	в
[	23.2	1.30	31.4	10.0	45.4	в
}	23.8	1.31	30.0	9.42	46.2	В
	24.2	1.32	29.2	9.09	46.6	В
	24.8	1.33	27.8	8.51	47.4	В
	26.4	1.38	25.0	7.46	48.6	B
	26.8 30.0	1.41 1.56	24.8 21.2	7.43 6.30	48.4	B B
	32.2	1.68	19.2	5.73	48.4 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	в
	48.0	2.67	6.4	2.0	45.6	В
ļ	51.4	2.90	3.6	1.2	45.0	В
l.	55.95	3.223	0	0	44.05	В

<sup>a</sup>Molalities calculated by the compilers.

<sup>b</sup>Solid phases:  $A = LiNO_3.3H_2O; B = UO_2(NO_3)_2.6H_2O.$ 

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Colani, A.
(2) Sodium nitrate; NaNO <sub>3</sub> ; [7631-99-4]	Compt. Rend., <u>1927</u> , 185, 1475 - 1476.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 298 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of uranyl nitrate in	n water at 25 <sup>0</sup> C was reported as
44.2 g/100 g of solution, and the	solubility of sodium nitrate at
25 <sup>0</sup> C in water was reported as 16.2	g/100 g of solution. The
equilibrium solids are UO <sub>2</sub> (NO <sub>3</sub> )2.6	H <sub>2</sub> O and NaNO <sub>3</sub> . The molality of
uranyl nitrate in a saturated solu	tion at the eutonic point at 25 <sup>0</sup> C
is 2.83 mol/kg (compilers).	
AUXILIARY II	SOURCE AND PURITY OF MATERIALS:
METHOD/APPARATUS/PROCEDURE:	
The isothermal analytical method	Nothing specified.
was used. No additional information	
was given.	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES:
	l l

COMPONENTS:		ORIGINAL M	EASUREMENTS:	:	
(1) Uranyl nitrate; UG [15905-86-9]	0 <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Colani, A	Colani, A.		
<pre>(2) Sodium nitrate; Na     [7631-99-4]</pre>	ano <sub>3</sub> ;	Bull. Soc 43, 194 -	. Chim. Fr., 195.	, <u>1928</u> ,	
(3) Water; H <sub>2</sub> O; [7732-	-18-5]				
VARIABLES:	<u></u>	PREPARED B	¥:		
One temperature: 298	к	L. Fuks;	S. Siekiers	ci	
EXPERIMENTAL VALUES:					
The UO,	(NO <sub>3</sub> ) <sub>2</sub> - NaNO <sub>3</sub>	- H <sub>2</sub> O Syste	m at 25 <sup>0</sup> C		
Cor	position of Sat	urated Solu	tions <sup>a</sup>		
ио <sub>2</sub> (NO <sub>3</sub> )	)2	NaNO <sub>3</sub>	Sc	olid <sub>b</sub>	
mass % mo	ol/kg mas	s % mol		lase"	
53.06 51.59 48.62 45.37	3.092       6.         2.941       9.         2.861       14.	06 1. 43 2. 39 4.	933 68 64 207 812	A A A A A A	
34.35 2 20.83 1 9.12 0	2.483       17.         2.009       22.         1.114       31.         0.455       40.         0       47.	26 6. 71 7. 06 9.		B B B B B	
<sup>a</sup> Molalities calcu <sup>b</sup> Solid phases: A <sup>C</sup> In Reference (1) i.e., with solid	= $UO_2(NO_3)_2.6H_2$ , this data poi	O; B = NaNO		onic point,	
,					
	AUXILIARY I	1			
METHOD/APPARATUS/PROCI Nothing specified, but the isothermal method Ref. (1).	AUXILIARY I EDURE:	SOURCE AND	PURITY OF Postified.	MATERIALS:	
METHOD/APPARATUS/PROCI Nothing specified, but the isothermal method	AUXILIARY I EDURE:	SOURCE AND	specified.	MATERIALS:	
METHOD/APPARATUS/PROCI Nothing specified, but the isothermal method	AUXILIARY I EDURE:	SOURCE AND Nothing ESTIMATED	specified.	ATERIALS:	
METHOD/APPARATUS/PROCI Nothing specified, but the isothermal method	AUXILIARY I EDURE:	SOURCE AND Nothing ESTIMATED	specified. ERROR: specified.	MATERIALS:	

$(NO_3)_2;$ $KNO_3;$ 8-5] ture $UO_2(NO_3)_2 - KI$	PREPARED	<u>04</u> , 37, 461 -	
8-5] ture U0 <sub>2</sub> (N0 <sub>3</sub> ) <sub>2</sub> - К	PREPARED	BY:	
8-5] ture U0 <sub>2</sub> (N0 <sub>3</sub> ) <sub>2</sub> - К	L. Fuks;		
ture Ио <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> - К	L. Fuks;		
ио <sub>2</sub> (ио <sub>3</sub> ) <sub>2</sub> - кі	L. Fuks;		· · · · · · · · · · · · · · · · · · ·
ио <sub>2</sub> (ио <sub>3</sub> ) <sub>2</sub> - кі	<u> </u>	S. Siekierski	1
	NO <sub>3</sub> - н <sub>2</sub> О :	System	
osition of Sat	urated Sol	utions <sup>a</sup>	
0_)_	KN	0	
•			Solid
			Phase
2.422	4.45	0.900	А А
3.864	10.39	2.893	A
			A
6.528 8.204	15.59 16.49	6.525 8.266	B B
кио <sub>3</sub> ; в = UO <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub> .KNO		
URE:	SOURCE AN	D PURITY OF MA	TERIALS:
he double salt the desired	Pure ura	anium - potass s used.	ium double
vaporation of	ESTIMATED	ERROR:	
$(NH_4)_2 S.$	Nothing	specified.	
e, U <sub>3</sub> 0 <sub>8</sub> .	REFERENCE	5:	
	2.422 2.800 3.864 6.221 6.528 8.204 ated by the co $KNO_3$ ; B = UO <sub>2</sub> AUXILIARY I URE: as used.	NOT       NOT	mol/kg       mass %       mol/kg         2.422       4.45       0.900         2.800       7.08       1.58         3.864       10.39       2.893         6.221       13.34       5.254         6.528       15.59       6.525         8.204       16.49       8.266         ated by the compilers.       KNO <sub>3</sub> ; B = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .KNO <sub>3</sub> .         AUXILIARY INFORMATION         URE:         SOURCE AND PURITY OF MA         Pure uranium - potass         he double salt         the desired         OURCE AND PURITY OF MA         Pure uranium - potass         salt was used.         ESTIMATED ERROR:         Nothing specified.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9]</pre>	Colani, A.
(2) Potassium nitrate; KNO <sub>3</sub> ; [7757-79-1]	Compt. Rend., <u>1927</u> , 185, 1475 - 1476.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 298 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	· L
	e hexahydrate in water at 25 <sup>0</sup> C the solution, and the solubility water is reported as 10.4 g/100 g
AUXILIARY	INFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. No additional information was given.	Nothing specified.
	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES:

······			·		
COMPONENTS:			ORIGINAL ME	ASUREMENTS:	
(1) Uranyl nitrate [15905-86-9]	; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	;	Colani, A.		
(2) Potassium nitra [7757-79-1]	ate; KNO <sub>3</sub> ;		Bull. Soc. 43, 194 - 1	<i>Chim. Fr., <u>1928</u>,</i> 199.	
(3) Water; H <sub>2</sub> 0; [7 <sup>,</sup>	732-18-5]	i			
VARIABLES:	······································	=	PREPARED BY	?:	
Temperature: 298 K			L. Fuks; S	5. Siekierski	
EXPERIMENTAL VALUES	5:		<u> </u>		
The	UO2(NO3)2 -	- кно <sub>з</sub> -	H <sub>2</sub> O System a	at 25 <sup>0</sup> C	
	Composition	n of Sati	urated Solut:	cions <sup>a</sup>	
u0 <sub>2</sub> (1	<sup>10</sup> 3)2		кио <sub>з</sub>	Solid <sub>b</sub> Phase	
mass &	mol/kg	mass	% mol/kg	g	
56.08 54.68 54.21 53.90	3.240 3.307 3.398 3.738	0 3.30 5.30 9.53	0 1.30 L 2.57	) A / A <sub>C</sub>	
53.88	3.828	10.40	2.88	30 A.	
48.65 40.60 25.80 9.71 6.46 3.16 0	3.012 2.314 1.065 0.350 0.225 0.109 0	10.36 11.11 12.74 19.94 21.23 23.15 27.44	1     2.27!       4     2.05!       1     2.80!       3     2.90!       5     3.10'	25 B 50 B 13 B 12 B 17 B	
<sup>a</sup> Molalities ca	lculated by	the com	milers.		
b Solid phases:	_		-		
			as the eutor	nic point, i.e.,	
the solid pha	ise is A + E	3.			
· ····		LTARY TH	FORMATION		<u></u>
METHOD/APPARATUS/PH				PURITY OF MATERIALS:	
Nothing specified, method was probably discussed in Ref. (	but the isc used, as	othermal			
		1	ESTIMATED EN	RROR:	
			Solubility:	Nothing specified.	
			Temperature	Nothing specified.	
		Í	REFERENCES:		
			1. Colani, Compt. Re	end., <u>1927</u> , 185, 147	5.

COMPONENT	s:		ORIGI	ORIGINAL MEASUREMENTS:				
(1) Urany	1 nitrate; 1 5-86-9]	<sup>10</sup> 2 <sup>(NO</sup> 3) <sup>2</sup> ;	Pero	Perova, A. P.				
•	sium nitrate	: KNO :	Zh.	Neorg. Khi	im., <u>1956</u> , 1	1, 323- 329.		
[7757	-79-1] ; H <sub>2</sub> O; [773]	2		. <i>J. Inorg</i> (Eng. tra	. Chem., <u>19</u> ins.)			
VARIABLES Compositi	: on and tempe	erature		RED BY: zanski; S.	Siekierski			
EXPERIMEN	TAL VALUES:			<u> </u>		· · · · · · · · · · · · · · · · · · ·		
	T	ne UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	- кно <sub>з</sub> - н	H <sub>2</sub> O System	n			
	Co	omposition of	Saturated	Solutions	,a			
t∕°c	00 <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub>	KN	0 <sub>3</sub>	н <sub>2</sub> 0	Solid		
	mass %	mol/kg	mass %	mol/kg	mass %	Phase <sup>-</sup>		
0			12.24	1.379	87.76	A		
	1.00	0.0289	11.3	1.27	87.7 83.4 <sup>c</sup> ,d	A		
	7.4	0.23	0	1.1		A		
	24.0 38.7	0.870 1.72	6.0 4.1	0.85 0.71	70.0 57.2	A A		
	30.7	1.16	47 e I	0./1		м		
	48.3	2.50	2.69	0.543	40.0 <sup>c,d</sup>	A+B		
	49.8	2.52			50.2	В		
5			14.4	1.66	85.6	Α		
	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 48.0	1.69 2.56	5.1 4.5	0.89	56.9	A		
				0.94	47.5 45.4 <sup>C</sup>	A		
	49.8	2.78	4.8	1.0		A+B		
	51.3	2.67			48.7	в		
10			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 (Continu	56.3	A Novt nago		
					led on the r	lext page		
		AUXILIA	RY INFORMA					
TETHOD/AP	PARATUS/PROC	EDURE:			TY OF MATER			
		component sys polythermal	tems 1.UO2	(NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub>	O and KNO3	both of		
		lass test tu was dipped		own purity	, recrystal	lized		
liquid ai:	r, and then	slowly warme		water.				
first cry	stals during	cooling and		ATED ERROR	:			
warming wa	as noted. To	st crystals verify resu	lts, Solubi	ility: Not	hing specif	ied.		
isotherma	l methods at	eutonic poin 0 C and 25	C Temper	rature: Pr	ecision $\pm 0$ .	1 К.		
		tigations we mostat with		ENCES:				
stirrer. :	Solutions wi	th a composi	tion					
		l points were						
		15% excess s	olid					
	added. Equil		and					
		ter 3 hours, Potassium a						
uranium me	easured drav	THEFT CALLY	1					

COMPONENT	S:		ORIGI	NAL MEASURE	MENTS:			
(1) Urany [1590	1 nitrate; [ 5-86-9]	JO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Pero	Perova, A. P.				
(2) Potas	sium nitrate -79-1]	; KNO <sub>3</sub> ;	Zh. N	eorg. Khim.	, <u>1956</u> , 1,	323 - 329.		
	; H <sub>2</sub> 0; [7732	2-18-5]		J. Inorg. ( (Eng. trans)				
EXPERIMEN	TAL VALUES:	(Continued)			<u> </u>			
	ተነ	$1002(NO_3)_2$	- кно <sub>з</sub> - н	2 <sup>0</sup> System				
	Cc	omposition of	Saturated	Solutions <sup>a</sup>				
t∕°c	00 <sub>2</sub> (	NO3)2	ĸ	NO <sub>3</sub>	н <sub>2</sub> 0	Solid Phase		
	mass %	mol/kg	mass %	mol/kg	mass %	Thube		
10	47.6	2.59	5.8	1.2	46.6	A		
	51.5	3.08	6.0	1.4	42.5 <sup>C</sup>	A+B		
	52.0	2.75			48.0	В		
15			20.0	2.47	80.0	A		
	0.75 6.8	0.024 0.23	19.8 17.0	2.46 2.21	79.45 76.2	A		
	22.4	0.23	11.7	1.76	65.9	A A		
	37.0	1.70	7.9	1.4	55.1	A		
	47.3	2.64	7.2	1.6	45.5	A		
	53.0	3.39	7.3	1.8	39.7 <sup>C</sup>	A+B		
	52.8	2.84			47.2	в		
20			23.95	3.115	76.05	A		
	0.7	0.02	23.6	3.08	75.7	A		
	6.4 22.0	0.22 0.867	20.15 13.6	2.713 2.09	73.45 64.4	A A		
	36.3	1.70	9.4	1.7	54.3	Â		
	46.3	2.62	8.8	1.9	44.9	A		
	53.6	3.63	8.9	2.3	37.5 <sup>C</sup>	A+B		
	54.4	3.03			45.6	В		
25			27.64	3.778	72.36	A		
	0.65	0.023	26.7	3.64	72.65	A		
	6.2 21.5	0.22 0.865	23.5 15.4	3.31	70.3	A		
	35.6	1.69	11.0	2.41 2.04	63.1 53.4	A A		
	45.8	2.67	10.6	2.40	43.6	Ä		
	54.1	3.92	10.9	3.08	35.0 <sup>C</sup>	A+B		
	55.9	3.22			44.1	В		
Init	ial Solution	I: UO2(NO3)	2 = 1.56 m	ass %, H <sub>2</sub> O =	= 98.44 mas	S %		
		(KNO <sub>3</sub> was	s added)					
- 0.2	1.56	0.0402			98.44	ice		
- 0.6	1.52	0.0400	1.96	0.201	96.52	ice		
- 1.6 - 2.0	1.50 1.44	0.0402	3.84	0.401	94.66	ice		
		0.0401	7.40	0.803	91.16	ice		
- 2.8	1.43	0.0404	8.80	0.970	89.77 <sup>C</sup>	ice+A		
1.5	1.39 1.34	0.0401 0.0401	10.71 13.79	1.205 1.607	87.90 84.87	A		
6.8		0.0401	1.1.79	1.5117	<b>MU M</b> .	A		

COMPONENTS:	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		ORIGINAL	MEASUREME	ENTS:	<u></u>
(1) Uranyl ni [15905-86	Perova,	Perova, A. P.				
	Zh. Neorg. Khim., <u>1956</u> , 1, 323 -					
(2) Potassiur [7757-79-	n nitrate; KN -1]	10 <sub>3</sub> ;	Russ. J	. Inorg. C	hem., <u>195</u>	329. <u>6,</u> 1,
(3) Water; H.	- 2 <sup>0;</sup> [7732-18-	·5]	) 140. (E	ng. trans.	)	
EXPERIMENTAL	VALUES: (Cor	tinued)				
	The UC	$(NO_3)_2 - KN$	10 H.O	Svstem		
		ition of Sat				
t/ <sup>o</sup> c	_		KNO		но	Solid <sub>b</sub>
0, 0	U02(NC	5 5			н <sub>2</sub> 0	Phase
	mass %	mol/kg				
Initial	Solution I:	$UO_2(NO_3)_2 = (KNO_3)_3$ was ad	1.56 mass Ided) (c	%, H <sub>2</sub> O = ontinued)	98.44 mas	s %
10.0	1.32	0.0402	15.25	1.808	83.43	A
12.8	1.30 1.27	0.0402 0.0399	16.66 18.03	2.009 2.210	82.04 80.70	A A
	1.23			2.611		À
24.2	1.20	0.0402	23.07	3.013	75.73	A
Initial	Solution II:	UO <sub>2</sub> (NO <sub>3</sub> ) = (KNO <sub>3</sub> was a	: 8 mass % Idded)	, <sup>H</sup> 2 <sup>O</sup> = 92	2.0 mass %	
- 1.0	8.0	0.22			92.0	ice
	7.68			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 <sup>C</sup>	ice+A
3.6	7.14	0.221	10.71	1.289		Α
9.8	6.89	0.220	13.79	1.720	79.32	A
14.6 18.6	6.66 6.45	0.220 0.221	16.66 19.35	2.149 2.579	76.68 74.20	A A
22.4	6.25	0.221	21.87	3.009	71.88	Â
25.6	6.06	0.221	24.25	3.442	69.69	A
Initial	Solution III	: UO2(NO3) (KNO3 Was	= 25 mass added)	%, H <sub>2</sub> O =	75 mass %	
- 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 <sup>C</sup>	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 31.5	21.73 20.83	0.845 0.846	13.04 16.66	1.977 2.636	65.23 62.51	A A
	Solution IV:		40 mass			A
-14.4	40.00	1.692			60.0	ice
-14.8	39.0	1.675	1.92	0.321	59.08 <sup>C</sup>	ice+A
-13.6 - 0.4	39.16 38.46	1.688 1.692	1.96 3.84	0.329 0.658	58.88 57.70	A 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	Ä
19.0	36.36	1.717	9.90	1.82	53.74	Α
24.4	35.71	1.691	10.71	1.977	53.58	A
			(0	Continued	on the ne	xt page)

COMPONENTS:	······································		ORIGINAL	MEASUREM	ENTS:						
	itrate; UO <sub>2</sub> (NC	)):	Perova, A. P.								
[15905-86	5-9]	3'2'	(	org. Khim.	, <u>1956</u> , <i>1</i>						
(2) Potassiun [7757-79-	n nitrate; KNC -1]	<sup>2</sup> ;		J. Inorg. Eng. trans		329. <u>56</u> , 1,					
(3) Water; H <sub>2</sub> O; [7732-18-5]											
EXPERIMENTAL	VALUES: (Cont	inued)	1								
	The Sys	stem UO <sub>2</sub> (NO <sub>3</sub>	) <sub>2</sub> - KNO <sub>3</sub>	, - н <sub>2</sub> о							
	Composi	ition of Sat	urated Sc	olutions <sup>a</sup>							
t∕°c	002(NO	3 <sup>)</sup> 2	KNC	) <sub>3</sub>	н <sub>2</sub> о	Solid <sub>b</sub> Phase					
	mass %	mol/kg	mass %	mol/kg	mass %	FildSe					
Initial	solution V: U	$JO_2(NO_3)_2 =$	50 mass &	$H_2^0 = 5$	0 mass %						
	( 1	KNO <sub>3</sub> was add	ed)								
1	50.00 49.01	2.538 2.537	 1.96	0.395	50.0 49.03	B B					
	48.47	2.579	3.84	0.796	47.69	B					
0.2	48.3	2.564	3.90	0.807		B+A					
1	47.17 46.29	2.538 2.537	5.66 7.40	1.19 1.58	47.17 <sup>C</sup> 46.31	A A					
23.0	45.45	2.583	9.90	2.19	44.65	A					
1 .	cies calculate										
	phases: A = KN		(NO <sub>3</sub> ) <sub>2</sub> .6H	1 <sub>2</sub> 0.							
1 -	aken from diag										
The sur	n of mass % is	s not equal	to 100 (c	compilers)	•						
COMMENT	AND/OR ADDITI	IONAL DATA:									
temperatures. of Solutions crystallizati	ns were used i . Investigatic I through V w ion areas of i canyl nitrate, mperatures:	on of the sy was directed ice and pota	stem with toward a ssium nit	h the init determin rate, reg	ial compo- ation of ions I -	sition the					
	0 <sup>0</sup> C, 5 <sup>0</sup> C,	10 <sup>0</sup> C, 15 <sup>0</sup> C	, 20 <sup>°</sup> C ar	nd 25 <sup>0</sup> C							
were obtained	l from polythe	ermal data b	y the gra	phic meth	od.						
The lowest en and has the f	itonic point f following comp	for the UO <sub>2</sub> ( position:	NO <sub>3</sub> ) <sub>2</sub> -КИС	0 <sub>3</sub> -H <sub>2</sub> 0 sys	tem is -1	9.4 <sup>0</sup> C,					
U02 (NO	$3_{2}^{2} = 45.2 \text{ mas}$	ss %, KNO <sub>3</sub> =	2.1 mass	s %, H <sub>2</sub> 0 =	52.5 mas	s %.					
area of KNO, solubility of present at lo e.g. in the at 0 C and 25 in the absence solubility in	$UO_2(NO_3)_2 = 45.2 \text{ mass } \text{\%}, \text{KNO}_3 = 2.1 \text{ mass } \text{\%}, H_2O = 52.5 \text{ mass } \text{\%}.$ The polytherm diagram has three areas: ice, KNO <sub>3</sub> , and $UO_2(NO_3)_2.6H_2O$ . The area of KNO <sub>3</sub> is the largest and $UO_2(NO_3)_2.6H_2O$ is the smallest. The solubility of KNO <sub>4</sub> decreases with increasing UO <sub>2</sub> (NO <sub>3</sub> ), concentration. The solubility of uranyl nitrate is smaller when potassium nitrate is present at low concentrations, and is greater at temperatures above 25°C, e.g., in the absence of potassium nitrate, solubility of uranyl nitrate at 0°C and 25°C is 97.8 and 126.7 per 100 g of water, respectively, and in the absence of KNO <sub>3</sub> , 91.9 and 154.4. Analogous data for KNO <sub>3</sub> solubility in the absence and presence of uranyl nitrate are 12.9 and 37.2, and 5.3 and 31.1 at 0°C and 25°C, respectively.										
Phase diagram	ns are given i	n the sourc	e paper.								

[159 (2) Pota [775	yl nitrate; 05-86-9] ssium nitra 7-79-1]	5	Pe Zh	ORIGINAL MEASUREMENTS: Perova, A. P. Zh. Neorg. Khim., <u>1956</u> , 1, 330 - 336.			
	r; H <sub>2</sub> 0; [77	32-18-5]		s.J.Inorg.Ch	em., <u>1956</u> ,	1, 140.	
VARIABLE Composit	ion and tem	perature		PARED BY: Sozanski; S.	Siekiersk	i	
EXPERIME	NTAL VALUES	:			,		
		The UO <sub>2</sub> (NO <sub>3</sub> )		H <sub>2</sub> O System d Solutions <sup>a</sup>			
t∕°c	U0 <sub>2</sub> (N			NO <sub>3</sub>	н <sub>2</sub> 0	Solid <sub>b</sub> Phase	
	mass %	mol/kg	mass %	mol/kg	mass %	Pliase	
50	0.88 4.82 17.20 30.53 40.00 52.6	0.040 0.222 0.8593 1.691 2.538 4.82	46.09 43.50 40.12 32.00 23.66 20.00 19.70	8.456 7.736 7.207 6.230 5.108 4.945 7.034	53.91 55.62 55.06 50.80 45.81 40.00 27.70	A <sup>C</sup> A A A A A	
	58.73	6.878	19.60	8.946		•	
	65.5 67.5	5.11 5.27	2.0	0.61	32.50 32.5	Bc	
70			57.9	13.6	42.10	c	
	0.98 4.20 14.35 26.00 35.22 48.34 56.80 61.30	0.058 0.244 0.8702 1.732 2.624 4.746 7.101 9.205	55.8 52.2 43.8 35.9 30.72 25.81 22.90 21.80	12.8 11.8 10.4 9.32 8.921 9.876 11.16 12.76	43.22 43.60 41.85 38.10 34.06 25.85 20.30 16.90	A A A A A A A	
	63.00 76.20 78.00	9.993 8.871 8.998	21.00 2.00	12.98 0.907 	16.00 21.80 22.00	A+C <sup>d</sup> Cc	
90	0.75 4.25	0.053 0.310	66.8 63.5 61.0	19.9 17.6 17.4 (continu	33.2 35.75 34.75 ed on the	A <sup>C</sup> A A next page)	
		AUXII	LIARY INFOR	MATION			
Solubili was dete visual m was part were fre avoid ev to check points. ture was minutes. measured	rmined by t ethod (1,2) ially ensur quently cha aporation. as also use data and e Equilibrium establishe Potassium	-component s he polytherr . Hermetisat ed and solut inged in orde The isotherr d at 50 C ar stablish eut at this ter d after 30 d and uranium	systems U0, pal, puf tion EST er to Sol mal to 90°C Tem conic mpera- to 40 REF were 1. s, 2. Tru	RCE AND PURI (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O ity, fecryst TMATED ERROR ubility: Not perature: Pr (C ERENCES: Alekseev, V. <i>R. Kh. O.</i> , Bergman, A. dy sessii AN , ed. AN SSS	and KNO <sub>3</sub> , allized <sup>3</sup> tw : hing speci obably <u>+</u> 0. ompilers) F. <u>1877</u> , 9, 2 G. SSSR, <u>193</u>	unknown fied. 1K 08. 2, II,	

mass %         mol/kg         mass %<	COMPONENT	S:		ORIGINA	AL MEASUREM	ENTS:		
	(1) Urany [1590	l nitrate 5-86-9]	; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	1	Perova, A. P.			
EXPERIMENTAL VALUES: (Continued) The UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> - KNO <sub>3</sub> - H <sub>2</sub> O System Composition of Saturated Solutions <sup>a</sup> $t/^{O}C$ UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> KNO <sub>3</sub> H <sub>2</sub> O Solid Phase 90 11.60 0.8558 54.0 15.5 34.40 Å 21.72 1.724 46.3 14.3 31.98 Å 29.70 2.595 41.25 14.04 29.05 Å 52.21 6.977 28.80 15.00 18.98 Å 52.21 6.977 28.80 15.00 18.98 Å 52.21 6.977 28.80 15.00 18.98 Å 66.60 14.32 21.60 18.11 11.80 Å+C <sup>6</sup> 80.20 11.15 1.55 0.840 18.25 C 81.0 10.82 19.00 C <sup>7</sup> Initial Solution I: UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> = 1.56 mass & H <sub>2</sub> O = 98.44 mass & 29.4 1.09 0.0399 29.57 4.721 66.914 Å 33.2 1.06 0.0402 31.97 4.722 66.97 Å 35.5 1.02 0.0400 35.66 5.568 64.77 Å 35.5 1.02 0.0400 35.66 5.568 64.77 Å 35.5 0.90 0.040 35.66 5.556 64.77 Å 35.5 1.02 0.0400 40.12 6.723 57.24 Å 41.4 0.99 0.040 35.66 5.556 64.77 Å 35.5 0.90 0.040 40.12 6.723 57.24 Å 41.4 0.99 0.040 40.12 6.732 58.95 Å 41.4 0.99 0.040 40.12 6.732 58.95 Å 41.4 0.99 0.040 45.65 5.62 Å 51.8 0.85 0.040 45.05 8.236 51.62 Å 51.8 0.85 0.040 45.25 8.739 52.65 Å 41.4 0.99 0.040 52.17 10.96 47.08 Å 56.1 0.81 0.040 47.91 9.241 51.28 Å 56.5 0.79 0.040 52.17 10.96 47.08 Å 64.8 0.73 0.040 54.95 12.25 44.35 Å 73.0 0.67 0.040 58.67 14.26 40.69 Å 64.8 0.73 0.040 54.95 12.25 44.35 Å 73.0 0.64 0.040 58.67 14.26 40.69 Å 64.8 0.73 0.040 54.95 12.25 44.35 Å 73.0 0.64 0.040 54.95 12.25 44.35 Å 73.0 0.64 0.040 56.85 13.24 42.48 Å 73.0 0.64 0.040 58.67 14.26 40.69 Å 73.4 0.64 0.040 58.67 14.26 40.69 Å 73.5 0.61 0.040 66.11 15.26 19.08 Å 65.5 0.59 0.040 66.51 13.54 40.69 Å 64.50 0.55 0.040 66.51 13.54 42.48 Å 73.0 0.66 0.221 27.26 4.030 66.91 Å 73.0 0.65 0.040 58.67 14.26 40.69 Å 73.0 0.65 0.040 58.67 14.26 40.69 Å 73.0 0.65 0.040 56.85 13.24 42.48 Å 73.0 0.65 0.0221 27.26 4.030 66.91 Å 73.1 0.66 0.221 24.24 3.440 69.70 Å 74.74 0.99 0.220 36.30 6.126 58.61 Å	[7757-	-79-1]	5	Russ.	J. Inorg.	Chem., <u>19</u>	336.	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	(3) Water	; H <sub>2</sub> 0; [7	732-18-5]					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	EXPERIMEN	FAL VALUE	S: (Continued)					
$ t/^{O_{C}} \underbrace{UO_{2}(NO_{3})_{2}}_{\text{mass } \frac{1}{8} \ \text{mol/kg}} \underbrace{KNO_{3}}_{\text{mass } \frac{1}{8} \ \text{mol/kg}} \underbrace{H_{2}O}_{\text{mass } \frac{1}{8}} \underbrace{Solid}_{\text{Phase}} \\ 90 \ 11.60 \ 0.8558 \ 54.0 \ 15.5 \ 34.40 \ A \\ 21.72 \ 1.724 \ 46.3 \ 14.3 \ 31.98 \ A \\ 43.32 \ 4.724 \ 33.41 \ 14.20 \ 23.27 \ A \\ 43.32 \ 4.724 \ 33.41 \ 14.20 \ 23.27 \ A \\ 52.21 \ 6.977 \ 28.80 \ 15.00 \ 18.98 \ A \\ 56.30 \ 9.276 \ 25.75 \ 15.97 \ 15.98 \ A \\ 66.60 \ 14.32 \ 21.60 \ 18.11 \ 11.80 \ A^{+C^{C}} \\ 80.20 \ 11.15 \ 1.55 \ 0.840 \ 18.25 \ C \\ 81.0 \ 10.82 \ \ \ 19.00 \ C^{C} \\ Initial Solution I: UO_{2}(NO_{3})_{2} = 1.56 \ mass \\ H_{0}O \ 98.44 \ mass \\ 33.2 \ 1.06 \ 0.0402 \ 31.97 \ 4.722 \ 66.97 \ A \\ 35.5 \ 1.02 \ 0.0400 \ 35.66 \ 5.568 \ 63.35 \ A \\ 41.4 \ 0.96 \ 0.0400 \ 35.66 \ 5.568 \ 63.35 \ A \\ 41.4 \ 0.96 \ 0.0400 \ 35.66 \ 5.568 \ 63.35 \ A \\ 41.4 \ 0.96 \ 0.0400 \ 35.66 \ 5.568 \ 63.35 \ A \\ 41.4 \ 0.96 \ 0.040 \ 35.66 \ 5.568 \ 63.35 \ A \\ 41.4 \ 0.96 \ 0.040 \ 35.66 \ 5.568 \ 63.35 \ A \\ 41.4 \ 0.96 \ 0.040 \ 35.66 \ 5.568 \ 63.35 \ A \\ 41.4 \ 0.96 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 50.0 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 51.8 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 51.8 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.040 \ 45.05 \ 6.236 \ 5.724 \ A \\ 56.1 \ 0.88 \ 0.771 \ 0.040 \ 50.49 \ 10.25 \ 44.74 \ A \\ 64.8 \ 0.773 \ 0.040 \ 50.49 \ 50.44 \ 44.48 \ A \\ 78.0 \ 0.64 \ 0.040 \ 56.85 \ 13.24 \ 42.48 \ A \\ 85.5 \ 0.55 \ 0.040 \ 45.05 \ 13.24 \ 42.48 \ A \\ 85.5 \ 0.55 \ 0.040 \ 64.54 \ 18.29 \ $			2 3 2	5 5	_			
$\frac{2}{mass $ mol/kg} = \frac{3}{mass $ mol/kg} $			Composition of	Saturated S	Solutions <sup>a</sup>			
90 11.60 0.6558 54.0 15.5 34.40 A 21.72 1.724 46.3 14.3 31.98 A 29.70 2.595 41.25 14.04 29.05 A 43.32 4.724 33.41 14.20 23.27 A 52.21 6.977 28.80 15.00 18.98 A 56.30 9.276 25.75 15.97 15.95 A 66.60 14.32 21.60 18.11 11.80 A+C <sup>C</sup> 80.20 11.15 1.55 0.840 18.25 C 81.0 10.82 19.00 C <sup>C</sup> Initial Solution I: $UO_2(NO_3)_2 = 1.56$ mass %, $H_2O = 98.44$ mass % 29.4 1.09 0.0399 29.57 4.722 66.97 A 35.5 1.02 0.0400 31.97 4.722 66.97 A 35.5 1.02 0.0400 31.97 4.722 66.97 A 35.5 1.02 0.0400 35.66 5.568 63.35 A 44.3 0.99 0.040 45.26 5.366 5.358 6.35 A 44.3 0.99 0.040 45.26 5.368 6.325 A 44.3 0.99 0.040 45.26 5.368 6.325 A 50.0 0.88 0.040 45.05 8.236 54.10 A 51.6 0.68 0.40 45.05 8.236 54.10 A 54.7 0.83 0.040 46.52 8.739 52.65 A 55.8 0.79 0.040 47.91 9.241 51.28 A 56.1 0.81 0.040 47.91 9.241 51.28 A 56.4 0.77 0.040 52.47 10.98 7.736 55.62 A 56.4 0.81 0.040 45.05 8.236 54.10 A 56.4 0.81 0.040 47.91 9.241 51.28 A 56.5 0.79 0.040 52.47 10.96 47.08 A 64.0 0.75 0.040 52.47 10.96 47.08 A 64.0 0.75 0.040 52.47 10.96 47.08 A 64.0 0.75 0.040 52.47 10.96 47.08 A 64.8 0.73 0.040 52.49 10.25 48.74 A 64.9 0.75 0.040 52.47 10.96 47.08 A 64.8 0.73 0.040 52.47 10.96 47.08 A 64.8 0.73 0.040 52.49 10.25 48.74 A 64.8 0.73 0.040 52.49 10.25 48.74 A 64.8 0.75 0.040 52.47 10.96 47.08 A 64.8 0.75 0.040 52.47 10.96 47.08 A 64.8 0.75 0.040 52.49 11.55 46.45 A 64.8 0.75 0.040 52.49 11.52 46.45 A 64.9 0.75 0.040 52.49 11.52 46.45 A 64.9 0.75 0.040 52.49 11.52 46.45 A 64.9 0.55 0.040 60.31 15.26 52.85 A 65.7 4.563 0.220 29.57 4.513 64.40 A 65.7 5.63 0.220 29.57 4.513 64.40 A 65.7 5.63 0.220 34.20 5.588 60.	t∕°c	0					Solid Phase	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		mass %	mol/kg	mass %	mol/kg	mass %		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	90	21.72 29.70	1.724 2.595	46.3 41.25	14.3 14.04	31.98 29.05	A A	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							Åf	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		66.60	14.32	21.60	18.11	11.80	λ+C <sup>e</sup>	
$ \begin{array}{c} \text{Initial Solution I: } U_2(NO_3)_2 = 1.56 \text{ mass } \$, H_2O = 98.44 \text{ mass } \$ \\ 29.4 1.09 0.0399 29.57 4.218 69.34 A \\ 33.2 1.06 0.0402 31.97 4.722 66.97 A \\ 35.5 1.02 0.0400 34.21 5.224 64.77 A \\ 38.3 0.99 0.040 35.66 5.568 63.35 A \\ 41.4 0.96 0.040 38.28 6.231 60.76 A \\ 44.3 0.93 0.040 40.12 6.732 58.95 A \\ 48.5 0.90 0.040 41.86 7.233 57.24 A \\ 50.0 0.88 0.040 43.50 7.736 55.62 A \\ 51.8 0.85 0.040 45.05 8.236 54.10 A \\ 54.7 0.83 0.040 45.05 8.236 54.10 A \\ 56.1 0.81 0.040 47.91 9.241 51.28 A \\ 56.5 0.77 0.040 50.49 10.25 48.74 A \\ 64.0 0.75 0.040 52.17 10.96 47.08 A \\ 64.8 0.73 0.040 52.82 11.25 46.45 A \\ 64.6 0.70 0.040 52.82 11.25 46.45 A \\ 68.6 0.70 0.040 52.82 11.25 44.35 A \\ 73.3 0.67 0.040 56.85 13.24 42.48 A \\ 78.0 0.64 0.040 56.85 13.24 42.48 A \\ 78.0 0.64 0.040 56.85 13.24 42.48 A \\ 78.0 0.65 0.040 60.31 15.26 39.08 A \\ 82.5 0.61 0.040 61.83 16.27 37.58 A \\ 89.0 0.57 0.041 63.94 17.82 36.19 A^{f} \\ 92.8 0.55 0.040 64.54 18.29 34.91 A \\ \end{array}$		80.20	11.15	1.55	0.840	18.25	с	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		81.0	10.82			19.00	cc	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Init	ial Solut	ion I: UO <sub>2</sub> (NO <sub>3</sub> )	2 = 1.56 mas (KNO <sub>3</sub> was a	ss %, H <sub>2</sub> O = added)	98.44 ma	ss %	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	41.4					60.76	A	
50.0 0.88 0.040 43.50 7.736 55.62 A 51.8 0.85 0.040 45.05 8.236 54.10 A 54.7 0.83 0.040 46.52 8.739 52.65 A 56.1 0.81 0.040 47.91 9.241 51.28 A 58.5 0.79 0.040 49.23 9.742 49.98 A 61.5 0.77 0.040 50.49 10.25 48.74 A 64.0 0.75 0.040 52.17 10.96 47.08 A 64.8 0.73 0.040 52.82 11.25 46.45 A 68.6 0.70 0.040 54.95 12.25 44.35 A 73.3 0.67 0.040 56.85 13.24 42.48 A 78.0 0.64 0.040 58.67 14.26 40.69 A 82.5 0.61 0.040 60.31 15.26 39.08 A 85.5 0.59 0.040 61.83 16.27 37.58 A 89.0 0.57 0.041 63.94 17.82 36.19 A <sup>f</sup> 92.8 0.55 0.040 64.54 18.29 34.91 A Initial Solution II: $UO_2(NO_3)_2 = 8 \text{ mass } *, H_2O = 92 \text{ mass } *$ 1.11 1.12 1.25 4.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.24 1.25 4.25 4.25 4.25 1.25 4.25 4.25 4.25 4.25 1.25 4.25 4.25 4.25 4.25 4.25 4.25 4.25 4								
51.8 0.85 0.040 45.05 8.236 54.10 A 54.7 0.83 0.040 46.52 8.739 52.65 A 56.1 0.81 0.040 47.91 9.241 51.28 A 58.5 0.79 0.040 49.23 9.742 49.98 A 61.5 0.77 0.040 50.49 10.25 48.74 A 64.0 0.75 0.040 52.82 11.25 46.45 A 68.6 0.70 0.040 54.95 12.25 44.35 A 73.3 0.67 0.040 54.95 12.25 44.35 A 73.3 0.67 0.040 58.67 14.26 40.69 A 82.5 0.61 0.040 60.31 15.26 39.08 A 85.5 0.59 0.040 61.83 16.27 37.58 A 89.0 0.57 0.041 63.94 17.82 36.19 A <sup>f</sup> 92.8 0.55 0.040 64.54 18.29 34.91 A Initial Solution II: $UO_2(NO_3)_2 = 8 \text{ mass } \text{$, H}_2O = 92 \text{ mass } \text{$, M}_2O = 92 \text{ m}_2O$								
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$								
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$								
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	56.1				9.241			
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			0.040				Α	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$								
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$								
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	78.0			58.67				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$								
92.8 0.55 0.040 64.54 18.29 34.91 A Initial Solution II: $UO_2(NO_3)_2 = 8 \text{ mass } 3, H_2O = 92 \text{ mass } 3$ (KNO <sub>3</sub> was added) 25.7 6.06 0.221 24.24 3.440 69.70 A 30.1 5.83 0.221 27.26 4.030 66.91 A 34.7 5.63 0.220 29.57 4.513 64.80 A 39.1 5.44 0.221 31.97 5.052 62.59 A 40.0 5.26 0.220 34.20 5.588 60.54 A 43.4 5.09 0.220 36.30 6.126 58.61 A							Af	
25.76.060.22124.243.44069.70A30.15.830.22127.264.03066.91A34.75.630.22029.574.51364.80A39.15.440.22131.975.05262.59A40.05.260.22034.205.58860.54A43.45.090.22036.306.12658.61A								
25.7       6.06       0.221       24.24       3.440       69.70       A         30.1       5.83       0.221       27.26       4.030       66.91       A         34.7       5.63       0.220       29.57       4.513       64.80       A         39.1       5.44       0.221       31.97       5.052       62.59       A         40.0       5.26       0.220       34.20       5.588       60.54       A         43.4       5.09       0.220       36.30       6.126       58.61       A	Init	ial Solut	ion II: UO <sub>2</sub> (NO	3 <sup>)</sup> 2 = 8 ma (KNO <sub>3</sub> was	ass %, H <sub>2</sub> O s added)	= 92 mass	¥	
30.15.830.22127.264.03066.91A34.75.630.22029.574.51364.80A39.15.440.22131.975.05262.59A40.05.260.22034.205.58860.54A43.45.090.22036.306.12658.61A	25.7	6.06				69.70	А	
39.15.440.22131.975.05262.59A40.05.260.22034.205.58860.54A43.45.090.22036.306.12658.61A	30.1			27.26			_	
40.0 5.26 0.220 34.20 5.588 60.54 A 43.4 5.09 0.220 36.30 6.126 58.61 A								
43.4 5.09 0.220 36.30 6.126 58.61 A							-	
(Continued on the next page								
( <b>   -</b>					(Continued	on the n	ext page)	

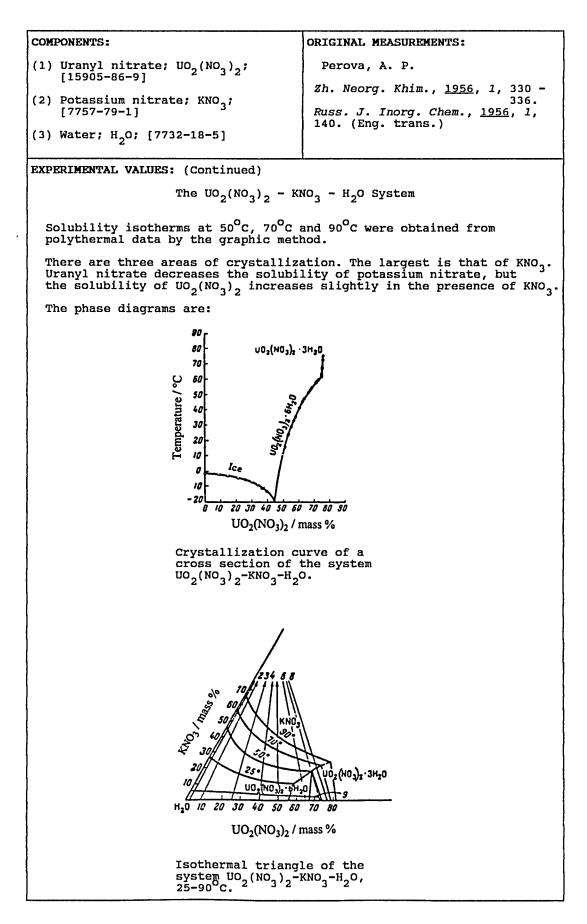
	COMPONENTS				ORIGI	NAL MEASUREM	ENTS:					
	(1) Uranyl [15905-	(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]				ova, A. P.						
	(2) Potassi [7757-7	um nitrate	; kno <sub>3</sub> ;		Russ	Neorg. Khim., J. Inorg. C. (Eng. trans.	hem., <u>19</u>	336.				
	(3) Water;	н <sub>2</sub> 0; [7732	-18-5]		1401	(IIIIg)	, 					
	EXPERIMENTAL VALUES: (Continued)											
			$e UO_2(NO_3)_2$			-						
	0		mposition of	Sati								
	t∕°c	ло <sup>5</sup> (NO	3)2 mol/kg			мо <sub>з</sub>	н <sub>2</sub> о	Solid <sub>b</sub> Phase				
		mass %	mol/kg	mas	35 ¥	mol/kg	mass %					
ļ	46.3	4.93	0.220		.27		56.80					
-	49.6 52.4	4.82 4.65	0.222 0.221		.12 .86	7.207 7.740	55.06 53.49					
	54.3	4.65	0.221		. 50	8.277	51.98					
	57.0	4.32	0.220		.93	8.769	50.68					
	60.4	4.29	0.221		52	9.354	49.19					
1	64.0	4.06	0.221		.24	10.43	46.70					
[	69.5	3.86	0.220		.69	11.50	44.45					
	74.5	3.68	0.220		.91	12.57	42.41					
	77.3 83.7	3.52 3.37	0.220		.94 80	13.65 14.72	40.54	-				
	86.2	3.23	0.220 0.220		.80 .51	14.72	38.83 37.28 <sup>f</sup>	À				
	91.0	3.11	0.220		.08	16.87	35.81	Â				
		1 Solution				mass %, H <sub>2</sub> O added)		S %				
	27.0	20.83	0.8457	16	66	2.636	62.51	A				
1	35.8	19.23	0.8458		.07	3.955	57.70					
-1	41.5	18.51	0.8453		92	4.613	55.57					
	44.0	17.86	0.8461		57	5.275	53.57					
1	49.5	17.23	0.8451		.03	5.932	51.74					
	51.9	16.66	0.8454		.33	6.592	50.01					
	54.7 58.3	16.12 15.62	0.8452 0.8456		.48 .50	7.251 7.912	48.40					
1	61.5	15.62	0.8458		. 39	8.570						
	67.0	14.28	0.8454		.85	9.886	45.46 42.87 40.55	À				
	72.6	13.51	0.8455		94	9.752	40.55	r A				
	77.8	12.82	0.8457		.71	12.52	38.47	A				
	82.4	12.19	0.8452	51.		13.84	36.60					
	89.5	11.62	0.8450	53.	48	15.16	34.90	A				
	Initia	l Solution	IV: UO <sub>2</sub> (N	0 <sub>3</sub> ) <sub>2</sub>	= 40 KNO <sub>3</sub>	mass %, H <sub>2</sub> O = added)	60 mass	8				
	24.6	35.71	1.691	10.	.71	1.977	53.58	A				
1	31.5	34.93	1.691	12	66	2.389	52.41					
	34.0	34.48	1.692	13		2.639	51.72					
	35.9	33.75	1.686	15		3.006	50.81					
	39.1 40.5	33.05	1.691 1.692	17.		3.460	49.60					
	40.5	32.39 31.74	1.691	19. 20.		3.872 4.284	48.59 47.63					
	45.6	31.12	1.691		.18	4.698	46.70					
	50.1	30.53	1.691		66	5.108	45.81					
	52.0	29.96	1.692	25.		5.521	44.95	A				
	54.5	29.41	1.692	26		5.941	44.10					
	58.0	28.36	1.691	29.	.08	6.758	42.56	A				
						(Continued	on the n	ext page)				
L												

COMPONENTS	5:		ORIGIN	ORIGINAL MEASUREMENTS:				
(1) Urany] [15905	l nitrate; 5-86-9]	UO2(NO3)2;	[	а, А. Р.				
-	sium nitrat	e; KNO.:	Zh. N	eorg. Khim.,	<u>1956</u> , 1	, 330 - 336.		
[7757-	-79-1]	2	<i>Russ.</i> 140.	J. Inorg. C (Eng. trans.	Chem., <u>19</u> )			
(3) Water;	; H <sub>2</sub> 0; [77:	32-18-5]						
EXPERIMENT	TAL VALUES:	: (Continued	)					
		The UO2(NO3	) <sub>2</sub> - кно <sub>3</sub> - н	2 <sup>0 System</sup>				
		Composition	of Saturated	Solutions <sup>a</sup>				
t∕°c	U0 <sub>2</sub> (N	10 <sub>3</sub> ) <sub>2</sub>	К	NO <sub>3</sub>	н <sub>2</sub> 0	Solidb		
	mass %	mol/kg	mass %		mass %	Phase		
Initi	ial Solutio	on IV: UO2	$(NO_3)_2 = 40 \text{ m}$ (KNO <sub>3</sub> a	ass %, H_O =	= 60 mass	8		
			5			_		
66.0 67.1	27.39 26.49	1.691 1.692	31.50 33.77	7.579 8.405	41.11 39.74	A A		
70.0	25.64	1.692	35.90	9.233	38.46			
74.5	24.82	1.689	37.88	10.04	37.30	Ä		
	24.09	1.691	39.75	10.87	36.16			
80.0	23.39	1.692	41.52	11.70	35.09			
83.8	22.72 22.10	1.691	43.18	12.52	34.10			
		1.664 1.691	44.20 46.23	12.97 14.17	33.70 32.27	A A		
89.5 92.4	20.94	1.691	40.23	15.00	31.42	A		
Initi	al Solutio	on V: UO <sub>2</sub> (NO	$3^{2} = 50 \text{ mass}$ (KNO <sub>3</sub> adde	*, H <sub>2</sub> O = 50 d)	) mass %			
27.0 33.7	45.45 44.44	2.583 2.537	9.9 11.11	2.2 2.472	44.65 44.45	А А		
35.5	43.47	2.560	13.43	3.082	43.10			
40.0	42.55	2.538	14.90	3.464	42.55	A		
44.2	41.66	2.537	16.66	3.954	41.68	А		
47.0	40.81	2.537	18.36	4.448	40.83			
49.0	40.00	2.538	20.00	4.945	40.00			
52.3 56.5	39.21 38.46	2.537 2.537	21.56	5.436	39.23	A		
59.7	37.73	2.537	23.07 24.52	5.931 6.424	38.47 37.75	A A		
66.4	36.98	2.625	27.27	7.545	35.75	Â		
69.0	35.08	2.536	29.82	8.403	35.10	Ä		
73.8	33.89	2.536	32.20	9.392	33.91	A		
76.6	32.78	2.536	34.42	10.38	32.80	A		
82.4	31.74	2.536	36.50	11.37	31.76	A		
84.6 88.6	30.76 29.85	2.536 2.537	38.46	12.36 13.35	30.78	A X		
92.6	28.98	2.537	40.29 42.02	13.35	29.86 29.0	A A		
Initi		on VI: UO <sub>2</sub> (NO	$(KNO_3)_2 = 65 \text{ mass}$	s %, H <sub>2</sub> O = 3 ed)	5 mass %			
46.0 44.9	65.00 59.09	4.713 4.713	°3 9.09	2.83	35.00 31.82	B B		
42.5	55.80	4.768	14.50	4.829	29.70	B+A		
53.7	54.16	5.087	18.82			Ad		
62.4	50.00	4.712	23.07	6.889 8.473	27.02 26.93	A A		
77.2	46.42	4.710	28.57	11.30	25.01	À		
90.6	43.33	4.173	33.34	14.13	23.33	Ä		
				(Continued	on next j	page)		

COMPONENT	'S:		ORI	ORIGINAL MEASUREMENTS:				
(1) Urany [1590	1 nitrate; 5-86-9]	UO2(NO3)2;	Pe	rova, A. P.				
(2) Potas	sium nitra -79-1]	te; KNO <sub>3</sub> ;		. Neorg. Khim., ss. J. Inorg. Ch		336.		
(3) Water	; H <sub>2</sub> 0; [77	32-18-5]	14	0. (Eng. trans.)				
EXPERIMEN	TAL VALUES	: (Continued	)					
		The UO <sub>2</sub> (NO <sub>3</sub>	) <sub>2</sub> - KNO <sub>3</sub> ·	- H <sub>2</sub> O System				
Composition of Saturated Solutions <sup>a</sup>								
t∕°c	U0 <sub>2</sub> (	NO3)2		KNO3	н <sub>2</sub> 0	Solid <sub>b</sub> Phase		
	mass %	mol/kg	mass %	mol/kg	mass %	Pllase		
Init	ial Soluti	on VII: UO <sub>2</sub>	$(NO_3)_2 = 73$	3.3 mass %, H <sub>2</sub> O ; <sub>3</sub> added)	= 26.7	mass %		
57.6 56.6	73.3 70.0	6.967 6.939	4.4	1.7	26.7 25.6	с с		
55.0	67.0	6.940	4.4	3.4	25.0	c		
54.2	64.2	6.933	12.3		23.5	С		
53.1	61.7	6.959	15.8	6.95	22.5	С		
52.5		7.176	20.0	9.46	20.9			
80.3 89.1	54.7 52.6	7.156 7.063	25.9 28.5	13.2 14.9	19.4 18.9	A A		
Initial Solution VIII: $UO_2(NO_3)_2 = 78$ mass %, $H_2O = 22$ mass % (KNO <sub>3</sub> added)								
81.8	78.00	8.998			22.0	A		
73.6	76.9 73.5	9.24 8.93	1.97 5.62	0.922 2.66	21.13 20.88	A A		
63.1	70.73	9.038	9.41	4.69	19.86	Ä		
58.5	66.10	9.117	15.5	8.33	18.40			
56.4	62.0 62.2	9.15 9.31	20.8 20.85	12.0 12.17	17.20 16.95	A A		
81.1	59.7	9.13	23.70	14.12	16.60	A		
89.2	58.3	9.25	25.72	15.91	15.18 <sup>1</sup>	A		
Init	ial Soluti	on IX: KNO <sub>3</sub>	= 5 mass % UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .(	$H_0 = 95 \text{ mass}$ $6H_2 0 \text{ was added}$	8			
- 1.2	8.9	0.26	5.00 4.44	0.521 0.507	95.00 86.66	ice ice		
- 3.0	15.1	0.475	4.44	0.510	80.74	ice		
- 4.5	21.7 26.5	0.740 0.962	3.84	0.510	74.46 69.93	ice		
- 6.0	30.5	1.17	3.57 3.33	0.505 0.498	69.93 66.17 <sub>e</sub>	ice ice		
- 8.5	34.0	1.37	3.12	0.491	72.88	ice		
-11.2	37.0	1.56	2.94	0.484	60.06	ice		
11.5	50.2 51.5	2.67 2.81	2.08 2.00	0.431 0.425	47.72 46.50	B B		
24.0	53.7	3.07	1.85	0.412	44.45	В		
29.0	55.5 57.1	3.29 3.51	1.72 1.61	0.398 0.386	42.78 41.29	B B		
35.8	58.5	3.71	1.51	0.373	39.99	в		
41.2 45.6	60.8 62.6	4.08 4.39	1.35	0.353 0.331	37.85	B		
45.8	64.1	4.59	1.21 1.11	0.316	36.19 34.79	B B		
49.1	65.3	4.92	1.02	0.300	33.68	в		
51.4	66.4	5.16	0.94	0.28	32.66	В		
				(Continued or	n the n	ext page)		
L								

,

COMPONENT	'S:			ORIGINAL MEASUREMENTS:					
(1) Urany	1 nitrate; 5-86-9]	UO2(NO3)2;		Pei	cova, A. P.				
(2) Potas	sium nitrat	e; KNO <sub>3</sub> ;		1	Neorg. Khim.		336.		
-	'-79-1] ; H <sub>2</sub> 0; [77:	2-18-51		<i>Russ</i> 140.	. J. Inorg. (Eng. trans	Chem., <u>19</u> .)	<u>56</u> , 1,		
(5) Haddi	207 [77		<u>,, ,</u>						
EXPERIMEN	TAL VALUES:	(Continued	•						
		The UO2(NO3			-				
Composition of Saturated Solutions <sup>a</sup>									
	U0 <sub>2</sub> (1	<u> </u>	<u> </u>		(NO <sub>3</sub>	<sup>H</sup> 2 <sup>O</sup>	Solid <sub>b</sub> Phase		
t∕°c	mass %	mol/kg			mol/kg				
Init	ial Solutio	$m: KNO_3 = 5$ $(UO_2)$	mass (NO <sub>3</sub> ) <sub>2</sub>	≹, н.с ∙6н <sub>2</sub> 0	) = 95 mass % was added)	(Continue	ed)		
52.4	67.2	5.34	0.8		0.27	31.93	в		
52.8	68.2	5.58	0.		0.25	31.01 <sub>f</sub>	B		
53.8	69.3	5.88	0.		0.26	29.72	B		
57.6	71.4	6.50 6.98	0.		0.26	27.87	B B		
59.0 59.5	72.8 73.7	6.98 7.31	0.1	72 71	0.27 0.27	26.48 25.59	B		
60.2	74.3	7.55	0.		0.28	24.99	В		
						f			
61.0	74.9	7.79	0.	70	0.28		B+C		
62.0	75.2	7.92	0.0		0.28	24.11	С		
63.0	75.5	8.04	0.0		0.28	23.82	С		
67.5	75.7	8.12	0.		0.27	23.66	C		
72.8	76.1	8.29	0.0		0.25	23.30	c		
74.0 75.1	76.3 76.4	8.38 8.42	0.9		0.25 0.25	23.11 23.02	с с		
_		ted by the							
					$_{2}$ o; c = $Uo_{2}(N)$	0 <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O	•		
-			bellen	, I, E	Berlin, <u>1923</u> .				
d <sub>Points</sub>	from the di	agram.							
<sup>e</sup> Point f	rom the iso	thermal met	hod.						
<sup>f</sup> The sum	of mass %	is not equa	l to 10	00 (cc	ompilers).				
COMMENTS	AND/OR ADI	ITIONAL DAT	'A						
Nine initial solutions were used and studied at different temperatures. In the case of Solutions I through VIII, KNO, was added to aqueous solutions of uranyl nitrate in order to determine the areas of crystallization of potassium nitrate and uranyl nitrate hexahydrate. In the case of Solution IX, uranyl nitrate hexahydrate was added in order to determine the areas of crystallization of the hexahydrate and of $UO_2(NO_3)_2.nH_2O.$									
					(Continued	on the ne	ext page		
					<b></b>				



COMPONENTS:		******	ORIGINAL ME	ASUREMENTS:					
(1) Uranyl ni	trate: NO ()	NO) :							
[15905-86	-9]	3,2,	Rimbach, E						
(2) Rubidium [13126-12	nitrate; Rb -0]	мо <sub>з</sub> ;	Ber., <u>1904</u> , 37, 461 - 488.						
(3) Cesium ni [7789-18-	trate; CsNO 6]	3'							
(4) Water; H <sub>2</sub>	0; [7732-18	-5]							
VARIABLES:			PREPARED BY	:					
Composition a	t: 289, 298	, 353 K	L. Fuks; S	. Siekierski					
EXPERIMENTAL.	VALUES:								
ť									
Composition of Saturated Solutions <sup>a</sup>									
		ור	RbN	0	Solid				
t∕°c	UO2(NO		mass %		Phase				
25.0	51.67	3.253	8.02	1.35	A				
80.0			18.99		в				
	50100	7.671	10.55	4.240					
1 .		ted by the co RbNO <sub>3</sub> , B = UO	-	3.					
		CsNO3,	16.1 <sup>0</sup> C						
In the u saturate i.e., 2. i.e., 1.	ranyl nitrat d solutions 610 mol/kg ( 11 mol/kg (d	te - cesium n is reported ( (compilers), a compilers), a	itrate syste to be 45.80 and 9.66 mas t 16.1°C.	m, the compo mass % of UO s % CsNO <sub>3</sub> ,	sition of 2 <sup>(NO</sup> 3)2				
		AUXILIARY I	NFORMATION						
METHOD/APPARA	TUS/PROCEDUI	RE:	SOURCE AND	PURITY OF MA	TERIALS:				
The isotherma Weighed amoun and water wer temperature. analyzed eith	ts of the do e mixed at 1 The solution	ouble salt the desired 1 was		m - rubidium esium double					
water, or aft	er the uran	ium was	ESTIMATED E	RROR:					
precipitated Uranium was m precipitate w	easured afte	er the	Nothing specified.						
			REFERENCES:						

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N.F.; Degtyarev, A. Ya.; Tsyan-Tsi, Yui
(2) Cesium nitrate; CsNO <sub>3</sub> ; [7789-18-6]	Radiokhim., <u>1963</u> , 5, 73 - 80. Sov. Radiochem., <u>1963</u> , 60. (Eng. trans.)
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 273 and 298 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	

The  $UO_2(NO_3)_2 - CSNO_3 - H_2O$  System at  $O^OC$ Composition of Saturated Solutions<sup>a</sup>

	U02(N03)2	2		CsN	CSNO <sub>3</sub> H <sub>2</sub> OSO1 Phas			Solid Phase	
mol %	mass %	mol/kg	mol %	mass	s %	mol/kg	mol %	mass %	rnase
0	0	0	0.86	8.0		0.48	99.14		j
0.06	1	0.03	0.81	8.0		0.45	99.13	90.77	
0.10	2.0	0.056	0.78	7.		0.44	<b>'99.12</b>	90.32	A
0.41	7.8	0.23	0.64	6.0		0.36	98.95		A
0.82	15	0.46	0.56	4.9		0.32	98.62	80.43	A
0.99	17	0.56	0.54	4.0		0.30	98.47		A
1.10	17.4 18.8	0.564 0.621	0.53	4.0		0.30	98.47 98.36	78.10 76.69	A A
1.56	24.7	0.885	0.54 0.55	4.		0.30 0.31	97.89		À
2.21	31.7	1.26	0.63	4.5		0.36	97.16		Â
2.82	37.2	1.62	0.71	4.0		0.41	96.47	58.17	À
2.84	37.2	1.64	0.79	5.1		0.46	96.37	57.69	Ä
3.32	40.7	1.93	0.94	5.3		0.55	95.74	53.63	Ä
3.45	41.6	2.00	0.97	5.8		0.56	95.58	52.65	A
3.69	43.2	2.15	0.97 1.02	5.9			95.29	50.95	A
3.71	43.2	2.16	1.06			0.618	95.23	50.70	A
4.04	45.2	2.36	1.13	6.2	26	0.661	94.83	48.53	A+B
4.00	45.2	2.34				0.596	94.98	49.08	в
4.01	45.4	2.34	0.97	5.4		0.57	95.02	49.18	в
4.07	45.9	2.38	0.90	5.0	)	0.53	95.03	49.04	в
4.11	46.2	2.40	0.89	5.0	נ	0.52	95.00	48.84	B+C
4.11	46.4	2.40	0.80	4.5	5	0.47	95.09	49.11	c
4.13	46.8 48.1	2.41	0.68	3.8	3	0.40	95.19	49.35	c ]
		2.44	0.33	1.9	<b>)</b>	0.19	95.47	50.01	C [
4.29	49.5	2.49	0	0		0	95.71	50.50	С
						(Conti	nued on	the next	: page)
			AUXILIA	RY IN	FOR	ATION			
METHOD/	APPARATUS/	PROCEDURE	8:		SOU	RCE AND PU	RITY OF	MATERIA	LS:
The metl	hod was de	scribed b	ov Yakim	ov	N	othing spe	cified.		ļ
et al.	in Ref. (1	). Uraniu	im was						ſ
measure	d as U <sub>2</sub> O <sub>2</sub> .	In order	to avo	id					1
cesium d	contaminät	ion, two	pptns o	f					[
ammoniu	m diruanat	e were ma	ide befo	re	EST:	IMATED ERR	OR:		]
calcinat	m diruanat tion to th ned radiom	e oxide.	Cesium	134					[
aetermin	ned radiom	errically	as Cs		No	othing spe	cified.		l
	STS-5 wit								
was used. Solid phase compositions REFERENCES: determined by Schreinemakers method. 1. Yakimov, M. A.; Nosova, N. F									
	on the ex				1.	Grishin,		Nosova, I	N. F.J
are dive	en in Ref.	(1) for	the	u		Zh. Neorg		1052 3	504
Ca(NO)	$2 - UO_2(NO)$	(1) = H C	) system			an. weory	• 1/11.4.1. • /	1930, 3	, 504.
3/3	2 22,10	3'2 2		•					]

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      COMPONENTS:
      (1) Uranyl nitrate; U02(N03)2;
      ORIGINAL MEASUREMENTS:

      (1) Uranyl nitrate; U02(N03)2;
      Yakimov, M. A.; Nosova, N. F.;

      (15905-86-9]
      Degtyarev, A. Ya.; Tsyan-Tsi, Yui

      (2) Cesium nitrate; CSN03;
      Radiokhim., <u>1963</u>, 5, 73 - 80.

      (3) Water; H20; [7732-18-5]
      Sov. Radiochem., <u>1963</u>, 60.
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The	$UO_2(NO_3)_2 -$	CsN	10 <sub>3</sub> -	<sup>н</sup> 20	System	at	25°C
	Composition	of	Satu	rated	a Soluti	ions	a

0

	U0 <sub>2</sub> (N0 <sub>3</sub> )	2		CsNO3		н <sub>2</sub> с	)	Solid Phase
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	78.22	Α
0.20	3.5	0.11	2.24	19.2	1.27	97.61 97.56 <sup>b</sup>	77.32	A
0.24	4.2	0.14	2.13	18.3	1.21	97.63 97.60 <sup>b</sup>	77.53	Α
0.26	4.5	0.15	2.14	18.3	1.22	97.60 <sup>D</sup>	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 <sub>b</sub>	71.89	A
1.11	17.3	0.634	1.78	13.7	1.02	97.11 <sup>D</sup>	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,	63.93	A
1.88	25.6	1.09	2.19	14.7	1.27	96.52 95.93 <sup>b</sup>	59.68	Α
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		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		Ä
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 <sub>b</sub>	44.46	В
4.05	41.4	2.42	2.99	15.1	1.79	92.96	43.46	в
4.06	42.8	2.41	2.32	12.1	1.38	93.62 <sub>b</sub>	45.11	в
4.39	45.3	2.61	2.09	10.7	1.24	93.52	44.08	В
4.34	45.2	2.57	2.00	10.3	1.19	93.66		В
4.40	45.6	2.61	1.97	10.1	1.17	93.63	44.34	В
4.38	45.7	2.59	1.86	9.60	1.10	93.76		В
4.52	46.4	2.68	1.92	9.74	1.14	93.56	43.88	в
4.71	47.7	2.80	1.79	8.97	1.06	93.50	43.31	В
4.77	48.1	2.83	1.75	8.74	1.04	93.48	43.13	В
4.81	48.5	2.86	1.70	8.47	1.01	93.49	43.07	в
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	С
5.30	54.3	3.12	0.30	1.5	0.18	94.40	44.20	С
5.49	56.0	3.23	0	0	0	94.51	44.04	C

<sup>a</sup>Molalities and mass % calculated by compilers. <sup>b</sup>Calculated by compilers. <sup>c</sup>Solid phases:  $A = CSNO_3$ ,  $B = CS_2UO_2(NO_3)_4$ ,  $C = UO_2(NO_3)_2 \cdot 6H_2O$ ,  $D = CSUO_2(NO_3)_3$ .

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.

COMPONENTIC			OPTO	TNAT MPAC	IDEMENI	c -	
COMPONENTS:	tentos tro /st		1	SINAL MEAS			F .
[15905-86	itrate; UO <sub>2</sub> (NO 5-9]	<sup>3</sup> <sup>2</sup>	Yakimov, M. A.; Nosova, N. F.; Degtyarev, A. Ya.; Tsyan-Tsi, Yui				
(2) Thallium [10102-45	<pre>nitrate; TINC 5-1]</pre>	<sup>3</sup> ;	Rad	liokhim.,	<u>1963</u> , 5	, 73 - 8	0.
	20; [7732-18-5	5]		. Radioch ng. trans.		<u>63</u> , 60.	
VARIABLES:			PREF	PARED BY:			
Composition a	at 273 and 298	А.	Sozanski;	S. Sie	kierski		
EXPERIMENTAL	VALUES:		, <b></b>				
	The UO2(NO	$_{2}$ - TINO <sub>3</sub>	- н <sub>2</sub> с	) System a	t o <sup>o</sup> c		
	Composi	tion of Sat	urate	ed Solutio	ns <sup>a</sup>		
U0 <sub>2</sub> ()	10 <sub>3</sub> ) <sub>2</sub>	T1N	о <sub>3</sub>		<sup>H</sup> 2	0	Solid Phase <sup>c</sup>
mol % mass	s % mol/kg	mol % mas	5 %	mol/kg	mol %	mass %	
0 0	0	0.27 3. 0.19 2.	8 7	0.15 0.11	99.73 99.68		A A
0.18 3.7		0.15 2.	1	0.084	99.67		À
0.29 5.9		0.13 1.		0.072 0.073	99.58 99.53	92.34 91.40	A A
0.46 9.0			6	0.067	99.42	89.36	A J
		0.11 1. 0.10 1.		0.062	99.14		A
1.04 18.5 1.15 20.1			2	0.056 0.056	98.86 98.75	80.32 78.76	A A
1.29 22.0	0.726	0.10 1.	2	0.056	98.61	76.86	A
1.57 25.6 1.82 28.5		0.11 1.	2 2	0.062 0.062	98.32 98.07		A A
2.03 30.8	3 1.15	0.12 1.	2	0.068	97.85	67.94	A
2.43 34.9		0.12 1. 0.13 1.		0.068 0.074	97.45 97.32	63.95 62.78	A A
3.06 40.4	1.75	0.14 1.	2	0.080	96.80	58.38	A ]
3.39 42.9 3.96 46.8		0.16 1.		0.092 0.10	96.45 95.86	55.76 51.78	A A
4.26 48.6		0.19 1.		0.11	95.55	49.89	A+B
4.27 49.0 4.29 49.5			78	0.058 0	95.63 95.71	50.20 50.50	B B
1				(Conti	nued on	the nex	t page)
		AUXILIARY I	NFORM	ATION			
METHOD/APPARA	TUS/PROCEDURE	3:	SOUR	RCE AND PU	RITY OF	MATERIA	LS:
et al. (1). U the oxide, U as ammonium d	as described h Jranium was me O <sub>2</sub> , after pre liuranate. Tha by potassium C to 130°C, a	easured as cipitation allium was	Noth	ning speci	fied.		
as Tl <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> .	C TO 130 C, 8	ma weighed	ESTIMATED ERROR:				
2 2 7			Nothing specified.				
			REFERENCES:				
			1. 1	(akimov, M Srishin, V	. A.; N . A	osova, N	. F.;
			2	Zh. Neorg.	Khim.,	<u>1958</u> , 3	, 504.

COMPONENTS: ORIGINAL MEASUREMENTS:							3:	
(1) Uran [159	yl nitrat 05-86-9]	e; UO <sub>2</sub> (NC	) <sub>3</sub> ) <sub>2</sub> ;		akimov, M. egtyarev, A			
(2) Thal	lium nitr	ate; TlNC	) <sub>3</sub> ;	R	adiokhim.,	<u>1963, 5,</u>	73 - 8	0.
-	.02-45-1] er; H <sub>2</sub> 0; [	7732-18-5	51		ov. Radioch Eng. trans.		3, 60.	
	INTAL VALU			`				
		•		$NO_{-} - H$	i <sub>2</sub> 0 System a	t 25 <sup>0</sup> C		
				-	ted Solutio	_		
	UO2(NO3)2			TINO <sub>3</sub>		н <sub>2</sub> с	)	Solid
mol %	mass %	mol/kg	mol %	mass %	mol/kg	mol %	mass %	Phase
<sup>b</sup> Calcula <sup>C</sup> Solid p COMMENTS Solubili	ted by th bhases: A S AND/OR A ty isothe	3.31 3.22 ass % cal e compile = TlNO <sub>3</sub> , DDITIONAI	0.47 O .culated ers. B = UO <sub>2</sub> DATA:	3.1 0 the (NO <sub>3</sub> ) <sub>2</sub> .	0.28 0 compilers. 6H <sub>2</sub> O.	93.93 94.51	78.51 76.41 73.78 71.39 70.93 70.48 69.99 66.59 66.59 59.37 57.35 56.54 55.39 54.27 49.93 48.74 45.32 42.58 41.24 42.05 44.04	А А А А А А А А А А А А А А А А А А А
5.49	56.0	3.22	U	U	U	94.51	44.04	в
<sup>a</sup> Molalities and mass % calculated by the compilers. <sup>b</sup> Calculated by the compilers. <sup>C</sup> Solid phases: A = T1NO <sub>3</sub> , B = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O. COMMENTS AND/OR ADDITIONAL DATA: Solubility isotherms are also given in graphical form in the source publication.								

COMPONEI	NTS:		ORIGINA	L MEASUREM	ENTS:			
(1) Uran [159	nyl nitrate; 905-86-9]	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Yakimo	Yakimov, M. A.; Nosova, N. F.				
(2) Bery	/llium nitra	te; Be(NO <sub>3</sub> ) <sub>2</sub> ;	Zh. Nec	rg. Khim.,	<u>1961</u> , 6,			
[139	597-99-4]	52			ham 100	,211.		
(3) Wate	er; H <sub>2</sub> 0; [77	32-18-5]		Russ. J. Inorg. Chem., <u>1961</u> , 6, 103. (Eng. trans.)				
VARIABLI	25:		PREPARE	PREPARED BY:				
Composition at 273 and 298 K A. Sozanski; S. Siekierski								
EXPERIM	ENTAL VALUES	:						
	The	$UO_2(NO_3)_2 - Bo$	$e(NO_{n})_{n} - H_{n}C$	System at	o <sup>o</sup> c			
		Composition of						
		-						
	U0 <sub>2</sub> (	<sup>NO</sup> 3 <sup>)</sup> 2	Be(N	0 <sub>3</sub> ) <sub>2</sub>	<sup>н</sup> 20	Solid Phase <sup>b</sup>		
t∕°c	mass %	mol/kg	mass %	mol/kg	mass %	t nubb		
0	0	0	50.1	7.55	49.9	А		
	0.80	0.04	50.0	7.64	49.2	А		
	2.1	0.11	49.5		48.4			
	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	в		
	4.6	0.23	44.9	6.68	50.5	В		
	4.5	0.22	43.8	6.37	51.7	В		
	4.2	0.20	42.6	6.02	53.2	B		
	4.0 4.4	0.19 0.21	42.2 41.9	5.90 5.87	53.8 53.7	B B		

15.0	0.616	23.2	2.82	61.8	В						
18.8	0.762	18.6	2.23	62.6							
21.0	0.871	17.8	2.19	61.2	В						
			(Continued	on the	next page)						
AUXILIARY INFORMATION											
METHOD/APPARATUS/PH	CCEDURE:	SOURCE AND PURITY OF MATERIALS:									
The procedure has h Ref. (1). Beryllium		UO2(NO3)2.6H2O, nothing specified.									
solution and in sol precipitation of be from oxalic acid so	id phase by the eryllium hydroxide plution. Uranium	nitrate, after adding concentrated									
was precipitated fi			c acid. Prod								

39.2

37.6

36.0

35.7

35.2

31.4

30.2

29.4

24.4

5.24

4.91

4.62

4.58

4.50

3.91

3.71

3.62

2.94

56.2

57.6

58.6

58.6

58.8

60.4

61.2

61.0

62.4

В

В

в

в

в

в

в

В

В

0.21

0.21

0.23

0.25

0.26

0.34

0.36

0.40

0.537

4.6

4.8

5.4

5.7

6.0

8.2

8.6

9.6

oxine, and ignited to U308.

13.2

4.37 % Be and 60.40 % NO<sub>3</sub> (theor. 4.39 % and 60.48 %, respectively). ESTIMATED ERROR: **REFERENCES:** Nothing specified. Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. Zh. Neorg. Khim., <u>1958</u>, 3, 504.

COMPONEN	ITS:	<u> </u>	ORIGI	ORIGINAL MEASUREMENTS:					
(1) Urar	nyl nitrate; 905-86-9]	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Yaki	Yakimov, M. A.; Nosova, N. F.;					
<pre>(2) Beryllium nitrate; Be(NO<sub>3</sub>);</pre>			Zh.	Zh. Neorg. Khim., <u>1961</u> , 6, 208 - 211.					
[135	597-99-4]	20, 20(103/2)		. J. Inorg. (Eng. trans					
(3) Water; H <sub>2</sub> O; [7732-18-5]									
EXPERIMENTAL VALUES: (Continued)									
The $UO_2(NO_3)_2 - Be(NO_3)_2 - H_2O$ System at $O^{O}C$									
Composition of Saturated Solutions <sup>a</sup>									
. 0		NO <sub>3</sub> ) <sub>2</sub>		<sup>0</sup> 3 <sup>)</sup> 2	H <sub>2</sub> O	Solid Phase			
t/°c	mass %	mol/kg		mol/kg		_			
0	24.5 25.6	1.02	14.8	1.83	60.7 60.0	B B			
ſ	26.8 28.7	1.12 1.23	12.6 12.0	1.56 1.52	60.6 59.3	B B			
	30.6	1.33	10.9	1.40	58.5	в			
]	33.1	1.47	9.6	1.3	57.3 56.8 <sup>c</sup>	В			
	34.1	1.52	9.2	1.2 0.93		B B			
	37.6 42.6	1.72 2.02	6.9 3.8	0.53	55.5 53.6	B			
1	46.6	2.26	1.1	0.16	52.3	В			
	49.5	2.49	0	0	50.5	В			
25	0	0	54.57	9.030	45.43				
1	2.0	0.12	53.9	9.19	44.1	A			
	6.6 8.4	0.40 0.51	51.0 50.0	9.04 9.04	42.4 41.6	A A			
}	10.2	0.638	49.2	9.11	40.6	À			
1	12.7	0.812	47.6	9.01	39.7	A			
1	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	В			
	18.4 18.4	1.19 1.10	42.2 39.5	8.05 6.97	39.4 42.6	B			
1	18.4	1.10	39.5	6.51	42.0	B B			
	18.3	1.01	35.8	5.86	45.9	B			
[	18.7	1.01	34.1	5.43	47.2	В			
	21.0	1.07	29.0	4.36	50.0	В			
	24.3	1.20	24.5	3.60	51.2	B			
1	30.2	1.27 1.46	22.3 17.2	3.24	51.8 52.6	B			
]	35.1	1.74	13.7	2.01	51.2	B			
	38.9	1.98	11.2	1.69	49.9	В			
	43.8	2.27	7.2	1.1	49.0	В			
	47.0 51.2	2.54 2.82	6.0 2.7	0.96 0.44	47.0 46.1	B B			
ł	55.95	3.223	0	0	44.05	B			
<sup>a</sup> Molalities calculated by the compilers. <sup>b</sup> Solid phases: $A = Be(NO_3)_2 \cdot 4H_2O; B = UO_2(NO_3)_2 \cdot 6H_2O.$									
The s	um of mass a	is equal to	100.1 (com	pilers).					
COMME	NTS AND/OR	ADDITIONAL DAT	Ά:						
In th has o	e source pub ne eutonic p	olication, a p point.	hase diagr	am is given.	Each isot	herm			

COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N. F. Zh. Neorg. Khim., <u>1960</u> , 5, 720 -	
<pre>(2) Magnesium nitrate; Mg(NO<sub>3</sub>)<sub>2</sub>; [10377-60-3] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	Russ. J. Inorg. Chem., <u>1960</u> , 5, 346. (Eng. trans.)	
VARIABLES:	PREPARED BY:	
Composition at 273 and 298 K	A. Sozanski; S. Siekierski	

EXPERIMENTAL VALUES:

The  $UO_2(NO_3)_2 - Mg(NO_3)_2 - H_2O$  System at  $O^OC$ Composition of Saturated Solutions<sup>a</sup>

	UO2(NO3)	2		Mg(NO <sub>3</sub> ) <sub>2</sub>		Solid Phase
mol %	mass %	mol/kg	mol %	mass %	mol/kg	rnube
0	0	0	7.12	38.8	4.27	λ
0.18	2.6	0.11	7.24	38.0	4.31	Α
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	в
0.61	8.2	0.37	6.90	34.9	4.14	В
0.79	10.8	0.474	6.15	31.4		в
0.92	12.6	0.545	5.57	28.7	3.30	В
1.26	17.0	0.752	5.08	25.6	3.01	В
1.62	21.5	0.966	4.47	22.0	2.63	в
1.90	24.6	1.12	4.05	19.7	2.38	В
2.02	26.0	1.19	3.80	18.4	2.23	в
2.18	27.7	1.28	3.63	17.4	2.14	в
2.34	29.6	1.37	3.59	15.7	1.94	в
2.56	32.0	1.51	3.03	14.2	1.78	
2.89	35.4	1.70	2.52	11.6	1.48	В
2.89	35.8	1.70	2.30	10.7	1.35	в
3.05	36.8	1.76	2.22	10.2	1.30	В
3.18	38.1	1.85	2.08			в
3.37	40.3	1.96	1.70	7.6	0.98	
3.76	44.5	2.18	0.86	3.8	0.50	В
4.29	49.5	2.49	0	0	0	В
				(Contin	nued on th	e next pag
	<u></u>	AUXILI	ARY INFORM	ATION		<u></u>
APPARA	TUS/PROCE	DURE:	SOUR	CE AND PU	RITY OF MA	TERIALS:

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 $Mg(C_9H_6ON)_2.4H_2O$ (the oxine method).	No information given.		
	ESTIMATED ERROR:		
	Solubility: Nothing specified.		
	Temperature: Nothing specified.		
	REFERENCES:		
	<ol> <li>Yakimov, M. A.; Nosova, N. F.; Grishin, V. A.</li> <li>Zh. Neorg. Khim., <u>1958</u>, 3, 504</li> </ol>		

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

The $UO_2(NO_3)_2 - Mg(NO_3)_2 - H_2O$ System	at	25 <sup>0</sup> C
Composition of Saturated Solution	ns <sup>a</sup>	

<sup>UO</sup> 2 <sup>(NO</sup> 3)2				Mg(NO <sub>3</sub> ) <sub>2</sub>		
mol %	mass %	mol/kg	mol %	mass %	mol/kg	Phase"
0	0	0	8.07	41.94	4.870	A
0.08	1.15	0.0507	8.05	41.30	4.838	А
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	А
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	Α
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	в
1.67	19.2	1.02	7.59	33.0	4.65	В
1.78	20.0	1.09	7.90	33.6	4.88	В
1.81	21.0	1.11	7.18	31.0	4.35	в
2.20	24.8	1.33	6.59	28.0	4.00	В
2.26	25.4	1.37	6.51	27.6	3.96	В
2.28	25.8	1.39	6.35	27.0	3.86	В
2.34	26.7	1.41	5.89	25.3	3.55	В
2.65	30.0	1.60	5.30	22.5	3.19	В
2.88	31.8	1.73	5.18	21.6	3.13	в
3.41	36.8	2.05	4.35	17.6	2.60	В
3.43	37.0	2.06	4.28	17.4	2.57	в
3.72	39.6	2.23	3.80	15.3	2.29	В
4.07	43.4	2.43	2.81	11.2	1.66	В
4.52	47.2	2.67	2.03	8.0	1.2 0.78 <sup>C</sup>	В
4.74	49.8	2.81	1.32	5.2	0.78	B B
5.12	52.8	3.03	0.77	3.0	0.46	в
5.41	55.95	3.223	0	0	0	В

<sup>a</sup>Molalities calculated by the compilers.

<sup>b</sup>Solid phases:  $A = Mg(NO_3)_2.6H_2O$ ,  $B = UO_2(NO_3)_2.6H_2O$ .

 $^{\rm C}{\rm The}$  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:	ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N. F.; Grishin, V. A.				
(2) Calcium nitrate; Ca(NO <sub>3</sub> ) <sub>2</sub> ; [10124-37-5] (3) Water; H <sub>2</sub> O; [7732-18-5]	Zh. Neorg. Khim., <u>1958</u> , 3, 504 - 507. Russ. J. Inorg. Chem., <u>1958</u> , 3, 358. (Eng. trans.)				
VARIABLES:	PREPARED BY:				
Composition at 273 and 298 K	A. Sozanski; S. Siekierski				
EXPERIMENTAL VALUES:					

The  $UO_2(NO_3)_2$  - Ca(NO<sub>3</sub>)<sub>2</sub> - H<sub>2</sub>O System at 0.1°C

Composition of Saturated Solutions<sup>a</sup>

Solid Phase	н <sub>2</sub> 0	<sup>3</sup> <sup>2</sup>	JO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> Ca(NO <sub>3</sub> ) <sub>2</sub>		UO2(NO3)2	
Flidde	mass %	mol/kg	mass %	mol/kg	mass %	
λ	50.50	0	0	2.488	49.50	
Α	52.60	0.482	4.16	2.084	43.22	
Α	52.39	1.210	10.41	1.802	37.21	
Α	53.23	1.777	15.52	1.490	31.25	
Α	53.49	2.334	20.49	1.235	26.02	
A	53.55	2.635	23.15	1.104	23.30	
Α	53.00	2.869	24.95	1.056	22.05	
Α	53.02	3.007	26.16	0.9966	20.82	
Α	51.97	4.200	35.82	0.5962	12.21	
Α	52.36	4.363	37.49	0.4920	10.15	
Α	51.82	4.637	39.43	0.429	8.75	
A	51.61	4.717	39.95	0.415	8.44	
A+B	49.92	5.288	43.32	0.344	6.76	
в	52.21	4.983	42.69	0.248	5.10	
В	52.25	5.039	43.20	0.221	4.55	
В	52.45	5.229	45.00	0.123	2.55	
В	49.37	6.250	50.63	0	0	

(Continued on the next page)

AUXILIARY INFORMATION					
AUXILIARY II 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 <sub>3</sub> O <sub>8</sub> . 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 was heated at 500°C to 600°C and weighed.	NFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, recrystallized three times. 2. Ca(NO <sub>3</sub> ) <sub>2</sub> , chemically pure. 3. H <sub>2</sub> O, twice distilled. ESTIMATED ERROR: Nothing specified. REFERENCES:				

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Yakimov, M.A.; Nosova, N. F.;		
[15905-86-9]	Grishin, V. A.		
(2) Calcium nitrate; Ca(NO <sub>3</sub> ) <sub>2</sub> ;	Zh. Neorg. Khim., <u>1958</u> , 3, 504 -		
[10124-37-5]	507.		
(3) Water; H <sub>2</sub> O; [7732-18-5]	Russ. J. Inorg. Chem., <u>1958</u> , 3, 358. (Eng. trans.)		

The UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> - Ca(NO<sub>3</sub>)<sub>2</sub> - H<sub>2</sub>O System at 25<sup>O</sup>C Composition of Saturated Solutions<sup>a</sup>

U02(N03)5		Ca(NO <sub>3</sub> ) <sub>2</sub> Ca(NO <sub>3</sub> ) <sub>2</sub>		н <sub>2</sub> о	Solid <sub>b</sub> Phase
mass %	mol/kg	mass %	mol/kg	mass %	1 11400
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	А
34.75	1.861	17.87	2.299	47.38	A
31.10	1.686	22.08	2.874	46.82	Α
29.65	1.569	22.40	2.847	47.95	Α
26.02	1.383	26.23	3.348	47.75	A
22.98	1.216	29.05	3.691	47.97	Α
17.60	0.9288	34.31	4.348	48.09_	А
16.40	0.8747	37.02	4.742	47.58 <sup>C</sup>	А
15.18	0.8446	39.21	5.239	45.61	Α
13.25	0.7358	41.05	5.474	45.70	A
9.66	0.558	46.40	6.435	43.94	Α
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	В
6.88	0.398	49.20	6.827	43.92	в
4.18	0.232	50.00	6.650	45.82	В
2.01	0.113	52.81	7.123	45.18	в
0	0	57.97	8.405	42.03	В

<sup>a</sup>Molalities calculated by the compilers. <sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2.6H_2O$ ,  $B = Ca(NO_3)_2.4H_2O$ . <sup>C</sup>The 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:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N. F.; Grishin, V. A. Zh. Neorg. Khim., <u>1958</u> , 3, 504 -		
(2) Strontium nitrate; Sr(NO <sub>3</sub> ) <sub>2</sub> ; [10042-76-9]	Russ. J. Inorg. Chem., <u>1958</u> , 3 358. (Eng. trans.)		
(3) Water; H <sub>2</sub> O; [7732-18-5]			
VARIABLES:	PREPARED BY:		
Composition at 298 K	A. Sozanski; S. Siekierski		

EXPERIMENTAL VALUES:

The  $UO_2(NO_3)_2$  - Sr(NO<sub>3</sub>)<sub>2</sub> - H<sub>2</sub>O System at 25<sup>o</sup>C

Composition of Saturated Solutions<sup>a</sup>

UO2(N	0 <sub>3</sub> ) <sub>2</sub>	Sr(NC	<sup>2</sup> 3 <sup>2</sup>	н <sub>2</sub> о	Solid Phase <sup>b</sup>
mass %	mol/kg	mass %	mol/kg	mass %	
55.87 52.64 51.55	3.213 2.887 2.856	0 1.09 2.65	0 0.111 0.273	44.13 46.35 <sup>c</sup> 45.80	А А А
51.39	2.976	4.78	0.515	43.83	A+B
49.76 47.48 46.05 45.24 40.39 37.33	2.826 2.647 2.542 2.456 2.126 1.942	5.55 7.00 7.97 8.02 11.39 13.88	0.587 0.727 0.819 0.811 1.116 1.344	44.69 45.52 45.98 46.74 48.22 48.70 <sup>C</sup>	B B B B B+C
34.10 27.75 20.40 11.20 0	1.681 1.367 0.9670 0.5192 0	14.42 20.75 26.06 34.05 4.12	1.324 1.904 2.300 2.939 3.731	51.48 51.50 53.54 54.75 55.88	0 0 0 0 0 0

<sup>a</sup>Molalities calculated by the compilers.

<sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2.6H_2O$ ,  $B = Sr(NO_3)_2$ ,  $C = Sr(NO_3)_2.4H_2O$ .

<sup>C</sup>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  $Sr(NO_3)_2.4H_2O$ , anhydrous  $Sr(NO_3)_2$ , and  $UO_2(NO_3)_2.6H_2O$ .

AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS: 1. $UO_2(NO_3)_2.6H_2O$ , recrystallized
Isothermal analytical method used. Saturated solutions in sealed tubes placed in thermostat. Tubes were	three times. 2. Sr(NO <sub>3</sub> ) <sub>2</sub> , chemically pure.
shaken 3 to 3-1/2 hours (equilibrium attained after 2 to 2-1/2 hours). The mixtures were allowed to settle, and	3. Water, twice distilled.
samples then taken for uranium and strontium analysis. The solid phase composition found by Schreinemakers	ESTIMATED ERROR: Solubility: Nothing specified.
method. Uranium and strontium found	Temperature: Precision ±0.05K.
gravimetrically. Low concentrations of Sr radiometrically by Sr	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N. F.; Grishin, V. A.
<pre>(2) Barium nitrate; Ba(NO<sub>3</sub>)<sub>2</sub>; [10022-31-8] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	Zh. Neorg. Khim., <u>1958</u> , 3, 504 - 507. Russ. J. Inorg. Chem., <u>1958</u> , 3, 358. (Eng. trans.)
VARIABLES:	PREPARED BY:
Composition and temperature	A. Sozanski; S. Siekierski

EXPERIMENTAL VALUES:

The  $UO_2(NO_3)_2$  -  $Ba(NO_3)_2$  -  $H_2O$  System Composition of Saturated Solutions<sup>a</sup>

ł	υο <sub>2</sub> (Νο <sup>3</sup> ) <sup>5</sup>		Ba(NO <sub>3</sub> ) <sub>2</sub>		н <sub>2</sub> 0	Solid <sub>b</sub>	
t/°c	mass %	mol/kg	mass	ફ	mol/kg	mass %	Phase <sup>b</sup>
0.1	49.39	2.477	0		0	50.61	A
}	39.41 31.64	1.658 1.182		27 42	0.017 0.024	60.32 67.94	B B
	21.65	0.7067	0.		0.030	77.75 81.84	B B
	17.36 11.82	0.5383 0.3467	0.	67	0.037 0.0739	86.51	B
1	8.82	0.251		00	0.0858	89.18	в
1	5.20 0	0.143	2.	60	0.108 0.196	92.20 95.12	B
	U	U	4.	88	0.138	95.12	Б
25	56.12	3.246	0		0	43.88	A
(	49.51	2.501		25	0.019	50.24	в
1	40.12	1.712	0.		0.026	59.48	В
	33.16	1.271	0.		0.038	66.19	B
1	30.74 23.34	1.139	0.		0.041	68.52 75.21	B
4	23.34	0.7876 0.6903	1.	45 61	0.0738 0.0796	77.35	B B
1	19.37	0.6254		03	0.0988		в
	16.78	0.5274		37	0.112	78.60 80.75 <sup>C</sup>	B
í .	14.00	0.4284		06	0.141	82.94	B
)	11.54	0.3452	3.		0.164	84.83	B
					(Continue)	d on the ne	ext page)
		AUXII	LIARY I	NFORM/	TION		
METHOD/2	APPARATUS/F	ROCEDURE:			CE AND PURIT		ALS:
Saturate	ed solution	hod was used. s were added	to		crystallized		nes.
stat. Th	ne solution	placed in a t is were shaker ibrium was re	13to	2. Ba	$(NO_3)_2$ , cher	mically pur	e.
after 2	to $2-1/2$ h	ours). The mi	ixtures	3. Wa	ter, twice	distilled.	
samples	were allowed to settle, after which samples were obtained using a pipet. The samples were filtered and used			ESTIN	ATED ERROR:		
for urar	ium and ba	the solid pr	5.	1	oility: Noth		1
was dete method.	ermined by Uranium an	Schreinemaken d barium were	rs e then	Tempe	erature: 0°C 50°C	and 25 <sup>0</sup> C, C, <u>±</u> 0.1K.	±0.05K;
barium s	ulfate.	ically as U <sub>3</sub> C	'8' and	REFER	ENCES:		
L				1			

COMPONEN	rs:		ORIC	SINAL MEASURE	MENTS:				
(1) Uran [159	yl nitrate 05-86-9]	; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;		akimov, M. A. rishin, V. A.	; Nosova, N	. F.;			
(2) Bari [100	um nitrate 22-31-8]	; Ba(NO <sub>3</sub> ) <sub>2</sub> ;	21	h. Neorg. Khi	m., <u>1958</u> , 3	, 504 - 507.			
-	r; H <sub>2</sub> 0; [7	732-18-5]		iss. J. Inorg 58. (Eng. tra:					
EXPERIME	EXPERIMENTAL VALUES: (Continued)								
	The $UO_2(NO_3)_2$ - Ba(NO <sub>3</sub> ) <sub>2</sub> - H <sub>2</sub> O System								
		Composition	of Saturate	ed Solutions <sup>a</sup>					
	UO <sub>2</sub> (N	10 <sub>3</sub> ) <sub>2</sub>	Ba ( 1	<sup>NO</sup> 3)2	н20	Solid <sub>b</sub> Phase			
t∕°c	mass %	mol/kg	mass %	mol/kg	mass %	Fliase			
25	8.25 5.20 0	0.241 0.149 0	4.78 6.20 9.18	0.210 0.268 0.387	86.97 88.60 90.82	B B B			
50	67.28	5.218	0	0	32.72	A			
	54.15 48.20 39.37 31.41 21.27 14.20 7.96 0	3.022 2.386 1.674 1.192 0.7217 0.4552 0.244 0	0.38 0.43 0.93 1.70 3.94 6.64 9.32 14.53	0.032 0.032 0.060 0.0972 0.202 0.321 0.431 0.6505	45.47 51.27 59.70 66.89 74.79 79.16 82.72 85.47	B B B B B B B B			
a <sub>M</sub>	olalities	calculated by	the compil	lers.					
		s: $A = UO_2(NC)$							
		mass % does r			).				
A j te	phase diag mperature,	/OR ADDITIONA ram is given the solubili	in the soun ity isothern	n consists vi	rtually of				
		nch. The seco e analytical		vas not studi	ed for lack				

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N. F.
(2) Zinc nitrate; Zn(NO <sub>3</sub> ) <sub>2</sub> ; [7779-88-6]	Vestn. Lenigr. Univ., <u>1962</u> , 4, 106 - 114.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

## VARIABLES:

EXPERIMENTAL VALUES:

Composition at 273 and 298 K

The  $UO_2(NO_3)_2 - Zn(NO_3)_2 - H_2O$  System at  $O^OC$ Composition of Saturated Solutions<sup>a</sup>

PREPARED BY:

L. Fuks; S. Siekierski

UO <sub>2</sub> (N	UO2(NO3)2		<sup>0</sup> 3) <sup>2</sup>	H <sub>2</sub> O	Solid. Phase <sup>b</sup>	
mass %	mol/kg	mass %	mol/kg	mass %	1 11436	
0 1.6	0 0.08	48.3 48.0	4.96 5.02	51.4 50.4	A A	
2.9	0.15	48.0	5.16	49.1	A+B	
3.3 3.8 3.6 6.5 12.9 16.5 17.8 21.9 24.0 28.1 32.3 37.3 38.3	0.17 0.19 0.18 0.31 0.603 0.764 0.807 1.01 1.12 1.30 1.56 1.77 1.82	46.3 45.1 44.5 40.3 32.8 28.7 26.2 23.1 21.8 17.0 15.0 9.3 8.2	4.85 4.66 4.53 4.00 3.19 2.77 2.47 2.22 2.12 1.17 1.50 0.92 0.81	50.4 51.1 51.9 53.2 54.2 54.8 56.0 55.0 54.2 54.9 52.7 53.4 53.5	B B B B B B B B B B B B B B B B B B B	
41.6 49.50	2.05	6.0 0	0.70	51.6 50.5	B 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	Nothing specified.
hours). Details of the procedure are described in Ref. (1). For analytical	ESTIMATED ERROR:
purposes, uranium was extracted from the solution as described in (2), then reextracted, precipitated with	Nothing specified.
ammonia, and ignited to oxide, U <sub>3</sub> O <sub>8</sub> . Zinc determined in the raffinate <sup>3</sup>	REFERENCES:
radiometrically measuring gamma radiation with MS-7 counter $(2n^{65})$ . The composition of the solid phases	<ol> <li>Yakimov, M. A.; Nosova, N. F.; Zh. Neorg. Khim., <u>1958</u>, 3, 504.</li> </ol>
was determined by Schreinemakers method.	2. Yakimov, M. A. Zh. Neorg. Khim., <u>1960</u> , 5, 720.

COMPONENTS:		ORIGINAL MEASUREMENTS:
	(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A. Nosova, N.F.;
	(2) Zinc nitrate; Zn(NO <sub>3</sub> ) <sub>2</sub> ; [7779-88-6]	Vestn. Leningr. Univ., <u>1962</u> , 4, 106 - 114.
	(3) Water; H <sub>2</sub> O; [7732-18-5]	

The UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> - Zn(NO<sub>3</sub>)2 - H<sub>2</sub>O System at 25<sup>o</sup>C Composition of Saturated Solutions<sup>a</sup>

U0 <sub>2</sub> (N	0 <sub>3</sub> ) <sub>2</sub>	Zn(NC	<sup>3</sup> <sup>2</sup>	н <sub>2</sub> о	Solid <sub>b</sub> Phase
mass %	mol/kg	mass %	mol/kg	mass %	i nabe
0	0	55.9	6.69	44.1	А
2.2	0.13	54.2	6.56	43.6	А
3.9	0.23	53.3	6.58	42.8	А
6.3	0.38	51.9	6.56	41.8	А
8.1	0.50	51.1	6.61	40.8	А
8.2	0.50	50.3	6.40	41.5	А
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 14.8 19.3	0.778 0.781 1.01	37.6 37.1 32.0	4.17 4.07 3.47	47.6 <sup>C</sup> 48.1 48.7	B B B B
24.0 25.8 34.4	1.01 1.27 1.35 1.85	28.2 25.8 18.3	3.11 2.81 2.04	47.8 48.4 47.3	B B B 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
2.2.5	J. 22	0	v	44.1	Б

<sup>a</sup>Molalities calculated by the compilers. <sup>b</sup>Solid phases:  $A = Zn(NO_3)_2.6H_2O$ ,  $B = UO_2(NO_3)_2.6H_2O$ . <sup>C</sup>The 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  $Zn(NO_3)_2.6H_2O$  and  $UO_2(NO_3)_2.6H_2O$ .

COMPONENTS:		OPTCTNAL	MEASUDEMENTS	·	
	ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N. F. Vestn. Leningr. Univ., <u>1962</u> , 4,				
(2) Cadmium nitrate; Cd(NO <sub>3</sub> ) <sub>2</sub> ; [10325-94-7]	106 - 11		··, <u>1908</u> , 4,		
(3) Water; H <sub>2</sub> O; [7732-18-5]					
VARIABLES:		PREPARED	BY:		
Composition at 273 and 298 K		L. Fuks	; S. Siekiers	ski	
EXPERIMENTAL VALUES:			· · · · · · · · · · · · · · · · · · ·		
The $UO_2(NO_3)_2 - $	Cd(NO <sub>3</sub> )	- н <sub>2</sub> о sy	ystem at O <sup>O</sup> C		
Composition					
UO2(NO3)2	Cd(NO3)	) <sub>2</sub>	н <sub>2</sub> о	Solid	
mass % mol/kg ma	ss %	mol/kg	mass %	Phase	
0 0 5	5.6	5.30	44.4	A	
	2.6	5.00	44.5	Ä	
	2.1	5.01	44.0	A	
6.1 0.35 4	9.8	4.78	44.1	A	
6.6 0.38 4	9.5	4.77	43.9	A+B	
7.6 0.43 4	8.0	4.57	44.4	в	
9.9 0.53 4	3.0	3.86	47.1	в	
1 · · · · · · · · · · · · · · · · · · ·	9.0	3.38	48.8	В	
ł	2.7	2.79	50.5	В	
	2.1	2.72	50.0	B	
	0.1 3.8	2.54 1.99	50.1 50.6	B B	
	3.5	1,96	50.7	B	
	2.3	1.87	50.4	B	
30.7 1.55 1	9.0	1.60	50.3	В	
	1.5	0.946	51.4	В	
	0.6	0.872	51.4	B	
	B.6 3.9	0.72 0.32	50.8 51.4	B B	
	0	0	50.5	B	
		((	Continued on	the next page)	
	LIARY IN	IFORMATION			
METHOD/APPARATUS/PROCEDURE:		_	ND PURITY OF	MATERIALS:	
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		Nothing s	specified.		
to 3 hours). Details of the pro		BOUTHS	N RDDOD+		
have been described (1). Cadmin analyzed by precipitation with		ESTIMATE	D ERROR:		
The resulting precipitate of Consolubilized in concentrated hyperbolic sectors and the sector of the sectors and the sectors and the sectors and the sectors are set of the sectors and the sectors are set of the sectors and the sectors are set of the se	Nothing	specified.			
chloric acid, then precipitates $(NH_4)_2HPO_4$ , and ignited to $Cd_2$	$P_2O_7$ .	REFERENCI	ES:		
Uranium was determined in filt, by precipitation with ammonia,		1. Yakimov, M. A.; Nosova, N. F.			
subsequent ignition to U308.		Zh. Neorg. Khim., <u>1958</u> , 3, 504.			

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yakimov, M. A.; Nosova, N. F.		
(2) Cadmium nitrate; Cd(NO <sub>3</sub> ) <sub>2</sub> ; [10325-94-7]	Vestn. Leningr. Univ., <u>1962</u> , 4, 106 - 114.		
(3) Water; H <sub>2</sub> O; [7732-18-5]			

The  $UO_2(NO_3)_2 - Cd(NO_3)_2 - H_2O$  System at 25°C Composition of Saturated Solutions<sup>a</sup>

$UO_2(NO_3)_2$		Cd(NO <sub>3</sub> ) <sub>2</sub>		н <sub>2</sub> 0	Solid <sub>b</sub> 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	А
5.9	0.39	56.0	6.22	38.1	A 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	в
9.5	0.63	52.2	5.77	38.3	В
9.9	0.66	51.8	5.72	38.3	В
10.2	0.672	51.6	5.71	38.2	В
10.9	0.692	49.1	5.18	40.0	В
12.9	0.795	45.9	4.71	41.2	В
13.0	0.813	46.4	4.83	40.6	в
15.2	0.932	43.4	4.43	41.4	В
20.2	1.21	37.5	3.75	42.3	в
26.8	1.56	29.7	2.89	43.5	В
33.4	1.91	22.3	2.13	44.3	В
48.1	2.74	7.4	0.70	44.5	В
55.9	3.22	0	0	44.1	в

<sup>a</sup>Molalities calculated by the compilers. <sup>b</sup>Solid phases:  $A = Cd(NO_3)_2 \cdot 4H_2O$ ;  $B = UO_2(NO_3)_2 \cdot 6H_2O$ . <sup>C</sup>The 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.

COMPONE	NTS:			ORIGINAL MEAS	UREMENTS:		
(1) Urai	nyl nitrate	; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	;				
[159	905-86-9]			Yakimov, M.			
(2) Mero [100	cury nitrat 045-94-0]	e; Hg(NO <sub>3</sub> ) <sub>2</sub> ;	;	Vestn. Lening 106 - 114.	r. Univ., <u>19</u>	<u>62</u> , 4,	
(3) Wate	er; H <sub>2</sub> O; [7	732-18-5]					
VARIABL	es:			PREPARED BY:			
Composi	tion and te	mperature		A. Sozanski;	S. Siekiersk	i	
	ENTAL VALUE						
ŗ	The UO <sub>2</sub> (NO <sub>3</sub>			System at 0 <sup>0</sup> C		5 <sup>o</sup> c	
		Composition	n of Sati	urated Solutio	ns <sup>a</sup>		
_	UO2(N	0 <sub>3</sub> ) <sub>2</sub>	Н	g(NO <sub>3</sub> ) <sub>2</sub>	H <sub>2</sub> O	Solid <sub>.</sub> Phase <sup>b</sup>	
t∕°c			mass	<pre>% mol/kg</pre>	mass %		
0	1.9	0.17	69.0	5 7.52	28.5	A+B	
	3.0 4.1	0.25	66.: 63.:		30.8 32.7	B B	
	6.7	0.48	58.3 53.		35.1 36.9	B B	
	12.5	0.815	48.0	6 3.85	38.9	В	
	13.2 15.5	0.850 0.981	47.4		39.4 40.1	B B	
	19.0	1.17	39.	7 2.96	41.3	В	
	22.7 24.3	1.37 1.40	35.3		42.1 44.1	B B	
	24.3	1.40	27.		44.5	B	
	31.0	1.69	22.		46./	B	
	34.0 35.6	1.81 1.87	18.4		47.6 48.2	B B	
	36.2	1.89	15.2		48.6	В	
	39.0 42.8	2.00 2.16	11.0		49.4 50.2	B B	
	46.4	2.34	3.3	2 0.20	50.4	В	
	49.5	2.49	0	0	50.5	В	
				(0			
					nued on the 1	next page)	
METHOD /				SOURCE AND BU		DTAT C.	
METHOD/APPARATUS/PROCEDURE:			4	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.					
R			REFERENCES:				
			1. Yakimov, M. A.; Nosova, N. F.				
				Zh. Neorg	. Khim., <u>195</u> 1	<u>3</u> , 3, 504.	

COMPONEN	ITS:		ORI	GINAL MEASU	REMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]			Ya	kimov, M. A	.; Nosova,	N. F.;
<pre>(2) Mercury nitrate; Hg(NO<sub>3</sub>)<sub>2</sub>; [10045-94-0]</pre>			Ve	stn. Lening 6 - 114.	r. Univ., <u>1</u>	<u>.962</u> , 4,
_	er; H <sub>2</sub> 0; [7					
			<u> </u>			
		S: (Continue		0	0	0
Т	he UO <sub>2</sub> (NO <sub>3</sub>	$)_2 - Hg(NO_3)$		tem at 0°C, ed Solution		:5°C
	ио <sub>2</sub> (и		Hg(NO		в Н <sub>2</sub> 0	Solid <sub>h</sub>
t∕°c						Phase
t/C	mass %	mo1/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	В
	13.8 15.3	1.04 1.11	52.5 49.8	4.80 4.40	33.7 34.9	B B
	19.5	1.37	49.0	3.79	36.1	B
	22.0	1.52	41.2	3.45	36.8	в
	26.4	1.69	34.0	2.65	39.6	В
	30.8	1.89	27.8	2.07	41.4	В
	36.5	2.16	20.7	1.49 1.10	42.8	В
	39.0 44.3	2.20 2.34	16.0 7.7	0.49	45.0 48.0	B B
	49.0	2.61	3.3	0.21	47.7	B
	52.9	2.85	0	0	47.1	В
25	4.8	0.69	77.6	13.6	17.6	A+B
	6.2	0.73	72.1	10.2	21.7	в
	8.1	0.86	68.0	8.77	23.9	В
	9.1 10.0	0.93 0.984	66.0 64.2	8.17 7.67	24.9 25.2	B 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	В
	15.0	1.24	54.3	5.45	30.7	В
	18.7	1.48	49.2	4.72	32.1	B
	19.3	1.48	47.7	4.45	33.0	В
	25.7 29.6	1.81 2.08	38.2 34.2	3.26 2.91	36.1 36.2	B 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	В
	39.1	2.51	21.3	1.66	39.6	В
	41.2	2.56	17.9	1.35	40.9	В
	43.2	2.65	15.4	1.15	41.4	В
	44.0 47.2	2.68 2.82	14.4	1.07	41.6	В
	4/.2 50.8	2.82	10.3 5.7	0.747 0.40	42.5 43.5	B B
	55.9	3.22	0	0	43.5	B
awalai	ities calo	ulated by th	e compilara			
_		= $Hg(NO_3)_2$ .			6Н_О-	
		<pre>% does not</pre>			<u>2</u>	
		ADDITIONAL		• • • • • • •		
corresp	onds to so	ation contai lutions in e o strong hyd	quilibrium	with uranyl	ly the bran nitrate he	ch which xahydrate

,

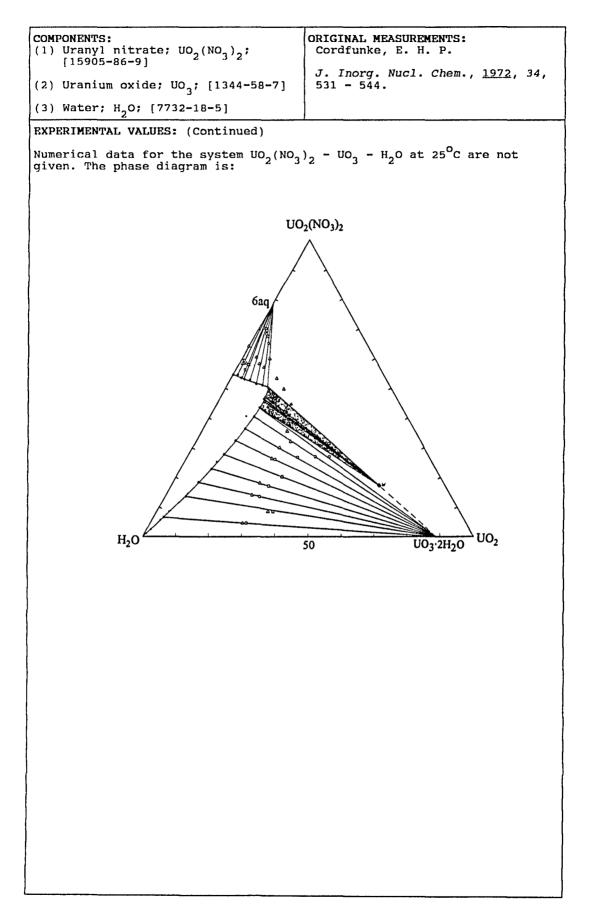
COMPONENTS:	ORIGINAL MEASUREMENTS:
<ol> <li>Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9]</li> <li>Uranyl oxalate; UO<sub>2</sub>C<sub>2</sub>O<sub>4</sub>; [2031-89-2]</li> <li>Water; H<sub>2</sub>O; [7732-18-5]</li> </ol>	Bol'shakov, K. A.; Korovin, S. S. Zh. Neorg. Khim., <u>1957</u> , 2, 1940 - 1950. Russ. J. Inorg. Chem., <u>1957</u> , 2, 365. (Eng. trans.)
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski

EXPERIMENTAL VALUES:

The  $UO_2(NO_3)_2 - UO_2C_2O_4 - H_2O$  System at 25°C Composition of Saturated Solutions<sup>a</sup>

UO <sub>2</sub> (N	10 <sub>3</sub> ) <sub>2</sub>	UO2C	2 <sup>0</sup> 4	н <sub>2</sub> 0	Solid Phase <sup>b</sup>	
mass %	mol/kg	mass %	mol/kg	mass %	r nabe	
0	0	0.58	0.016	99.42	Α	
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 47.97	A	
51.78	2.745	0.35	0.020	47.97	A	
55.50	3.187	0.31	0.020	44.19	A+B	
55.85	3.229	0.26	0.017	43.89	В	
56.00	3.239	0.12	0.0076	43.88	в	
56.23	3.260	0	0	43.77	В	
1	ies calculat					
Solid p	hases: A = U	0 <sub>2</sub> C <sub>2</sub> 0 <sub>4</sub> .3H <sub>2</sub> 0	; $B = UO_2(NO)$	3 <sup>)</sup> 2 <sup>.6H</sup> 2 <sup>O</sup> .		
<sup>C</sup> The sum	of mass % i	s equal to	100.1 (compi	lers).		
Source paper h	COMMENTS AND/OR ADDITIONAL DATA Source paper has a phase diagram. Solution $M_{2}(NO_{3})_{2}$ .			e of uranyl	oxalate has	
		AUXILIARY I	NFORMATION			
METHOD/APPARAT	US/PROCEDURE	:	SOURCE AND PURITY OF MATERIALS:			
Appropriate am	he isothermal method was used. ppropriate amounts of uranyl nitrate nd uranyl oxalate were shaken for 3			No information given.		
to 4 days with	water in a	vessel	ESTIMATED ERROR:			
formation of b	rotected from light to prevent the ormation of basic uranium(IV) xalate. Uranium and oxalate were easured by potentiometric titration.			Solubility: Nothing specified.		
measured by po				: Nothing sp	ecified.	
Nitrates were Kjeldahl metho procedure are	d. Details o	f the		v,K. A.; Kor v, V. E.; Er		
			Zh. Neorg.	Khim., <u>1954</u>	, 2, 222.	

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	ORIGINAL MEASUREMENTS: Cordfunke, E. H. P.
(2) Uranium oxide; UO <sub>3</sub> ; [1344-58-7]	J. Inorg. Nucl. Chem., <u>1972</u> , 34, 531 - 544.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
Numerical data for the system UO <sub>2</sub> (NO <sub>3</sub> given. The phase diagram is given on <sup>3</sup>	), - UO <sub>3</sub> - H <sub>2</sub> O at 25 <sup>0</sup> C are not the next page.
COMMENTS AND/OR ADDITIONAL DATA The results are given in the phase di been found with the corresponding so Within the solubility region of UO <sub>3</sub> . a basic salt (w, on the phase diagran tion times. This is gradually conver- nitrate hexahydrate and $\alpha$ -UO <sub>3</sub> .H <sub>2</sub> O, an resembles UO <sub>2</sub> .2H <sub>2</sub> O, but still has a	iagram. Two solubility regions have lids UO.2H.O and UO.(NO.).6H.O. 2H.O, a small region <sup>2</sup> exists in <sup>2</sup> which m) <sup>2</sup> is formed after short equilibra- ted into the mixture of uranyl nd a new phase which closely
AUXILIARY II	NFORMATION
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 <sub>2</sub> O <sub>8</sub> , nitrate as NH <sub>3</sub> 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	<pre>was purified by recrystallizing several times and drying over H<sub>2</sub>SO<sub>4</sub> to constant composition. 2. UO, was obtained by ignition of hydrated UO<sub>2</sub>.2H<sub>2</sub>O at 425 C. ESTIMATED ERROR: Nothing specified.</pre>
solution.	J.J.Katz and E. Rabinowitch, The Chemistry of Uranium, McGraw - Hill, New York, <u>1951</u> , 329.



COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Efimova, V. S.; Gromov, B. V.
(2) Uranium oxide; UO <sub>3</sub> ; [1344-58-7]	At. Energ., <u>1973</u> , 35, 57 - 59.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition and temperature	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	L
The UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> - UO <sub>3</sub> - H <sub>2</sub> O System at 2 form of a phase diagram. The phase di Lacher (1) and Cordfunke (2).	0°C and at 95°C is given in the agram also includes data from
COMMENTS AND/OR ADDITIONAL DATA: Two solid phases exist: $A = UO_{3.2H_{2}O}$ $B = 6.1 UO_{3.0.5N_{2}O_{5.25H_{2}O} (UO_{3}^{3} = 64.2)$ mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions	exist mostly as dimers, and at
Two solid phases exist: $A = UO_{3.2H_{2}O}$ B = 6.1 UO_{3.0.5N_{2}O_{5.25H_{2}O} (UO <sub>3</sub> = 64.2 mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions	exist mostly as tetramers.
Two solid phases exist: $A = UO_{3.2H_{2}O}$ B = 6.1 UO0.5N_O_5.25H_O (UO_3 = 64.2 mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions AUXILLARY I	exist mostly as tetramers.
Two solid phases exist: $A = UO_{3.2H_2O}$ B = 6.1 $UO_{3.0.5N_2O_5.25H_2O}$ ( $UO_{3} = 64.2$ mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions	NFORMATION
Two solid phases exist: A = UO <sub>3</sub> .2H <sub>2</sub> O B = 6.1 UO <sub>2</sub> .0.5N <sub>2</sub> O <sub>5</sub> .25H <sub>2</sub> O (UO <sub>3</sub> = 64.2 mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The solutions of uranyl nitrate and of uranium oxide were contained in	exist mostly as dimers, and at exist mostly as tetramers.
Two solid phases exist: A = UO <sub>3</sub> .2H <sub>2</sub> O B = 6.1 UO <sub>3</sub> .0.5N <sub>2</sub> O <sub>5</sub> .25H <sub>2</sub> O (UO <sub>3</sub> <sup>-</sup> = 64.2 mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions MUXILIARY I METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The solutions of uranyl nitrate and of	NFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> prepared as in (3). 2. UO <sub>3</sub> prepared as in (3).
Two solid phases exist: A = UO <sub>3</sub> .2H <sub>2</sub> O B = 6.1 UO <sub>3</sub> .0.5N <sub>2</sub> O <sub>5</sub> .25H <sub>2</sub> O (UO <sub>3</sub> = 64.2 mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions MUXILIARY I METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The solutions of uranyl nitrate and of uranium oxide were contained in closed vessels at 20°C, and with occasional shaking for a period of 1-1/2 years (equilibrium was attained after 8 months). Data for the system at 95°C were obtained after 9 to 10	NFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> prepared as in (3). 2. UO <sub>3</sub> prepared as in (3).
Two solid phases exist: A = UO <sub>3</sub> .2H <sub>2</sub> O B = 6.1 UO <sub>3</sub> .0.5N <sub>2</sub> O <sub>5</sub> .25H <sub>2</sub> O (UO <sub>3</sub> = 64.2 mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions equilibrium with phase B, uranyl ions MUXILIARY I METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The solutions of uranyl nitrate and of uranium oxide were contained in closed vessels at 20°C, and with occasional shaking for a period of 1-1/2 years (equilibrium was attained after 8 months). Data for the system at 95°C were obtained after 9 to 10 hours. The solid phase composition was determined by Schreinemakers (4) method. Uranium was measured by a gravimetric method. Nitrate ions were	EXIST MOSTLY as dimers, and at exist mostly as tetramers. NFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> prepared as in (3). 2. UO <sub>3</sub> prepared as in (3). ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Lacher, J.
Two solid phases exist: A = UO <sub>3</sub> .2H <sub>2</sub> O B = 6.1 UO <sub>2</sub> .0.5N <sub>2</sub> O <sub>5</sub> .25H <sub>2</sub> O (UO <sub>3</sub> = 64.2 mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions method/APPARATUS/PROCEDURE: The isothermal method was used. The solutions of uranyl nitrate and of uranium oxide were contained in closed vessels at 20°C, and with occasional shaking for a period of 1-1/2 years (equilibrium was attained after 8 months). Data for the system at 95°C were obtained after 9 to 10 hours. The solid phase composition was determined by Schreinemakers (4) method. Uranium was measured by a	EXIST MOSTLY as dimers, and at exist mostly as tetramers. NFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> prepared as in (3). 2. UO <sub>3</sub> prepared as in (3). ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Lacher, J.
Two solid phases exist: A = UO <sub>3</sub> .2H <sub>2</sub> O B = 6.1 UO <sub>3</sub> .0.5N <sub>2</sub> O <sub>5</sub> .25H <sub>2</sub> O (UO <sub>3</sub> = 64.2 mass %). It was found that solid phas duration of the experiment (1.5 y), b hours. Data on the analysis of aqueou equilibrium with phase A, uranyl ions equilibrium with phase B, uranyl ions equilibrium with phase B, uranyl ions MUXILIARY I METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The solutions of uranyl nitrate and of uranium oxide were contained in closed vessels at 20°C, and with occasional shaking for a period of 1-1/2 years (equilibrium was attained after 8 months). Data for the system at 95°C were obtained after 9 to 10 hours. The solid phase composition was determined by Schreinemakers (4) method. Uranium was measured by a gravimetric method. Nitrate ions were determined by the reverse titration	EXIST MOSTLY as dimers, and at exist mostly as tetramers. NFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> prepared as in (3). 2. UO <sub>3</sub> prepared as in (3). 2. UO <sub>3</sub> prepared as in (3). ESTIMATED ERROR: Nothing specified. REFERENCES: 1. Lacher, J. Inorg. Chem., <u>1962</u> , 1, 4. 2. Cordfunke, E. J. J. Inorg. Nucl. Chem., <u>1972</u> , 34

				ODTOTIVIT W			
COMPONE				ORIGINAL MEASUREMENTS:			
(1) Ura [15	nyl nitrat( 905-86-9]	e; UO <sub>2</sub> (NO <sub>3</sub>	) <sub>2</sub> ;	Harmon, M. K.; Cooper, V. R.			
(2) Amm [64	onium nitra 84-52-2]	ate; NH <sub>4</sub> NO	3'	Report, <u>1948</u> , HW-10137.			
(3) Nit	(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]						
(4) Water; H <sub>2</sub> O; [7732-18-5]							
VARIABL	ES:		,,, <sup>1996</sup>	PREPARED BY	· ·		
Composi	tion and to	emperature		A. Sozansk	i; S. Sie	kierski	L
EXPERIM	ENTAL VALU	es:					
	The	e UO <sub>2</sub> (NO <sub>3</sub> )	$_2$ - NH <sub>4</sub> NO <sub>3</sub>	$-HNO_3 - H_2$	0 System		
				urated Solut			
	density	UNH <sup>C</sup>	UO2 (NO3)2	NH4	N0 <sub>3</sub>	HN	10 <sub>3</sub>
t∕°c	g/cm <sup>3</sup>		z 3'z mol/kg		mol/kg	g/dm <sup>3</sup>	mol/kg
$\begin{array}{c} -19.3 \\ -18.9 \\ -17.9 \\ -17.2 \\ -16.6 \\ -16.2 \\ -15.9 \\ -15.4 \\ -15.0 \\ -14.9 \\ -13.9 \\ -13.9 \\ -13.3 \\ -13.1 \\ -11.1 \\ -7.9 \\ 6.7 \\ 13.3 \\ -19.7 \\ -19.2 \\ -18.3 \end{array}$	1.4133 1.4037 1.4367 1.3304 1.4808 1.5026 1.2927 1.5052 1.5536 1.2637 1.5921 1.6062 1.2019 1.6260 1.1196 1.6618 1.7590 1.8066 1.3559 1.3840 1.3251	33.1 29.8 35.6 25.3 38.2 40.7 21.4 41.0 43.7 17.6 47.5 48.5 10.9 50.3 0.0 52.7 59.4 61.7 26.8 28.6 23.6	1.28 1.11 1.41 0.895 1.59 1.74 0.728 1.75 1.91 0.577 2.21 2.30 0.335 2.45 0.0 2.70 3.39 3.53 0.984 1.08 0.840	318.0 326.1 315.6 315.3 329.0 323.06 318.6 318.3 314.5 322.0 317.3 320.3 320.9 318.1 317.1 327.0 326.5 319.6 319.8 327.4 321.0 (Con	5.438 5.474 5.250 5.809 5.764 5.259 5.663 5.564 5.243 5.821 5.938 5.151 5.970 4.937 6.316 6.656	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.4189
}		λ	UXILIARY IN				
METHOD				1		MATEDT	AT.S.
METHOD/APPARATUS/PROCEDURE: The synthetic method was used. Freezing points for the solutions were established in an apparatus consisting of a round bottom tube				SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR:			
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			Solubility: Temperature	the aver more rep	age of licates	four or	
with the	e aid of a	Spencer m	icro-lamp.	REFERENCES:			

COMPONEN	ITS:		0	RIGINAL MEA	SUREMENT	s:	
(1) Uran	nyl nitrate 905-86-9]	; UO <sub>2</sub> (NO <sub>3</sub>	) <sub>2</sub> ;	Harmon, M.	K.; Coop	er, V. R	•
			· · · · · · · · · · · · · · · · · · ·	Report, <u>194</u>	<u>8</u> , HW-10	137.	
(2) Ammo [648	nium nitra 14-52-2]	te; NH4NO	3'	• • • • • • • • • • • • • • • • • • • •			
(3) Nitr	ic acid; H	INO <sub>3</sub> ; [769	7-37-2]				
(4) Wate	(4) Water; H <sub>2</sub> O; [7732-18-5]						
EXPERIME	NTAL VALUE	S: (Conti	nued)				
			- NH <sub>4</sub> NO <sub>3</sub> - Н				
	c	Compositio	n of Saturat	ed Solution	s <sup>a,b</sup>		-
	density	UNHC	$UO_2(NO_3)_2$	<sup>NH</sup> 4		HN	
t∕°c	g/cm <sup>3</sup>	mass %	mol/kg	g/dm <sup>3</sup>	mol/kg	g/dm <sup>3</sup>	mol/kg
-17.5	1.2971	20.4	0.701	320.1			
-16.4	1.4383	33.5	1.36	335.4	5.21	16.91	
-15.3	1.4806 1.2387	37.6 13.8	1.57	318.6 321.85	5.639 5.2623		
-14.7	1.5148	40.0	0.444 1.76	332.9	6.072		
-14.7	1.2150	10.3	0.319	319.7	5.122		
-13.6	1.5423	42.1	1.86	321.2	5.782		
-12.8	1.5767	45.5	2.14	326.7	6.103		0.4364
-12.3	1.6177	58.2	2.33	316.9	5.943		
-12.2	1.1282	0.0	0.0	323.4	5.125		
-12.0	1.6140	48.4	2.36	320.4	6.064		
- 8.3	1.6246	48.9	2.39	321.3	6.068		
- 4.4 1.6	1.6632 1.6896	51.5 53.6	2.61 2.83	319.8 321.2	6.115 6.287		
15.5	1.8586	59.8	3.41	319.2	6.153	19.6	
-20.0	1.2787 1.3259	16.3 21.0	0.566	322.9	5.495	58.01	
-19.3	1.2544	12.7	0.762 0.432	319.2 335.0	5.473 5.697	59.32 59.75	
-19.1	1.3293	21.2	0.789	338.0	5.946	60.5	
-16.7	1.1941	0.3	0.007	319.2	4.906		
-16.7	1.4398	31.6	1.29	318.1	5.644	60.46	1.363
-15.7	1.4406	32.2	1.33	321.5	5.785		
-15.0	1.1486	0.0	0.0	319.2	5.168		
-14.4	1.4776	33.0	1.37	326.6	5.762		1.349
-13.5 -13.5	1.4817 1.5234	35.4 38.5	1.53 1.73	327.1 320.87	5.994 5.9296		
- 8.1	1.5234	44.3	2.14	317.1	6.021	62.08	1.497
6.7	1.7032	52.8	2.88	319.9	6.427	56.32	1.437
-18.9	1.2061	0.0	0.0	320.3	5.641	176.4	3.946
-17.8	1.2509	6.3	0.22	320.4	5.687	165.3	3.727
-16.7 -14.4	1.2510	12.8	0.504	319.8	6.342		
-14.4	1.3550 1.4289	18.2 25.1	0.731 1.10	321.0 321.3	5.959 6.182		3.945
- 4.5	1.5439	35.2	1.78	323.62		185.51	
0.3	1.5878	39.6	2.08	319.6	6.618		4.501
13.9	1.7439	51.6	3.26	318.1	7.235		4.917
a <sub>Mo</sub>	lalities c	alculated	by the comp	ilers.			
b <sub>Na</sub>	ture of th	e equilib	rium solid pl	hases not s	pecified	•	
_	$H = UO_2(NC)$						
COM	IMENTS AND	OR ADDITI	ONAL DATA:				
oth tak	er cases r en as the	temperatu	g" was neces oling occurr re of incipi he path of th	ed, so that ent crystal	the free lization	ezing po	int was

		ORIGINAL 1	MEASUREMENTS:	:	
ltrate; UO <sub>2</sub> ( 5-9]	NO <sub>3</sub> ) <sub>2</sub> ;	Kurnakova	Kurnakova, A. G.; Nikolaev, A. V.		
nitrate; NH -2]	4 <sup>NO</sup> 3;	Zh. Neorg. Khim., <u>1958</u> , 3, 1028 - 1036.			
id; HNO <sub>3</sub> ; [	7697-37-2]	Russ. J. Inorg. Chem., <u>1958</u> , 3, 298. (Eng. trans.)			
2 <b>0; [7732-1</b> 8	-5]				
		PREPARED I	BY:		
at 298 K		L. Fuks;	S. Siekiers	:i	
VALUES:		- <u>-</u>	· · · · · · · · · · · · · · · · · · ·		
ie UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	- NH <sub>4</sub> NO <sub>3</sub> - H	ию <sub>3</sub> – н <sub>2</sub> о я	System at 25 <sup>0</sup>	°c	
NH4	NO3	00 נאס	$(23)_{2}^{2}$	0.111	
mass %	mol/kg	mass %	mol/kg	Solid Phase <sup>b</sup>	
				A	
51.09	6.38	13.88	0.35	À	
43.50	5.43	25.36	0.64	A	
40.46	5.05	28.84	0.73	A	
38.73	4.84	30.58	0.78	A+B	
35.80	4.47	36.09	0.92	В	
				В	
				B B	
		51.19	1.30	B+C	
		49.50	1.26	C	
10.00	1.J2 	48.79	1.21	C C	
	hieu in 1 EN				
			<sup>14</sup> 4 <sup>NO</sup> 3.2H <sub>2</sub> O,		
C =	UO2(NO3)2.6H2	0.			
	AUXILIARY	INFORMATION:	Nothing spe	cified.	
ty and spec ated soluti t 25 C:	ific gravity ons for the	50	,		
2 <sup>-NH</sup> 4 <sup>NO</sup> 3 <sup>-HN</sup>	о <sub>3</sub> -н <sub>2</sub> о	% ss		2.0	
°3•		/max		$\langle \langle \cdot \rangle$	
	2 <sup>.2H</sup> 2 <sup>0</sup> .	ຼິ <b>25</b> -	a grade a		
103)2.6H20.		Ê, [		> -1.5	
'dm <sup>3</sup> HNO <sub>3</sub> .		2 5	•	3	
		JL		\ 1	
		0	25	<u>50</u> 1.1	
	$\begin{array}{c} \text{nitrate; NH} \\ \text{-2]} \\ \text{nitrate; NH} \\ \text{-2]} \\ \text{sid; HNO_3; [} \\ \text{o; [7732-18]} \\ o; [$	nitrate; $NH_4NO_3$ ; -2] bid; $HNO_3$ ; $[7697-37-2]$ at 298 K VALUES: De $UO_2(NO_3)_2 - NH_4NO_3 - H$ Composition of Sat $\frac{NH_4NO_3}{mass \ mol/kg}$ 61.09 7.63 51.09 6.38 43.50 5.43 40.46 5.05 38.73 4.84 35.80 4.47 23.25 2.90 21.56 2.70 20.36 2.54 19.83 2.48 16.68 2.08 10.60 1.32  D_3 concentration is 1.5N. bhases: $A = NH_4NO_3$ , $B = U$ $C = UO_2(NO_3)_2$ .6H <sub>2</sub> AUXILIARY J ty and specific gravity rated solutions for the t 25°C: $2^{-NH_4NO_3-HNO_3-H_2O}$ D <sub>3</sub> . $IO_3.UO_2(NO_3)_2.2H_2O.$ $IO_3)_2.6H_2O.$	$\frac{1}{3} + 29 + 100 + 1$	Kurnakova, A. G.; NIA nitrate; $NH_4NO_3$ ; 2] Sid; $HNO_3$ ; $[7697-37-2]$ [0; [7732-18-5] NUMUES: The UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> - $NH_4NO_3$ - $HNO_3$ - $H_2O$ System at 25 <sup>C</sup> Composition of Saturated Solutions <sup>a</sup> NH <sub>4</sub> NO <sub>3</sub> $MH_4NO_3$ $IO_2(NO_3)_2$ - $NH_4NO_3$ - $HNO_3$ - $H_2O$ System at 25 <sup>C</sup> Composition of Saturated Solutions <sup>a</sup> $NH_4NO_3$ $IO_2(NO_3)_2$ Mass % mol/kg G1.09 7.63 $IO_2(NO_3)_2$ mass % mol/kg G1.09 7.63 $IO_2(NO_3)_2$ mass % mol/kg $IO_2(NO_3)_2$ $IO_2(NO_3)_2$ $IO_2(NO_3)_2$ $IO_3 + 100 + 1$	

\*

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ſ <del></del>						
COMPONENTS:		ORIG	INAL MEASURE	EMENTS:		
(1) Uranyl nitrate [15905-86-9]	e; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Chri	stensen, H.1	h.; Holmb	erg, K.E.	
(2) Cesium nitrate; CsNO <sub>3</sub> ; [7789-18-6]			kleonik, <u>196</u>	<u>8, 11,</u> 16	5 - 170.	
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]						
(4) Water; H <sub>2</sub> O; [7	732-18-5]					
VARIABLES:		PREP	ARED BY:			
Composition at 298	3 K	Α.	Sozanski; S.	Siekiers	ki	
EXPERIMENTAL VALUE	CS :					
The UC	$(NO_3)_2 - CSNO_3 -$	• нио <sub>з</sub> -	H <sub>2</sub> O System	at 25 <sup>0</sup> C		
	Composition of S	Saturate	d Solutions <sup>a</sup>	L		
U02(N03)5	CsNC	) <sub>3</sub>	HN	10 <sub>3</sub>	Solid Phase	
mol % mol/k	g mol %	mol/kg	mol %	mol/kg	FIIASE	
1.113         0.683           0.577         0.363           0.227         0.152           0.201         0.138           0.192         0.136	1.113       0.6837       0.483       0         0.577       0.363       0.539       0         0.227       0.152       0.752       0         0.201       0.138       0.874       0		8.04 10.70 16.06 18.27 20.70	4.94 6.735 10.75	A+B A+B A+B A+B A+B A+B	
					M., N. &	
	AUXILIARY					
METHOD/APPARATUS/F	PROCEDURE:	SOUR	SOURCE AND PURITY OF MATERIALS:			
A 20 mL portion of investigated was p cryostat with stin After 2 to 3 hours separated by centr 2000 g). Nitric ac	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			Water was purified on ion exchange resins, and twice distilled from quartz.		
were measured by p titration (1,2), o	esium by polaro-	ESTI	ESTIMATED ERROR:			
	graphic analysis, after separation of uranium by anion exchange resin.			Solubility: Nothing specified.		
				Temperature: Precision $\pm 0.02$ to 0.04 K.		
		REFE	RENCES:			
		A	hrland, S. cta Chem. Sc 035.	and., <u>196</u>	<u>0</u> , 14,	
			otojima, K.; nal. Chem.,			

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Kurnakova, A. G.; Nikolaev, A. V.
<pre>(2) Magnesium nitrate; Mg(NO3); [10377-60-3];</pre>	Zh. Neorg. Khim., <u>1958</u> , 3, 1028 - 1036.
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Russ. J. Inorg. Chem., <u>1958</u> , 3, 298. (Eng. trans.)
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 298 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
	- HNO <sub>3</sub> - H <sub>2</sub> O System at 25 <sup>o</sup> C
Composition of Sat	turated Solutions <sup>a</sup>
Density Mg(NO <sub>3</sub> ) <sub>2</sub>	UO2(NO3)2 Solid Phase
g/cm <sup>3</sup> mass %	mass %
1.409 38.94	A
1.415 35.74	4.18 A
1.448 34.34	8.21 A 12.12 A
1.485 33.00 1.527 30.19	12.12 A 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 1.538 22.20	21.39 B 21.85 B
1.538 22.20	23.14 B
1.535 20.58	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
a. 1.684	48.79 B
<sup>a</sup> Nitric acid concentration, 1.5	
<sup>b</sup> Solid phases: A = Mg(NO <sub>3</sub> ) <sub>2</sub> .6H	
AUXILIARY	INFORMATION: Nothing specified.
Colubility and apositic security	sp grav
of the sustained	40 Mg(NO <sub>3</sub> ) <sub>2</sub> -6H <sub>2</sub> O 1.7
Mg(NO <sub>3</sub> ) <sub>2</sub> -UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> -HNO <sub>3</sub> -H <sub>2</sub> O	
	20 1.5
Mg(NO <sub>3</sub> ) <sub>2</sub> -UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> -HNO <sub>3</sub> -H <sub>2</sub> O 1.5 mol/dm <sup>3</sup> HNO <sub>3</sub> .	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ·6H <sub>2</sub> O
Ŭ Ž	
	$0 \frac{1}{20} \frac{1}{40} \frac{1}{60} 1.3$
	40 00
	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> /mass %

В

в

в

В

0.74

0.86

0.98

0.99

COMPONENTS:			ORIGINAL MEAS	SUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]			Kurnakova, A	A. G.; Niko	laev, A. V.
(2) Calcium nitrate; Ca(NO <sub>3</sub> ) <sub>2</sub> ; [10124-37-5]			Zh. Neorg. H	Khim., <u>1958</u>	, 3, 1028 - 1036.
(3) Nitric acid	l; HNO <sub>2</sub> ; [76	97-37-2]	Russ. J. Ind	org. Chem.,	<u>1958</u> , 3,
(4) Water; H <sub>2</sub> 0;			298. (Eng. t	crans.)	
VARIABLES:			PREPARED BY:		
Composition at 298 K			L. Fuks; S.	Siekierski	
EXPERIMENTAL VA	LUES:		.1		
The L			HNO <sub>3</sub> - H <sub>2</sub> O Sys turated Solutio	-	c <sup>a</sup>
Density	Ca(	NO3)2	U02(N03)		Solid
g/cm <sup>3</sup>		mol/kg	mass %		Phase
1.508	48.72	2.97	<u> </u>	 0.15	A
1.551	45.36 41.68	2.76 2.54	10.18	0.15	A A
1.590	40.80	2.49	10.35	0.27	Ä
1.604	40.08	2.44	10.69	0.27	A+B
1.604	40.29	2.46	11.28	0.27	В
	38.94				В
1.578	32.58	2.19		0.43	В
1.584	25.87	1.58	22.01	0.56	B

33.92 38.72 39.35 48.79 1.684 \_\_\_\_ \_\_\_\_ 1.24 в <sup>a</sup>HNO<sub>3</sub> concentration 1.5N. <sup>b</sup>Molalities calculated by compilers. <sup>C</sup>Solid phases:  $A = Ca(NO_3)_2.6H_2O$ ,  $B = UO_2(NO_3)_2.6H_2O$ .

29.05

1.11

0.82

0.50

0.41

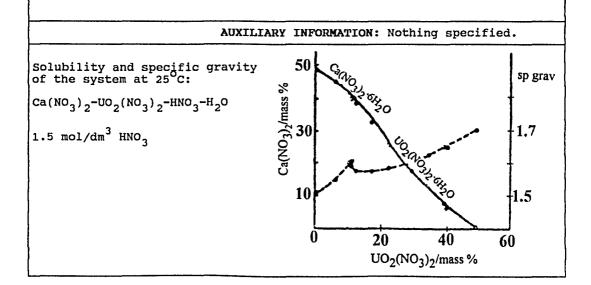
18.18

13.42 8.15 6.80

1.604

1.626

1.650

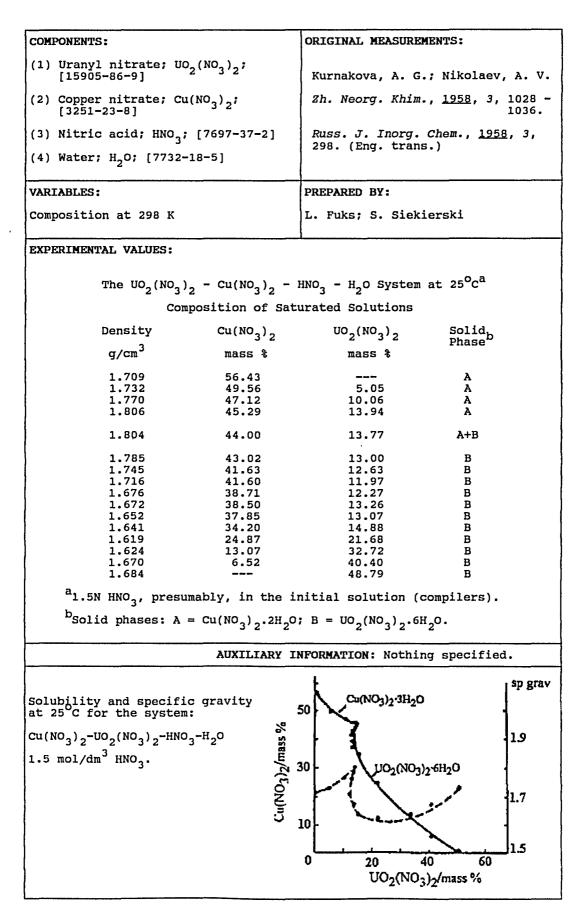


COMPONENTS	5:			ORIGINAL M	EASUREMENTS	5:
(1) Urany: [15905	1 nitrate; 1 5-86-9]	UO2(NO3)2;		Christensen, H. Th.;Holmberg, K. E.		
(2) Strontium nitrate; Sr(NO <sub>3</sub> ) <sub>2</sub> ; [10042-76-9]			Nukleonik, <u>1968</u> , 11, 165 - 170.			
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]						
(4) Water;	; H <sub>2</sub> 0; [773	2-18-5]		)		
VARIABLES	•			PREPARED E	Y:	
Compositio	on at 298 K			A. Sozansk	i; S. Sieki	erski
EXPERIMENT	FAL VALUES:	<u></u>		1		
	The UO <sub>2</sub> (NO	$_{3})_{2} - sr(NC)$	0 <sub>3</sub> ) <sub>2</sub> - 1	нио <sub>3</sub> - н <sub>2</sub> о	System at 2	:5 <sup>0</sup> c <sup>a</sup>
UO <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub>	Sr()	<sup>NO</sup> 3 <sup>)</sup> 2		hno <sub>3</sub>	Solid
mol %	mol/kg	mol %	mol/k	g mol	<pre>% mol/kg</pre>	
0.156 0.105 0.0856 0.05			4 9.0	5 5.58	A+B	
0.167 0.156 0.144 <sup>a</sup> Molaliti	0.111 0.105 0.100 ies calculat	0.142 0.0856 0.0448 ted by the	0.094 0.05 0.03 compile	41 15.9 78 17.5 13 20.3	6 10.6 7 11.9 0 14.2	A+B A+B A+B A+B
0.167 0.156 0.144 <sup>a</sup> Molaliti	0.111 0.105 0.100	0.142 0.0856 0.0448 ted by the U0 <sub>2</sub> (N0 <sub>3</sub> ) <sub>2</sub> .6	0.094 0.05 0.03 compile	41 15.9 78 17.5 13 20.3 ers. = Sr(NO <sub>3</sub> ) <sub>2</sub>	6 10.6 7 11.9 0 14.2	A+B A+B
0.167 0.156 0.144 <sup>a</sup> Molaliti <sup>b</sup> Solid ph	0.111 0.105 0.100 ies calculat nases: A = 1	0.142 0.0856 0.0448 ted by the UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6	0.094 0.05 0.03 compile	41 15.9 78 17.5 13 20.3 ers. = Sr(NO <sub>3</sub> ) <sub>2</sub> NFORMATION	6 10.6 7 11.9 0 14.2	A+B A+B A+B
0.167 0.156 0.144 <sup>a</sup> Molaliti <sup>b</sup> Solid pr	0.111 0.105 0.100 ies calculat nases: A = 1 PARATUS/PROC	0.142 0.0856 0.0448 ted by the UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .0 AUXII CEDURE:	0.094 0.05 0.03 compile 5H <sub>2</sub> O, B	41 15.9 78 17.5 13 20.3 ers. = Sr(NO <sub>3</sub> ) <sub>2</sub> NFORMATION SOURCE AND	6 10.6 7 11.9 0 14.2	A+B A+B A+B MATERIALS:
0.167 0.156 0.144 <sup>a</sup> Molaliti <sup>b</sup> Solid ph METHOD/APH The isothe 20 mL port investigat	0.111 0.105 0.100 ies calculat nases: A = 0 PARATUS/PROC ermal method tion of the ted was place	0.142 0.0856 0.0448 ted by the UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6 AUXII CEDURE: d was used. solution h ced in an u	0.094 0.05 0.03 compile 5H <sub>2</sub> O, B LIARY II	41 15.9 78 17.5 13 20.3 ers. = $Sr(NO_3)_2$ NFORMATION SOURCE AND The UO <sub>2</sub> (NO	6 10.6 7 11.9 0 14.2	A+B A+B A+B MATERIALS: Sr(NO <sub>3</sub> ) <sub>2</sub> and
0.167 0.156 0.144 <sup>a</sup> Molaliti <sup>b</sup> Solid ph METHOD/APH The isothe 20 mL port investigat cryostat, 2 to 3 hou	0.111 0.105 0.100 ies calculat nases: A = 0 PARATUS/PROC ermal method tion of the	0.142 0.0856 0.0448 ted by the UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6 AUXII CEDURE: d was used. solution h ced in an u d cooled. <i>J</i> Is were sep	0.094 0.05 0.03 compile 5H <sub>2</sub> O, B LIARY II LIARY II LIARY II	41 15.9 78 17.5 13 20.3 ers. = $Sr(NO_3)_2$ NFORMATION SOURCE AND The UO <sub>2</sub> (NO HNO <sub>3</sub> were	6 10.6 7 11.9 0 14.2	A+B A+B A+B MATERIALS: Sr(NO <sub>3</sub> ) <sub>2</sub> and
0.167 0.156 0.144 <sup>a</sup> Molaliti <sup>b</sup> Solid pr METHOD/APH The isothe 20 mL port investigat cryostat, 2 to 3 hou by centrid g). Nitric	0.111 0.105 0.100 ies calculat nases: A = 1 PARATUS/PROC ermal method tion of the ted was plac stirred and urs, crysta	0.142 0.0856 0.0448 ted by the UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6 AUXII CEDURE: d was used solution h ced in an u d cooled. A ls were sep minutes af uranium wer	0.094 0.05 0.03 compile 5H <sub>2</sub> O, B LIARY II LIARY II LIARY II After parated t 2000	41 15.9 78 17.5 13 20.3 ers. = $Sr(NO_3)_2$ NFORMATION SOURCE AND The $UO_2(NO_1)_2$ HNO <sub>3</sub> were ESTIMATED	6 10.6 7 11.9 0 14.2	A+B A+B A+B MATERIALS: Sr(NO <sub>3</sub> ) <sub>2</sub> and le.
0.167 0.156 0.144 <sup>a</sup> Molaliti <sup>b</sup> Solid pr METHOD/APH The isothe 20 mL port investigat cryostat, 2 to 3 hou by centrid g). Nitric	0.111 0.105 0.100 ies calculat hases: A = 1 PARATUS/PROC ermal method tion of the ted was plac stirred and urs, crysta fugation (4 c acid and u d by potent	0.142 0.0856 0.0448 ted by the UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6 AUXII CEDURE: d was used solution h ced in an u d cooled. A ls were sep minutes af uranium wer	0.094 0.05 0.03 compile 5H <sub>2</sub> O, B LIARY II LIARY II LIARY II After parated t 2000	41 15.9 78 17.5 13 20.3 ers. = $Sr(NO_3)_2$ NFORMATION SOURCE AND The $UO_2(NO_1)$ HNO <sub>3</sub> were ESTIMATED Solubility	6 10.6 7 11.9 0 14.2 • • • • • • • • • • • • • • • • • • •	A+B A+B A+B A+B MATERIALS: $Sr(NO_3)_2$ and le. specified.
0.167 0.156 0.144 <sup>a</sup> Molaliti <sup>b</sup> Solid pr METHOD/APH The isothe 20 mL port investigat cryostat, 2 to 3 hou by centrid g). Nitric determined	0.111 0.105 0.100 ies calculat hases: A = 1 PARATUS/PROC ermal method tion of the ted was plac stirred and urs, crysta fugation (4 c acid and u d by potent	0.142 0.0856 0.0448 ted by the UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6 AUXII CEDURE: d was used solution h ced in an u d cooled. A ls were sep minutes af uranium wer	0.094 0.05 0.03 compile 5H <sub>2</sub> O, B LIARY II LIARY II LIARY II After parated t 2000	41 15.9 78 17.5 13 20.3 ers. = $Sr(NO_3)_2$ NFORMATION SOURCE AND The $UO_2(NO_1)$ HNO <sub>3</sub> were ESTIMATED Solubility	6 10.6 7 11.9 0 14.2 • • • • • • • • • • • • • • • • • • •	A+B A+B A+B A+B MATERIALS: $Sr(NO_3)_2$ and le. specified.
0.167 0.156 0.144 <sup>a</sup> Molaliti <sup>b</sup> Solid pr METHOD/APH The isothe 20 mL port investigat cryostat, 2 to 3 hou by centrid g). Nitric determined	0.111 0.105 0.100 ies calculat hases: A = 1 PARATUS/PROC ermal method tion of the ted was plac stirred and urs, crysta fugation (4 c acid and u d by potent	0.142 0.0856 0.0448 ted by the UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6 AUXII CEDURE: d was used solution h ced in an u d cooled. A ls were sep minutes af uranium wer	0.094 0.05 0.03 compile 5H <sub>2</sub> O, B LIARY II LIARY II LIARY II After parated t 2000	41 15.9 78 17.5 13 20.3 ers. = $Sr(NO_3)_2$ NFORMATION SOURCE AND The $UO_2(NO_1)$ HNO <sub>3</sub> were ESTIMATED Solubility Temperatur REFERENCES 1. Ahrland	6 10.6 7 11.9 0 14.2 • • • • • • • • • • • • • • • • • • •	A+B A+B A+B A+B MATERIALS: $Sr(NO_3)_2$ and le. specified. on $\pm 0.02$ to

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Christensen, H. Th.;Holmberg, K. E.		
[15905-86-9]	Nukleonik, <u>1968</u> , 11, 165 - 170.		
(2) Barium nitrate; Ba(NO <sub>3</sub> ) <sub>2</sub> ; [10022-31-8]	Maniconan, <u>2200</u> , 11, 100 2001		
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]			
(4) Water; H <sub>2</sub> O; [7732-18-5]			
VARIABLES:	PREPARED BY:		
One temperature: 298 K	A. Sozanski; S. Siekierski		
EXPERIMENTAL VALUES:			
The $UO_2(NO_3)_2 - Ba(NO_3)_2 - Ba(NO_3)_3 - Ba(NO_3)_3$	HNO <sub>3</sub> - H <sub>2</sub> O System at 25 <sup>0</sup> C <sup>a</sup>		
$UO_2(NO_3)_2$ Ba(NO <sub>3</sub> ) <sub>2</sub>	- Pnase		
mol % mol/kg mol % mol	/kg mol % mol/kg		
1.34         0.813         0.0051         0.0           0.75         0.46         0.0042         0.0           0.22         0.14         0.0035         0.0           0.16         0.11         0.0029         0.0	034       5.79       3.48       A+B         031       7.17       4.35       A+B         026       9.61       5.95       A+B         023       14.17       9.188       A+B         019       16.32       10.85       A+B         017       19.40       13.39       A+B		
<sup>b</sup> Solid phases: A = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub>	0, $B = Ba(NO_3)_2$ .		
AUXILIARY I	NFORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. A 20 mL portion of the solution being investigated was placed in an ultra- cryostat, stirred and cooled. After	"AR" UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> . $6H_2O$ , Ba(NO <sub>3</sub> ) <sub>2</sub> , HNO <sub>3</sub> . Ion exchanged water was distilled twice from a quartz apparatus.		
2 to 3 hours, crystals were separated by centrifuging (4 minutes, 2000 g).	ESTIMATED ERROR:		
Nitric acid and uranium were measured by potentiometric titration (1,2).	Solubility: Nothing specified.		
	Temperature: Precision ±0.02 to 0.04 K.		
	REFERENCES:		
,	<ol> <li>Ahrland, S. Acta Chem. Scand., <u>1960</u>, 14, 2035.</li> <li>Motojima, K.; Izawa, K. Anal. Chem., <u>1964</u>, 36, 733.</li> </ol>		

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COMPONENTS:		ORIGINAL MEASURE	MENTS:	
(1) Uranyl nitrate; UO	2 <sup>(NO</sup> 3)2;	Kurnakova, A. G.; Nikolaev, A. V.		
[15905-86-9] (2) Zinc nitrate; Zn(N( [7779-88-6]	D <sub>3</sub> ) <sub>2</sub> ;	Zh. Neorg. Khim., <u>1958</u> , 3, 1028 - 1036.		
		Dues T Trees		
(3) Nitric acid; HNO <sub>3</sub> ;		298. (Eng. tran	<i>Chem., <u>1958</u>, 3,</i> s.)	
(4) Water; H <sub>2</sub> O; [7732-:	18-5]			
VARIABLES:		PREPARED BY:		
Composition at 298 K		L. Fuks; S. Sie	kierski	
EXPERIMENTAL VALUES:		<u> </u>		
The UO <sub>2</sub> (NO <sub>3</sub> )	$_2$ - Zn(NO <sub>3</sub> ) <sub>2</sub> -	HNO <sub>3</sub> - H <sub>2</sub> O System	at 25°C <sup>a</sup>	
		urated Solutions		
Density	Zn(NO <sub>3</sub> ) <sub>2</sub>	002(N03)2	Solid	
g/cm <sup>3</sup>	mass %	mass *	Phase	
1.659	51.94	est 100 m	A	
1.717	48.81	6.87	A	
1.754 1.797	44.87 41.91	12.05 17.56	A	
1.810	41.23	18.44	A A	
1.738	38.50	16.35	A+B	
1.707	37.66	16.06	B	
1.670 1.637	36.47 34.56	15.36 17.15	B B	
1.596	27.49	19.74	B	
1.594	15.83	29.16	В	
1.661 1.684	4.02	45.56 48.79	B B	
		nitial solution ( , B = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .61		
	AUXILIARY I	NFORMATION: Nothin	ng specified.	
Solubility and specific at 25°C for the system:	gravity	Zn(NO <sub>3</sub> ) <sub>2</sub> ·6H <sub>2</sub> O	sp grav <b>20</b>	
Zn(NO <sub>3</sub> ) <sub>2</sub> -UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> -HNO <sub>3</sub>	-H <sub>2</sub> O %	* 7	U	
	X mas	n <u>x</u>	10	
1.5 mol/dm <sup>3</sup> HNO <sub>3</sub>	Zn(NO <sub>3</sub> )2/mass %	UO2(NO3	)2·6H2O	
		UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> /m	13 10 10 10 10 10 10 10 10 10 10 10 10 10	



COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Bol'shakov, K. A.; Korovin, S. S.			
(2) Uranyl oxalate; UO <sub>2</sub> C <sub>2</sub> O <sub>4</sub> ; [2031-89-2]	Zh. Neorg. Khim., <u>1957</u> , 2, 1940 - 1950.			
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2] (4) Water; H <sub>2</sub> O; [7732-18-5]	Russ. J. Inorg. Chem., <u>1957</u> , 2, 365. (Eng. trans.)			
VARIABLES:	PREPARED BY:			
Composition at 298 K	A. Sozanski; S. Siekierski			

## EXPERIMENTAL VALUES:

The  $UO_2(NO_3)_2 - UO_2C_2O_4 - HNO_3 - H_2O$  System at 25<sup>o</sup>C Composition of Saturated Solutions<sup>a</sup>

UO2(N	10 <sub>3</sub> ) <sub>2</sub>	00 <sub>2</sub> 0	2 <sup>0</sup> 4	HNC	3	Solid Phase <sup>b</sup>
mass %	mol/kg	mass %	mol/kg	mass %	mol/kg	rnase
		Se	ction I			
47.50	2.596	0	0	6.06	2.07	Α
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	В
28.31	1.062	0.46	0.019	3.55	0.832	в
21.21	0.6879	0.54	0.019			в
14.42	0.4305	0.57	0.019			в
7.58	0.209	0.53	0.016			В
		Se	ction 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	в
35.28	1.622	0.37	0.019	9.15	2.63	В
31.97	1.200	0.43	0.018			В
22.80	0.7541	0.47	0.017			в
14.90	0.4472	0.55	0.018			в
8.83	0.247	0.75	0.018			В

(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	Nothing specified.	
	case of Section I through Section III the ratio of uranyl nitrate to nitric	ESTIMATED ERROR:	
	acid was constant. In the case of Section IV, the concentration of	Nothing specified.	
	nitric acid was constant at about 22 mass %. The solutions and solid		
i	phases were shaken at constant temperature for 3 to 6 days. Uranium	REFERENCES:	
	and oxalate were measured by potentiometric titration with KMnO <sub>4</sub> , nitrate by Kjeldahl's method (1).	<ol> <li>Bol'shakov, K.A.;Korovin, S.S.; Plyushchev, V.E.;Ermakova, T.A. Zh. Neorg. Khim., <u>1954</u>, 2, 222.</li> </ol>	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Bol'shakov, K. A.; Korovin, S. S.
(2) Uranyl oxalate; UO <sub>2</sub> C <sub>2</sub> O <sub>4</sub> ; [2031-89-2]	Zh. Neorg. Khim., <u>1957</u> , 2, 1940 - 1950.
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Russ. J. Inorg. Chem., <u>1957</u> , 2, 365. (Eng. trans.)
(4) Water; H <sub>2</sub> O; [7732-18-5]	

EXPERIMENTAL VALUES: (Continued)

The  $UO_2(NO_3)_2 - UO_2C_2O_4 - HNO_3 - H_2O$  System at 25<sup>o</sup>C Composition of Saturated Solutions<sup>a</sup>

UO2(N	0 <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> UO <sub>2</sub> C <sub>2</sub> O <sub>4</sub> H		UO2C2O4 HNO3		UO2C2O4 HNO3		0 <sub>3</sub>	Solid <sub>b</sub> Phase
mass %	mol/kg	mass %	mol/kg	mass %	mol/kg	Filase		
		Se	action III					
31.96	1.804	0	0	23.08	8.147	A		
31.44	1.770	0.83	0.051	22.66	7.979	A+B		
31.06	1.665	0.55	0.032	21.05	7.057	В		
27.06	1.252	0.38	0.019	17.70	5.120	В		
22.31	0.8932	0.37	0.016	13.93	3.487	В		
17.44	0.5388	0.42	0.014			В		
16.63	0.5862	0.44	0.017	10.94	2.412	B B		
10.62	0.3031	0.47	0.015			в		
6.27	0.171	0.55	0.106			В		
		Se	ction IV					
26.52	1.325	0.47	0.026	22.22	6.943	в		
23.38	1.101	0.42	0.022	22.31	6.570			
18.73	0.8294	0.40	0.019	23.56	6.524	B B		
16.07	0.6643	0.41	0.019	22.42	5.818	в		
10.23	0.3880	0.48	0.020	22.37	5.305	в		
5.45	0.195	0.70	0.027	22.60	5.035	В		
1.81	0.0617	1.26	0.047	22.51	4.800	в		

<sup>a</sup>Molalities calculated by the compilers.

<sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2 \cdot 6H_2O$ ,  $B = UO_2C_2O_4 \cdot 3H_2O$ .

COMMENTS AND/OR ADDITIONAL DATA:

The phase diagram is given in the source publication.

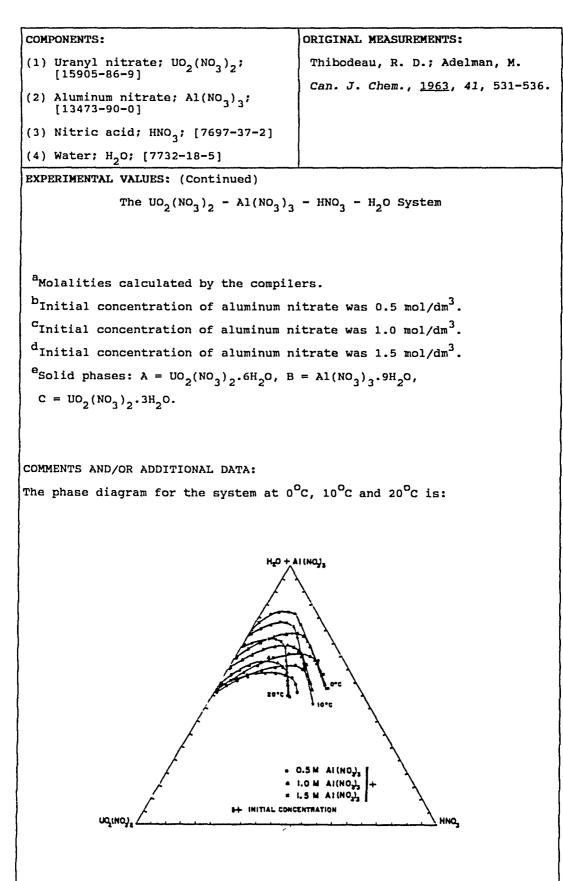
ORIGINAL MEASUREMENTS: COMPONENTS: (1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>2</sub>); Lacher, J. R.; Ensley, K.; Park, J. D. [15905-86-9] Inorg. Chem., 1962, 1, 944 - 945. (2) Uranium oxide; UO<sub>2</sub>; [1344-58-7] (3) Nitric acid; HNO<sub>2</sub>; [7697-37-2] (4) Water; H<sub>2</sub>O; [7732-18-5] VARIABLES: PREPARED BY: A. Sozanski; S. Siekierski Composition and temperature EXPERIMENTAL VALUES: 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). COMMENTS AND/OR ADDITIONAL DATA: 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  $UO_2(NO_3)_2 \cdot N_2O_4 \cdot H_2O$  has been identified. Uranyl nitrate dissolves  $UO_3$ . AUXILIARY INFORMATION METHOD/APPARATUS/PROCEDURE: SOURCE AND PURITY OF MATERIALS: Standard procedures (3) were used to Nothing specified. produce and equilibrate mixtures of  $\overline{\text{UO}}_{1}$ , HNO<sub>3</sub> and water. ESTIMATED ERROR: Solubility: Nothing specified. Temperature: Nothing specified. REFERENCES: 1.Colani, A. Bull. Soc. Chim. France, 1926, 39, 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, 1960.

СОМРО	NENTS:			ORIGINA	ORIGINAL MEASUREMENTS:			
(1) U	ranyl nit	rate; UO <sub>2</sub> ()	<sup>10</sup> 3) <sub>2</sub> ;	Thibodeau, R. D.; Adelman, M.				
-	15905-86-	-		Can. J. Chem., <u>1963</u> , 41, 531-536.				
(2) A [	13473-90-	itrate; Al( 0]	NO3 <sup>2</sup> 2					
(3) N	itric aci	d; HNO <sub>3</sub> ; [7	7697-37-2]					
(4) W	ater; H <sub>2</sub> 0	; [7732-18-	-5]					
VARIA	BLES:	· · · · · · · · · · · · · · · · · · ·		PREPARE	D BY:			
Compo	sition an	d temperatı	ire	A. Soz	anski; S. S	iekierski		
EXPER	IMENTAL V	ALUES:						
		The UO, (NO,	), - Al(NO3	$)_{-}$ - HNO <sub>2</sub>	- H_O Syst	em		
			tion of Sat	5 5	64			
	ມດຸ(	NO3)2	Al(NC	3 <sup>)</sup> 3	HN	0 <sub>3</sub>		
t∕°c			mass %			-	Solid Phase <sup>e</sup>	
0 <sup>b</sup>	45.8 41.5 35.7 29.9 22.9 17.1 13.0 10.2 8.9 9.3	2.43 2.13 1.74 1.40 1.01 0.742 0.565 0.449 0.405 0.447	5.7 6.1 6.5 6.8 6.7 7.3 7.2 7.3 7.2 7.3 7.2	0.56 0.58 0.59 0.55 0.59 0.58 0.59 0.58 0.59 0.61 0.46	0.7 2.9 5.6 9.1 12.8 17.1 21.4 24.8 28.1 32.7	0.2 0.93 1.7 2.7 3.53 4.64 5.82 6.82 7.99 9.83	A+B A+B A+B A+B A+B A+B A+B A+B B+C B+C	
			2.2	0.20		11.5	B+C	
			AUXILIARY					
	•	US/PROCEDUI		1	SOURCE AND PURITY OF MATERIALS:			
were	prepared	hod used. T to range fr and 0.5, 1. um nitrate.	The solution com 0 to 10 .0, 1.5 .10 mL of	s Nothin	Nothing specified.			
each	of these	solutions v	vas pipetted	ESTIMAT	ESTIMATED ERROR:			
suffi to sa were	cient ura turate th sealed wi	nyl nitrate e solutions	e hexahydrat . Bottles /lene tops,	e Solubil	Solubility: Accuracy of analytical method <u>+</u> 0.1%. All analyses in duplicate.			
and t for 4	hen suspe 8 hours.	nded in a v Equilibrium	vater bath a attained	Tempera	Temperature: Precision $\pm 0.1$ K.			
phase	were wei	ghed and di	luted.	REFEREN	CES:			
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				Unpul r Chall m 2. Lund e Bur.	hers, J. A. blished Com k River ( <u>19</u> ell, G.E.F. <i>Std. J. R</i> e	municatio 55). ; Knowles	n, AECL, , H.B.	

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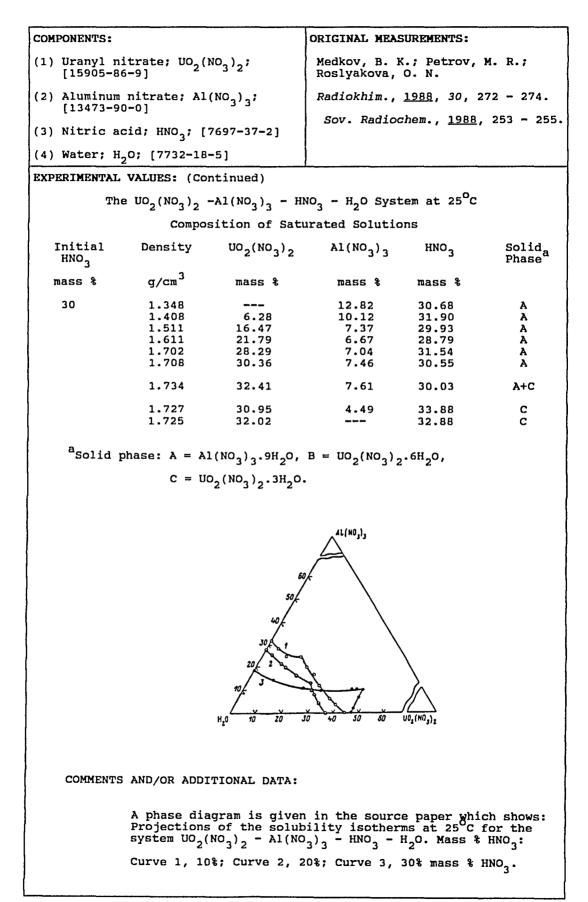
СОМРО	NENTS:			ORIGIN	IAL MEASUREM	ENTS:	
(1) U [	ranyl nit 15905-86-	rate; UO <sub>2</sub> ( 9]	NO3)2;	Thibo	odeau, R. D.	; Adelman,	м.
(2) A [	luminum n 13473-90-	itrate; Al 0]	(NO <sub>3</sub> ) <sub>3</sub> ;	Can.	J. Chem., <u>1</u>	<u>963</u> , 41, 5:	31-536.
(3) N	itric aci	d; hno <sub>3</sub> ; [	7697-37-2]				
(4) W	ater; H <sub>2</sub> 0	; [7732-18	-5]				
EXPER	IMENTAL V	ALUES: (Co	ntinued)				
		The UO <sub>2</sub> (NO	$_3)_2 - Al(N)$	ю <sub>3</sub> ) <sub>3</sub> - нис	0 <sub>3</sub> - H <sub>2</sub> O Sys	tem	
		Compos	ition of S	aturated S	Solutions <sup>a</sup>		
	U0 <sub>2</sub> (	NO3)2	Al(N	10 <sub>3</sub> ) <sub>2</sub>	н	NO <sub>3</sub>	Solide
t/ <sup>o</sup> c	mass %	mol/kg	mass %	mol/kg	mass %	mol/kg	Phase
0°C	34.6 29.3 23.8 18.7 13.8 10.1 8.5	1.55 1.26 0.984 0.759 0.558 0.415 0.36	8.2 8.9 9.9 10.9 12.1 12.9	0.68 0.71 0.68 0.74 0.815 0.921 1.01	0.7 2.9 5.9 8.9 12.5 16.1 18.5	0.20 0.78 1.5 2.3 3.16 4.14 4.89	A+B A+B A+B A+B A+B A+B A+B A+B
	8.4 9.2 9.7 10.3	0.37 0.42 0.45 0.509	11.5 7.8 4.8 2.6	0.942 0.66 0.41 0.24	22.8 27.5 31.1 35.7	6.31 7.86 9.07 11.0	B+C B+C B+C B+C
ođ	20.9 15.2 12.4 9.1 7.3	0.770 0.540 0.443 0.33 0.27	9.1 10.1 10.7 11.8 12.4	0.62 0.664 0.708 0.788 0.843	1.1 3.3 5.9 8.8 11.2	0.25 0.73 1.3 2.0 2.57	A+B A+B A+B A+B A+B
	7.5 8.6 9.1 9.7 10.2 10.6	0.30 0.37 0.41 0.43 0.480 0.536	13.1 12.1 9.2 5.5 3.7 2.6	0.958 0.973 0.76 0.45 0.32 0.24	15.2 20.9 25.2 28.0 32.2 36.6	3.76 5.68 7.08 7.82 9.48 11.6	B+C B+C B+C B+C B+C B+C
10 <sup>b</sup>	48.5 44.0 39.5 35.0 29.6 24.5 20.3 17.1 15.4	2.64 2.29 1.99 1.69 1.40 1.14 0.959 0.807 0.747	4.2 4.8 5.0 4.6 5.6 5.8 7.3 7.3 7.3 7.6	0.42 0.46 0.41 0.49 0.50 0.64 0.64 0.68	0.6 2.5 5.0 7.9 11.2 15.3 18.7 21.8 24.7	0.2 0.81 1.6 2.4 3.32 4.46 5.53 6.43 7.49	A+B A+B A+B A+B A+B A+B A+B A+B A+B A+B
	15.2 15.9	0.749 0.823	6.1 5.6	0.56 0.54	27.2 29.5	8.38 9.55	B+C B+C
10 <sup>C</sup>	38.9 33.8 29.3 24.7 20.2 16.2 14.4 13.2 14.0 13.7 16.6	1.74 1.47 1.25 1.02 0.824 0.659 0.606 0.584 0.678 0.630 0.902	3.9 5.7 5.7 6.1 6.4 8.0 9.4 9.3 6.3 5.1	0.32 0.40 0.45 0.43 0.46 0.48 0.62 0.77 0.83 0.54 0.51	0.4 2.8 5.3 8.0 11.5 15.0 17.3 20.0 24.3 24.8 31.6	0.1 0.76 1.4 2.1 2.93 3.81 4.55 5.53 7.36 7.13 10.7	A+B A+B A+B A+B A+B A+B A+B A+B A+B A+B

Сомро	NENTS:	· · · · · · · · · · · · · · · · · · ·		ORIGIN	ORIGINAL MEASUREMENTS:			
(1) U [	Vranyl nit 15905-86-	rate; UO <sub>2</sub> () 9]	10 <sub>3</sub> ) <sub>2</sub> ;	Thibo	Thibodeau, R. D.; Adelman, M.			
-	(2) Aluminum nitrate; Al(NO <sub>3</sub> ) <sub>3</sub> ; [13473-90-0]			Can.	J. Chem., <u>1</u>	<u>963</u> , 41, 5	31-536.	
(3) N	litric aci	d; hno <sub>3</sub> ; [7	7697-37-2]					
(4) W	later; H <sub>2</sub> C	; [7732-18-	•5]					
EXPER	IMENTAL V	VALUES: (Cor	tinued)					
		The UO2(NO3	$_{2}$ - Al(NO	3) <sub>3</sub> - нио	3 - Н <sub>2</sub> 0 Sys	tem		
		Compos	ition of S	aturated	Solutions <sup>a</sup>			
	UO <sub>2</sub> (	NO3)2	Al(N	0 <sub>3</sub> ) <sub>3</sub>	H	INO <sub>3</sub>	Solide	
t∕°c	mass %	mol/kg	mass %	mol/kg	mass %	mol/kg	Phase -	
10 <sup>d</sup>	25.8 21.4 17.6 14.1 11.9 10.6	1.00 0.807 0.658 0.522 0.443 0.407	8.3 8.5 9.0 9.3 9.3 10.1	0.60 0.59 0.62 0.64 0.64 0.717	0.6 2.8 5.5 8.0 10.6 13.2	0.1 0.66 1.3 1.9 2.47 3.17	A+B A+B A+B A+B A+B A+B	
	11.0 13.5 14.0 15.3 18.2	0.438 0.642 0.678 0.767 1.09	8.5 11.4 8.8 5.2 4.2	0.63 1.00 0.79 0.48 0.46	16.8 21.7 24.8 28.9 35.1	4.19 6.45 7.51 9.06 13.1	B+C B+C B+C B+C B+C	
20 <sup>b</sup>	48.2 42.0 39.0 35.1 31.4 28.6 25.2 22.8 20.9 21.0 22.2	2.69 2.14 1.98 1.75 1.56 1.44 1.28 1.17 1.08 1.14 1.30	6.4 6.2 6.7 7.2 7.8 8.0 7.7 7.5 7.3 7.1	0.66 0.59 0.63 0.64 0.73 0.75 0.73 0.72 0.74 0.77	0.0 2.1 4.4 7.2 10.2 13.3 16.9 20.0 22.6 25.1 27.3	0.0 0.67 1.4 2.2 3.16 4.20 5.37 6.41 7.32 8.55 9.98	А А А А А А А А А А А	
20 <sup>C</sup>	46.4 40.2 36.4 32.3 28.1 24.6 23.0 21.8	2.68 2.13 1.89 1.62 1.40 1.19 1.17 1.14	9.7 10.0 10.6 10.9 11.2 11.4 11.9 11.9	1.04 0.982 1.02 1.01 1.03 1.02 1.12 1.15	0.0 2.0 4.0 6.3 9.6 11.6 15.2 17.7	0.0 0.66 1.3 2.0 3.0 3.51 4.83 5.78	A+B A+B A+B A+B A+B A+B A+B A+B A+B	
	21.6 22.7 25.3	1.14 1.28 1.48	10.5 10.3 5.7	1.03 1.07 0.62	20.0 21.9 25.6	6.63 7.71 9.36	B+C B+C B+C	
20 <sup>d</sup>	30.9 27.8 25.0 21.2 19.1 17.8	1.31 1.17 1.05 0.878 1.784 0.744	8.7 9.2 9.7 10.2 9.4 9.5	0.68 0.71 0.75 0.781 0.71 0.73	0.5 2.5 4.8 7.3 9.7 12.0	0.1 0.66 1.3 1.9 2.5 3.14	A+B A+B A+B A+B A+B A+B	
	17.2 19.6 21.2 23.5 25.6	0.762 0.946 1.09 1.32 1.50	10.9 10.4 10.1 8.7 6.1	0.893 0.928 0.962 0.90 0.66	14.6 17.4 19.4 22.6 25.0 (Continued	4.04 5.25 6.24 7.93 9.16 I on the ne	B+C B+C B+C B+C B+C B+C ext page)	



COMPONENTS:			ORIGINAL MEASUREMENTS:				
	itrate: NO ()	IO ) •	Medkov, B. K.; Petrov, M. R.;				
(1) Uranyl n: [15905-86	6-9]	3'2'	Roslyakova, O. N.				
(2) Aluminum [13473-90	nitrate; Al( 0-0]	NO <sub>3</sub> ) <sub>3</sub> ;	Radiokhim.,				
(3) Nitric ad	cid; HNO <sub>3</sub> ; [7	697-37-2]	Eng. transl	hem., <u>1988</u> , ation.	253 - 255,		
(4) Water; H	2 <sup>0;</sup> [7732-18-	•5]					
VARIABLES: Composition a	at 298 K		PREPARED BY: S. L. Phillip	S			
EXPERIMENTAL	VALUES:						
The	e UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> -	- Al(NO3)2 -	HNO <sub>3</sub> - H <sub>2</sub> O Sys	tem at 25 <sup>0</sup> C			
	Compos	ition of Sat	urated Solutio	ns			
Initial HNO <sub>3</sub>	Density	UO2(NO3)2	A1(NO <sub>3</sub> ) <sub>3</sub>	ниоз	Solid Phase <sup>a</sup>		
mass %	g/cm <sup>3</sup>	mass %	mass %	mass %			
10	1.379		29.63	8.73	A		
	1.409 1.444	3.94 8.77	25.75 21.80	8.82 10.33	A A		
	1.516	15.04	22.77	9.00	A+B		
	1.521 1.533	18.54 22.66	18.96 15.46	9.85 9.77	B 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	в		
	1.663	40.44		10.12	В		
20	1.364	شنة نزي جب	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	В		
	1.568	22.83	7.49	17.86	В		
	1.575	26.45	3.32	19.87	В		
			(Continued on the next page)				
		AUXILIARY I	NFORMATION				
METHOD/APPAR	ATUS/PROCEDUR	RE:	SOURCE AND PURITY OF MATERIALS:				
approached fi		he saturated	$d = \frac{(NO_3)_2 \cdot 6H_2 0}{(NO_3)_2 \cdot 6H_2 0}, A1(NO_3)_2 \cdot 9H_2 0.$				
solutions, to After establ	ishing equili	brium,	ESTIMATED ERROR:				
samples were and liquid pl	hases using a	onstant	Nothing spec	ified.			
temperature of analyzed volu			1 Thibodoon	PD + Mai	man M		
(2); nitrate	by potention	etry (3).	1. Thibodeau, Can. J. Ch	R.D.; Adeli em., <u>1963</u> , 4			
Nitric acid			2. Petrov, M.				
potentiometr:	ic titration	to pH 6 in	Roslyakova	, O.N.			
the presence				Khim., <u>1979</u>			
buffer. Solid determined b	a phase compo	Sition was	3. Markov,V.K	.;Vinograd, thods for I			
(4). Density				omizdat, Mo			
pycnometrical		-	4. Schreinema	kers, F. A.	н.		
			Z. physik.	Chem., <u>189</u>	3, 11, 81.		

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COMPONENTS:	ORIGINAL MEASUREMENTS:					
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Vogler, S.; Grosvenor, D. E.; Lewitz, N. M.					
(2) Plutonium nitrate; Pu(NO <sub>3</sub> ) <sub>4</sub> ; [13823-27-3]	Report, <u>1972</u> , ANL-7917.					
(3) Plutonyl nitrate; PuO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;						
[22853-0-5] (4) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]						
(5) Water; H <sub>2</sub> O; [7732-18-5]						
VARIABLES:	PREPARED BY:					
Composition and temperature	A. Sozanski; S. Siekierski					
EXPERIMENTAL VALUES:						
The $UO_2(NO_3)_2 - Pu(NO_3)_4^a - HNO_3 - H_2O$ System						
Composition of Saturated Solutions <sup>b</sup>						
U	Pu HNO <sub>3</sub>					
t/°C mol/dm <sup>3</sup>	mol/dm <sup>3</sup> mol/dm <sup>3</sup>					
1.5 0.70	0.70 3.4					
3.2 1.28 5.3 0.98	0.34 2.0 0.42 3.4					
10.2 <sub>c</sub> 1.12	0.28 3.4					
12.6 1.4	0 3.4					
	0.2 2.0					
15.3 1.28 15.9 1.6	0.34 3.4 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					
<sup>a</sup> See Comments, next page.						
<sup>b</sup> Solid phase = $UO_2(NO_3)_2.6H_2O_3$						
CExtrapolated from Dillon's data (	1).					
	(Continued on the next page)					
AUXILIARY I	NFORMATION					
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:					
Synthetic method was used. The test solution was prepared from 2.52 mgl/dm uranyl nitrate, 1.5 mol/dm3 plutonium nitrate, and 16	Nothing specified.					
mol/dm <sup>3</sup> HNO <sub>3</sub> . 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	ESTIMATED ERROR: Solubility: Crystallization point determined 2 or 3 times for each solution.					
stirring. The change in solution temperature as a function of time was recorded. Onset of crystallization	Temperature: Precision $\pm 1K$ , above 10 C, $\pm 1.5K$ , below 10 C.					
	REFERENCES:					
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.	1. Dillon, I. ANL, Private Communication, 1950.					
CONTING-CULVE BEYMENCE.						

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Vogler, S.; Grosvenor, D. E.; Lewitz, N. M.		
(2) Plutonium nitrate; Pu(NO <sub>3</sub> ) <sub>4</sub> ; [13823-27-3]	Report <u>1972</u> , ANL-7917.		
(3) Plutonyl nitrate; PuO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [22853-0-5]			
(4) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]			
(5) Water; H <sub>2</sub> O; [7732-18-5]			

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:	EVALUATOR:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (2) Various organics</pre>	S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.

CRITICAL EVALUATION:

THE  $UO_2(NO_3)_2 - (C_2H_5)_2O - H_2O$  SYSTEM

INTRODUCTION

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.

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:

Solid Phase	Formula
Uranyl nitrate hexahydrate	U02(N03)2.6H20
Uranyl nitrate trihydrate monoetherate	U0 <sub>2</sub> (N0 <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> 0.(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0
Uranyl nitrate dihydrate dietherate	U02(N03)2.2H20.2(C2H5)20
Uranyl nitrate dihydrate etherate	U02(N03)2.2H20.4(C2H5)20
Uranyl nitrate dietherate	U02(N03)2.2(C2H2)20

Misciattelli claimed that  $UO_2(NO_3)_2$  was the solid phase in the ether system when water was absent (6,8); however, this assignment is most improbable (35).

The phase diagram for the system  $UO_2(NO_3)_2 - (C_2H_5)_2O - H_2O$  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.

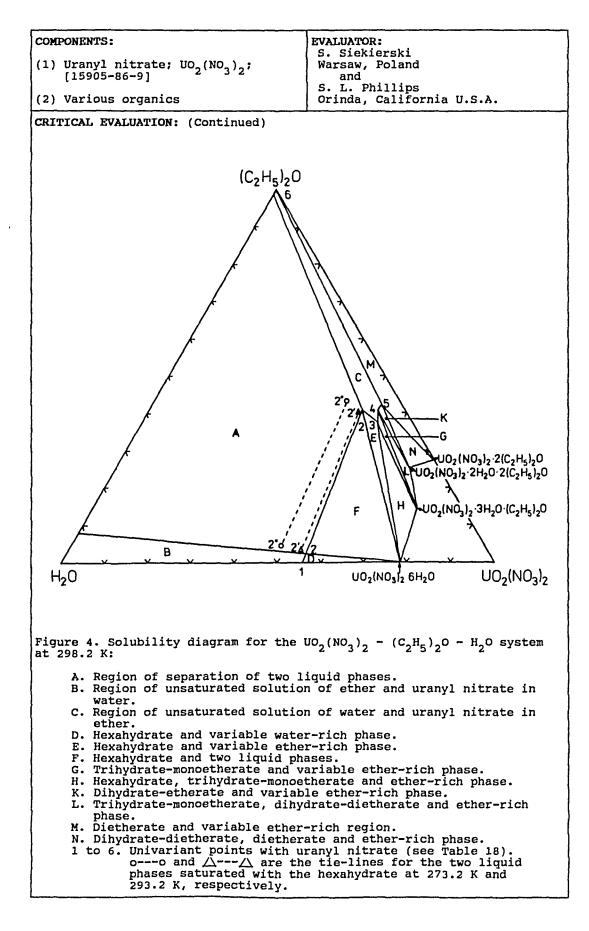
(Continued on the next page)

COMPONE	MPONENTS:		EVALUATOR:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]		S. Siekiers Warsaw, Pol and					
(2) Var	ious orga	nics		S. L. Phill Orinda, Cal	ips ifornia U.S	S.A.	
CRITICA	L EVALUAT	ION: (Con	tinued)				
1							
നംപര	17 Cumm	ary of the	colubility	of NO (NO )	in the sw	rtom	
Table				of $UO_2(NO_3)_2$			
	002(1	<sup>3</sup> <sup>2</sup> <sup>0</sup> <sup>2</sup>	<sup>-</sup> ( <sup>c</sup> 2 <sup>n</sup> 5)2 <sup>0</sup>	- H <sub>2</sub> O with tw	o riquid þi	lases.	
Aqueous Phase				Ether Phase	9		
U02(N03)2 (C2H5)20		(C2H5)20	U02 (N	0 <sub>3</sub> ) <sub>2</sub>	н <sub>2</sub> 0	Ref.	
Т/К	mass %	mol/kg	mass %	mass %	mol/kg	mass %	
273.2	48.54 <sup>a</sup> 48.31	2.394 <sup>a</sup> 2.37	4.58 <sup>a</sup>	44.92 <sup>a</sup> 46.3	2.070 <sup>a</sup> 2.19	11.92 <sup>a</sup>	8 18
280.2 290.1 <sup>b</sup>	49.0	2.44		46.3	2.19		5 14
293.2	54.23	3.007	3.30	49.08	2.446	12.80	7
293.2 <sub>b</sub> 293.2 <sup>b</sup>	52.61	2.817	3.87	49.02 49.16	2.440 2.459	8.10	8 14
293.2 298.2 <sup>b</sup>	54.3	3.01		49.1	2.45		18 14
298.2 298.2 313.2 <sup>b</sup>	55.53 <sup>a</sup>	3.169 <sup>a</sup>	2.41 <sup>a</sup>	50.52 49.65 51.01	2.591 2.503 2.642	9.34 <sup>a</sup>	14 16 14
313 2							

# <sup>a</sup>Mean value.

122

<sup>b</sup>The presence of the aqueous phase is not reported in the source publication.



		DMPONENTS:
<ul> <li>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>;</li> <li>(15905-86-9]</li> <li>(2) Various organics</li> <li>(2) Various organics</li> <li>(3) S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.</li> </ul>	Warsaw, Poland and	[15905-86-9]

The published solubilities for uranyl nitrate in the two liquid phases system  $UO_2(NO_3)_2 - (C_2H_5)_2O - H_2O$  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 UO2(NO3)2.6H2O 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 UO2(NO3)2.6H2O-H2O 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.

The solubility in the  $UO_2(NO_3)_2 \cdot 3H_2O - (C_2H_5)_2O - H_2O$  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, (Continued on the next page)

	EVALUAT	OR:		
trate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; 5-9]	Warsaw	, Poland		
organics	S. L.	S. L. Phillips Orinda, California U.S.A.		
LUATION: (Continued)				
3. Univariant points in	the UO <sub>2</sub> (N	10 <sub>3</sub> ) <sub>2</sub> -(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub>	0-H <sub>2</sub> 0 Syst	ema
. Phases in	ио <sub>2</sub> ( N		н <sub>2</sub> о	Ref
Equilibrium <sup>C</sup>	mass %	mol/kg <sup>a</sup>	mass %	
sat. ether-rich	44.91	2.070	11.92	0
sat. water-rich	48.54	2.394	46.89	8
sat. ether-rich	49.05	2.443	10.45	
A+ sat. water-rich	53.42	2.910	43.00	7,8
A + sat. aqueous	56.0	3.23	44.0	d
sat. ether-rich	49.7	2.50	9.3	
A+ sat. water-rich	55.5	3.17	42.1	16
A + B + sat. liquid	54.9	3.08	7.7	16
B + C + sat. liquid	53.4	2.90	6.2	16
-		2.93	5.0	е
-		0.026		7,27
ies calculated by the (	compilers.			·
		0.(NO.).3H.	0.(C.H.).0	
$C = UO_2(NO_3)_2 \cdot 2H_2O \cdot 2(C_2H_5)_2O$ , $D = UO_2(NO_3)_2 \cdot 2(C_2H_5)_2O$ <sup>d</sup> Recommended solubility value: refer to evaluation of the binary system.				
<sup>e</sup> Estimated by the evaluators from data in Ref. (27).				
$\begin{array}{l} \textbf{Recommended solubili}\\ \textbf{UO}_{2}(\textbf{NO}_{2})_{2} - (\textbf{C}_{2}\textbf{H}_{2})_{2} \end{array}$	ties in th - H <sub>2</sub> 0.	e two liquid	phase sys	tem
Aqueous Phase Organic Phase				
T/K mol/kg				
273.2 2.37		2.15		
278.2 2.50		2.20		
288.2 2.79		2.34		
293.2 2.96		2.44 2.54		
JUN J		4 1 3 3		
298.2         3.15           303.2         3.35		2.66		
	Phases in Equilibrium Equilibrium Sat. ether-rich A+ sat. water-rich A+ sat. ether-rich A+ sat. ether-rich A + sat. aqueous sat. ether-rich A + sat. aqueous sat. ether-rich A + B + sat. liquid B + C + sat. liquid C + D + sat. liquid D + sat. ether cies calculated by the of s refer to the points in phases: A = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .60 C = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .24 ended solubility value: ced by the evaluators for D - Recommended solubility UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> - (C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> O Aqueous Pha T/K mol/kg 273.2 2.50 283.2 2.63 288.2 2.79	itrate; $UO_2(NO_3)_2$ ; S. Sie Warsaw and S. L. Orinda UUATION: (Continued) 3. Univariant points in the $UO_2(N)$ b Phases in Equilibrium mass % sat. ether-rich 44.91 A+ sat. water-rich 48.54 sat. ether-rich 49.05 A+ sat. water-rich 53.42 A + sat. aqueous 56.0 sat. ether-rich 49.7 A+ sat. water-rich 55.5 A + B + sat. liquid 54.9 B + C + sat. liquid 53.4 C + D + sat. liquid 53.4 C + D + sat. liquid 53.4 C + D + sat. liquid 53.6 D + sat. ether 1.0 Cies calculated by the compilers. s refer to the points in Fig. 4. C = $UO_2(NO_3)_2 \cdot 2H_2O \cdot 2(C_2H_5)_2$ ended solubility value: refer to C = $UO_2(NO_3)_2 - (C_2H_5)_2O - H_2O.$ $UO_2(NO_3)_2$ $UO_2(NO_3)_2$ $VO_3(NO_3)_2$ $VO_3(NO_3)_2$ $VO_3(NO_3)_2$ $VO_3($	itrate; $UO_2(NO_3)_2$ ; brganics UUATION: (Continued) 3. Univariant points in the $UO_2(NO_3)_2 - (C_2H_5)_2$ b Phases in the $UO_2(NO_3)_2 - (C_2H_5)_2$ b Equilibrium ast. ether-rich the the the the the the the the the th	irrate; $UO_2(NO_3)_2$ ;       S. Siekierski         brganics       S. Siekierski         warsaw, Poland       and         substance       S. Siekierski         warsaw, Poland       and         substance       S. Divariant points in the $UO_2(NO_3)_2 - (C_2H_5)_2O-H_2O$ System         c       Phases in $UO_2(NO_3)_2$ $H_2O$ sat. ether-rich $\overline{44.91}$ $\overline{2.070}$ $\overline{11.92}$ A+       sat. ether-rich $48.54$ $2.394$ $46.89$ sat. ether-rich $49.05$ $2.443$ $10.45$ A+       sat. ether-rich $49.05$ $2.443$ $10.45$ A+       sat. ether-rich $53.42$ $2.910$ $43.00$ A + sat. aqueous $56.0$ $3.23$ $44.0$ sat. ether-rich $49.7$ $2.50$ $9.3$ A+       sat. ether rich $55.5$ $3.17$ $42.1$ A + B + sat. liquid $53.4$ $2.90$ $6.2$ $C + D + sat.$ $100.026$ $$ cises calculated by the compilers.       srefer to the points in Fig. 4. $0.02(NO_3)_2.2(C_2H_5)_2O.$ $C = UO_2(NO_3)_2.2(C_2H_5)_2O.$ <td< td=""></td<>

COMPONENTS:	EVALUATOR:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (2) Various organics</pre>	S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.

The solubility of  $UO_2(NO_3)_2.2H_2O$  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  $UO_2(NO_3)_2.2H_2O$  in diethyl ether.

The solubility of  $UO_2(NO_3)_2$  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 discrepency between solubility data published by Vdovenko et al. (22,25), and in their later publication (27). The solubility of anhydrous  $UO_2(NO_3)_2$  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 discrepency 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).

The  $UO_2(NO_3)_2$  - Other Organic Solvents -  $H_2O$  Systems

The solubility of uranyl nitrate in a variety of alcohols, ketones, (Continued on the next page)

COMPONENTS:	EVALUATOR:
<pre>(1) Uranyl nitrate; UO2(NO3)2; [15905-86-9]</pre> (2) Various organics	S. Siekierski Warsaw, Poland and S. L. Phillips Orinda, California U.S.A.

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  $UO_2(NO_3)_2.6H_2O$  is dissolved are specified. There are only a few systems which can be critically evaluated.

The  $UO_2(NO_3)_2$  - isobutyl alcohol - water system was thoroughly studied by Katzin and Sullivan (16). According to this study, the solubility of  $UO_2(NO_3)_2.6H_2O$  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).

The solubility of  $UO_2(NO_3)_2.6H_2O$  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/dm<sup>3</sup> of solution cannot be compared with other data because the density is not given. The solubility of  $UO_2(NO_3)_2.6H_2O$  at 293.2 K in 2-butanone has been studied (14,19), and agreement between the two results is very good. The system  $UO_2(NO_3)_2$  - 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 (Continued on the next page)

COMPONENTS:		EVALUATOR:	
	(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	S. Siekierski Warsaw, Poland and	
	(2) Various organics	S. L. Phillips Orinda, California U.S.A.	

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.

The  $UO_2(NO_3)_2$  - diisopropyl ether - water system was investigated by Vdovenko et al. (28). The 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.

The solubility of  $UO_2(NO_3)_2.6H_2O$  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.

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  $UO_2(NO_3)_2 - (C_2H_5)_2O - D_2O$  can be found in Vdovenko and Legin (32). COMPONENTS: EVALUATOR: (1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; S. Siekierski [15905-86-9] Warsaw, Poland and S. L. Phillips (2) Various organics Orinda, California U.S.A. CRITICAL EVALUATION: (Continued) REFERENCES 1. De Conninck, Oe. Compt. Rend., 1900, 131, 1303. 2. De Conninck, Oe. Compt. Rend., 1901, 132, 90. 3. Moore, R. B.; Schlundt, H. Phil. Mag., <u>1906</u>, 12, 393. 4. Lebeau, P. Bull. Soc. Chim. France, 1911, 9, 295. 5. Lebeau, P. Bull. Soc. Chim. France, 1911, 9, 298. 6. Misciattelli, P. Phil. Mag., <u>1929</u>, 670. 7. Guempel, O. Bull. Soc. Chim. Belg., 1929, 38, 443. 8. Misciattelli, P. Gazz. Chim. Italiana, 1930, 60, 839. 9. Kraus, C. A. Report, 1942, AECD-3867. 10. Van Name, R. G. Report, 1942, AECD-4086. 11. Bachelet, M.; Cheylan, E. J. Chim. Phys., 1947, 44, 234. 12. Norstrom, A.; Sillen, L. G. Svensk. Kem., 1948, 11, 227. 13. Yaffe, L. Can. J. Res., 1949, 27B, 638. 14. De Keyser, W. L.; Cypres, R.; Herrmann, M. Bull. Centre Phys. Nucl. Universite Libre de Bruxelles, 1950, No. 17. 15. Templeton, C. C.; Hall, N. F. Can. J. Res., 1950, 28B, 156. 16. Katzin, L. I.; Sullivan, J. C. J. Phys. Chem., <u>1951</u>, 55, 346. 17. Warner, R. K. Australian J. Appl. Sci., 1952, 3, 156. 18. Warner, R. K. Australian J. Appl. Sci., 1953, 4, 427. 19. Warner, R. K. Australian J. Appl. Sci., <u>1953</u>, 4, 581. 20. Wendlandt, W. W.; Bryant, J. M. J. Phys. Chem., 1956, 60, 1145. 21. Healy, T. V.; McKay, H. A. C. Trans. Faraday Soc., 1956, 52, 633. 22. Vdovenko, V. M.; Kovalskaya, M. P.; Kovaleva, T. V. Zh. Neorg. Khim., <u>1957</u>, 2, 1677. Russ. J. Inorg. Chem., <u>1957</u>, 2, 359. 23. Vdovenko, V. M.; Kovalskaya, M. P.; Gerbanevskaya, M. M. Trudy Radievogo Inst. im. V. G. Khlopina, 1958, 8, 8. 24. Vdovenko, V. M.; Kovaleva, T. V.; Moskalkova, A. E. Trudy Radievogo Inst. im. V. G. Khlopina, 1958, 8, 17. 25. Vdovenko, V. M.; Kovaleva, T. V. Trudy Radievogo Inst. im. V. G. Khlopina, <u>1958</u>, 8, 22. Vdovenko, V. M.; Suglobova, I. G. Zh. Neorg. Khim., <u>1958</u>, 3, 1403. Russ. J. Inorg. Chem., <u>1958</u>, 3, 187.
 Vdovenko, V. M.; Suglobova, I. G.; Suglobov, D. N. Radiokhim., <u>1959</u>, 1, 637. (Continued on the next page)

COMPONENTS:	EVALUATOR:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	S. Siekierski Warsaw, Poland and		
(2) Various organics	S. L. Phillips Orinda, California U.S.A.		
CRITICAL EVALUATION: (Continued)			
28. Vdovenko, V. M.; Suglobova, I. G. 388. <i>Sov. Radiochem.</i> , <u>1962</u> , 4, 34	; Mezei, M. Radiokhim., <u>1962</u> , 4, 2.		
	29. Hurwic, J.; Michalczyk, J. Proc. Symp. Theory and Structure of Complex Compounds, Wroclaw, <u>1962</u> , Pergamon Press, Oxford and WNT, Warszawa, <u>1964</u> , 289.		
30. Verstegen, J. M. P. J. Inorg. Nuc	1. Chem., <u>1964</u> , 26, 1589.		
31. Nikolaev, A. V.; Dyadin, Yu. A.; SSSR, <u>1964</u> , 158, 1130.	31. Nikolaev, A. V.; Dyadin, Yu. A.; Yakovlev, I. I. Dokl. Akad. Nauk SSSR, <u>1964</u> , 158, 1130.		
32. Vdovenko, V. M.; Legin, E. K. Rad	iokhim., <u>1966</u> , 8, 317.		
33. Ripan, R.; Eger, I.; Bojan, N. Re	v. Roum. Chim., <u>1968</u> , 13, 421.		
	34. Marcus, Y.; Kertes, A. S. Ion Exchange and Solvent Extraction of Metal Complexes, J. Wiley - Interscience, London, <u>1969</u> .		
35. Khod'ko, N. N.; Kolevich, T. A.; <u>1989</u> , 34, 1808. <i>Russ. J. Inorg.</i>			

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COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	De Conninck, Oe.	
(2) Methanol; CH <sub>4</sub> O; [67-56-1]	Compt. Rend., <u>1900</u> , <i>131</i> , 1303 - 1305.	
(3) Ethanol; C <sub>2</sub> H <sub>6</sub> O; [64-17-5]		
(4) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES:	PREPARED BY:	
Temperature: 285 to 287 K	L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:	••••••••••••••••••••••••••••••••••••••	
The solubility of uranyl nitrate reported to be as follows:	in methanol and ethanol is	
Material For	mula UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	
Methanol CH <sub>3</sub>	OH 1 part/55 parts alcohol	
Ethanol CH <sub>3</sub>	CH <sub>2</sub> OH 1 part/30 parts alcohol	
The solubility of ethanol is an at temperatures of 12.7 <sup>0</sup> C, 12.9 <sup>C</sup>	average value of determinations and 12.6 <sup>0</sup> C. average value of determinations C and 13 <sup>0</sup> C.	
AUXILIARY I	NFORMATION	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	
Nothing specified.	1. Uranyl nitrate, presumably the hexahydrate (compilers), dried 5 hours 90°C.	
	2. Rectified pure grade methanol.	
	ESTIMATED ERROR:	
	Nothing specified.	
	REFERENCES:	

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COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9]</pre>	De Conninck, Oe.
(2) Methanol; CH <sub>3</sub> OH; [67-56-1]	Compt. Rend., <u>1901</u> , 132, 90-91.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Temperature: About 283 to 288 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of uranyl nitrate reported to be 1 part/23.5 parts	in methanol is alcohol.
COMMENTS AND/OR ADDITIONAL DATA:	
over the specified temperature r	e is an average of determinations ange. The solubility in determinations at 10.6 <sup>°</sup> C, 11.2 <sup>°</sup> C,
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	1. Methanol was obtained from methyl oxalate.
	2. Ethyl ether dehydrated with excess of quicklime.
	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES:
	]

COMPONENTS:		ORIGINAL MEASUREM	ENTS:
(1) Uranyl nitrate; U [15905-86-9]	JO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Yaffe, L.	
(2) Various alcohols		Can. J. Res., <u>19</u>	
(3) Water; H <sub>2</sub> O; [7732	2-18-5]		645.
VARIABLES: One temperature: 293	K	PREPARED BY: L. Fuks; S. Sieki	erski
EXPERIMENTAL VALUES:			<u></u>
Solubility of UO <sub>2</sub> (	$NO_3)_2.6H_2O$ in va	rious alcohols is	reported to be:
			UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O
Alcohol	For	mula	$g/(100 \text{ cm}^3)$
1-Pentanol	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> OH; [7	1-41-0]	55
3-Methyl-1-butanol	(CH <sub>3</sub> ) <sub>2</sub> CH(CH <sub>2</sub> ) <sub>2</sub> O	H; [123-51-3]	57
3-Pentanol	CH3CH2CH(OH)CH2	CH <sub>3</sub> ; [584-02-1]	57
2-Methyl-1-pentanol	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> CH(CH <sub>3</sub>	)CH <sub>2</sub> OH; [105-30-6]	43
2-Ethyl-1-butanol	CH <sub>3</sub> CH <sub>2</sub> CH(C <sub>2</sub> H <sub>5</sub> )C	H <sub>2</sub> OH; [97-95-0]	49
1-Heptanol	СН <sub>3</sub> (СН <sub>2</sub> ) <sub>6</sub> ОН; [1	_ 11-70-6]	43
1-Octanol	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>7</sub> OH; [1	11-87-5]	37
Geraniol	(CH <sub>3</sub> ) <sub>2</sub> C=CHCH <sub>2</sub> CH [106-24-1]	2 <sup>C(CH<sub>3</sub>)=CHCH<sub>2</sub>OH;</sup>	36
1-Undecanol	СН <sub>3</sub> (СН <sub>2</sub> ) <sub>10</sub> ОН; [	112-42-5]	27
2-Ethoxyethanol	сн <sub>3</sub> сн <sub>2</sub> о(сн <sub>2</sub> ) <sub>2</sub> он	; [110-80-5]	102
(cellosolve) 2-Hexoxyethanol	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> OCH <sub>2</sub> CH	<sub>2</sub> OH; [112-25-4]	68
4-Methoxy-4-butoxy- 1-butanol	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O(CH <sub>2</sub> )	<sub>4</sub> сн <sub>2</sub> он;	44
2,3-Dibromo-1- propanol	CH2BrCHBrCH2OH;	[96-13-6]	32
	AUXILIARY I	NFORMATION	
METHOD/APPARATUS/PROC The isothermal method mL portion of the sol grams of uranyl nitra were placed in a ther bath at 20°C. Additic until solution was sa minimum time for satu was taken to be 24 hr analysis, solution wa remove any suspended The uranyl nitrate wa into water, and the c measured colorimetric diluting solution to where Beer's law appl these analyses were c U-233 as tracer (1).	l was used. A 25 yent and a few the hexahydrate mostated water onal solid added aturated. The tration to occur t. Before an as centrifuged to solid material. the back-extracted concentration a concentration ied. Results of	<0.01% rare ea 2. Alcohols were or better. ESTIMATED ERROR: Solubility: Nothi resul metho	hexahydrate was the Eldorado ining Co. The ties consisted o rths. "practical" grad
		1. Yaffe, L. Can. Chem. Pro 31, 812.	cess Inds., <u>1947</u>

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COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	De Keyser, W. L.; Cypres, R.; Herrmann, M.		
(2) Various alcohols	Bull. Centre Phys. Nucl.		
(3) Water; H <sub>2</sub> O; [7732-18-5]	Universite Libre de Bruxelles, No. 17, <u>1950</u> .		
VARIABLES:	PREPARED BY:		
One temperature: 293 K	A. Sozanski; S. Siekierski		

EXPERIMENTAL VALUES:

The solubility of  $UO_2(NO_3)_2.6H_2O$  at  $20^{\circ}C$  in various organic solvents is tabulated as follows:

Organic	Formula	U0 <sub>2</sub> (N0 <sub>3</sub> ) <sub>2</sub> <sup>a</sup>	
		mass %	mol/kg
2-butanol (sec-butyl alcohol)	сн <sub>3</sub> сн <sub>2</sub> снонсн <sub>3</sub> ; [78-92-2]	47.12	2.261
2-Methyl-1-propanol (isobutyl alcohol)	(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> OH; [78-83-1]	44.07	2.000
3-Methyl-1-butanol (isoamyl alcohol)	(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CH <sub>2</sub> OH; [123-51-3]	39.45	1.653
4-Methyl-2-pentanol (methyl isobutyl carbinol)	(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CHOHCH <sub>3</sub> ; [108-11-2]	34.00	1.307

 $^{\rm a}$  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 <sup>3</sup> 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 <sup>3</sup> 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.	<pre>UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>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:</pre>
	1

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO2(NO3)2;	Templeton, C. C.; Hall, N. F.
	Can. J. Res., <u>1950</u> , 28B, 156 -
(2) 3-Methyl-1-butanol; C <sub>5</sub> H <sub>11</sub> OH; [123-51-3]	160.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Temperature: 298 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	1
The solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O alcohol) is: 44.1 g UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> /100 g solu	
<sup>a</sup> Molality calculated by the comp which consists of the alcohol and	ilers as moles/kg of the mixture nd water.
AUXILIARY I	SOURCE AND PURITY OF MATERIALS:
METHOD/APPARATUS/PROCEDURE: A suitable volume of solvent was	"Practical" grade solvent was
mixed in a test tube with appropriate amount of the uranyl nitrate hexa- hydrate. The sample was rotated at 30 rpm at 25°C for 5 days. Saturation	used.
was assured by the presence of distinct lumps in the final solid phase. The solution was then filtered	ESTIMATED ERROR:
and the solubility determined by weighing the solution in a covered	Temperature: Within $\pm 0.05$ .
platinum crucible and igniting.	REFERENCES:

COMPONENTS: (1) Uranyl [15905- (2) 2-Methy [78-83- (3) Water;	nitrate; •86-9] /1-1-propa •1]	nol; C <sub>4</sub> H <sub>10</sub> O	;	Kat J.	GINAL MEASUR tzin, L. I.; Phys. Collo 6-374.	Sullivan,	
VARIABLES: Composition	<del>_</del>	· · · · · · · · · · · · · · · · · · ·			PARED BY: Sozanski; S.	Siekierski	
EXPERIMENT				l	•		
		2-M	ethyl-	l-Pro	opanol		
Ac	The Jueous Pha	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> se	- (СН <sub>3</sub>	) <sub>2</sub> CH	CH <sub>2</sub> OH - H <sub>2</sub> O Organic Pha	System <sup>a</sup> se	
U02(N	<sup>10</sup> 3)2	H <sub>2</sub> O	1	00 <sub>2</sub> ()	NO3)2	н <sub>2</sub> о	Solid Phase <sup>b</sup>
mass %	mol/kg	mass %	mass	5 %	mol/kg	mass %	Thabe
		86.04		-			
6.67	0.181	82.04	0.0	02	0.0005	15.00	Ì
12.87	0.3749	77.45		36	0.022	14.42	
	0.4935	74.28		56	0.0402	13.34	
30.15 33.91	1.095	61.93 56.74	10.0		0.3019 0.4841	14.75 14.82	
	1.302 1.582	52.83	16.0 24.1		0.4841	14.82	
43.69	1.969	49.52	30.1		1.134	14.66	
55.61	3.179	39.66	46.0	06	2.167	15.34	А
55.39	3.151	39.97	46.		2.184	15.03	A
			46.0	06	2.167	12.18	A
			46.3	16	2.176	9.11	A
			49.	59	2.496	6.84	A
			49.9		2.534	6.04	A
			51.3		2.861	6.13	A
			51.3 54.4		2.721	5.97	A A
			55.		3.031 3.174	6.04 5.52	À
			57.9		3.439	5.12	Ä
			0,0			ed on the n	1
		AUXIL	IARY I	FOR	MATION		
		OFDIDE.		COL			TATE
METHOD/APPA			Solid		RCE AND PURI		
		quilibrated		<b>1</b>	Mallinckrodt	<sup>2</sup> Chemical C	o. Lower
		ne week. Li			hydrates pre		
		mixtures we		) (	over concent	rated H_SO	under
		y a few hou			reduced pres		'
		s closed to				<b>.</b>	_
		ected from d on princi		2.	Alcohols wer	e C. P. gra	de.
of wet resi	ldues (1).	Weighed sa	mples	EST	IMATED ERROR	:	
		and water.		Col	ubiliture not	hing specif	ind The
		rom solvent made up to			ubility: not	rage deviat	
		and alcohol				nium and wa	
aliquots were withdrawn, evaporated,		i		erminations			
and ignited	to U <sub>2</sub> O <sub>2</sub> .	Alcohols w	ere	]		<u>+</u> 0.3%,resp	
estimated b	oy differe	nce. Water	by	l			(
Karl Fische dried betwe	er reagent	. Solid pha	se was	Tem	perature: Pr	ecision $\pm 0$ .	03K.
		ranium, thr		REF	ERENCES:		
for water a					Schreinemake	rs, F. A. H	r <b>.</b>
	•				Z. physik. C		
				L			

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Katzin, L. I.; Sullivan, J. C.
(2) 2-Methyl-1-propanol; C <sub>4</sub> H <sub>10</sub> O; [78-83-1]	J. Phys. Colloid Chem., <u>1951</u> , 55, 346-374.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

2-Methyl-1-Propanol

The 
$$UO_2(NO_3)_2$$
 -  $(CH_3)_2CHCH_2OH - H_2O$  System<sup>a</sup>

Organic Phase

UO2(NO3)2		H <sub>2</sub> O	Solid Phase <sup>b</sup>	
mass %	mol/kg	mass %	Thubb	
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	

<sup>a</sup>Molalities calculated by compilers as moles per 1 kg of the mixture consisting of isobutyl alcohol and water.

<sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2.6H_2O$ ,  $B = UO_2(NO_3)_2.3H_2O$ ,

 $C = UO_2(NO_3)_2.2H_2O.C_4H_9OH, D = UO_2(NO_3)_2.3C_4H_9OH.$ 

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; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Katzin, L. I.; Sullivan, J. C.
(2) 2-Methyl-2-propanol; C <sub>4</sub> H <sub>10</sub> O; [75-65-0]	J. Phys. Colloid Chem., <u>1951</u> , 55, 346-374.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

#### 2-Methyl-2-Propanol

The 
$$UO_2(NO_3)_2$$
 -  $(CH_3)_3COH - H_2O$  System<sup>a</sup>

U0 <sub>2</sub> (	(NO <sub>3</sub> ) <sub>2</sub>	н <sub>2</sub> о	Solid Phase
mass %	mol/kg	mass %	FlidSe
54.50	3.040	45.50	A
55.33	3.143	39.79	A
47.86	2.330	43.25	в
45.16	2.090	44.40	В
41.46	1.797	37.51	В
37.26	1.507	29.41	В
24.73	0.8338	9.47	В
22.64	0.7427	7.86	В
15.15	0.4531	2.54	В
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	с
34.51	1.337	1.30	С

<sup>a</sup>Molalities calculated by the compilers as moles/kg of the mixture consisting of tertiary butyl alcohol and water.

<sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2.6H_2O$ ,  $B = UO_2(NO_3)_2.3H_2O.3(CH_3)_3COH$ ,  $C = UO_2(NO_3)_2.2H_2O.4(CH_3)_3COH$ ,  $D = UO_2(NO_3)_2.3(CH_3)_3COH$ .

r	······································	1				
		ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]		Warner, R. K.				
(2) Various alcohol	ទ	Austral 581 - 5	lian J. Appl.	. Sci., <u>1953</u> , 4,		
(3) Water; H <sub>2</sub> O; [77	32-18-5]					
VARIABLES:		PREPAREI	BY:			
One temperature: 29	3 К	L. Fuks	S. Siekiers	ski		
EXPERIMENTAL VALUES	:					
The solubility of	$UO_2(NO_3)_2.6H_2O$ in v	various a	alcohols is a	reported to be:		
			U02 (NO	3 <sup>)</sup> 2		
Alcohol	Formula		g/(g soln)	mol/kg <sup>a</sup>		
Methanol	CH <sub>3</sub> OH; [67-56-1]		0.675	5.27		
Ethanol	сн <sub>3</sub> сн <sub>2</sub> он; [64-17-	5]	0.615	4.05		
1-Propanol	сн <sub>3</sub> сн <sub>2</sub> сн <sub>2</sub> он; [71-	23-8]	0.529	2.85		
2-Propanol	сн <sub>3</sub> снонсн <sub>3</sub> ; [67-63	3-0]	0.549	3.09		
1-Butanol	CH3 (CH2) 3 OH; [71-	36-3]	0.462	2.18		
1-Pentanol	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> OH; [71-	41-0]	0.387	1.60		
1-Hexanol	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> OH; [111-	-27-3]	0.341	1.31		
1-Heptanol	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>6</sub> OH; [111-70-6]		0.310	1.14		
2-Ethyl-1- hexanol	Ethyl-1- CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> CH(C <sub>2</sub> H <sub>5</sub> )CH hexanol [104-76-7]		0.235	0.780		
1-Octanol CH <sub>3</sub> (CH <sub>2</sub> ) <sub>7</sub> OH; [111-		-87-5]	0.280	0.987		
2-Octanol CH	23-96-6]	0.271	0.943			
Cyclohexanol	08-93-0]	0.403	1.71			
<sup>a</sup> Molalities ca consisting of	<sup>a</sup> Molalities calculated by the compilers, mol/kg of the mixture consisting of the alcohol and water.					
	AUXILIARY II	NFORMATIC	)N			
METHOD/APPARATUS/PR	OCEDURE:		ND PURITY OF			
The isothermal meth excess of uranyl ni		<ol> <li>"AR" UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O.</li> <li>C.P. grade anhydrous alcohols.</li> </ol>				
was placed with the amount of pure solv	appropriate ent in a_small	ESTIMATED ERROR:				
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		Solubility: Determinations repeat until agreement withi 0.2 mass %. Temperature: Precision ±0.05 K.		greement within 5 %.		
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 <sub>3</sub> 0 <sub>8</sub> .		REFERENCES:				

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	De Conninck, Oe.
(2) Ethyl acetate; C <sub>4</sub> H <sub>8</sub> O <sub>2</sub> ; [141-78-6]	Compt. Rend., <u>1901</u> , 132, 90-91.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: about 283 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	<b></b>
The solubility of uranyl nitrate	in $CH_3COOC_2H_5$ is reported to be
1 part of the salt per 18.4 parts	s of ethyl acetate. This value is
an average of determinations at :	10.3 <sup>0</sup> C, and at 10.7 <sup>0</sup> C.
The initial salt was probably a m	mixture of hexa- and trihydrate

(compilers).

### AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	Nothing specified.
	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
	Kraus, C. A.
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Report, <u>1942</u> , AECD-3867.
(2) Ethyl acetate; C <sub>4</sub> H <sub>8</sub> O <sub>2</sub> ; [141-78-6]	
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 299 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
	CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub> at 26 <sup>0</sup> C was reported
to be 66.74 mass %, i.e. 200.7 c	
The corresponding molality was o	
2.790 <sup>a</sup> mol/kg, assuming that the	solubility value in mass % refers
to the content of the hexahydrat	e.
acetate and water.	
AUXILIARY 1	NFORMATION
METHOD/APPARATUS/PROCEDURE:	
	SOURCE AND PURITY OF MATERIALS:
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 $U_{3}O_{8}$ . No additional information.	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>Ethyl acetate, anhydrous. Carbide and Carbon Chemical,</li> </ol>
supersaturated solution was seeded and allowed to come to equilibrium at 26°C. Samples of the solution were analyzed by converting the solute to	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>2. Ethyl acetate, anhydrous.</li> </ol>
supersaturated solution was seeded and allowed to come to equilibrium at 26°C. Samples of the solution were analyzed by converting the solute to	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>Ethyl acetate, anhydrous. Carbide and Carbon Chemical,</li> </ol>
supersaturated solution was seeded and allowed to come to equilibrium at 26°C. Samples of the solution were analyzed by converting the solute to	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>Ethyl acetate, anhydrous. Carbide and Carbon Chemical, 99% pure, not depatured, b.p. range 75°C to 85°C.</li> </ol>
supersaturated solution was seeded and allowed to come to equilibrium at 26°C. Samples of the solution were analyzed by converting the solute to	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>Ethyl acetate, anhydrous. Carbide and Carbon Chemical, 99% pure, not denatured, b.p. range 75°C to 85°C.</li> <li>ESTIMATED ERROR:</li> </ol>
supersaturated solution was seeded and allowed to come to equilibrium at 26°C. Samples of the solution were analyzed by converting the solute to	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>Ethyl acetate, anhydrous. Carbide and Carbon Chemical, 99% pure, not denatured, b.p. range 75°C to 85°C.</li> <li>ESTIMATED ERROR: Nothing specified.</li> </ol>
supersaturated solution was seeded and allowed to come to equilibrium at 26°C. Samples of the solution were analyzed by converting the solute to	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>Ethyl acetate, anhydrous. Carbide and Carbon Chemical, 99% pure, not denatured, b.p. range 75°C to 85°C.</li> <li>ESTIMATED ERROR: Nothing specified.</li> </ol>
supersaturated solution was seeded and allowed to come to equilibrium at 26°C. Samples of the solution were analyzed by converting the solute to	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>Ethyl acetate, anhydrous. Carbide and Carbon Chemical, 99% pure, not denatured, b.p. range 75°C to 85°C.</li> <li>ESTIMATED ERROR: Nothing specified.</li> </ol>
supersaturated solution was seeded and allowed to come to equilibrium at 26°C. Samples of the solution were analyzed by converting the solute to	<ol> <li>C. P. uranyl nitrate hexahydrate was twice recrystallized.</li> <li>Ethyl acetate, anhydrous. Carbide and Carbon Chemical, 99% pure, not denatured, b.p. range 75°C to 85°C.</li> <li>ESTIMATED ERROR: Nothing specified.</li> </ol>

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Yaffe, L.
[15905-86-9]	Can. J. Res., <u>1949</u> , 27B, 638-645.
(2) Various esters	Can. 5. Kes., <u>1242</u> , 272, 656 645.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 293 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of UO2(NO3)2.6H2C	) in various esters is reported to be:
	U02(N03)2.6H20
Ester F	Formula g/(100 cm3)
2-Ethyl-1-butanol (C <sub>2</sub> H <sub>5</sub> ) [97-95-0]	2 <sup>CHCH</sup> 2 <sup>OH</sup> 49
Vinyl acetate CH <sub>3</sub> COC [108-05-4]	DCH=CH <sub>2</sub> 31
Ethyl acetate CH <sub>3</sub> COC [141-78-6]	DCH <sub>2</sub> CH <sub>3</sub> 82
Isopropyl acetate CH <sub>3</sub> COC [108-21-4]	OCH(CH <sub>3</sub> ) <sub>2</sub> 64
Ethyl acetylglycolate CH <sub>3</sub> COC	осн <sub>2</sub> соосн <sub>2</sub> сн <sub>3</sub> 110
Isoamyl formate CHOO(C [35073-27-9]	CH <sub>2</sub> ) <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub> 24
Amyl formate CHOO(C [638-49-3]	CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub> 56
Butyl acetate CH <sub>3</sub> COC [123-86-4]	о(сн <sub>2</sub> ) <sub>3</sub> сн <sub>3</sub> 68
sec-Butyl acetate CH <sub>3</sub> COOCH( [105-46-4]	CH <sub>3</sub> ) <sub>2</sub> C <sub>2</sub> H <sub>5</sub> 61
	(Continued on the next page)
AUXILIAR	Y INFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. A 25 cm portion of the solvent and few grams of uranyl nitrate hexa- hydrate were placed in a sealed centrifuge tube, and agitated in a water bath thermostatically set at 20°C. Additional solid was adde until a saturated solution was obtained. The minimum time for saturation to occur was 24 hr. Pri to analysis, the solution was centrifuged to remove any suspende solid material. The uranyl nitrate	Mining and Refining Co. The maximum impurities consisted of <0.1% rare earths. 2. Esters "practical grade" or better. ESTIMATED ERROR: or Solubility: Results of the two analysis methods agreed to within ±5 %.
was back-extracted into water, and the concentration determined color metrically after diluting the solution so that the uranium conte was in the proper range to obey Beer's law. Results were checked w U-233 as tracer	Temperature: Precision <u>+</u> 0.05 K.

COMPONENTS:		ORIGINAL MEASUREMEN	ITS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub>	);;	Yaffe, L.	
[15905-86-9]	£	Can. J. Res., <u>1949</u>	, <i>27B</i> , 638-645.
(2) Various esters			
(3) Water; H <sub>2</sub> O; [7732-18-5]			
EXPERIMENTAL VALUES: (Conti			
The solubility of UO <sub>2</sub> (NO <sub>3</sub>	) <sub>2</sub> .6H <sub>2</sub> O in		
			3)2.6H20
Ester	Form		100 cm <sup>3</sup> ) _
Isobutyl acetate [110-19-0]	сн <sub>3</sub> соосн <sub>2</sub> с	CH(CH <sub>3</sub> ) <sub>2</sub>	50
2-Ethoxyethyl acetate [111-15-9]	сн <sub>3</sub> соосн <sub>2</sub> с	CH <sub>2</sub> OC <sub>2</sub> H <sub>5</sub>	125
Isoamyl acetate [123-92-2]	сн <sub>3</sub> соо(сн	2) 2 <sup>CH ( CH</sup> 3) 2	55
Amyl acetate [628-63-7]	сн <sub>3</sub> соо(сн	2) 4 <sup>CH</sup> 3	46
Isobutyl propionate [540-42-1]	сн <sub>3</sub> сн <sub>2</sub> соос	<sup>CH</sup> 2 <sup>CH(CH</sup> 3)2	31
Butyl propionate [590-01-2]	CH3CH2COO	(CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub>	55
Amyl propionate [624-54-4]	CH <sub>3</sub> CH <sub>2</sub> COO	(CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub>	37
Methyl phenyl acetate [101-41-7]	с <sub>6</sub> н <sub>5</sub> сн <sub>2</sub> сос	осн <sub>з</sub>	33
Amyl butyrate [540-18-1]	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> C	200(CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub>	25
Phenyl ethyl acetate [103-45-7]	сн <sub>3</sub> соо(сн <sub>2</sub>	2) 2 <sup>C</sup> 6 <sup>H</sup> 5	35
Butyl oxalate [2050-60-4]	[-COO(CH <sub>2</sub> )	3 <sup>CH</sup> 3 <sup>2</sup>	20
Pentanoic acid pentyl ester; [2173-56-0]	CH3(CH2)30	COO(CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub>	21
Butyl cellosolve acetate; [112-07-2]	CH3COOCH2	CH <sub>2</sub> ) <sub>2</sub> CH <sub>2</sub> O(CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub>	77
Isoamyl caproate [2198-61-0]	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> C	COO(CH <sub>2</sub> ) <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	7
Geraniol acetate [16409-44-2]	сн <sub>3</sub> соосн <sub>2</sub> с	CH=C(CH <sub>3</sub> )(CH <sub>2</sub> ) <sub>2</sub> CH=C(	CH <sub>3</sub> ) 16
Amyl succinate [645-69-2]	[-CH <sub>2</sub> COO(0	<sup>CH</sup> <sub>2</sub> ) <sub>4</sub> <sup>CH</sup> <sub>3</sub> ] <sub>2</sub>	25
Butyl adipate [105-99-7]	[-(CH <sub>2</sub> ) <sub>2</sub> CC	00(CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub> ] <sub>2</sub>	40
Ethyl sebacate [110-40-7]	[-(CH <sub>2</sub> ) <sub>4</sub> CC	OOCH <sub>2</sub> CH <sub>3</sub> ] <sub>2</sub>	48
Butyl sebacate [109-43-3]	[-(CH <sub>2</sub> ) <sub>4</sub> CC	00(CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub> ] <sub>2</sub>	37

COMPONENTS:		ORIGINAL MEASUR	EMENTS:	
(1) Uranyl nitrate; [15905-86-9]	; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	De Keyser, W. 1 Herrmann, M.	L.; Cypres	, R.;
(2) Various esters		Bull. Centre P. Universite Lib No. 17, <u>1950</u> .	hys. Nucl. re de Brux	celles,
(3) Water; H <sub>2</sub> O; [7]	732-18-5]			
VARIABLES:		PREPARED BY:		
One temperature: 29	эз к	A. Sozanski; S	• Siekiers	:ki
EXPERIMENTAL VALUES	5:	<u>4</u>		
The Solu	ubility of UO <sub>2</sub> (NO <sub>3</sub> )		-	
	Composition of Sat	urated Solutions	a	
Ester	Formula	t∕°c	UO <sub>2</sub> (N	
Ethyl acetate [141-78-6]	сн <sub>3</sub> соос <sub>2</sub> н <sub>5</sub>	15.7 20.3 25 30	mass % 44.68 46.29 48.33 50.67	2.050 2.187 2.374
Isopropyl acetate [108-21-4]	сн <sub>3</sub> соосн(сн <sub>3</sub> ) <sub>2</sub>	20	41.70	1.815
Butyl acetate [123-86-4]	сн <sub>3</sub> соосн <sub>2</sub> сн <sub>2</sub> сн <sub>2</sub> сн	3 15.9 20 25 30	33.49 34.40 35.92 38.39	1.423
Amyl acetate [628-63-7]	сн <sub>3</sub> соо(сн <sub>2</sub> ) <sub>4</sub> сн <sub>3</sub>	16.4 20 25 30	33.24 34.54 36.08 37.65	1.264 1.339 1.432 1.532
<sup>a</sup> Molalities ca Solid phase =	alculated by the com = $UO_2(NO_3)_2 \cdot 6H_2O$ (co	mpilers. ompilers).		
	AUXILIARY I	FORMATION		
METHOD/APPARATUS/PROCEDURE: The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm 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 portion was pipetted for weighing. Uranium was determined as U <sub>2</sub> O <sub>8</sub> in samples which had the liquid phase evaporated. The samples were then dried and calcined in platinum crucible to constant weight of U <sub>3</sub> O <sub>8</sub> at 900 C.		SOURCE AND PURI The uranyl nitra had 21.30 % wat crystallization	ate hexahy er of	drate
		ESTIMATED ERROR: Solubility: reported solubilities are the mean of two values. Temperature: Nothing specified.		
		REFERENCES:	Ling spec	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Templeton, C. C.; Hall, N. F.
(2) Ethyl butyrate; C <sub>6</sub> H <sub>12</sub> O <sub>2</sub> ; [105-54-4]	Can. J. Res., <u>1950</u> , 28B, 156-160.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 298 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	1

The solubility of  $UO_2(NO_3)_2.6H_2O$  in  $CH_3(CH_2)_2COOCH_2CH_3$  at  $25^{\circ}C$  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.

## AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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	"Practical" grade solvent was used.
	ESTIMATED ERROR:
for 5 days. Saturation was ensured by the presence of distinct lumps in the final solid phase. The solution was then filtered and the	Temperature: Within ±0.05 <sup>0</sup> C.
solubility was determined by the	REFERENCES:
weighing of a desired amount of the solution in a covered platinum crucible, followed by ignition (1).	1. Templeton, C. C.; Hall, N. F. <i>J. Phys. Colloid Chem.</i> , <u>1947</u> , 51, 1441.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	De Conninck, Oe.
(2) Acetone; C <sub>3</sub> H <sub>6</sub> O; [67-64-1]	Compt. Rend., <u>1900</u> , <i>131</i> , 1303 - 1305.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: about 285 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of uranyl nitrate one part of nitrate per 60 parts average of two values at 11.9 C,	in acetone was reported to be CH <sub>3</sub> COCH <sub>3</sub> . This value is the and at 12.2 C.
AUXILIARY II	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	Uranyl nitrate, presumably the hexahydrate (compilers), was dried at 90°C. Acetone was purified with sodium hydrogen sulfite.
	ESTIMATED ERRORS:
	Nothing specified.
	REFERENCES:

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COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO2(NO3); [15905-86-9]</pre>	Moore, R. B.; Schlundt, H.
(2) Acetone; C <sub>3</sub> H <sub>6</sub> O; [67-64-1]	Phil. Mag., <u>1906</u> , 12, 93-396.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Room temperature	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
AUXILIARY IN	IFORMATION
······································	FORMATION SOURCE AND PURITY OF MATERIALS:
AUXILIARY IN METHOD/APPARATUS/PROCEDURE: Five grams of uranyl nitrate were dissolved in 60 cm of acetone. The solution was slightly cloudy, probably due to the presence of a small amount of undissolved nitrate.	
METHOD/APPARATUS/PROCEDURE: Five grams of uranyl nitrate were dissolved in 60 cm <sup>2</sup> of acetone. The solution was slightly cloudy, probably due to the presence of a	SOURCE AND PURITY OF MATERIALS:
METHOD/APPARATUS/PROCEDURE: Five grams of uranyl nitrate were dissolved in 60 cm <sup>2</sup> of acetone. The solution was slightly cloudy, probably due to the presence of a	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate - Kahlbaum's be
METHOD/APPARATUS/PROCEDURE: Five grams of uranyl nitrate were dissolved in 60 cm <sup>2</sup> of acetone. The solution was slightly cloudy, probably due to the presence of a	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate - Kahlbaum's be ESTIMATED ERROR:
METHOD/APPARATUS/PROCEDURE: Five grams of uranyl nitrate were dissolved in 60 cm <sup>2</sup> of acetone. The solution was slightly cloudy, probably due to the presence of a	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate - Kahlbaum's be ESTIMATED ERROR: Nothing specified.
METHOD/APPARATUS/PROCEDURE: Five grams of uranyl nitrate were dissolved in 60 cm <sup>2</sup> of acetone. The solution was slightly cloudy, probably due to the presence of a	SOURCE AND PURITY OF MATERIALS: Uranyl nitrate - Kahlbaum's be ESTIMATED ERROR: Nothing specified.

F			
COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9] (2) Various aldehydes and ketones (3) Water; H <sub>2</sub> O; [7732-18-5]		ORIGINAL MEASUREMENTS: Yaffe, L. Can. J. Res., <u>1949</u> , 27B, 638-645.	
VARIABLES: One temperature: 293 K	l	PREPARED BY: L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES: The solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O in various alder reported to be:		various aldehydes and ketones is UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O	
Aldehyde	Formu	3	
Butanal (butyraldehyde) [123-72-8]	сн3(сн2	2) 2 <sup>CHO</sup> 22	
4-Methoxybenzaldehyde [123-11-5]	сн <sub>з</sub> ос <sub>6</sub> с	сн <sub>4</sub> сно 27	
5[R]-3,7-Dimethyl-6-octen [106-23-0] (CH		cronellal) H(CH <sub>2</sub> ) <sub>2</sub> CH(CH <sub>3</sub> )CH <sub>2</sub> CHO 34	
Ketone	Formu	11a g/100 cm <sup>3</sup>	
2-Butanone <sup>a</sup> CH <sub>3</sub> [78-93-3]	сн <sub>2</sub> сосн	I <sub>3</sub> 100	
3-Pentanone CH [96-22-0]	сн <sub>2</sub> сосн	1 <sub>2</sub> СН <sub>3</sub> 76	
Cyclohexanone CH [108-94-1]	(CH <sub>2</sub> ) <sub>4</sub> C	20 105	
4-Methyl-2-pentanone (CH [108-10-1]	3) 2 <sup>CHCH</sup>	1 <sub>2</sub> COCH <sub>3</sub> 75	
2-Heptanone CH <sub>3</sub> [110-43-0]	(CH <sub>2</sub> ) <sub>4</sub> C	COCH <sub>3</sub> 68	
2,4-Dimethyl-3-pentanone [565-80-0] (CH <sub>3</sub> ),CHC <sup>a</sup> actually a mixture of 85% ketone		41 D(CH <sub>3</sub> ), und 15% xylene, C <sub>6</sub> H <sub>10</sub> .	
AUXILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE: Isothermal method was used. A 25 cm <sup>3</sup> 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 <sup>o</sup> 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.		<ul> <li>SOURCE AND PURITY OF MATERIALS:</li> <li>1. Uranyl nitrate hexahydrate from Eldorado Mining and Refining. Maximum impurities consisted of &lt;0.1% rare earths.</li> <li>2. Organic solvents "practical" grade or better.</li> <li>ESTIMATED ERROR:</li> <li>Soly: Nothing specified. Results of two methods agreed to ±5 %.</li> </ul>	
		Temp: Precision ±0.5 K. REFERENCES:	

COMPONENTS:	ORIGINAL MEASUREMENTS:
	{
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	De Keyser, W. L.; Cypres, R.; Herrmann, M.
(2) 2-Butanone; C <sub>4</sub> H <sub>8</sub> O; [78-93-3]	Bull. Centre Phys. Nucl. Universite Libre de Bruxelles, No. 17, <u>1950</u> .
(3) 4-Methyl-2-pentanone; C <sub>6</sub> H <sub>12</sub> O; [108-10-1]	
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 293 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O i reported to be:	n the two ketones at 20 <sup>0</sup> C is
Ketone	$UO_2(NO_3)_2^a$
	mass % mol/kg
2-Butanone	54.67 3.061
4-Methyl-2-pentanone	43.07 1.920
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20 cm of solvent, and mixed for 30 min at a temperature 10°C to 20°C above the desired 20°C.	Nothing specified. The uranyl nitrate hexahydrate had 21.30 % water of crystallization, compared with a theoretical 21.52 %.
The liquid together with the crystals was transferred to a thermostat where	
the liquid was stirred for 30 more 3 min. After 15 min. settling, a 10 cm 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	Soly: The reported solubility is the mean of two values which differ by 0.003 and 0.07 mol/kg.
platinum crucible to a constant weight of $U_3O_8$ .	Temp: Nothing specified.
	REFERENCES:
	REFERENCES:

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COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (2) 2-Octanone; C<sub>8</sub>H<sub>16</sub>O; [111-13-7] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	Templeton, C. C.; Hall, N. F. <i>Can. J. Res.</i> , <u>1950</u> , 28B, 156-160.
VARIABLES:	PREPARED BY:
One temperature: 298 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O in ( to be 38.6 g of the anhydrous nitrate of methyl-n-hexyl ketone and water (d	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> COCH <sub>3</sub> at 25 <sup>O</sup> C was reported e per 1 kg of the mixture consisting compilers).

### AUXILIARY INFORMATION

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METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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	"Practical" grade solvent was used. ESTIMATED ERROR: Temperature: Within ±0.05 <sup>0</sup> C.
solution was then filtered, and the solubility determined by weighing the solution in a covered platinum crucible and igniting.	REFERENCES:

ORIGINAL MEASUREMENTS:
Katzin, L. I.; Sullivan, J. C.
J. Phys. Chem., <u>1951</u> , 55, 346 - 374.
PREPARED BY:
A. Sozanski; S. Siekierski
tone
<sub>3</sub> - H <sub>2</sub> O System at 25 <sup>0</sup> C
urated Solutions <sup>a</sup>
H <sub>2</sub> O Solid <sub>b</sub>
Phase <sup>D</sup> mass %
45.5 A
37.54 A 27.14 A
25.12 A
21.21 A
22.39 A
17.41 A 15.55 A
15.37 A
11.73 A+B
11.71 A+B
11.33 A+B
10.40 B+C 10.61 B+C
(Continued on the next page)
NFORMATION
SOURCE AND PURITY OF MATERIALS:
<ol> <li>Uranyl nitrate hexahydrate was C.P. grade, Mallinckrodt Chem. Co. Lower hydrates prepared by desiccation over concentrated H<sub>2</sub>SO<sub>4</sub> under reduced pressure.</li> <li>Acetone, C.P. grade.</li> <li>4-Methyl-2-pentanone,C.P. grade treated to remove alcoholic impurities, washed with water.</li> </ol>
<pre>ESTIMATED ERROR: Soly: The average deviation of</pre>

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Katzin, L. I.; Sullivan, J. C.
(2) Acetone; C <sub>3</sub> H <sub>6</sub> O; [67-64-1]	J. Phys. Chem., <u>1951</u> , 55, 346 - 374.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

### Acetone

The  $UO_2(NO_3)_2$  -  $CH_3COCH_3$  -  $H_2O$  System at 25°C Composition of Saturated Solutions<sup>a</sup>

υ0 <sub>2</sub> ()	NO <sub>3</sub> ) <sub>2</sub>	н <sub>2</sub> о	Solid <sub>b</sub> Phase
mass %	mol/kg	mass &	1 mube
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

<sup>a</sup>Molalities calculated by the compilers as moles per 1 kg of the mixture consisting of acetone and water.

<sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2 \cdot 6H_2O$ ,  $B = UO_2(NO_3)_2 \cdot 4H_2O$ ,  $C = UO_2(NO_3)_2 \cdot 3H_2O$ ,  $D = UO_2(NO_3)_2 \cdot 2H_2O \cdot CH_3COCH_3$ ,  $E = UO_2(NO_3)_2 \cdot 2CH_3COCH_3$ .

COMMENT AND/OR ADDITIONAL DATA:

Existence of the tetrahydrate is unlikely (compilers).

(Continued on the next page)

COMPONENTS	:		ORI	GINAL MEASURI	EMENTS:	
(1) Uranyl [15905-	nitrate; -86-9]	uo <sub>2</sub> (No <sub>3</sub> ) <sub>2</sub> ;		tzin, L. I.;		
(2) 4-Methy [108-10	y1-2-penta )-1]	none; C <sub>6</sub> H <sub>12</sub> O;	J.	Phys. Chem.	, <u>1951</u> , 55,	346 - 374.
(3) Water;	н <sub>2</sub> 0; [773	2-18-5]				
EXPERIMENTA	AL VALUES:	(Continued)				
		4-Meth	yl-2-pen	itanone		
e 1	The UO <sub>2</sub> (NO	$(CH_3)_2 - (CH_3)_2 C$	нсн <sub>2</sub> сосн	1 <sub>3</sub> - H <sub>2</sub> O Syste	em at 25 <sup>0</sup> C	
Ac	queous Pha	se		Organic Phas	se	
UO2(N	NO3)2	H <sub>2</sub> O	U0_2(	NO3)2	н <sub>2</sub> 0	Solid <sub>b</sub> Phase
mass %	mol/kg	mass %	mass %	mol/kg	mass %	rnuse
14.41 16.68 28.80 35.48 37.93 38.69 41.24	0.4273 0.5081 1.027 1.396 1.51 1.602 1.781	94.23 76.60 78.70 67.58 62.38 57.95 57.41 55.03	0.37 0.64 7.12 16.67 20.52 21.93 26.50	0.0094 0.016 0.195 0.5077 0.6552 0.7129 0.9150	1.68 2.06 4.11 3.08 5.00 5.04 5.75 6.04	
55.41	3.154	42.94	44.14 44.01 46.42 47.86	2.005 1.995 2.199 2.330	8.11 8.04 7.24 6.71	А А А А
			54.53 54.10 54.78 55.13 55.21	3.043 2.991 3.074 3.118 3.128	5.97 5.70 5.59 5.47 5.34	A+B A+B A+B A+B A+B
			55.56 55.92 56.04 56.15 57.71 58.45	3.173 3.219 3.235 3.250 3.463 3.570	5.05 5.04 5.33 4.78 4.17	B B B B B
			60.29 59.45 60.08	3.853 3.721 3.819	3.75 3.99 3.75	B+C B+C B+C
			55.56 57.92 55.21 56.67	3.173 3.493 3.128 3.319	3.95 3.76 3.62 3.41	C+D C+D C+D C+D
			53.85 52.25 51.21 49.78	2.961 2.777 2.664 2.516	3.39 2.98 3.38 2.83	D D D D
a <sub>Molal</sub> mixtu	lities cal ure consis	culated by the ting of keton	e compil e and wa	ers as moles iter.	per 1 kg o	f the
<sup>b</sup> solid	d phases:	$A = UO_2(NO_3)_2$	.6H <sub>2</sub> O, B	$= UO_2(NO_3)_2$	.зн <sub>2</sub> о,	
		2 <sup>(NO</sup> 3)2.2H20.				с <sub>4</sub> н <sub>9</sub> .
				(Continue	ed on the n	ext page)

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COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (2) Acetone; C<sub>3</sub>H<sub>6</sub>O; [67-64-1]</pre>	Katzin, L. I.; Sullivan, J. C. J. Phys. Chem., <u>1951</u> , 55, 346 - 374.
(3) 4-Methyl-2-pentanone; C <sub>6</sub> H <sub>12</sub> O; [108-10-1]	
(4) Water; H <sub>2</sub> O; [7732-18-5]	

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:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>;     [15905-86-9]</pre>	Warner, R. K.
(2) 3,3-Dimethyl-2-butanone; C <sub>6</sub> H <sub>12</sub> O; [75-97-8]	Australian J. Appl. Sci., <u>1953</u> , 4,   427 - 443. 
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Temperature: 275, 293, 313 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
Solubility of $UO_2(NO_3)_2$ in $CH_3C(CH)$	<sub>3</sub> ) <sub>2</sub> COCH <sub>3</sub> - H <sub>2</sub> O Two Phase System <sup>a</sup>
Aqueous Phase	Organic Phase
t/ <sup>O</sup> C mass % mol/kg	mass % mol/kg
2 48.9 2.43 20 54.4 3.03	38.6 1.60
20 54.4 3.03 40 56.4 3.28	43.0 1.91 43.9 1.99
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. The procedure was based on the two phases equilibration in the presence	1. $UO_2(NO_3)_2.6H_2O$ was purified (1).
of excess solid for a period of 8 to 10 hours at 20°C. After sampling each phase, the system was stored over- night at 20°C. On the following day, it was intermittently agitated for an	
10 hours at 20°C. After sampling each phase, the system was stored over- night at 20°C. On the following day, it was intermittently agitated for an additional 2 hours, and the phases	redistilled prior to use.
10 hours at 20°C. After sampling each phase, the system was stored over- night 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	redistilled prior to use. ESTIMATED ERROR: Soly: Nothing specified.
10 hours at 20°C. After sampling each phase, the system was stored over- night 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	redistilled prior to use. ESTIMATED ERROR: Soly: Nothing specified.
10 hours at 20°C. After sampling each phase, the system was stored over- night 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	redistilled prior to use. ESTIMATED ERROR: Soly: Nothing specified. Temp: Precision ±0.05 K.
10 hours at 20°C. After sampling each phase, the system was stored over- night 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	redistilled prior to use. ESTIMATED ERROR: Soly: Nothing specified. Temp: Precision ±0.05 K. REFERENCES:

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Particular	J
COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Warner, R. K.
(2) Various ketones	Australian J. Appl. Sci., <u>1953</u> , 4, 581 - 589.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 293 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The Solubility of UO2(NO3)2.6H20	
Ketone Formula	U02(N03)2 <sup>a</sup>
	g/(g soln) mol/kg
Acetone CH <sub>3</sub> COCH <sub>3</sub> ; [67-64·	-1] 0.617 4.09
2-Butanone CH <sub>3</sub> CH <sub>2</sub> COCH <sub>3</sub> ; [78-	-93-3] 0.547 3.06
2-Hexanone $CH_3(CH_2)_3COCH_3;$	[591-78-6] 0.425 1.83
3,3-Dimethyl-2-butanone CH <sub>3</sub> C(CH <sub>3</sub> ) <sub>2</sub> COCH <sub>3</sub> ;	[75-97-8] 0.415 1.80
<sup>a</sup> Molalities calculated by compile mixture consisting of ketone and	ers as moles per 1 kg of the d water.
	(Continued on the next page)
AUXILIARY II	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used.	1. "AR" UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O.
Excess uranyl nitrate hexahydrate was placed with the appropriate amount of	2. C.P. grade anhydrous ketones.
pure solvent in a small flask, warmed to between $30^{\circ}$ C - $50^{\circ}$ C, and agitated	ESTIMATED ERROR:
for 15 min. Then the flask was placed in a thermostat bath at 20 <sup>o</sup> C and shaken for 6 to 8 hours. When equili- brium was attained, the solution was decanted, filtered, and sampled for subsequent analysis. The analysis	Soly: Repeat determinations of the solubility made until agreed within 0.2 mass %. Temp: Precision ±0.05 K.
consisted of the total uranium nitrate concentration, determined by evaporation of the weighed aliquots, and subsequent ignition to $U_3O_8$ .	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Warner, R. K.
(2) Various ketones	Australian J. Appl. Sci., <u>1953</u> , 4, 581 - 589.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

The solubility of UO2(NO3)2.6H20 in Various Ketones at 20°C is<sup>a</sup>

Ester	Formula	UO <sub>2</sub> ( NO <sub>3</sub> )	р 2
		g/(g soln)	mol/kg
2-Pentanone [107-87-9]	сн <sub>3</sub> (сн <sub>2</sub> ) <sub>2</sub> сосн <sub>3</sub>	0.484	2.38
4-Methy1-2-pentanone [108-10-1]	(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> COCH <sub>3</sub>	0.428	1.90
2-Heptanone [110-43-0]	$CH_3(CH_2)_4COCH_3$	0.382	1.57
Methyl phenyl ketone [98-86-2]	сн <sub>3</sub> сос <sub>6</sub> н <sub>5</sub>	0.312	1.15

<sup>a</sup>The solubility of uranyl nitrate hexahydrate reported as the solubility of the anhydrous nitrate in the organic solvent-rich (upper) phase.

<sup>b</sup>Molalities calculated by the compilers as moles per 1 kg of the mixture consisting of the ketone and water.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Ripan, R.; Eger, I.; Bojan, N.
(2) Acetone; C <sub>3</sub> H <sub>6</sub> O; [67-64-1]	Rev. Roum. Chim., 1968, 13, 421 -
(3) Water; H <sub>2</sub> O; [7732-18-5]	424.
VARIABLES:	PREPARED BY:
One temperature: 298 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of uranyl nitrate hyd reported to be:	Brates in acetone, CH <sub>3</sub> COCH <sub>3</sub> is
Uranyl nitrate hydrate	$uo_2(NO_3)_2$ $g/dm^3$
UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O	1065.75
UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> O	1225.52
AUXILIARY I	NFORMATION
AUXILIARY I 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 UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, Analar. 2. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> O prepared by dehydration of the hexahydrate

COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Ripan, R.; Eger, I.; Bojan, N.			
(2) Carbon tetrachloride; CCl <sub>4</sub> ; [56-23-5]	Rev. Roum. Chim., <u>1968</u> , 13, 421 424			
(3) Acetone; C <sub>3</sub> H <sub>6</sub> O; [67-64-1]				
(4) Water; H <sub>2</sub> O; [7732-18-5]				
VARIABLES:	PREPARED BY:			
Composition and number of waters of uranyl nitrate hydrate	A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:				
solubility of $UO_2(NO_3)_2.6H_2O$ in th $CH_3COCH_3 - CCl_4$ :	e two phase system consisting of			
Acetone phase: 977.10 g of anh of solution.	ydrous UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> per 1 dm <sup>3</sup>			
CCl <sub>4</sub> phase: 1.16 g of anhydrou	s $UO_2(NO_3)_2$ per 1 dm <sup>3</sup> of solution.			
The solubility of $UO_2(NO_3)_2.2H_2O$ in $CH_3COCH_3 - CCl_4$ :	the two phase system consisting of			
Acetone phase: 1203.60 g of anhydrous UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> per 1 dm <sup>3</sup> of solution.				
CCl <sub>4</sub> phase: 1.26 g of anhydrou	$s UO_2(NO_3)_2$ per 1 dm <sup>3</sup> of solution.			
COMMENTS AND/OR ADDITIONAL DATA:				
Volume ratio of CH <sub>3</sub> COCH <sub>3</sub> :CCl, 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.				
(Continued on the next page)				
AUXILIARY I	NFORMATION			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. An	1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, Analar.			
excess of the uranyl hydrate was mixed with the mixtures of acetone and carbon tetrachloride. The test	2. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> O prepared by			
tube was thermostated in a Webser	dehydration of the hexahydrate			
thermostat. Two organic phases were observed in each case. Uranium was	over H <sub>2</sub> SO <sub>4</sub> .			
determined by gravimetric or photometric (small amounts) methods.	4. CCl <sub>4</sub> , acetone: AR grade.			
	ESTIMATED ERROR:			
Nothing specified.				

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REFERENCES:

		ORIGINAL	MEASUREMENTS:	
<ol> <li>1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9]</li> <li>2) Acetone; C<sub>3</sub>H<sub>6</sub>O; [67-64-1]</li> </ol>		Ripan, R.; Eger, I.; Bojan, N.		
		Rev. Roum. Chim., <u>1968</u> , 13, 421 - 424.		
(3) Carbon tetrachloride; ( [56-23-5]	ccl <sub>4</sub> ;			
(4) Water; H <sub>2</sub> O; [7732-18-5]				
EXPERIMENTAL VALUES: (Conti	inued)			
The $UO_2(NO_3)_2$ -	- сн <sub>з</sub> сосн <sub>з</sub> ·	- cc1 <sub>4</sub> - s	ystem at 25 <sup>0</sup> C	
Solubilit	y of Solid	Uranyl Ni	trates	
CH3COCH3/CC14ª	U02(N03)	2.6H20 <sup>b</sup>	uo <sub>2</sub> (No <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> o <sup>b</sup>	
v/v	g/dı	" <sup>3</sup>	g/dm <sup>3</sup>	
10:90	0	.62	6.24	
20:80		.64	18.84	
30:70		.64	84.38	
40:60		.10	169.00	
50:50	170		272.40	
60:40	266		386.80	
70:30	394.00		490.00	
80:20 90:10	609		700.00 930.00	
100 acetone	820 1065		1225.52	
<sup>a</sup> Volume/volume ratio.				
		51 002(1103	) <sub>2</sub> (anhydrous nitrate).	
	WXILIARY I	VFORMATION		
	·····	r	D PURITY OF MATERIALS:	
METHOD/APPARATUS/PROCEDURE: Carbon tetrachloride was ad nown amount of saturated a	ided to a acetone	SOURCE AN		
AETHOD/APPARATUS/PROCEDURE: Carbon tetrachloride was ac snown amount of saturated a solution of uranyl nitrate until the desired compositi	dded to a acetone hydrate .on,	SOURCE AN	D PURITY OF MATERIALS: revious page.	
ETHOD/APPARATUS/PROCEDURE: Carbon tetrachloride was ac nown amount of saturated a solution of uranyl nitrate	ided to a acetone hydrate on, ride, was acetone - re of the	SOURCE AN Same as p ESTIMATED	D PURITY OF MATERIALS: revious page.	

COMPONENTS:	ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	De Conninck, Oe.				
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Compt. Rend., <u>1901</u> , 132, 90 - 91.				
(3) Water; H <sub>2</sub> O; [7732-18-5]					
VARIABLES:	PREPARED BY:				
One temperature: About 285 K	L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES: The solubility of uranyl nitrate in one part of the nitrate per 16 par average of values at 11.9°C, 12.4°C	n diethyl ether is reported to be ts of (C.H.).20. This value is an C, and 12.7°C.				
AUXILIARY I	NFORMATION				
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:				
Nothing specified.	Uranyl nitrate, presumably the hexahydrate (compilers) was dried for 4 hours at 85°C to 90°C.				
	ESTIMATED ERROR:				
	Nothing specified.				
	REFERENCES:				

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COMPONENTS:	ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Lebeau, P.				
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Bull. Soc. Chim. France, <u>1911</u> , 9, 295 - 297.				
(3) Water; H <sub>2</sub> O; [7732-18-5]					
VARIABLES:	PREPARED BY:				
One temperature: 280 K	L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES:	L				
The solubility of uranyl nitrate hexahydrate in (CH <sub>3</sub> CH <sub>2</sub> ) <sub>2</sub> O at 7 <sup>O</sup> C is reported to be 59 mass %. The conjugated aqueous phase is reported to contain 62.5 mass % of the solute. Apparently, the mass % values refer to the hexahydrate and not to the anhydrous salt. If so, then the corresponding molalities are					
COMMENT AND/OR ADDITIONAL DATA: Two species of crystals were obtained from the ether phase after water removal with $Ca(NO_3)_2$ and cooling: one at -70°C, the other at -10°C. These crystals lose ether in dry air. The residue is $UO_2(NO_3)_2.2H_2O$ .					
AUXILIARY I					
	F				
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. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O was crystallized from an aqueous solution at room temperature.				

COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Lebeau, P.			
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Bull. Soc. Chim. France, <u>1911</u> , 9, 298 - 300.			
(3) Water; H <sub>2</sub> O; [7732-18-5]				
VARIABLES:	PREPARED BY:			
Two temperatures: 280 and 283 K	L. Fuks; S. Siekierski			

# EXPERIMENTAL VALUES:

The Solubility of  $UO_2(NO_3)_2.2H_2O$  in  $(C_2H_5)_2O$  at 7<sup>o</sup>C and 10<sup>o</sup>C is reported to be 52.39 mass % and 54.25 mass %, respectively. 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).

### AUXILIARY INFORMATION

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 <sub>2</sub> SO <sub>4</sub> .			
ESTIMATED ERROR:			
Nothing specified.			
REFERENCES:			

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Guempel, O.
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Bull. Soc. Chim. Belg., <u>1929</u> , 38, 443 - 477.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 293 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
phase is 49.08 mass % UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> consisting of ether and water (	i.e. 0.024 mol/kg (compilers). ${}^{H_{5}}_{2}$ , 0 - H <sub>2</sub> O system consists of The composition of the water-rich , i.e. 2.446 mol/kg of a mixture compilers). The composition of the ${}^{*}$ of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> , i.e. 3.007 mol/kg
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The uranyl nitrate concentration in both liquid phases was determined gravimetrically. Diethyl ether was	Nothing specified.
determined in the aqueous phase by a comparison with the amount of ether	ESTIMATED ERROR:
which should be added to a saturated uranyl nitrate - aqueous solution. Diethyl ether and water contents in the ether phase were calculated from	Nothing specified.
the masses of the two phases, the total quantity of uranyl nitrate, and the total amount of ether.	REFERENCES :

COMPONENTS	5:		ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;				Misciattelli, P.			
[15905-86-9] 2 3 2			Phil. Mag.	, <u>1929</u> , 670	) - 674.		
(2) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]							
(3) Diethy	l ether;	C4H10; [60					
VARIABLES:	:		PREPARED BY	:			
Compositio	on and tem	perature		L. Fuks; S	. Siekiersk	:i	
EXPERIMENT		_			_		
The		· •		CH2)20 System		nd 20°C	
	Con	position of	f the Sat	urated Solu	tions <sup>a, b</sup>		
	ບວຸ(	NO3)2	Th	NO <sub>2</sub> )	Ether	Solid	
t∕°c		mol/kg			mass %	Phase	
0	22 22.5	0.716 0.747	0 1.02	0	78 74.48	A A	
	24 24	0.840 0.839	3.5 3.43	0.100 0.0984	72.57 <sup>d</sup> 72.50	A+B A+B	
	19.2 18 16.5 12.2 8.2 3.0 0	0.639 0.593 0.537 0.383 0.25 0.086 0	4.5 5.6 7 8.3 8 5.8	0.14 0.15 0.18 0.21 0.19	76.3 77 81 82.5 89 94.2	B B B B B B B	
10	8.78	0.244	0	0	91.22	A	
	5.5 3.1 0 0	0.15 0.082 0 0	0.5 1 1.4 1.6	0.022 0.030	94 95.9 98.6 98.4	B B B B	
				(Con	tinued on t	he next page	
		AUX	ILIARY IN	FORMATION			
METHOD/APP	PARATUS/PR	OCEDURE:		SOURCE AND	PURITY OF M	ATERIALS:	
solubiliti shaking th	les were d ne solutio	nod was used letermined l ons in the p or both so	by presence	Anhydrous u nitrate and	ranium nitr ether were	rate, thorium used.	
phases in	a large t	est tube p	laced in	ESTIMATED E	RROR:		
a Dewar vessel containing melting ice or in a thermostat at the required temperature. Portions of the solution were weighed and analyzed separately.		Nothing specified.					
The ether after the nearly neu with a boi The result ignited ar uranium wa filtrate a addition c was heated	was remov addition utral solu ing thori nd weighed as precipi as ammoniu of ammonia	red by dist of water. tion was t ic acid so um oxalate as oxide. tated from um uranate t. The prec	illation The cold reated lution. was The the by the ipitate	REFERENCES :			

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COMPONENTS:				ORIGINAL MEAS	UREMENTS:	······································
(1) Uranyl 1 [15905-8	nitrate; UC	0 <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;		Misciattelli	, P.	
(2) Thorium [13823-2	nitrate; T	<sup>h</sup> (NO <sub>3</sub> ) <sub>4</sub> ;		Phil. Mag.,	<u>1929</u> , 670	- 674.
(3) Diethyl	-	[10; [60-2	9-7]			
EXPERIMENTAL		20				
$UO_2(NO_3)_2 - Th(NO_3)_4 - (CH_3CH_2)_2O$ System at Various Temperatures						
Composition of the Saturated Solutions <sup>a,b</sup>						
	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> Th(NO			(NO3)4	Ether	Solid
t/°c ī	mass % m	iol/kg	mass %	mol/kg	mass %	Phase
0 16 19		).839 ).557 ).299	3.43 1.7 0.4	0.0985 0.044 0.0093	72.57 80.6 89.1	A+B A+B <sup>e</sup> A+B <sup>e</sup>
20 22	8.78 0	.244	0 0 0	0 0 0	91.22 92 92.63	А А А
<sup>C</sup> Solid <sup>d</sup> The su <sup>e</sup> Compil COMMENT	phases: A um of mass lers. TS AND/OR A sults are a	DDITIONAL	<sub>2</sub> , B = qual to DATA:			phase

COMPONENTS:	<u> </u>	ORIGIN	AL MEASU	REMENTS:			
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>;</pre>			ORIGINAL MEASUREMENTS: Misciattelli, P.				
[15905-86-9]							
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]			Gazz. Chim. Italiana, <u>1930</u> , 60, 839 - 842.				
(3) Water; H <sub>2</sub> O; [7732-1							
VARIABLES:		PREPAR	ED BY:				
Composition at 273 and	293 K	L. Fuk	s; S. Si	ekierski	•		
EXPERIMENTAL VALUES:							
The UO	$(NO_3)_2 - (CH)$	3 <sup>CH</sup> 2 <sup>)</sup> 2 <sup>O</sup>	- н <sub>2</sub> о sy	stem			
Compositio	on of the Sat	urated S	olutions	at O <sup>O</sup> C <sup>a</sup>	L		
Water Phase			Ether F	hase		Solid Phase	
H <sub>2</sub> O Ether UO <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub>	н <sub>2</sub> о	Ether	UO2(N	10 <sub>3</sub> ) <sub>2</sub>	1 mabe	
mass % mass % mass	<pre>% mol/kg</pre>	mass %	mass %	mass %	mol/kg	j	
		7.00	78.00 68.50	22.00 24.50			
47.47         4.15         48.38           46.30         5.00         48.70           30.60 <sup>C</sup> 69.40 <sup>C</sup>	2.379 2.409 5.756	10.29 13.56	45.15 41.17 	44.56 45.27	2.040 2.099 	B B B	
Compositio	on of the Sat	urated S	olutions	at 20 <sup>0</sup> 0	a		
	* * *	1.10	91.22 86.40	8.78 12.50			
43.52 3.87 52.61 45.60 54.40			42.88	49.02	2.440	B B	
<sup>a</sup> Moles per 1 kg of the 1	mixture consi	sting of	water a	nd ether	(compi	lers).	
<sup>b</sup> Solid phase: $A = UO_2(NG)$	$(D_3)_2, B = UO_2$	(NO3)2.6	н <sub>2</sub> о.				
<sup>C</sup> Typographical errors in are: 51 mass % of wate	the table.	From the	phase d	iagram t (compile	he valu ers).	les	
	AUXILIARY	INFORMAT	ION				
METHOD/APPARATUS/PROCED	JRE:	SOURCE	AND PUR	ITY OF M	ATERIA	LS:	
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 <sub>3</sub> O <sub>8</sub> .						by	
		ESTIMA	TED ERRC	RS:			
	Nothi	Nothing specified.					
REFERENCES: 1. Misciatelli, P. Gazz. Chim. Italiana, <u>1930</u> , 60 83. 2. Marketos, M. Bull. Soc. Chim., <u>1912</u> , 11, 24 Compt. Rend., <u>1912</u> , 155, 210. 3. DeForcrand, R. Ann. Chim., <u>1915</u> , 3, 5.					1, 244.		

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	ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Van Name, R. G.	
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Report, <u>1942</u> , AECD-4086.	
(3) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES:	PREPARED BY:	
Composition at 274 K	A. Sozanski; S. Siekierski	
EXPERIMENTAL VALUES:	Landan	
A few small crystals <sup>a</sup> were observed composition:	d at the following organic phase	
Component Mol fra	ction mol/kg <sup>b</sup>	
Ether 0.43 Water 0.07		
$UO_2(NO_3)_2$ 0.48		
<sup>D</sup> Molality calculated by the comp		
AUXILIARY II		
AUXILIARY II		
AUXILIARY II METHOD/APPARATUS/PROCEDURE: Experiments were conducted in 50 cm <sup>3</sup> conical flask. The uranyl nitrate was weighed, then partially dehydrated by	NFORMATION	
AUXILIARY II METHOD/APPARATUS/PROCEDURE: Experiments were conducted in 50 cm <sup>3</sup> 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	NFORMATION SOURCE AND FURITY OF MATERIALS: Uranyl nitrate hexahydrate; U <sub>3</sub> O <sub>8</sub> content 78.52, 78.58 mass %, (theor. 78.48). Absolute ether, Merck reagent.	
AUXILIARY II METHOD/APPARATUS/PROCEDURE: Experiments were conducted in 50 cm <sup>3</sup> 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,	NFORMATION SOURCE AND PURITY OF MATERIALS: Uranyl nitrate hexahydrate; U <sub>3</sub> O <sub>8</sub> content 78.52, 78.58 mass %, (theor. 78.48). Absolute ether, Merck reagent.	
AUXILIARY II METHOD/APPARATUS/PROCEDURE: Experiments were conducted in 50 cm <sup>3</sup> conical flask. The uranyl nitrate was	NFORMATION SOURCE AND PURITY OF MATERIALS: Uranyl nitrate hexahydrate; U <sub>3</sub> O <sub>8</sub> content 78.52, 78.58 mass %, (theor. 78.48). Absolute ether, Merck reagent.	

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COMPONENTS:	ORIGINAL MEASUREMENTS:				
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Bachelet, M.; Cheylan, E.				
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	J. Chim. Phys., <u>1947</u> , 44, 234 - 253.				
(3) Water; H <sub>2</sub> O; [7732-18-5]					
VARIABLES:	PREPARED BY:				
T/K = 113 to 303 K	L. Fuks; S. Siekierski				
EXPERIMENTAL VALUES:					
The solubility of uranyl nitrate dihydrate in ethyl ether, $(C_2H_5)_2O_1$ , in the temperature range 113 - 303 K is presented only in the form of a phase diagram. The composition of the crystals which are in equilibrium with the solution was established as $UO_2(NO_3)_2.x(C_2H_5)_2O_2$ . In the temperature range +15°C to 0°C, $x = 1.98$ 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).					
AUXILIARY I	NFORMATION SOURCE AND PURITY OF MATERIALS:				
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.	Uranyl nitrate dihydrate and anhydrous ether were used.				
Formula of the uranyl species which precipitated from solution was found	ESTIMATED ERRORS:				
by analysis of the crystals. These crystals precipitated upon cooling the saturated solutions to desired	Temperature: <u>+</u> 1 K.				
temperature: from $+45^{\circ}$ C to $+15^{\circ}$ C; from $+15^{\circ}$ C to $0^{\circ}$ C; from 0 to $-3$ , $-7^{\circ}$ or $-15^{\circ}$ C, respectively; from $-15^{\circ}$ C to $-30^{\circ}$ C; and from $-30^{\circ}$ C to $-80^{\circ}$ 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, precipita- tion with ammonia and calcining at 700°C to U <sub>20</sub> ; or by weighing the uranium nitrate dihydrate crystals after ether evaporation in an air	REFERENCES :				
stream at room temperature. Ether content calculated as the mass difference of the crystals and the measured uranium nitrate dihydrate.					

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NG [15905-86-9]	0 <sub>3</sub> ) <sub>2</sub> ;	EVALUATOR: Yaffe, L.		
(2) Various ethers		Can. J. Res., <u>1949</u> , 27B, 638 - 645.		
(3) Water; H <sub>2</sub> O; [7732-18-	5]			
VARIABLES: One temperature: 293 K		PREPARED BY: L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES:	······	1		
The solubility of UO <sub>2</sub> (NO	3) <sub>2</sub> in vario	us ethers at	: 25 <sup>0</sup> C is reported as:	
			UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O	
Ether	Form	ula	g/100 cm <sup>3</sup>	
Diethyl ether [60-29-7]	(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0		74	
Triethylene glycol dichloride [112-26-5]	(-cH <sub>2</sub> ocH <sub>2</sub> CH <sub>2</sub> Cl) <sub>2</sub>		57	
Dichloroisopropyl ether	(CH <sub>3</sub> ) <sub>2</sub> C(C	1) oc ( c1 ) ( cH <sub>3</sub>	) <sub>2</sub> 5	
Diisopropyl ether [108-20-3]	(CH <sub>3</sub> ) <sub>2</sub> CHO	сн(сн <sub>3</sub> ) <sub>2</sub>	9	
Dimethyl dioxane	C6H14O2	92		
Butyl ether [142-96-1]	сн <sub>3</sub> (сн <sub>2</sub> ) 3	o(cH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub>	16	
4-Butoxy butanol	сн <sub>3</sub> (сн <sub>2</sub> ) <sub>3</sub> (	O(CH <sub>2</sub> ) <sub>4</sub> OH (Con	49 tinued on the next page)	
	AUXILIARY II	NFORMATION		
Isothermal method was used. 25 cm <sup>3</sup> 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				
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COMPONENTS:	EVALUATOR:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yaffe, L.
(2) Various ethers	Can. J. Res., <u>1949</u> , 27B, 638 - 645.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

The solubility of  $UO_2(NO_3)_2$  in various ethers at 25<sup>O</sup>C is reported as:

Ether	Formula	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O g/100 cm <sup>3</sup>
Pentyl ether [693-65-2]	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> 0(CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub>	11
Hexyl ether [112-58-3]	сн <sub>3</sub> (сн <sub>2</sub> ) <sub>5</sub> 0(сн <sub>2</sub> ) <sub>5</sub> сн <sub>3</sub>	9
Octyl ether [629-82-3]	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>7</sub> O(CH <sub>2</sub> ) <sub>7</sub> CH <sub>3</sub>	17
Tetraethylene glycol dibutyl ether	сн <sub>3</sub> (сн <sub>2</sub> ) <sub>3</sub> осн <sub>2</sub> (сн <sub>2</sub> осн <sub>2</sub>	,) <sub>3</sub> CH <sub>2</sub> O(CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub>
		90
Xanthyl ether	C <sub>26</sub> H <sub>18</sub> O <sub>3</sub>	14

CONDONENTES	ODICINAL WEACHDEWENDE.		
COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	De Keyser, W. L.; Cypres, R.; Herrmann, M.		
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Bull. Centre Phys. Nucl. Universite Libre de Bruxelles,		
(3) Water; H <sub>2</sub> O; [7732-18-5]	No. 17, <u>1950</u> .		
VARIABLES:	PREPARED BY:		
T/K = 290 to 303 K	A. Sozanski; S. Siekierski		
EXPERIMENTAL VALUES:			
The Solubility of UO <sub>2</sub> (NO <sub>3</sub>	) <sub>2</sub> .6H <sub>2</sub> O in CH <sub>3</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub>		
Composition of Sat	urated Solutions <sup>a</sup>		
UO2 (NO3)2	Solid <sub>b</sub>		
$t/^{\circ}C$ mass % mol	Phase <sup>D</sup> /kg		
16.9 47.85 2.			
10.9 $47.85$ $2.$			
25 50.52 2.	591 A		
30 51.01 2.	642 A		
<sup>a</sup> Molalities calculated by the co	mpilers.		
<sup>b</sup> Solid phase: $A = UO_2(NO_3)_2.6H_2O_3$			
	(Continued on the next page)		
AUXILIARY I	NFORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. An excess of uranyl nitrate hexahydrate was placed in 20cm <sup>3</sup> 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 <sup>3</sup> aliquot was pipetted for weighing. Uranium was analyzed as U <sub>3</sub> O <sub>8</sub> after evaporation of solvent and water. The solid was then	<ol> <li>Nothing specified for the uranyl nitrate hexahydrate. The water of crystallization was 21.30 %, with 21.52 % theoretical.</li> </ol>		
dried at 120°C and calcined at 900°C	ESTIMATED ERROR:		
in a platinum crucible to a constant weight.	Soly: Reported solubilities are the mean of two values (except 25°C).		
	Temp: Nothing specified.		
	REFERENCES:		

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	De Keyser, W. L.; Cypres, R.;
[15905-86-9]	Herrmann, M.
(2) 2-Propoxy-2-propane; C <sub>6</sub> H <sub>14</sub> O;	Bull. Centre Phys. Nucl.
[108-20-3]	Universite Libre de Bruxelles,
(3) Water; H <sub>2</sub> O; [7732-18-5]	No. 17, <u>1950</u> .

The solubility of  $UO_2(NO_3)_2.6H_2O$  in  $(CH_3)_2CHOCH(CH_3)_2$  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).

COMPONENTS:				ORIG	INAL MEASURE	MENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]				Katzin, L. I.; Sullivan, J. C.			
				Ј.	Phys. Chem.,	<u>1951</u> , 55	, 346 <del>-</del> 374.
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7] (3) Water; H <sub>2</sub> O; [7732-18-5]							574.
(3) Water;	H <sub>2</sub> 0; [7732-	18-5}					
VARIABLES:				PREI	PARED BY:		
Composition at 298 K				Α.	Sozanski; S.	Siekiers	ki
EXPERIMENTA					. <u> </u>		<u></u>
	The $UO_2(NO)$	<sub>3</sub> ) <sub>2</sub> - (CH <sub>3</sub> C	<sup>H</sup> 2 <sup>)</sup> 2 <sup>0</sup>	) - H	I <sub>2</sub> 0 System at	25°C <sup>a</sup>	
A	Aqueous Phas	e			Organic Phas	se	
	10 <sub>3</sub> ) <sub>2</sub>			_	NO <sub>3</sub> ) <sub>2</sub>		Solid <sub>b</sub> Phase
mass %	mol/kg	mass %	mas	35 %	mol/kg	mass %	
10.27 29.05 36.23 38.44 44.24	0.245 0.2905 1.039 1.442 1.585 2.014 2.067 2.276	94 83.49 80.86 66.44 59.71 56.14 51.75 53.25 44.23	0. 5. 19. 24. 34. 39.	- 00 .00 .80 .35 .32 .52 .42 .97	0.000 0.156 0.6089 0.8155 1.338 1.651	1.25 1.25 1.10 2.04 4.23 5.49 7.55 7.79 8.95	
55.48 55.47	3.163 3.174	42.20 41.93	49. 54. 54. 54.	60 70 95 28 71	2.508 3.096 3.013 3.066	9.32 9.36 8.36 7.56 7.21	A A A+B A+B A+B
			55.	49	3.164 (Continued		
		AUXILIA	RY II	FORM	ATION		
METHOD/APPA	RATUS/PROCE	DURE:		SOUR	CE AND PURIT	Y OF MATE	RIALS:
solid and 1 brated by s one week. I mixtures we a few hours closed to t protected f were perfor	mal method iquid mixtu stirring for iquid-liqui re equilibr . Equilibri the atmosphe from strong med on the	re was equi approximat d distribut ated for on um vessels re, and light. Anal principle o	li- ely ion ly were yses f	9 1 d 1 2. D 1	Jranyl nitrate grade. Malling Lower hydrates lesiccation of 1 <sub>2</sub> SO <sub>4</sub> , under 1 Diethyl ether redistilled.	ckrodt Che s prepared ver concen reduced p:	emical Co d by ntrated ressure.
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 $U_2O_6$ ; the organic component was estimated by the difference. Water was measured by Karl Fischer reagent.			Temp: Precision ±0.03 K.				
Solid phase of filter p pressure pr perceptible sample was analysis, a	was dried oaper until oduced only wetting of weighed for and thee sam water anal	between she moderate a barely the paper. the uranium ples were	ets One	1. 5	Schreinemaker: . physik. Che		

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Katzin, L. I.; Sullivan, J. C.
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	J. Phys. Chem., <u>1951</u> , 55, 346 - 374.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

The  $UO_2(NO_3)_2$  -  $(CH_3CH_2)_2O$  -  $H_2O$  System at  $25^{O}C^{A}$ Aqueous Phase Organic Phase

U0 <sub>2</sub> (	NO3)2	H <sub>2</sub> 0		NO <sub>3</sub> ) <sub>2</sub>	H20	Solid.
mass %	mol/kg	mass %	mass %	mol/kg	mass &	Solid <sub>b</sub> Phase
			53.01 53.69	2.863	6.30 6.16	B+C B+C
			53.16	2.342	5.39	С
			53.39	2.907	4.72	č

<sup>a</sup>Molalities calculated by the compilers as mole per 1 kg of the mixture consisting of diethyl ether and water.

<sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2 \cdot 6H_2O$ ,  $B = UO_2(NO_3)_2 \cdot 3H_2O \cdot (C_2H_5)_2O$ ,  $C = UO_2(NO_3)_2 \cdot 2H_2O \cdot 2(C_2H_5)_2O$ .

#### COMMENTS AND/OR ADDITIONAL DATA:

A plot of the water molality versus the uranyl nitrate molality in the organic phase yields a linear relation 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. A phase diagram is given in the source paper.

COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Warner, R. K.			
(2) 2-Propoxy-2-propane; C <sub>6</sub> H <sub>14</sub> O; [108-20-3]	Australian J. Appl. Sci., <u>1952</u> , 3 156 - 172.			
(3) Water; H <sub>2</sub> O; [7732-18-5]				
VARIABLES:	PREPARED BY:			
One temperature: 293 K	L. Fuks; S. Siekierski			
EXPERIMENTAL VALUES:	L			
Solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O in	(CH <sub>3</sub> ) <sub>2</sub> CHOCH(CH <sub>3</sub> ) <sub>2</sub> - H <sub>2</sub> O System			
The two phase system consisting of ether and water and in the presence of the solid complex (probably UO <sub>2</sub> (NO <sub>3</sub> ).3H <sub>2</sub> O.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).				
	g in the water-rich phase;			
compilers).				
Compilers). AUXILIARY II 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	NFORMATION SOURCE AND PURITY OF MATERIALS: 1. AR grade UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, or purified by diethÿl ether dissolving, evaporating the solvent, and crystallization from distilled water. 2. Diisopropyl ether redistilled after peroxide removal by the			
compilers).         AUXILIARY II         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	NFORMATION SOURCE AND PURITY OF MATERIALS: 1. AR grade UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, or purified by diethyl ether dissolving, evaporating the solvent, and crystallization from distilled water. 2. Diisopropyl ether redistilled			
Compilers). AUXILIARY II 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	NFORMATION SOURCE AND PURITY OF MATERIALS: 1. AR grade UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, or purified by diethyl ether dissolving, evaporating the solvent, and crystallization from distilled water. 2. Diisopropyl ether redistilled after peroxide removal by the			
Compilers). AUXILIARY II 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	<pre>NFORMATION SOURCE AND PURITY OF MATERIALS: 1. AR grade UO_(NO_)6H_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.</pre>			
Compilers). AUXILIARY II 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	<pre>NFORMATION SOURCE AND PURITY OF MATERIALS: 1. AR grade UO_(NO_)6H_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.</pre>			

COMPONENTS:		ORIGI	NAL MEASURE	MENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO [15905-86-9]						
			Katzin, L. I.; Sullivan, J. C.			
(2) 1,2-Diethoxy ethane; C <sub>6</sub> H <sub>14</sub> O <sub>2</sub> ; [629-14-1]			J. Phys. Chem., <u>1951</u> , 55, 346 - 374.			
(3) Water; H <sub>2</sub> O; [7732-18-5	3					
VARIABLES:		PREPA	RED BY:			
Composition at 298 K		A. So	ozanski; S.	Siekiersk:	i	
EXPERIMENTAL VALUES:						
The $UO_2(NO_3)_2 - CH_3$	сн <sub>2</sub> осн <sub>2</sub> сн2	осн <sub>2</sub> сн <sub>3</sub>	– H <sub>2</sub> O Syst	em at 25°	c <sup>a</sup>	
Aqueous Phase			Organic Pha	5e		
U02(N03)2	н <sub>2</sub> 0	UO2(N	10 <sub>3</sub> ) <sub>2</sub>	<sup>H</sup> 2 <sup>O</sup>	Solid Phase <sup>b</sup>	
mass % mol/kg m	ass % m	ass %	mol/kg	mass %	Filuse	
16.55 0.5033 6 20.47 0.6532 5 25.93 0.8884 5 29.13 1.043 5	1.06 5.52 1 6.19 2 5.83 2	8.16 7.22 4.14 9.69 3.73	0.225 0.5279 0.8076 1.702 1.972	3.28 4.56 6.88 9.10 10.45 11.52		
	9.83 5 5 5	3.49 4.05 4.18 5.31 4.25	2.919 2.985 3.001 3.141 3.009	12.55 12.22 11.91 10.77 10.31	A A A A A+B	
	AUXILIARY	TNFORM		d on the i	next page)	
METHOD/APPARATUS/PROCEDURE		1	SOURCE AND PURITY OF MATERIALS:			
		1				
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		d 2. Lo de a H, e 3. Et	wer hydrate hydration c SO <sub>4</sub> under r hylene glyc P. grade.	s prepared of hexahyd: educed pro	d by rate over essure.	
residues (1). Samples were for uranium and water. To	avoid	ESTIN	ESTIMATED ERROR:			
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 <sub>2</sub> O <sub>8</sub> . Organic component was estimated by			Soly: The average deviation of uranium and water analyses was ±0.1% and ±0.3%, respectively.			
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.			<pre>XENCES: chreinemaker</pre>	s, F. A. 1	н.	
			Z. physik. Chem., <u>1893</u> , 11, 81.			

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COMPONENTS:		<u></u>	ORIGI	NAL MEASUREN	IENTS:	
(1) Uranyl [15905-	nitrate; UO <sub>2</sub> ( 86-9]	(NO <sub>3</sub> ) <sub>2</sub> ;		Katzin, L. I.; Sullivan, J. C.		
(2) 1,2-Diethoxy ethane; C <sub>6</sub> H <sub>14</sub> O <sub>2</sub> ; [629-14-1]			J. P	hys. Chem.,	<u>1951</u> , 55,	346 - 374.
(3) Water; H <sub>2</sub> O; [7732-18-5]						1
EXPERIMENTA	L VALUES: (Co	ontinued)				
The	$UO_2(NO_3)_2 - 0$	сн <sub>з</sub> сн <sub>2</sub> осн <sub>2</sub> сі	н <sub>2</sub> осн <sub>2</sub> сн <sub>3</sub>	- н <sub>2</sub> 0 - Sys	stem at 25	°c <sup>a</sup>
	Aqueous Phase	3		Organic Phas	e	
UO2(N	10 <sub>3</sub> ) <sub>2</sub>	H <sub>2</sub> O	UO2(N	0 <sub>3</sub> ) <sub>2</sub>	H <sub>2</sub> 0	Solidb
mass %	mol/kg	mass %	mass %	mol/kg	mass %	Phase
			45.63	2.130	6.57	B+C
			45.08 45.60	2.083 2.127	6.32 6.33	B+C B+C
			46.01	2.163	6.48	B+C
			48.21	2.362	5.86	с
mixtu	ities calcula re consisting ater.	ted by the of ethyle	compiler: ne glycol	s as moles p diethyl eth	er 1 kg o er (cello	f the solve)
<sup>b</sup> solid	phases: A =	UO2(NO3)2.6	6H <sub>2</sub> O, B =	UO2(NO3)2.3	H_O. (C_H_	1 <sup>0</sup> 2),
		UO2(NO3)2.			2 01	Ŧ £
COMMEN	TS AND/OR ADE			14 2		
with t Anothe format	to either imp the organic ma r complication ion in the so by reaction	aterial, som on experience olid phase of	me aberra ced with of what w	nt liquid po this solvent as probably	ints were : was a sl	found. ow
in the to fal slope	of the water organic phas l on this lir is within exp trations, the	se is quite ne. At low u perimental e	linear. uranyl ni error and	Only the hig trate concen is equal to	hest poin trations,	ts fail the
A phas	e diagram is	given in th	ne source	publication	l <b>.</b>	
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COMPONENTS (1) Uranyl [15905-	COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]				ORIGINAL MEASUREMENTS: Katzin, L. I.; Sullivan, J. C.		
(2) Hexyl ether; C <sub>12</sub> H <sub>26</sub> O; [112-58-3]				J. Phys. Chem., <u>1951</u> , 55, 346 - 374.			
(3) Water;	H <sub>2</sub> 0; [7732	-18-5]					
VARIABLES: Composition	n at 298 K			ARED BY: Sozanski; S.	. Siekiers	ski	
EXPERIMENT	AL VALUES:						
The 1	UO2(NO3)2 -	• сн <sub>3</sub> (сн <sub>2</sub> ) <sub>4</sub> сн	20CH2 (CH2	) <sub>4</sub> CH <sub>3</sub> - H <sub>2</sub> O	System at	: 25 <sup>0</sup> C	
	Aqueous Ph	ase		Organic Pha	ise		
	NO <sub>3</sub> ) <sup>a</sup>	<sup>н</sup> 20		NO <sub>3</sub> ) <sup>a</sup>	Н_О	Solid	
mass %		mass %				Phase •	
		99			0.1		
	1.575	60.44		0.00	0.1	_	
55.31	3.141	43.42	3.27 13.54	0.0858 0.3974	0.31 1.27	A A	
			18.09	0.5603 0.5780	1.92	A+B A+B	
			17.82		1.93		
			22.19	0.7237 0.7615	2.66 2.06		
a Mola	lities calc	ulated by co	mpilers a	s moles per		:he	
mixt	ure consist	ing of hexyl	mpilers a ether an	s moles per d water.	1 kg of t	:he	
mixt	ure consist 1 phases: A	ing of hexyl = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	mpilers a ether an .6H <sub>2</sub> O, B	as moles per ad water. = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .	l kg of t .3H <sub>2</sub> O,	:he	
mixtu <sup>b</sup> Solid	ure consist 1 phases: A C	$u_{2} = UO_{2}(NO_{3})_{2}$ $u_{3} = UO_{2}(NO_{3})_{2}$	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C	as moles per ad water. = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .	l kg of t .3H <sub>2</sub> O,	:he	
mixto <sup>b</sup> Solid COMMEN A plot in the slope	ure consist 1 phases: A C NTS AND/OR t of the wa e organic p is equal t	ing of hexyl $X = UO_2(NO_3)_2$ $C = UO_2(NO_3)_2$ ADDITIONAL D ther molality whase is well to 2.0, withi	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim	is moles per id water. = $UO_2(NO_3)_2$ . $C_6H_{13})_2O$ (?). the uranyl ni- thed by a structure of the structure of th	1 kg of t .3H <sub>2</sub> O,	lality	
mixto <sup>b</sup> Solid COMMEN A plot in the slope	ure consist 1 phases: A C NTS AND/OR t of the wa e organic p is equal t	ing of hexyl $A = UO_2(NO_3)_2$ $C = UO_2(NO_3)_2$ ADDITIONAL D ther molality whase is well is given in	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim	as moles per ad water. = $UO_2(NO_3)_2$ $C_6H_{13})_2O$ (?) the uranyl ni- thed by a stri- thental error se publication	1 kg of t .3H <sub>2</sub> O,	lality	
mixto <sup>b</sup> Solid COMMEN A plot in the slope A phas METHOD/APPA	ure consist d phases: A C NTS AND/OR t of the wa e organic p is equal t se diagram ARATUS/PROC	ing of hexyl $A = UO_2(NO_3)_2$ $C = UO_2(NO_3)_2$ ADDITIONAL D oter molality whase is well to 2.0, withit is given in AUXILIA EEDURE:	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim the source RY INFORM	as moles per ad water. = $UO_2(NO_3)_2$ $C_6H_{13})_2O$ (?) the uranyl ni- thed by a stri- thental error se publication	1 kg of t .3H <sub>2</sub> O,	ality ne. The	
METHOD/APPA The isother and liquid by stirring week. Liqu	ure consist d phases: A C NTS AND/OR t of the wa e organic p is equal t se diagram ARATUS/PROC rmal method mixture we g, usually id-liquid d	ing of hexyl $A = UO_2(NO_3)_2$ $C = UO_2(NO_3)_2$ ADDITIONAL D ter molality thase is well to 2.0, withit is given in AUXILIA	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim the sourc RY INFORM olid ted 1. U e L	as moles per ad water. = $UO_2(NO_3)_2$ $G^H_{13}_2O$ (?) the uranyl ni- ted by a structure ted by a structure tental error. te publication (ATION	1 kg of t .3H <sub>2</sub> O,	ality ne. The RIALS: drate, ( ed by	
mixto <sup>b</sup> Solid COMMEN A plot in the slope A phas METHOD/APPA The isother and liquid by stirring week. Liquid mixtures we few hours.	ure consist d phases: A C NTS AND/OR t of the wa e organic p is equal t se diagram ARATUS/PROC rmal method mixture we g, usually id-liquid d dere equilib Equilibriu	ing of hexyl $A = UO_2(NO_3)_2$ $C = UO_2(NO_3)_2$ ADDITIONAL D ter molality whase is well to 2.0, withing is given in AUXILIA EEDURE: I was used. So for about on distribution was vessels we	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim the source RY INFORM SOUR olid ted ly a sre 2. H	as moles per ad water. = $UO_2(NO_3)_2$ $C_6H_{13}_2O$ (?) the uranyl ni- ted by a str tental error te publication <b>EXAMP PURIT</b> URANYL hydrate lesiccation of	1 kg of t .3H <sub>2</sub> O,	ality ne. The RIALS: Arate, C	
METHOD/APPA The isother and liquid by stirring week. Liqui mixtures we few hours. closed to a from strong	ure consist d phases: A C NTS AND/OR t of the wa e organic p is equal t se diagram ARATUS/PROC rmal method mixture we g, usually id-liquid d ere equilib Equilibriu atmosphere, g light. An	ing of hexyl $A = UO_2(NO_3)_2$ $C = UO_2(NO_3)_2$ ADDITIONAL D ther molality whase is well is given in AUXILIA EEDURE: A was used. S are equilibration for about on distribution orated for on m vessels we and protect halves were	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim the source RY INFORM olid ted ly a ere ed ESTI	is moles per id water. = $UO_2(NO_3)_2$ $C_6H_{13})_2O$ (?) the uranyl ni- the dby a stri- the dby a stri- the uranyl ni- the uranyl ni- the uranyl ni- the uranyl hydrate lesiccation of sulfuric acid	1 kg of t .3H <sub>2</sub> O,  itrate mol raight lin on. <b>FY OF MATE</b> te hexahyd es prepare over conce 1. C.P.	ality ne. The RIALS: drate, ( ed by	
mixto <sup>b</sup> Solid COMMEN A plot in the slope A phas METHOD/APPA The isother and liquid by stirring week. Liquid by stirring mixtures we few hours. closed to a from strong carried out residues (1 for uraniuu solvent di	ure consist d phases: A C NTS AND/OR t of the wa e organic p is equal t se diagram ARATUS/PROC rmal method mixture we g, usually id-liquid d ere equilib Equilibriu atmosphere, g light. An t on the pr 1). Sampless m and water fficulties,	ing of hexyl = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ADDITIONAL D ter molality hase is well to 2.0, withi is given in AUXILIA EEDURE: Was used. Sa for about on distribution brated for on the vessels we and protect halyses were inciple of w were analyze . To avoid samples for	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim the source RY INFORM olid ted ly a re ed et ed ESTI et soly	as moles per ad water. = $UO_2(NO_3)_2$ $C_6H_{13})_2O$ (?) the uranyl ni- ted by a structure ted by a structure ted by a structure ter uranyl ni- ter uranyl ni- ter uranyl hydrate CE AND PURITY Uranyl hydrate cover h	1 kg of t .3H <sub>2</sub> O,	ality ne. The <b>ERIALS:</b> drate, ( ed by entrated	
mixto <sup>b</sup> Solid COMMEN A plot in the slope A phas METHOD/APPA The isother and liquid by stirring week. Liqu: mixtures we few hours. closed to a from strond carried out residues (1 for uraniun solvent di uranium and volume in a methanol.	ure consist d phases: A C NTS AND/OR t of the wa e organic p is equal t se diagram ARATUS/PROC rmal method mixture we g, usually id-liquid d ere equilib Equilibriu atmosphere, g light. An t on the pr 1). Sampless m and water fficulties, alysis were a mixture o Aliquots we	ing of hexyl = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ADDITIONAL D ther molality whase is well is given in AUXILIA EEDURE: Was used. S are equilibration barted for one and protect halyses were inciple of w were analyz To avoid samples for e made up to of water and protect and ser e withdrawn	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim the source RY INFORM olid ted ly a et ed et ed Soly of Temp	as moles per ad water. = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>13</sub> ) <sub>2</sub> O (?) the uranyl ni- ted by a str tental error te publication (ATION CE AND PURIT Uranyl hydrat desiccation of the uranyl ether, (MATED ERROR (*) The average uranium an	1 kg of t .3H <sub>2</sub> O,         	ality ne. The <b>ERIALS:</b> drate, ( ed by entrated	
METHOD/APPA The isother and liquid by stirring week. Liqu mixtures we few hours. closed to a from strong carried our residues (1 for uranium solvent di uranium ana volume in a methanol.	ARATUS/PROC main method mixture we g, usually id-liquid d equilibriu atmosphere, g light. An t on the pr 1). Samples m and water fficulties, alysis were a mixture of Aliquots we a mixture of aliquots we	ing of hexyl = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ADDITIONAL D ther molality hase is well to 2.0, withi is given in AUXILIA EDURE: I was used. S bre equilibra for about on Distribution orated for on un vessels we and protect inciple of w s were analyz . To avoid samples for e made up to of water and ere withdrawn ted to U <sub>2</sub> O <sub>0</sub> .	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim the sourc RY INFORM olid ted ly a re ed ESTI et ed Soly of Temp	as moles per ad water. = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> . C <sub>6</sub> H <sub>13</sub> ) <sub>2</sub> O (?). the uranyl ni- ted by a structure ted by a structure terror.	1 kg of t .3H <sub>2</sub> O,         	ality ne. The <b>ERIALS:</b> drate, ( ed by entrated	
mixto b Solid A plot in the slope A phas METHOD/APPA The isother and liquid by stirring week. Liqui mixtures we few hours. closed to a from strong carried out residues () for uranium solvent di uranium and volume in methanol. A evaporated Organic con difference	ure consist d phases: A C NTS AND/OR t of the wa e organic p is equal t se diagram ARATUS/PROC rmal method mixture we g, usually id-liquid d ere equilib Equilibriu atmosphere, g light. An t on the pr 1). Samples m and water fficulties, alysis were a mixture o Aliquots we , and ignit mponent was . Water det	ing of hexyl = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ADDITIONAL D ther molality base is well to 2.0, withi is given in AUXILIA EDURE: I was used. S are equilibration brated for on the vessels we and protect balyses were inciple of w s were analyz . To avoid samples for e made up to of water and are withdrawn te to U <sub>2</sub> O <sub>8</sub> . s estimated by K	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: versus t represen n experim the source RY INFORM olid ted ly a re ed ed e ed ESTI et ed Soly	as moles per ad water. = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> . C <sub>6</sub> H <sub>13</sub> ) <sub>2</sub> O (?) the uranyl ni- ted by a stri- tental error. te publication (ATION CE AND PURIT Uranyl hydrate desiccation of the uranyl hydrate cover hydrate desiccation of the average uranium and were ±0.1 respective CE ENCES:	1 kg of t .3H <sub>2</sub> O,	ality he. The <b>ERIALS:</b> drate, ( d by entrated ion of analyses .3%,	
METHOD/APPA The isother and liquid by stirring week. Liqui mixtures we few hours. closed to a from strond carried out residues (1 for uraniun solvent di uranium and volume in methanol. A evaporated Organic con difference Fischer rea dried betw	ARATUS/PROC mixture wa atmosphere, glight. An atmosphere, glight. Atmosphere, glight. Atmosphe	ing of hexyl = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ADDITIONAL D ther molality hase is well to 2.0, withi is given in AUXILIA EDURE: I was used. S bre equilibra for about on Distribution orated for on un vessels we and protect inciple of w s were analyz . To avoid . samples for e made up to of water and ere withdrawn ted to U <sub>2</sub> O <sub>8</sub> .	mpilers a ether an .6H <sub>2</sub> O, B .2H <sub>2</sub> O.2(C ATA: Versus t represen n experim the source RY INFORM Olid ted 1. U e 2. H ed 2. H ed 2. H ed 5019 of Temp y REFE arl 1. S	as moles per ad water. = UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>13</sub> ) <sub>2</sub> O (?) the uranyl ni ted by a str ted by a str ter publication (ATION CE AND PURIT Granyl hydrat cover hydrate lesiccation of gulfuric acid dexyl ether, (MATED ERROR 7: The average uranium and were ±0.1 respective 0: Precision	1 kg of t .3H <sub>2</sub> O,       	ERIALS: ERIALS: drate, of ed by entrated ion of analyses .3%, H.	

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COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Warner, R. K.		
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Australian J. Appl. Sci, <u>1953</u> , 4, 427 - 443.		
(3) Water; H <sub>2</sub> O; [7732-18-5]			
VARIABLES:	PREPARED BY:		
Temperature: 275 and 293 K	L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES:	L		
Solubility of $UO_2(NO_3)_2$ in t	he (CH <sub>3</sub> CH <sub>2</sub> ) <sub>2</sub> O - H <sub>2</sub> O System <sup>a</sup>		
Composition of the Eth	er Saturated Phase		
Aqueous phase	Ether Phase		
t/ <sup>O</sup> C mass % mol/kg	mass % mol/kg		
2 48.3 2.37 20 54.3 3.01	46.3 2.19 49.1 2.45		
solid is the hexahydrate (compi	1615).		
AUXILIARY I	NFORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:		
The isothermal method was used. The procedure was based on the two phases	1. Uranyl nitrate hexahydrate, not specified, was purified (1).		
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	2. Diethyl ether redistilled after removal of peroxides by the standard sulfate method.		
intermittently agitated for further 2 hours, and the phases were analyzed for solute content to ensure	ESTIMATED ERROR:		
saturation had been reached. The uranium nitrate concentration was	Soly: Nothing specified.		
determined by evaporation of weighed aliquots, followed by ignition to	Temp: Precision ±0.05 K.		
<sup>U</sup> <sub>3</sub> <sup>O</sup> <sub>8</sub> .	REFERENCES:		
	1. Warner, R. K.		
	Australian J. Appl. Sci., <u>1952</u> , 3, 156.		

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	ORIGINAL MEASUREMENTS: Warner, R. K.	
(2) Various ethers	Australian J. Appl. Sci., <u>1953</u> , 4,   581 - 589.	
(3) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES: One temperature: 293 K	PREPARED BY: L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:	1	
The Solubility of UO <sub>2</sub> (NO <sub>3</sub> )	2.6H <sub>2</sub> O in Various Ethers	
Composition of Satur	ated Solutions <sup>a</sup>	
	U02(N03)2	
Ether Formula	g/(g soln) mol/kg	
Furan (110-00-9) 0 	0.003 0.0076	
Diethyl ether (C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0 [60-29-7]	0.491 2.451	
Dioxane / \ [123-91-1] 0 0	0.291 1.04	
Dibenzyl ether (C <sub>5</sub> H <sub>5</sub> CH <sub>2</sub> ) <sub>2</sub> O [103-50-4]	0.017 0.044	
<sup>a</sup> Molalities calculated by the co	mpilers.	
AUXILIARY I	NFORMATION	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	
The isothermal method was used. An	1. AR grade UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O.	
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	<ol> <li>Anhydrous furan synthesized by a standard method.</li> <li>C.P. anhydrous diethyl ether, dioxane, and dibenzyl ether.</li> </ol>	
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 concentra- tion was measured by evaporation of the weighed aliquots, followed by ignition to $U_{3}O_{8}$ .	ESTIMATED ERROR: Soly: Repeat determinations made until results agreed to within 0.2 mass %. Temp: Precision ±0.05 K.	
	REFERENCES:	

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COMPONENTS:		ORIGINAL MEASU	REMENTS:	
(1) Uranyl nitrat	e: UO_(NO_) :	Vdovenko, V. M.; Kovalskaya, M. P.;		
[15905-86-9]	2, 00, 2, 10, 3, 2,	Kovaleva, T. V.		
(2) Ethyl ether;	C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Zh. Neorg. Khim., <u>1957</u> , 2, 1677 - 1681.		
(3) Water; H <sub>2</sub> O; [7732-18-5]		Russ. J. Inc. 359-367.	rg. Chem., <u>1957</u> , 2,	
VARIABLES:		PREPARED BY:		
T/K = 273 to 298	к	L. Fuks; S. Si	ekierski	
EXPERIMENTAL VALU	ES:	- <b>I</b>		
UO2(NO3)2 -	C2H50C2H5 Anhydrous	System at Vario	ous Temperatures	
	Composition of Sat	urated Solutions	sa	
	Uranium	UO2(NO3)2		
t/°c	g/(100 g ether)	2' 3'2 mol/kg	Solid Phase	
0	4.6	0.24	A	
15 25	5.3	0.28 0.29	A A	
	calculated by the co			
	= $UO_2(NO_3)_2.2(C_2H)$			
		52		
1				
		(Continu	led on the next page)	
	AUXILIARY I	NFORMATION		
METHOD/APPARATUS/	PROCEDURE:	SOURCE AND PUR	ITY OF MATERIALS:	
Nothing specifie	d.	Nothing speci:	fied.	
		1		
		ESTIMATED ERROL	R:	
		Soly: Nothing	specified.	
		Temp: Nothing	specified.	
		REFERENCES:	····	
		ſ		

COMPONENTS:		ORIGINAL MEASUREME	ENTS:				
(1) Uranyl nitrate [15905-86-9]	; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	Vdovenko, V. M.; H Kovaleva, T. V.					
(2) Ethyl ether; (	C <sub>4</sub> H <sub>10</sub> O; [60-29-7]		Zh. Neog. Khim., <u>1957</u> , 2, 1677 -				
(3) Water; H <sub>2</sub> O; [7		Russ. J. Inorg. C 359-367.	1681. Chem., <u>1957</u> , 2,				
EXPERIMENTAL VALUE	S: (Continued)	<u></u>					
The UO2 (NO3)	) <sub>2</sub> - C <sub>2</sub> H <sub>5</sub> OC <sub>2</sub> H <sub>5</sub> - H	20 System at Various	Temperatures				
	Composition of S	aturated Solutions <sup>a</sup>					
t∕°c	Uranium	002(N03)2					
	g/(100 g ether)	mol/kg	Solid <sub>b</sub> Phase				
-60 -50	0.9	0.039	A				
-40	3.1 6.6	0.14 0.31	A A				
-30	9.7	0.48	A				
-20 -10	15.5 21.0	0.878 1.35	A A				
0	28.7	2.30	A+B				
10	31.1	2.69	В				
15 20	31.8 32.6	2.98	B B				
			2				
_	calculated by the						
Solid phases	$A = UO_2(NO_3)_2.2$	$H_{2^{0.4(C_{2}H_{5})}2^{0.}}$					
	$B = UO_2(NO_3)_2 \cdot 2$	H <sub>2</sub> 0.2(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0.					
The UO,	$(NO_3)_2 - (C_2H_5)_2C_3$	) - H <sub>2</sub> O System at 15 <sup>0</sup> 0	2				
		aturated Solutions					
	Uranium	Solid Phase	a				
	g/(100 g ether)						
	31.8	UO2(NO3)2.2H20.2	2(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0				
	29.9	U0 <sub>2</sub> (N0 <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O.(	(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> O				
	5.3	U02(N03)2.2(C2H5	5 <sup>)</sup> 2 <sup>0</sup>				
Heat of Solu	Heat of Solution of Uranyl Nitrate Hydrates in Ether and Water						
_		of Solution, kJ/mol					
Form		20 (C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0					
UO2 (NO3)	2.6H <sub>2</sub> O 2	3.0 5.23					
U02(N03)		-29.6					
U02(N03)	2 <sup>2</sup> <sup>2</sup> <sup>2</sup> <sup>2</sup> <sup>2</sup> -2	-45.4					
U0 <sub>2</sub> (N0 <sub>3</sub> )	2 -4	9.8 -76.8					

184		

COMPONENTS:					
			ORIGINAL MEAS	SUREMENTS:	
(1) Uranyl nitrate; [15905-86-9]			Vdovenko, V Gerbanevska	. M.; Kovalskaya, M. P. va, M. M.	
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]			Trudy Radievogo Inst. im. V. G.		
(3) Water; H <sub>2</sub> O; [7732-18-5]			<i>Khlopina</i> , <u>1958</u> , 8, 8-16. (Report, <u>1958</u> , AEC-tr-4474, 8-19.)		
VARIABLES:			PREPARED BY:		
T/K = 213 - 293			A. Sozanski	; S. Siekierski	
EXPERIMENTAL VALUES	:		<u> </u>		
The Sol	ubility of 1	002(N03)	2.2H <sub>2</sub> 0 in CH	<sub>з</sub> сн <sub>2</sub> осн <sub>2</sub> сн <sub>3</sub>	
	Composition	of Satu	urated Solution	ons <sup>a</sup>	
	U	UO <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub>	Solid Phase <sup>b</sup>	
t∕ <sup>o</sup> c	mass %	mass %	mol/kg		
20	32.6 31.1	54.0 51.5	2.989 2.69	A	
	31.1 28.7	51.5 47.5	2.69	A	
U	28./	4/.5	2.30	λ	
	21.0	34.8	1.35	В	
		25.7		В	
	9.7	16	0.48	В	
	6.6	11	0.31	B	
-50 -60	3.1 0.9	5.1	0.14 0.039	B B	
<sup>a</sup> Molalities ca <sup>b</sup> Solid phases:	$A = UO_2(NO_2)$	3)2·2H2			
All 1	AUXI	LIARY I	FORMATION	, , , , , , , , , , , , , , , , , , ,	
METHOD/APPARATUS/PR	OCEDURE:		SOURCE AND P	URITY OF MATERIALS:	
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			obtained ) a hexahyd recrystal 2. Diethyl e	trate dihydrate was by vacuum drying of rate which had been lized three times. ther, for narcosis, lled and carefully	
solution which was starting material. then allowed to set	tle, and the	e clear			
solution which was starting material.	tle, and the	e clear	ESTIMATED ER	ROR:	
solution which was starting material. then allowed to set supernatant solutio	tle, and the	e clear	ESTIMATED ER		
solution which was starting material. then allowed to set supernatant solutio	tle, and the	e clear	ESTIMATED ER	in uranium analysis was	
solution which was starting material. then allowed to set supernatant solutio	tle, and the	e clear	ESTIMATED ER Soly: Error ±0.2%.	in uranium analysis was	
solution which was starting material. then allowed to set supernatant solutio	tle, and the	e clear	ESTIMATED ER Soly: Error ±0.2%. Temp: Nothing	in uranium analysis was	

COMPONENTS:			ORIGINAL MEASU	REMENTS:
(1) Uranyl nit [15905-86-	rate; UO <sub>2</sub> (NO 9]	<sub>3</sub> ) <sub>2</sub> ;	Vdovenko, V. M.; Kovaleva, T. V.; Moskalkova, E. A.	
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]			Trudy Radievogo Institute im. V.G. Khlopina, <u>1958</u> , 8, 17-21.	
(3) Water; H <sub>2</sub> 0; [7732-18-5]			Report, <u>1958</u> ,	AEC-tr-4474, 20-26.
VARIABLES:			PREPARED BY:	······································
T/K = 263 - 298			A. Sozanski; S.	. Siekierski
EXPERIMENTAL V	ALUES:		1	
	The UO <sub>2</sub> (No	о <sub>3</sub> ) <sub>2</sub> - (СН <sub>3</sub>	CH <sub>2</sub> ) <sub>2</sub> 0 - H <sub>2</sub> O Sys	stem
Compo	sition of the	e Ether Pha	se of the Satura	ated Solutions
	U	UO,	(NO <sub>3</sub> ) <sup>a</sup>	Solid <sub>b</sub> Phase <sup>b</sup>
t∕°c	mass %			Phase
<sup>b</sup> Solid ph	31.55 29.88 29.42 28.63 27.94 s % and mola ase: A = UO <sub>2</sub> olid: UO <sub>2</sub> (NO	(NO <sub>3</sub> ) <sub>2</sub> .3H <sub>2</sub> O	2.409 2.286 2.184 calculated by 1	A A A A A the compilers.
		AUXILIARY I	NFORMATION	
METHOD/APPARAT	US/PROCEDURE	:	SOURCE AND PUR	ITY OF MATERIALS:
The isothermal determinations apparatus cons cylinder provi fitted with a nitrate and et apparatus whic thermostat. Th thermostat was desired temper	method was a were made in isting of a ded with a si mercury seal her were place h was then si e temperature 10 C higher ature. The e tirred with the undisso he solution with the undisso tle for 30 m r solution with her apparature desired temp olid phase si on was stirre id was allow min. Analysis t of the eth	used. The n an glass tirrer, and . Uranyl ced in the et in a e of the than the ther the aqueous lved salt was then in. There- as trans- s, and was erature. On eparated, ed for 3 ed to s for the er solution	specified. 1 recrystalli: 2. Diethyl eth Probably "fo carefully d (compilers) ESTIMATED ERRON Nothing spect	R:
settle for 30 uranium conten	min. Analysis t of the eth	s for the er solution		

COMPONENTS:			ORIGINAL M	EASUREMENTS:	
(1) Uranyl nitr [15905-86-9	rate; UO <sub>2</sub> (NO <sub>3</sub>	3 <sup>)</sup> 2 <sup>;</sup>	Vdovenko, V. M.; Kovaleva, T. V.		
(2) Diethyl ether; $C_4H_{10}O;$ [60-29-7] (3) Water; $H_2O;$ [7732-18-5] VARIABLES: T/K = 273 to 298			Trudy Radievogo Institute im. V.G. Khlopina, <u>1958</u> , 8, 22-24. Report, 1958, AEC-tr-4474, 27-30.		
			A. Sozans	ki; S. Siekierski	
			EXPERIMENTAL VA	LUES:	
The	Solubility	of UO <sub>2</sub> (NO <sub>3</sub>	) <sub>2</sub> in CH <sub>3</sub> CH	2 <sup>0CH2</sup> CH3	
	Compositio	on of Satur	ated Soluti	ons <sup>a</sup>	
	U	00 <sub>2</sub> (	NO3) <sup>2</sup>	Solid Phase <sup>b</sup>	
t∕°c	mass %	mass %	mol/kg		
0 15 25	4.6 5.3 6.2	7.6 8.8 10.3	0.21 0.24 0.291	А А А	
	ase: $A = UO_2($	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub>	2 <sup>H</sup> 5)2 <sup>0</sup> .	NO <sub>3</sub> ) <sub>2</sub> .	
<sup>b</sup> Solid pha	se: $A = UO_2($	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub>	2 <sup>H</sup> 5)2 <sup>0</sup> .	NO3)2.	
<sup>b</sup> Solid pha	se: A = UO <sub>2</sub> ( al solid pha	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub> ase was anh	2 <sup>H</sup> 5)2 <sup>0</sup> .	NO <sub>3</sub> ) <sub>2</sub> .	
<sup>b</sup> Solid pha The initi	se: A = UO <sub>2</sub> ( al solid pha	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub> ase was and	H <sub>5</sub> ) <sub>2</sub> 0. Nydrous UO <sub>2</sub> (	NO3)2. PURITY OF MATERIALS:	
<sup>b</sup> Solid pha The initi <b>METHOD/APPARATU</b> The isothermal procedure is de	ase: A = UO <sub>2</sub> ( al solid pha al solid pha A S/PROCEDURE: method was u escribed in a	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub> ase was and AUXILIARY I	H <sub>5</sub> ) <sub>2</sub> O. ydrous UO <sub>2</sub> ( <b>INFORMATION</b> SOURCE AND 1. Anhydro prepare (2) fro	PURITY OF MATERIALS: us uranyl nitrate was d according to Marketos m $UO_2(NO_3)_2 \cdot 2H_2O$ .	
<sup>b</sup> Solid pha The initi METHOD/APPARATU The isothermal procedure is de	ase: A = UO <sub>2</sub> ( al solid pha al solid pha A S/PROCEDURE: method was u escribed in a	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub> ase was and AUXILIARY I	<pre>H<sub>5</sub>)<sub>2</sub>O. hydrous UO<sub>2</sub>( <b>INFORMATION</b> SOURCE AND 1. Anhydro prepare (2) fro 2. Diethyl Probabl purifie</pre>	PURITY OF MATERIALS: us uranyl nitrate was d according to Marketos	
<sup>b</sup> Solid pha The initi METHOD/APPARATU The isothermal procedure is de	ase: A = UO <sub>2</sub> ( al solid pha al solid pha A S/PROCEDURE: method was u escribed in a	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub> ase was and AUXILIARY I	<pre>H<sub>5</sub>)<sub>2</sub>O. hydrous UO<sub>2</sub>( <b>INFORMATION</b> SOURCE AND 1. Anhydro prepare (2) fro 2. Diethyl Probabl purifie</pre>	PURITY OF MATERIALS: us uranyl nitrate was d according to Marketos m $UO_2(NO_3)_2.2H_2O.$ ether not specified. y "for narcosis," and d by distillation and (compilers).	
<sup>b</sup> Solid pha The initi <b>METHOD/APPARATU</b> The isothermal procedure is de	ase: A = UO <sub>2</sub> ( al solid pha al solid pha A S/PROCEDURE: method was u escribed in a	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub> ase was and AUXILIARY I	<pre>H<sub>5</sub>)<sub>2</sub>O. ydrous UO<sub>2</sub>( INFORMATION SOURCE AND 1. Anhydro prepare (2) fro 2. Diethyl Probabl purifie drying ESTIMATED</pre>	PURITY OF MATERIALS: us uranyl nitrate was d according to Marketos m $UO_2(NO_3)_2.2H_2O.$ ether not specified. y "for narcosis," and d by distillation and (compilers).	
<sup>b</sup> Solid pha	ase: A = UO <sub>2</sub> ( al solid pha al solid pha A S/PROCEDURE: method was u escribed in a	(NO <sub>3</sub> ) <sub>2</sub> .2(C <sub>2</sub> ase was and AUXILIARY I	<pre>H<sub>5</sub>)<sub>2</sub>O. ydrous UO<sub>2</sub>( INFORMATION SOURCE AND 1. Anhydro prepare (2) fro 2. Diethyl Probabl purifie drying ESTIMATED</pre>	PURITY OF MATERIALS: us uranyl nitrate was d according to Marketos m UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2H <sub>2</sub> O. ether not specified. y "for narcosis," and d by distillation and (compilers). ERROR: specified.	

COMPONENTS:	EVALUATOR:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Vdovenko, V. M.; Suglobova, J. G.			
	Zh. Neorg. Khim., <u>1958</u> , 3, 1403 -			
(2) Butyl ether; C <sub>8</sub> H <sub>18</sub> O; [142-96-1]	1409.			
(3) Water; H <sub>2</sub> O; [7732-18-5]	Russ. J. Inorg. Chem., <u>1958</u> , 3, 187-196.			
VARIABLES:	PREPARED BY:			
One temperature: 298 K	L. Fuks; S. Siekierski			
EXPERIMENTAL VALUES:				
The $UO_2(NO_3)_2 - [CH_3(CH_2)_3]_2$	0 (Bu <sub>2</sub> O) - H <sub>2</sub> O System at 25 <sup>0</sup> C			
Composition of Satu				
Aqueous Phase	Ether Phase			
UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> H <sub>2</sub> O Bu <sub>2</sub> O <sup>b</sup>	UO2(NO3)2 H2O Bu2Op			
	mass % mol/kg mass % mass %			
0 0 99.9 0.1	0 0 0.15 99.85			
32.0         1.19         58.0         0           38.92         1.617         57.5         3.58	0.06 0.002 0.15 99.79 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           52.02         2.752	1.64 0.0423 0.35 98.01 5.22 0.140 0.74 94.04			
	(Continued on the next page)			
AUXILIARY II	NFORMATION			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:			
Dibutyl ether, uranyl nitrate hydrates and water were shaken in a thermostatted ampoule at 25°C, 7 to	<ol> <li>Dibutyl ether of the "purum" quality was dried (2).</li> </ol>			
10 days. After reaching equilibrium,	2. Various hydrates of uranyl			
the liquid phases were analyzed for uranium and water contents. Analysis	nitrate were obtained carefully purified UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O.			
for water was carried out by Karl Fischer titration; for uranium by the	ESTIMATED ERROR:			
ammonium diuranate precipitation followed by ignition to U.O. Two	Temp: Precision to $\pm 0.02^{\circ}$ C.			
different methods for the solid phase composition analysis were used:	Water content: ±0.5 to 1% of the investigated value.			
1. The solid was pressed between two sheets of filter paper in a steam of dry CO <sub>2</sub> , and then analyzed.	Uranium content: Cameron method ±1 to 1.5%. Ignition method ±3 to 6%.			
2. The Cameron method (1), using radioactive $Sn-(C_6H_6)_4$ as an	REFERENCES:			
additional component of the solution.	<ol> <li>Anosov, V. Ya.; Pogodin, S. A.</li> <li>"Basic Principles of Physico- Chemical Analysis," in Russian, Moscow, <u>1957</u>.</li> </ol>			
	<ol> <li>Weigand, K.</li> <li>"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>.</li> </ol>			

COMPONENTS:	EVALUATOR:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9]</pre>	Vdovenko, V. M.; Suglobova, I. G. Zh. Neorg. Khim., <u>1958</u> , 3, 1403 -
<pre>(2) Butyl ether; C<sub>8</sub>H<sub>18</sub>O; [142-96-1] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	1409. <i>Russ. J. Inorg. Chem., <u>1958</u>, 3,</i> 187-196.

The  $UO_2(NO_3)_2$  -  $[CH_3(CH_2)_3]_2O$  (Bu<sub>2</sub>O)- H<sub>2</sub>O System at 25<sup>O</sup>C Composition of Saturated Solutions<sup>a</sup>

UO <sub>2</sub> (1	NO <sub>3</sub> ) <sub>2</sub>	<sup>н</sup> 2 <sup>0</sup>	Bu <sub>2</sub> 0b
1255 %			
	mol/kg	mass %	mass %
7.72	0.212	0.96	91.32
8.39	0.232	1.02	90.59
9.12	0.255	1.15	89.73
0.14	0.2864	1.27	88.59
0.14	0.2864	1.28	88.58
7.65	0.5439	2.05	80.30
8.33	0.5696	2.09	79.58
26.27	0.9042	2.85	70.88~
32.07	1.198	3.35	64.58 <sup>C</sup>
31,90	1.189	3.32	64.78 <sup>d</sup>
	1.157	3.39	64.78 <sup>d</sup> 65.30 <sup>d</sup>
1.70	1,178	3.30	65.00 <sup>d</sup> 65.45 <sup>d</sup> 54.19
			65.45 <sup>d</sup>
			54.19 <sup>e</sup>
			54.78
			54.46
	1.796	3.57	54.99 <sup>e</sup>
4.05	1.998	2.97	52.98 <sup>f</sup>
7.46	0.205	0.21	92.33 <sup>g</sup>
			95.80 <sup>g</sup>
4.17	0.110		95.83 <sup>g</sup>
	8.39 9.12 0.14 10.14 10.14 17.65 18.33 26.27 32.07 31.90 31.31 31.70 31.48 12.19 11.80 12.22 11.44 14.05 7.46 4.17	8.39       0.232         9.12       0.255         10.14       0.2864         10.14       0.2864         10.14       0.2864         10.14       0.5696         26.27       0.9042         32.07       1.198         31.90       1.189         31.31       1.157         31.70       1.178         31.48       1.166         12.19       1.852         41.80       1.823         42.22       1.854         41.44       1.796         44.05       1.998         7.46       0.205         4.17       0.110	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

<sup>c</sup>Solid phase =  $UO_2(NO_3)_2 \cdot 6H_2O$ 

<sup>d</sup>Solid phase =  $UO_2(NO_3)_2.6H_2O + UO_2(NO_3)_2.3H_2O$ 

<sup>e</sup>Solid phase =  $UO_2(NO_3)_2 \cdot 3H_2O + UO_2(NO_3)_2 \cdot 2H_2O \cdot 2Bu_2O$ 

<sup>f</sup>Solid phase =  $UO_2(NO_3)_2 \cdot 2H_2O \cdot 2Bu_2O + UO_2(NO_3)_2 \cdot 2Bu_2O$ 

 $g_{\text{Solid phase}} = UO_2(NO_3)_2.2Bu_2O.$ 

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9] (2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7] (3) Water; H <sub>2</sub> O; [7732-18-5] VARIABLES: Composition at 298 K	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Suglobova, I. G. Suglobov, D. N. Radiokhim., <u>1959</u> , 1, 637 - 644. PREPARED BY: A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:				
The $UO_2(NO_3)_2 - (CH_3CH_2)_2$ Composition of Satura	2			
-				
<sup>UO</sup> 2 <sup>(NO</sup> 3)2 <sup>H</sup> 2 <sup>O</sup>	Ether Solid Phase <sup>b</sup>			
mass % mol/kg mass %				
53.61 2.933 4.95	41.44 A			
32.56       1.225       2.50         31.44       1.164       2.48         13.75       0.4046       1.02         11.23       0.3211       0.80         10.61       0.3012       0.78         2.31       0.0600       0.17         2.16       0.0560       0.15         1.33       0.0342       0.07         1.01       0.0259	66.08 B 85.23 B 87.97 B 88.61 B 97.52 B 97.69 B 98.6 B 98.6 B 98.99 B es of uranyl nitrate per 1 kg of and diethyl ether) and mass %			
<sup>b</sup> Solid phases: $A = UO_2(NO_3)_2.2H_2$	0.2(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0.			
$B = UO_2(NO_3)_2.2(C$	2 <sup>H</sup> 5 <sup>)</sup> 2 <sup>O</sup> •			
	(Continued on the next page)			
AUXILIARY I	NFORMATION			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:			
Solubility was determined as described previously (1).	Nothing specified. The uranyl nitrate hydrates were obtained as described previously (1).			
	ESTIMATED ERROR:			
	Nothing specified.			
	REFERENCES:			
	1. Vdovenko, V.M.; Suglobova, I.G. Zh. Neorg. Khim., <u>1958</u> , 3, 1403.			

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Vdovenko, V. M.; Suglobova, I. G.; Suglobov, D. N.		
(2) 2,2'-Dichloroethoxyethane; C <sub>4</sub> H <sub>8</sub> Cl <sub>2</sub> O; [111-44-4]	Radiokhim., <u>1959</u> , 1, 637 - 644.		
(3) Water; H <sub>2</sub> O; [7732-18-5]			

The  $UO_2(NO_3)_2$  -  $(CH_2ClCH_2)_2O$  -  $H_2O$  System at 25<sup>O</sup>C

Composition of Saturated Solutions<sup>a</sup>

U0 <sub>2</sub> (1	<sup>NO</sup> 3)2	н <sub>2</sub> 0	H <sub>2</sub> O UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>		н <sub>2</sub> 0	Ether
mass %	mol/kg	mass %	mass %	mol/kg	mass %	mass %
0	0	98.9	0	0	0.526	99.474
55.85	3.210	44.15	0.248	0.0645	0.824	96.69g~
			3.25	0.0852	0.910	96.696 <sup>D</sup> 95.84
			11.44	0.0852	1.80	86.84 <sup>b</sup>
			12.81	0.3729	1.66	85.53 <sup>C</sup>
			14.24	0.4214	2.12	83.64 <sup>C</sup>
			22.95	0.7559	2.33	74.72 <sup>C</sup>
			22.45	0.7347	2.35	75.2 <sup>d</sup> .
			25.00	0.8459	2.38	75.72 <sup>d</sup>
			26.03	0.8931	2.25	71.72 <sup>e</sup>
			16.32	0.4949	1.53	82.15 <sup>e</sup>
			10.00	0.2820	0.844	89.156 <sup>f</sup>
			0.762	0.0195	0.060	99.178 <sup>1</sup>

 $^{\rm a}{\rm Molality}$  of uranyl nitrate and mass % of ether calculated by the compilers.

<sup>b</sup>Solid phase =  $UO_2(NO_3)_2 \cdot 6H_2O$ . <sup>c</sup>Solid phases =  $UO_2(NO_3)_2 \cdot 6H_2O + UO_2(NO_3)_2 \cdot 3H_2O$ . <sup>d</sup>Solid phases =  $UO_2(NO_3)_2 \cdot 3H_2O + UO_2(NO_3)_2 \cdot 2H_2O$ . <sup>e</sup>Solid phases =  $UO_2(NO_3)_2 \cdot 2H_2O + UO_2(NO_3)_2 \cdot 2(CH_2ClCH_2)_2O$ <sup>f</sup>Solid phase =  $UO_2(NO_3)_2 \cdot 2(CH_2ClCH_2)_2O$ 

A triangular phase diagram is given in the source publication.

COMPONENTS: (1) Uranyl nit	ORIGINAL MEASUREMENTS:						
[15905-86-	9] 2 5	Vdovenko, V. M.; Suglobova, I. G.; Mezei, M.					
(2) 2-Propoxy- ether); C <sub>6</sub>	2-propane (iso H <sub>14</sub> 0; [108-20-		Radiokh	im., <u>196</u>	2, 4, 388	- 392.	
(3) Water; H <sub>2</sub> 0	Sov. Rad	iochem.,	<u>1962</u> , 4,	342-346.			
VARIABLES: Composition at	298 K		PREPARED A. Sozans		iekierski		
EXPERIMENTAL V	ALUES:						
The	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> - [	(CH <sub>3</sub> ) <sub>2</sub> CH]	<sub>2</sub> о - н <sub>2</sub> о s	ystem at	25 <sup>0</sup> C <sup>a</sup>		
Aqueous	Phase <sup>b</sup>	01	rganic Pha	se <sup>b</sup>	Solid	Phase	
UO2(NO3)2	H <sub>2</sub> O	U02 ( NO	0 <sub>3</sub> ) <sub>2</sub>	Н20	UO2(NO3	) <sub>2</sub> H <sub>2</sub> O	
mass % mol/k	g mass %	mass %	mol/kg	mass %	mass %	mass %	
36.65 1.468	62.81		 0.018	0.90			
45.40 2.110		5.33					
48.82 2.421		9.98		2.15		c	
	 50.60	10.60 10.40	0.3009 0.2946	2.18 2.10	51.06 51.69	7.26 <sup>C</sup> 7.80 <sup>C</sup>	
40.02 2.421		10.70			50.84	7.78 <sup>C</sup>	
48.85 2.424		10.45			52.00	7.10 <sup>C</sup>	
48.82 2.421		10.52		2.09		7.30	
48.80 2.419		10.50			52.11	7.18	
48.79 2.418		10.40		2.17	52.19	7.07 <sup>C</sup>	
48.81 2.420		10.57			52.08	7.15 <sup>C</sup>	
		10.00	0.2820		52.41	7.19 <sup>C</sup>	
			(0	ontinued	on the ne	xt page)	
<u> </u>	AU	XILIARY I	NFORMATION	!			
METHOD/APPARAT	US/PROCEDURE:		SOURCE AN	D PURITY	OF MATERI	ALS:	
The solubility	1. UO <sub>2</sub> (NC	03 <sup>)</sup> 2 <sup>.6H</sup> 2 <sup>O</sup>	, purified	(1).			
(1).	2. Isopropyl ether, purified (2).						
1				ESTIMATED ERROR:			
			Nothing specified.				
			REFERENCES:				
			1. Vdovenko, V.M.; Suglobova, I.G.				
			Zh. Ne	org. Khi	m., <u>1958</u> ,	3, 1403.	
				erger, A. 1, D.; Tu	; Proskaue ps, E.E.	r, E.S.;	
				cheski R 1958.	estvoritel	i.	
			l				

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COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Vdovenko, V. M.; Suglobova, I. G.; Mezei, M.		
<pre>(2) 2-Propoxy-2-propane (isopropyl ether); C<sub>6</sub>H<sub>14</sub>O; [108-20-3] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	Radiokhim., <u>1962</u> , 4, 388 - 392. Sov. Radiochem., <u>1962</u> , 4, 342-346.		

	Aqueous Pha	ase	Organic Phase <sup>b</sup>			Solid Phase	
U02(N03)2		H <sub>2</sub> O	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> H <sub>2</sub> O UO <sub>2</sub> (NO <sub>3</sub> )		U02(N03)2 H2		
nass %	mol/kg	mass %	mass %	mol/kg	mass %	mass %	mass %
		·	9.45	0.265	1.86	50.60	6.06
			9.33	0.261	1.80	49.41	5.15
			9.38	0.263	1.77	49.98	4.78
			9.42	0.264	1.80	50.50	4.75 <sup>0</sup>
			7.64	0.210	1.35	48.00	4.12
			4.32	0.115	0.72	47.47	4.09
			2.37	0.0616	0.22	47.10	4.15
			2.35	0.0611	0.20	47.40	4.28
			2.36	0.0613	0.20	47.40	4.28
			2.38	0.0619	0.20	47.39	<b>4.20<sup>€</sup></b>
			2.34	0.0608	0.14	61.15	2.30 <sup>f</sup>
			3.50	0.0920	0.06	66.00	0.24
			4.50	0.120	0.06	65.86	0.219
		** ** **	4.38	0.116	0.12	65.85	0.32
			4.50	0.120	0.08	65.80	0.24

<sup>a</sup>Molalities calculated by the compilers.

<sup>b</sup>Moles UO<sub>2</sub>(NO<sub>3</sub>) in 1 kg of the mixture consisting of isopropyl ether and water (compilers).

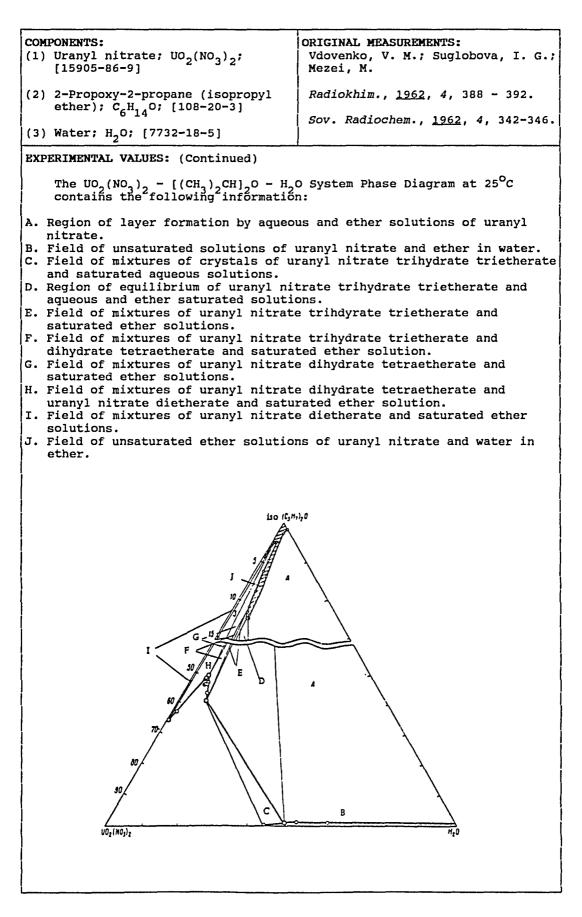
<sup>c</sup>Solid phase =  $UO_2(NO_3)_2.3H_2O.3(CH_3H_7)_2O.$ 

<sup>d</sup>solid phases =  $UO_2(NO_3)_2 \cdot 3H_2O \cdot 3(C_3H_7)_2O + UO_2(NO_3)_2 \cdot 2H_2O \cdot 4(C_3H_7)_2O$ .

<sup>e</sup>Solid phase =  $UO_2(NO_3)_2 \cdot 2H_2O \cdot 4(C_3H_7)_2O$ .

<sup>f</sup>Solid phases =  $UO_2(NO_3)_2 \cdot 2H_2O \cdot 4(C_3H_7)_2O + UO_2(NO_3)_2 \cdot 2(C_3H_7)_2O$ . <sup>g</sup>Solid phases =  $UO_2(NO_3)_2 \cdot 2(C_3H_7)_2O$ .

The phase diagram is given in the source publication.



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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Vdovenko, V. M.; Suglobova, I. G.; I-Wui, Wang; Suglobov, D. N.
(2) Ethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Radiokhim., <u>1964</u> , 6, 532 - 538.
(3) Heptane; C <sub>7</sub> H <sub>16</sub> ; [142-82-5]	Sov. Radiochem., <u>1964</u> , 6, 514-519.
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 298 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The $UO_2(NO_3)_2 - (CH_3CH_2)_2$	O - CH <sub>2</sub> (CH <sub>2</sub> ) <sub>c</sub> CH <sub>2</sub> System
	rated Solutions at 25 <sup>0</sup> C <sup>a</sup>
- UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	(c <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0
$2^{3/2}$ mol/dm <sup>3</sup>	mol/dm <sup>3</sup>
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	
<sup>a</sup> The initial organic phase consis and heptane. It is not clear wh dietherate was the initial or ea	sted of a mixture of diethyl ether ether uranium nitrate dihydrate- quilibrium solid (compilers).
	(Continued on the next page)
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. An excess of uranyl nitrate dihydrate-	Nothing specified.
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.	ESTIMATED ERROR:
	Temp: Precision ±0.05 K.
	REFERENCES:
	l

COMPONENTS: ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Suglobova, I. G.; (1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; I-Wui, Wang; Suglobov, D. N. [15905-86-9] (2) Ethyl ether; C<sub>4</sub>H<sub>10</sub>O; [60-29-7] Radiokhim., 1964, 6, 532 - 538. (3) Chloroform; CHCl<sub>3</sub>; [67-66-3] Sov. Radiochem., 1964, 6, 514-519. (4) Carbon tetrachloride; CCl,; [56-23-5] (5) Water; H<sub>2</sub>O; [7732-18-5] EXPERIMENTAL VALUES: (Continued) The  $UO_2(NO_3)_2 - (C_2H_5)_2O - CHCl_3$  System Composition of the Saturated Solutions at 25°Ca (C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>0  $UO_2(NO_3)_2$ mol/dm<sup>3</sup> mol/dm<sup>3</sup> 4.05 242 11.5 453 25.8 665 864 36.2 63.7 1230 66.9 1230 104 1257 129.7 1563 156 1870 <sup>a</sup>The initial organic phase consisted of a mixture of diethyl ether and chloroform. It is not clear whether uranium nitrate dihydratedietherate was the initial or equilibrium solid (compilers) The  $UO_2(NO_3)_2 - (C_2H_5)_2O - CCl_4$  System Composition of the Saturated Solutions at 25°Ca  $UO_{2}(NO_{3})_{2}$ (C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>O mol/dm<sup>3</sup> mol/dm<sup>3</sup> 4.17 232 16.4 455 453 17.7 487 18.4 856 57.5 127.3 1260 169 1511 190 1552 184 1510 <sup>a</sup>The 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) (2) Ethyl ether;  $C_{4}H_{10}O$ ; [60-29-7] Radiokhim., <u>1964</u>, 6, 532 - 538.

Sov. Radiochem., <u>1964</u>, 6, 514-519.

EXPERIMENTAL VALUES: (Continued)

(3) Benzene; C<sub>6</sub>H<sub>6</sub>; [71-43-2]

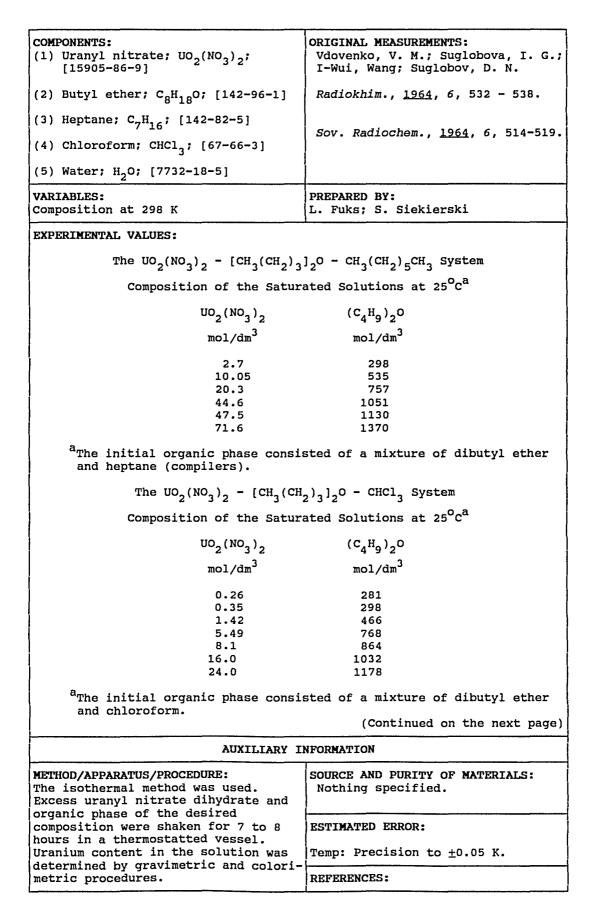
(4) Water; H<sub>2</sub>O; [7735-18-5]

The  $UO_2(NO_3)_2 - (C_2H_5)_2O - C_6H_6$  System

Composition of the Saturated Solutions at  $25^{\circ}C^{a}$ 

UO2(NO3)2	(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0
mol/dm <sup>3</sup>	mol/dm <sup>3</sup>
13.1	239
28.0	464
32.2	454
87.0	863
174	1210
182	1122
275	1550
329	1840
408	2020
540	2340

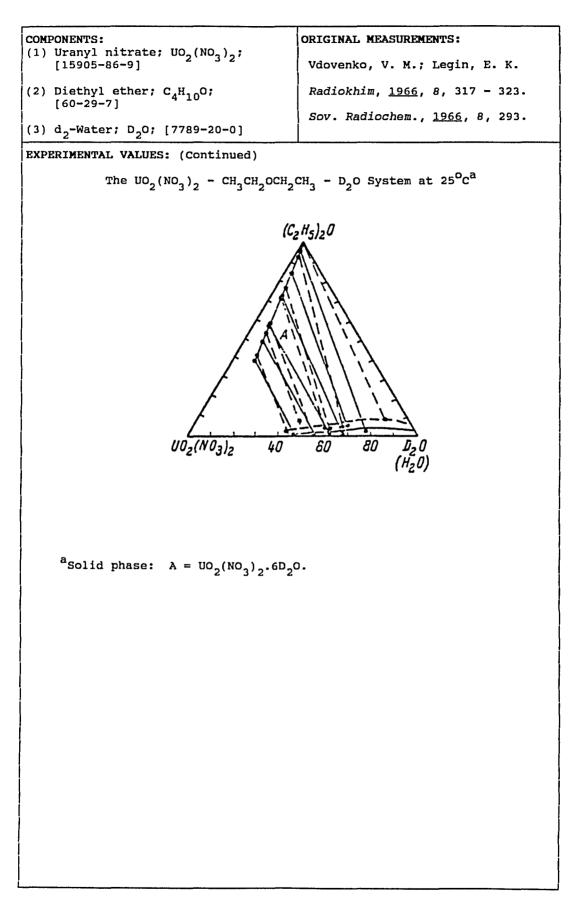
<sup>a</sup>The initial organic phase consisted of a mixture of diethyl ether and benzene. It is not clear whether uranyl nitrate dihydratedietherate was the initial or equilibrium solid (compilers).



COMPONENTS: ORIGINAL MEASUREMENTS: (1) Uranyl nitrate; UO2(NO3); Vdovenko, V. M.; Suglobova, I. G.; I-Wui, Wang; Suglobov, D. N. [15905-86-9] (2) Butyl ether; C<sub>8</sub>H<sub>18</sub>O; [142-96-1] Radiokhim., 1964, 6, 532 - 538. Sov. Radiochem., 1964, 6, 514-519. (3) Carbon tetrachloride; CCl<sub>4</sub>; [56 - 23 - 5](4) Benzene; C<sub>6</sub>H<sub>6</sub>; [71-43-2] (5) Water; H<sub>2</sub>O; [7732-18-5] EXPERIMENTAL VALUES: (Continued) The  $UO_2(NO_3)_2$  - [(CH<sub>3</sub>(CH<sub>2</sub>)<sub>3</sub>]<sub>2</sub>O - CCl<sub>4</sub> System Composition of the Saturated Solutions at 25°Ca  $UO_2(NO_3)_2$  $(C_4 H_9)_2 O$  $mol/dm^3$ mol/dm<sup>3</sup> 1.04 298 3.45 466 13.2 768 19.0 841 34.0 980 43.6 1137 78.0 1350 128 1640 <sup>a</sup>The initial organic phase consisted of a mixture of dibutyl ether and carbon tetrachloride. The  $UO_2(NO_3)_2$  -  $[CH_3(CH_2)_3]_2O - C_6H_6$  System Composition of the Saturated Solutions at 25°Ca  $UO_2(NO_3)_2$  $(C_4 H_9)_2 O$ mol/dm<sup>3</sup> mol/dm<sup>3</sup> 6.9 280 7.1 280 570 28.4 56.5 765 59.0 780 67.5 870 86.0 970 97.3 971 <sup>a</sup>The initial organic phase consisted of a mixture of dibutyl ether and benzene.

198

				ORIGI	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]				Vdov	Vdovenko, V. M.; Legin, E. K.			
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]			Radio	okhim, <u>196</u>	<u>6</u> , 8, 317	- 323.		
(3) d <sub>2</sub> -Water; D <sub>2</sub> O; [7789-20-0]				Sov.	Radiochem	., <u>1966</u> , 8	3, 293.	
VARIABLES:				PREPA	RED BY:	<u> </u>		
Composition at 298 K				A. 5	ozanski; S	. Siekiers	ki	
EXPI	ERIMENTAL	VALUES:	<u></u>	<u></u>				
	Т	he UO <sub>2</sub> (NO <sub>3</sub>	) <sub>2</sub> - CH <sub>3</sub> CH <sub>2</sub>	осн <sub>2</sub> сн <sub>3</sub> -	D <sub>2</sub> 0 System	at 25 <sup>0</sup> C <sup>a</sup>		
	А	queous Pha	se		Ether Pha	se		
	UO2(N	0 <sub>3</sub> ) <sub>2</sub>	D <sub>2</sub> 0	U0 <sub>2</sub> (1	NO3)2	D <sub>2</sub> 0	Solid Phase	
	mass %	mol/kg	mass %	mass %	mol/kg	mass %		
			97.30					
	20.58	0.6576	76.48 67.94	3.18	0.0834 0.3719	1.92		
	31.89	T.188	0/.94 66 05	12.78 22.21				
	27.57 37.11	1.498	66.05 61.43	35.84	0.7246 1.418	6.15 8.09		
		2.002			1.873	9.28		
	53.12	2.876	46.93		2.659			
	53.12 51.73	2.876	48.27				A	
	<sup>a</sup> Molali	ties calcu	lated by th	e compiler	5.			
	<sup>b</sup> Solid	phase: A	= UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	.6D <sub>2</sub> 0.				
	COMMENT	'S AND/OR A	DDITIONAL D	ATA:				
	A phase	diagram i	s given in	the source	publicati	on. Extra	ted	
			4 molecules					
			AUXILIA	RY INFORMA	TION			
The mixing glas light their sed: uran both grav	isotherm ture was ss ampoul nt, and s rmostat f imentatio nium and n phases. vimetrica	placed in e protecte haken vigo or 6 hours n, samples D <sub>2</sub> O determ Uranium w lly as U <sub>2</sub> O	was used. T sealed drie d from dire rously in a . After 1 h were taken inations in as measured g. Water wa	he 1. UO d di ct pu our of for wa ai s 2. Di	ethyl ethe	D was obta O, in DNO, ether exti ained by c oled D,O. y bubbled r dried wi	ined by , and t faction. lissolvi Solutio in dry ith CaCl	
measured by the Karl Fischer method in dried methanol.			3. D <sub>2</sub> di	and metallic Na, then distillé 3. D <sub>2</sub> O, 99.8%, was purified by distillation in dried quartz				
				}	paratus.			
					ATED ERROR			
REFERENCES :				Soly:		pecified. determine of 1-2 % a	ed with	



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91.
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202		
COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	De Conninck, Oe.	
(2) Acetic acid; C <sub>2</sub> H <sub>4</sub> O <sub>2</sub> ; [64-19-7]	Compt. Rend., <u>1900</u> , 131, 1303 1305.	
(3) Water; H <sub>2</sub> O; [7732-18-5]	1305.	
VARIABLES:	PREPARED BY:	
One temperature: about 287 K	L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES: The solubility of uranyl nitrate in CH, COOH 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.		
The initial salt was probably a mixture of hexa- and trihydrate. (compilers).		

1303 -1305.

## AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	Uranyl nitrate, presumably the hexahydrate (compilers) was dried at 90°C.
	Acetic acid with a density of 1.035 g/cm was used.
	ESTIMATED ERROR:
	Nothing specified
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Yaffe, L.	
(2) Various nitro organics	Can. J. Res., <u>1949</u> , 27B, 638-645.	
(3) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES:	PREPARED BY:	
One temperature: 293 K	L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:		
The Solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O in Various Nitro Compounds is:		
	UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> 0 <sup>а</sup>	
Nitro Compound Formula	g/(100 cm <sup>3</sup> )	
Nitromethane CH <sub>3</sub> NO <sub>2</sub> ; [7]	5-52-5] 64	
1-Nitropropane C <sub>3</sub> H <sub>7</sub> NO <sub>2</sub> ; [	108-03-2] 8	
2-Nitropropane (CH <sub>3</sub> ) <sub>2</sub> CHNO	2; [79-46-9] 4	
Nitrobenzene C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub> ; [	98-95-3] 1.5	
<sup>a</sup> Solubilities are g of the hydrated salt per 100 cm <sup>3</sup> of the solvent. Initial Solid phase: UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O.		
AUXILIARY I	NFORMATION	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	
Isothermal method was used. 25 cm <sup>3</sup> 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.	<ol> <li>UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O obtained from the Eldorado Mining and Refining Co. The maximum impurities were &lt;0.1% of rare earths.</li> <li>Organics were "practical" grade or better.</li> <li>ESTIMATED ERROR:</li> <li>Soly: Nothing specified. Results of the two methods of analysis agreed within ±5%.</li> </ol>	

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COMPONENTS:		OR	ORIGINAL MEASUREMENTS:		
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]		W	arner, R.	к.	
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]				J. Appl. Sci., <u>1953</u> , 6,	
(3) Nitromethane; CH <sub>3</sub> NO <sub>2</sub> ; [75-52-5]			27 - 443.		
(4) Water; H <sub>2</sub> O; [7732-18-5]					
VARIABLES:		PF	EPARED BY	•	
Concentration of HNO <sub>3</sub> at 293 K		L.	Fuks; S.	Siekierski	
EXPERIMENTAL VAI	LUES:				
The U	JO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> - CH <sub>3</sub> NO	$D_2 - HNO_3$	– н <sub>2</sub> о sys	stem at 20 <sup>0</sup> C	
	Composition o				
	U0 <sub>2</sub> (	NO3)2		Number of	
HNO3 <sup>b</sup>	Aqueous Phase	Organi	c Phase		
mol/dm <sup>3</sup>	mass %	mas	s %		
15		40	.7	1	
10		35		1	
5	42.5	25		2	
2.5	48.5	18	-	2	
1.0	51.3 53.8	15 13		2	
and nitric	<sup>a</sup> Both solvent and aqueous phases consisted of water, nitromethane and nitric acid. Initial solid phase was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O. <sup>b</sup> Initial normality of HNO <sub>3</sub> .				
			DNATTON		
AUXILIARY II					
METHOD/APPARATUS/PROCEDURE:			URCE AND 1	PURITY OF MATERIALS:	
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				2.6H <sub>2</sub> O of unspecified as purified (1). nane was redistilled	
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 <sub>3</sub> O <sub>8</sub> .		ig )			
		s ES hours			
		ons	iy: Nothir	ng specified.	
		had  Te trate	mp: Precis	sion <u>+</u> 0.1 K.	
		RE	FERENCES: Warner, F Australia 3, 156.	R. K. An J. Appl. Sci., <u>1952</u> ,	

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COMPONENTS:		ORIGINAL ME	ASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> ( [15905-86-9]	Warner, R.	к.		
(2) Various nitro organi	Australian 581 - 589.	J. Appl. Sc	i., <u>1953</u> , 4,	
(3) Water; H <sub>2</sub> O; [7732-18-5]		561 - 569.		
VARIABLES:		PREPARED BY:		
One temperature: 293 K	L. Fuks; S.	Siekierski		
EXPERIMENTAL VALUES:				
	7		טס <sub>2</sub> (אס	3) <sup>a</sup>
Nitro Organic	Formula		g/(g soln)	mol/kg
Nitromethane	CH <sub>3</sub> NO <sub>2</sub> ; [75-!	52-5]	0.140	0.413
Nitroethane	с <sub>2</sub> н <sub>5</sub> NO <sub>2</sub> ; [79-	-24-3]	0.051	0.136
1-Nitropropane	C <sub>3</sub> H <sub>7</sub> NO <sub>2</sub> ; [10]	8-03-2]	0.011	0.028
	AUXILIARY I	NFORMATION		
METHOD/APPARATUS/PROCEDU	RE:	SOURCE AND PURITY OF MATERIALS:		
The isothermal method wa	s used.	1. AR grade	UO_(NO_)6	н.о.
Excess uranyl nitrate he placed with the appropri of pure solvent in a sma warmed to 30°C to 50°C a	2. C.P. grad compounds	le anhydrous	-	
for 15 min. Then the fla in a thermostat bath at	ESTIMATED ERROR:			
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			ility were m	
nitrate concentration de by evaporation of the we		Temp: Precis	sion <u>+</u> 0.05 K	•
aliquots, followed by ig U <sub>3</sub> 08.		REFERENCES:		
		1		<u> </u>

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COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Vdovenko, V. M.; Kuzina, M. G.			
(2) Trioctylamine nitrate (TOA.HNO <sub>3</sub> ); C <sub>24</sub> H <sub>52</sub> N <sub>2</sub> O <sub>3</sub> ; [1116-76-3]	Lipovskij, A. A. <i>Radiokhim., <u>1964</u>, 6, 121 - 123.</i>			
(3) Chloroform; CHCl <sub>3</sub> ; [67-66-3]				
(4) Carbon tetrachloride; CCl <sub>4</sub> ; [56-23-5]				
(5) Water; H <sub>2</sub> O; [7732-18-5]				
VARIABLES:	PREPARED BY:			
One temperature: probably 298 K	L. Fuks; S. Siekierski			
EXPERIMENTAL VALUES:				
The $UO_2(NO_3)_2 - N(C_8H_{17})_3$ . Composition of Satur				
]	H <sub>2</sub> O Initial Solid			
2 3 2 3	2 Phase <sup>D</sup> l/dm <sup>3</sup>			
69 42	30 A			
	60 B 70 B			
<sup>a</sup> Temperature not specified; prob	bably 25 <sup>0</sup> C (compilers).			
<sup>b</sup> Solid phases: $A = UO_2(NO_3)_2.2H$	$_{2}O, B = UO_{2}(NO_{3})_{2}.6H_{2}O.$			
The $UO_2(NO_3)_2 - N(C_8H_{17})_3$ .				
Composition of Satur	5 - 5			
$UO_2(NO_3)_2$ TOA.HNO <sub>3</sub>	H20 Initial Solid			
	<sup>3</sup> Phase 1/dm <sup>3</sup>			
3 <sup>d</sup> 615 <sup>e</sup> 705 <sup>e</sup>	A 130 <sup>e</sup> A			
325 <sup>e</sup> 517 <sup>e</sup>	150 <sup>е</sup> В			
<sup>a</sup> Temperature not specified, prob	ably 25 <sup>0</sup> C (compilers).			
<sup>b</sup> Two organic phases were observed	d.			
<sup>C</sup> Solid phases: $A = UO_2(NO_3)_2 \cdot 2H_2$	$0, B = UO_2(NO_3)_2.6H_2O.$			
<sup>d</sup> Lighter organic phase. <sup>e</sup> Heavier				
AUXILIARY INFORMATION				
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. Uranyl nitrate dihydrate or hexa- hydrate was equilibrated with the TOA	Nothing specified.			
nitrate solution at the desired concentration. Uranium, TOA nitrate,	ESTIMATED ERROR:			
and water content were determined in the organic phase.	Nothing specified.			
	REFERENCES:			

COMPONENTS: ORIGINAL MEASUREMENTS: (1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] Vdovenko, V. M.; Kuzina, M. G. Lipovskij, A. A. (2) Trioctylamine nitrate (TOA.HNO2) Radiokhim., 1964, 6, 121 - 123.  $C_{24}H_{52}N_{2}O_{3};$  [1116-76-3] (3) 1,2-Dichloroethane; C<sub>2</sub>H<sub>4</sub>Cl<sub>2</sub>; [107-06-2] (4) Benzene; C<sub>6</sub>H<sub>6</sub>; [71-43-2] (5) Water; H<sub>2</sub>O; [7732-18-5] EXPERIMENTAL VALUES: (Continued) The  $UO_2(NO_3)_2 - N(C_8H_{17})_3$ . HNO<sub>3</sub> - ClCH<sub>2</sub>CH<sub>2</sub>Cl - H<sub>2</sub>O System<sup>a</sup> Composition of Saturated Solutions TOA.HNO, UO2(NO3)2 Initial Solid н,0 Phase mol/dm<sup>3</sup>  $mol/dm^3$ mol/dm<sup>3</sup> 45 46 30 A 214 226 80 A 29 43 120 в 127 210 130 R <sup>a</sup>Temperature not specified, probably 25<sup>o</sup>C (compilers). <sup>b</sup>Solid phases:  $A = UO_2(NO_3)_2 \cdot 2H_2O$ ,  $B = UO_2(NO_3)_2 \cdot 6H_2O$ . The  $UO_2(NO_3)_2 - N(C_8H_{17})_3$ . HNO<sub>3</sub> -  $C_6H_6 - H_2O$  System<sup>a</sup> Composition of Saturated Solutions<sup>b</sup> TOA. HNO, UO2(NO3)2 H<sub>2</sub>0 Initial Solid Phase  $mol/dm^3$ mol/dm<sup>3</sup> mol/dm<sup>3</sup> 41<sup>d</sup> 44<sup>d</sup> A 356<sup>e</sup> 38.8<sup>e</sup> A 28 47 30 в 228 143 60 в 300 510 <sup>a</sup>Temperature not specified, probably 25<sup>0</sup>C (compilers). <sup>b</sup>In the case of UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.2H<sub>2</sub>O, two organic phases were observed. <sup>c</sup>Solid phases:  $A = UO_2(NO_3)_2 \cdot 2H_2O$ ,  $B = UO_2(NO_3)_2 \cdot 6H_2O$ . <sup>d</sup>Lighter organic phase. e<sub>Heavier</sub> organic phase.

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; (2) Trichloromethane; CHCl <sub>3</sub> ; (3) Nitrobenzene; C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub> ; [98-95-3] (4) Water; H <sub>2</sub> O; [7732-18-5] VANIABLES: One temperature: 294 K EXPERIMENTAL VALUES: The solubility of JUO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O in CHCl <sub>3</sub> at 21 <sup>O</sup> C was reported as 0.00410 mol/dm <sup>-</sup> . The solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O in C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub> at 21 <sup>O</sup> C was reported as 0.011 mol/dm <sup>-</sup> . MUXILIARY INFORMATION METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Finely ground uranyl nitrate hexa- hydrate was shaken for at least 12 hours with the solvent, separated by filtration, replaced by fresh solid, minal separation was by contrifuging. Soly: nothing specified. Soly: nothing specified. Soly: nothing specified. Soly: nothing specified. Soly: nothing specified. Soly: nothing specified. Soly: nothing specified. REFERENCES: 1. Master Analytical Manual, Tho-7015, Soction 1, 1956. 2. Claassen, A.; Visser, J. Rec. Trav. Chim., 1946, 05, 211		
AUXILIARY INFORMATION METHOD/APPARATUS/PROCEDURE: The isothermal method was used. Finely ground uranyl nitrate hexa- hydrate 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 thiccyanate (1) and by precipitation with oxine (2). REFERENCES: 1. Master Analytical Manual, TID-7015, Section 1, 1958. 2. Claassen, A.; Visser, J.	(1) Uranyl nitrate; $UO_2(NO_3)_2$ ; [15905-86-9] (2) Trichloromethane; $CHCl_3$ ; [67-66-3] (3) Nitrobenzene; $C_6H_5NO_2$ ; [98-95-3] (4) Water; $H_2O$ ; [7732-18-5] VARIABLES: One temperature: 294 K EXPERIMENTAL VALUES: The solubility of $UO_2(NO_3)_2 \cdot 6H_2O_3$ as 0.00410 mol/dm <sup>3</sup> .	Verstegen, J. M. P. J. J. Inorg Nucl. Chem., <u>1964</u> , 26, 1589 - 1599. PREPARED BY: A. Sozanski; S. Siekierski D in CHCl <sub>3</sub> at 21 <sup>0</sup> C was reported
METHOD/APPARATUS/PROCEDURE:SOURCE AND PURITY OF MATERIALS:The isothermal method was used. Finely ground uranyl nitrate hexa- hydrate 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).1. UO2(NO3)2.6H2O, Merck p.a. 2. Chloroform, nitrobenzene, nothing specified.Soly: Nothing specified.2. Chloroform, nitrobenzene, nothing specified.Boly: nothing specified.Soly: nothing specified.Soly: nothing specified.Temp: Precision ±2 K.REFERENCES: 1. Master Analytical Manual, TID-7015, Section 1, 1958. 2. Claassen, A.; Visser, J.		
The isothermal method was used. Finely ground uranyl nitrate hexa- hydrate 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). I. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, Merck p.a. 2. Chloroform, nitrobenzene, nothing specified. Soly: nothing specified. Soly: nothing specified. Temp: Precision ±2 K. REFERENCES: 1. Master Analytical Manual, TID-7015, Section 1, 1958. 2. Claassen, A.; Visser, J.	[	
	The isothermal method was used. Finely ground uranyl nitrate hexa- hydrate 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	<pre>1. UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>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.</pre>

COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Verstegen, J. M. P. J.	
(2) Trioctylamine nitrate; C <sub>24</sub> H <sub>52</sub> N <sub>2</sub> O <sub>3</sub> ; [1116-76-3]	J. Inorg. Nucl. Chem., <u>1964</u> , 2 1589-1599.	26,
(3) Benzene; C <sub>6</sub> H <sub>6</sub> ; [71-43-2]		
(4) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES:	PREPARED BY:	<del>,,</del>
Composition at 294 K	A. Sozanski; S. Siekierski	
EXPERIMENTAL VALUES:		
The $UO_2(NO_3)_2 - (C_8H_{17})_3N.HNO_3N.H$	$_3$ - C <sub>6</sub> H <sub>6</sub> - H <sub>2</sub> O System at 21 <sup>O</sup> C	
	Saturated Solutions	
UO <sub>2</sub> (NO <sub>3</sub> ) <sup>a</sup> (C	H17) N.HNO3 H2O	
	mol/dm <sup>3</sup> mol/dm <sup>3</sup>	
0.063	0.1 0.022	
0.029 0.016	0.05 0.016 0.025 0.016	
<sup>a</sup> The values of the uranyl nitra have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F	te solubility in the pure diluent e in the amine nitrate phase. The 2 <sup>0</sup> . (Continued on the next pa	e
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F	e in the amine nitrate phase. The 2 <sup>0</sup> .	e
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F	e in the amine nitrate phase. The 2 <sup>0</sup> . (Continued on the next pa	age
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F AUXILIARY METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The	e in the amine nitrate phase. The 2 <sup>0</sup> . (Continued on the next pa INFORMATION	age
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F AUXILIARY METHOD/APPARATUS/PROCEDURE:	e in the amine nitrate phase. The 2 <sup>O</sup> . (Continued on the next pand INFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, Merck p.a. 2. Tri-n-octylamine nitrate was purified (3).	age 
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F AUXILIARY METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phase prepared by shaking 0.01 mol/dm amine solutions with empirically determined amounts of aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentration	e in the amine nitrate phase. The 2 <sup>0</sup> . (Continued on the next pa INFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, Merck p.a. 2. Tri-n-octylamine nitrate was purified (3).	e age 
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F AUXILIARY METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phase prepared by shaking 0.01 mol/dm amine solutions with empirically determined amounts of aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentratic to the desired value. Finely ground hydrated uranyl nitrate was shaken	<ul> <li>in the amine nitrate phase. The 2<sup>O</sup>.</li> <li>(Continued on the next particular of the next part</li></ul>	age 
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F AUXILIARY METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phase prepared by shaking 0.01 mol/dm amine solutions with empirically determined amounts of aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentratic to the desired value. Finely ground hydrated uranyl nitrate was shaken for at least 12 hours with the solvent, replaced by fresh solid, ar shaken for an additional 6 hours.	<pre>e in the amine nitrate phase. The 2<sup>0</sup>. (Continued on the next pa INFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O, Merck p.a. 2. Tri-n-octylamine nitrate was purified (3). ESTIMATED ERROR: Soly: Nothing specified. Amine nitrate concentration ±25 the desired value. Temp: Precision ±2 K.</pre>	age 
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F AUXILIARY METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phase prepared by shaking 0.01 mol/dm amine solutions with empirically determined amounts of aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentratic to the desired value. Finely ground hydrated uranyl nitrate was shaken for at least 12 hours with the solvent, replaced by fresh solid, ar	<pre>e in the amine nitrate phase. The 2<sup>0</sup>. (Continued on the next pa INFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O, Merck p.a. 2. Tri-n-octylamine nitrate was purified (3). ESTIMATED ERROR: Soly: Nothing specified. Amine nitrate concentration ±25 the desired value. Temp: Precision ±2 K.</pre>	age
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F AUXILIARY METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phase prepared by shaking 0.01 mol/dm amine solutions with empirically determined amounts of aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentratic to the desired value. Finely ground hydrated uranyl nitrate was shaken for at least 12 hours with the solvent, replaced by fresh solid, ar shaken for an additional 6 hours. Final separation of solid and liqui was accomplished by centrifugation. The metal was extracted back from th saturated organic phase with 0.5 mol/dm HNO <sub>3</sub> . Uranium determined by thiocyanate and precipitated with	<pre>e in the amine nitrate phase. The 2<sup>0</sup>. (Continued on the next pa INFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O, Merck p.a. 2. Tri-n-octylamine nitrate was purified (3). ESTIMATED ERROR: Soly: Nothing specified. Amine nitrate concentration ±23 the desired value. Temp: Precision ±2 K. REFERENCES: e 1. Verstegen, J. M. P. J.</pre>	e age : s
have been subtracted from thos initial solid was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6F AUXILIARY METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The organic phase prepared by shaking 0.01 mol/dm <sup>-</sup> amine solutions with empirically determined amounts of aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentratic to the desired value. Finely ground hydrated uranyl nitrate was shaken for at least 12 hours with the solvent, replaced by fresh solid, ar shaken for an additional 6 hours. Final separation of solid and liqui was accomplished by centrifugation. The metal was extracted back from th saturated organic phase with 0.5 mol/dm <sup>-</sup> HNO <sub>2</sub> . Uranium determined by	<pre>e in the amine nitrate phase. The 2<sup>0</sup>. (Continued on the next pa INFORMATION SOURCE AND PURITY OF MATERIALS: 1. UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O, Merck p.a. 2. Tri-n-octylamine nitrate was purified (3). ESTIMATED ERROR: Soly: Nothing specified. Amine nitrate concentration ±23 the desired value. Temp: Precision ±2 K. REFERENCES: 1. Verstegen, J. M. P. J. Trans. Faraday Soc., <u>1962</u>, 5</pre>	e age : : : : : : :

COMPONENTS:	ORIGINAL MEASUREMENTS:
	ONTAINAL REASUREMENIS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Verstegen, J. M. P. J.
(2) Tri-n-octylamine nitrate; C <sub>24</sub> H <sub>52</sub> N <sub>2</sub> O <sub>3</sub> ; [1116-76-3]	J. Inorg. Nucl. Chem., <u>1964</u> , 26, 1589 - 1599.
(3) Dodecane; C <sub>12</sub> H <sub>26</sub> ; [112-40-3]	
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 294 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
The $UO_2(NO_3)_2 - (C_8H_{17})_3N.HNO_3$	- CH <sub>3</sub> (CH <sub>2</sub> ) <sub>10</sub> CH <sub>3</sub> <sup>a</sup> System at 21 <sup>0</sup> C
Composition of Sat	urated Solutions
$uo_2(NO_3)_2^{b,c}$ (C <sub>8</sub> )	H <sub>17</sub> ) <sub>3</sub> N.HNO <sub>3</sub> H <sub>2</sub> O
	mol/dm <sup>3</sup> mol/dm <sup>3</sup>
0.018 0.029 0.034	0.1 0.022 0.05 0.023 0.025 0.038
<sup>a</sup> Modified dodecane with 6 mole % initial solid phase was UO <sub>2</sub> (NO <sub>3</sub>	of 1-octanol as diluent. The
b The value of the uranyl solubil subtracted from those in the am	ity in the pure diluent has been
<sup>C</sup> Concentration measured in the l	ight portion of the organic phase.
	(Continued on the next page)
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. The	1. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O, Merck p.a.
organic phase was prepared by shaking 0.01 mol/dm amine solutions with empirically determined amounts of	2. $(C_8H_{17})_3N$ was purified (3).
aqueous nitric acid and centrifuging (1,2). Pure diluents were added to bring the amine nitrate concentration	ESTIMATED ERROR:
to the desired level. Finely ground hydrated uranyl hydrate was shaken at least 12 hours with the solvent, replaced by fresh solid, and shaken	Soly: Nothing specified. Amine nitrate concentration ±2% of the desired value.
for another 6 hours. Final separation of solid and liquid phases was done	Temp: Precision $\pm 2$ K.
by centrifuging. Metal was extracted back from the saturated organic	REFERENCES:
phase with 0.5 mol/dm HNO. Uranium was determined by the thiodyanate method and precipitation with oxine. Water analyses were performed by	1. Verstegen, J. M. P. J. Trans. Faraday Soc., <u>1962</u> , 58, 1878.
Karl Fischer titrations.	2. Verstegen, J. M. P. J. J. Inorg. Nucl. Chem., <u>1964</u> , 26, 1085.
	3. Verstegen, J. M. P. J.;
	Ketelaar, A. A. <i>Trans. Faraday Soc.</i> , <u>1961</u> , 57, 1527.

COMPONENTS: ORIGINAL MEASUREMENTS: (1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; Verstegen, J. M. P. J. [15905-86-9] (2) Tri-n-octyl amine nitrate; J. Inorg. Nucl. Chem., 1964, 26,  $C_{24}H_{52}N_2O_3$ ; [1116-76-3] 1589 - 1599. (3) Trichloromethane; CHCl<sub>2</sub>; [67-66-3] (4) Nitrobenzene; C<sub>6</sub>H<sub>5</sub>NO<sub>2</sub>; [98-95-3] (5) Water; H<sub>2</sub>O; [7735-18-5] EXPERIMENTAL VALUES: (Continued) The  $UO_2(NO_3)_2$  -  $(C_8H_{17})_3N.HNO_3$  - CHCl<sub>3</sub> - H<sub>2</sub>O System at 21°C Composition of the Saturated Solutions 002(N03)2<sup>a</sup> (C8H12)3N.HNO3 н<sub>2</sub>о mol/dm<sup>3</sup> mol/dm<sup>3</sup> mol/dm<sup>3</sup> 0.045 0.1 0.051 0.022 0.05 0.052 0.012 0.025 0.052 The  $UO_2(NO_3)_2 - (C_8H_{17})_3N.HNO_3 - C_6H_5NO_2 - H_2O$  System at 21°C Composition of the Saturated Solutions  $UO_2(NO_3)_2^a$ (C<sub>8</sub>H<sub>17</sub>)<sub>3</sub>N.HNO<sub>3</sub> H<sub>2</sub>0 mol/dm<sup>3</sup> mol/dm<sup>3</sup> mol/dm<sup>3</sup> 0.093 0.1 0.133 0.054 0.05 0.117 0.026 0.025 0.099 <sup>a</sup>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 UO2(NO3)2.6H2O.

(2) N (3) C (4) W VARIA One t	15905-86- itric aci arbon tet 56-23-5]	rate; UO <sub>2</sub> ( 9] .d; HNO <sub>3</sub> ;   rachloride	7697-37-2	1		Zil'berman, B. Ya	
(3) C [4] (4) W VARIA	arbon tet 56-23-5]	2		] Rad.	iokhim, 1986		
(4) W VARIA One t	56-23-5]	rachloride	; CC1,;	1	LONNILINI <u>1990</u>	i, 28, 33 - 37.	
VARIA One t	ater; H <sub>2</sub> C		4	Sov	. Radiochem.,	<u>1986</u> , 28, 26-29.	
One t		(4) Water; H <sub>2</sub> O; [7732-18-5]					
	BLES:	VARIABLES:			ARED BY:		
	emperatur	e: 293 K		<b>s.</b> :	L. Phillips		
EXPER	IMENTAL V	ALUES:					
	г	he UO <sub>2</sub> (NO.	), - HNO,	- cc1 <sub>4</sub> -	H <sub>2</sub> O System a	at 20 <sup>0</sup> C	
				•	ous and Organ		
		Aqu	leous Phas	е		Organic Phase	
-	HNO3	U0 <sub>2</sub> (1	<sup>10</sup> 3)2	Density	H <sub>2</sub> O	ниоз	
1	mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	mol/kg	g/cm <sup>3</sup>	mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	
	4.6	1.24	1.18	1.541		0.00072	
	6.6		0.85			0.0015	
	7.6	1.09	0.957	1.568	36.6	0.0027	
	9.6	1.45	1.28	1.701		0.0064	
	13.4 16.0	1.05 1.20	0.860 0.977	1.634	20.9 12.3	0.022 0.101	
	UO <sub>2</sub> (NO <sub>2</sub> )	es calcula 2, probabl ation was	.y hexahyd	rate (com	. Solid pha biler). Initi dm <sup>3</sup> .	se was al CCl <sub>4</sub>	
			AUXILIA	RY INFORM	TION		
METHOI	)/APPARAT	US/PROCEDU	JRE:	SOUR	E AND PURITY	OF MATERIALS:	
at 20'	C. The p	s extracte hases were	e separate	a"	anyl nitrate	e was purified.	
was ca	arried ou	nding, the it at a high	gh ratio o	f	4 -		
the organic phase to the aqueous one, the ratio was several tens at a low HNO <sub>3</sub> concentration. The concentration of acid in the absence of uranium was determined by potentiometric titra- tion (0.1 mol/dm <sup>3</sup> NaOH). Concentra- tion of uranium and HNO <sub>3</sub> in the presence of uranium, present in equilibrium with the solid salt, was			ow	No additional details given.			
			was ESTI				
			a- Noth	Nothing specified.			
• · • • • • • • • • • • • • • • • • • •				RENCES :			

COMPONENTS: (1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ;	ORIGINAL MEASUREMENTS:
[15905-86-9] 2 3'2'	Wendlandt, W. W.; Bryant, J. M.
(2) Tri-n-butyl phosphate; $C_{12}^{H} C_{27}^{O} C_{4}^{P}$ ; [126-73-8]	J. Phys. Chem., <u>1956</u> , 60, 1145 - 1146.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: Room	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
was reported to be 43.4 and 43.6	d 1.96 moles in 1 kg of the mixture
AUXILIARY II	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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	<ol> <li>UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O, reagent grade.</li> <li>TBP, commercial product with no purification.</li> </ol>
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,	Soly: nothing specified, but standard deviation is about
and analyzed for the metal salt content. The metal ion content, after	REFERENCES:
reextraction into the TBP/benzene- water system, was determined in the aqueous phase by standard procedures (1,2).	<ol> <li>Scott, W. W. Standard Methods of Chemical Analysis, Vol. I, Van Nostrand Inc., New York, <u>1946</u>.</li> </ol>
	2. Lundell, G.E.F.; Bright, H.A.; Hoffman, J. I. Applied Inorganic Chemistry, J. Wiley & Sons, New York <u>1953</u> .

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COMPONENTS:			EVALUATOR:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]			Healy, T. V.; McKay, H. A. C.	
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]			Trans. Faraday S 633 - 642.	Soc., <u>1956</u> , 52,
/	H <sub>2</sub> 0; [7732-18-9	5]		
VARIABLES:			PREPARED BY:	
Temperature	: 273 to 323 K		L. Fuks; S. Siek	tierski
EXPERIMENTAL	L VALUES:			
The solubi	lity of UO <sub>2</sub> (NO	3) <sub>2</sub> in TBP wa	as reported at 0 <sup>0</sup> 0	$25^{\circ}C$ and $50^{\circ}C$
		Saturated So	olution	
± .0-	U02(N03)2	mol	le ratios	
t∕°c	mol/kg	TBP/nitrat	te H <sub>2</sub> O/nitrate	Number <sup>a</sup>
0 25	1.60	2.01	0.04	2
50	1.59	1.98		
a <sub>From 1</sub>	TBP dilution da	ata.		
aFrom 7	TBP dilution da			
aFrom 7	TBP dilution da	AUXILIARY II	VFORMATION	
	TBP dilution da	AUXILIARY II	NFORMATION SOURCE AND PURITY	OF MATERIALS:
METHOD/APPAN Solubility o by solid ura	RATUS/PROCEDUR determinations anyl nitrate ho	AUXILIARY II E: were made exahydrate		e hexahydrate was
METHOD/APPAN Solubility o by solid ura with TBP for thermostat, TBP phase. A	RATUS/PROCEDUR	AUXILIARY II E: were made exahydrate in a yzing the ater was	SOURCE AND PURITY	e hexahydrate was
METHOD/APPAN Solubility of by solid ura with TBP fon thermostat, TBP phase. A carried out titration, a	RATUS/PROCEDUR determinations anyl nitrate he r several days and then analy Analysis for wa by the Karl F and colorimetr	AUXILIARY II E: were made exahydrate in a yzing the ater was ischer ically for	SOURCE AND PURITY 1. Uranyl nitrate A. R. product.	e hexahydrate was
METHOD/APPAN Solubility of by solid ura with TBP fon thermostat, TBP phase. A carried out titration, a	RATUS/PROCEDUR determinations anyl nitrate he r several days and then analy Analysis for wa by the Karl F	AUXILIARY II E: were made exahydrate in a yzing the ater was ischer ically for	SOURCE AND PURITY 1. Uranyl nitrate A. R. product.	e hexahydrate was
METHOD/APPAN Solubility of by solid ura with TBP fon thermostat, TBP phase. A carried out titration, a	RATUS/PROCEDUR determinations anyl nitrate he r several days and then analy Analysis for wa by the Karl F and colorimetr	AUXILIARY II E: were made exahydrate in a yzing the ater was ischer ically for	SOURCE AND PURITY 1. Uranyl nitrate A. R. product. 2. TBP was purifi	e hexahydrate was .ed (1).
METHOD/APPAN Solubility of by solid ura with TBP fon thermostat, TBP phase. A carried out titration, a	RATUS/PROCEDUR determinations anyl nitrate he r several days and then analy Analysis for wa by the Karl F and colorimetr	AUXILIARY II E: were made exahydrate in a yzing the ater was ischer ically for	SOURCE AND PURITY 1. Uranyl nitrate A. R. product. 2. TBP was purifi ESTIMATED ERROR:	e hexahydrate was .ed (1).

COMPONENTS:	EVALUATOR:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Hurwic, J.; Michalczyk, J.
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Proc. Symp. Theory and Structure of Complex Compounds, Wroclow, <u>1962</u> , Pergamon Press, Oxford and WNT, Warszawa, <u>1964</u> , 289 - 294.
(3) Water; H <sub>2</sub> O; [7732-18-5]	WN1, Wal52awa, <u>1904</u> , 209 - 294.
VARIABLES:	PREPARED BY:
One temperature: 293 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The concentration of uranium in the nitrate in TBP after dehydration as was reported to be 0.4260 mole frac- found to be 0.19 mass %.	described in the procedure
AUXILIARY II	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. Uranyl nitrate hexahydrate was	Nothing specified.
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	ESTIMATED ERROR:
organic phase in equilibrium with the aqueous phase were dried and	Nothing specified.
deacidified using a mixture of uranyl nitrate hexahydrate dried at 190°C	
and 260°C. Uranyl nitrate content was determined spectrophotometrically.	REFERENCES:
Water concentration was measured by the Karl Fischer method.	

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Nikolaev, A. V.; Dyadin, Yu. A.; Yakovlev, I. I.	
,	
Dokl. Akad. Nauk SSSR, <u>1964</u> , 158, 1130 - 1132.	
A. Sozanski; S. Siekierski	
L	
- H <sub>2</sub> O System at 0 <sup>°</sup> C to 100 <sup>°</sup> C	
e of Saturated Solutions <sup>a</sup>	
н <sub>2</sub> о	
g mass %	
1 0.15 5 0.25	
8 0.54	
9 0.76	
2 1.14 6 1.53	
4 1.59	
NFORMATION	
SOURCE AND PURITY OF MATERIALS:	
Nothing specified.	
ESTIMATED ERROR:	
Nothing specified.	
REFERENCES:	
<ol> <li>Nikolaev, A. V.; Dyadin, Yu. A. Dokl. Akad. Nauk SSSR, <u>1963</u>, 153, 118.</li> </ol>	
2. Markov, V. K.; Vinogradov, A. V. Ukran. Metody ego opredelenya.	
Moskva, <u>1960</u> , p. 175.	

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Nikolaev, A. V.; Yakovlev, I. I.
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Dokl. Akad. Nauk SSSR, <u>1962</u> , 145,
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	1064 - 1067.
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 295 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The composition of saturated sol $UO_2(NO_3)_2 - HNO_3 - H_2O$ was prese of <sup>2</sup> a triangular <sup>3</sup> phase diagram wh tetrahedron representing the qua $UO_2(NO_3)_2 - TBP - HNO_3 - H_2O.$ Th in <sup>2</sup> the <sup>3</sup> ternary system <sup>3</sup> are the he	nted graphically in the form ich was the basis of a ternary system at 22°C of
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used.	Nothing specified except that distilled TBP was used.
	ESTIMATED ERROR:
	Soly: Nothing specified.
	Temp: Precision <u>+</u> 1 K.
	REFERENCES:
	1

			ORIGINAL MEASUR	ements:
(1) Uranyl nitrat [15905-86-9]	e; UO <sub>2</sub> (NO <sub>3</sub> )	) <sub>2</sub> ;	Aartsen, J. J.	V.; Korvezee, A. E.
(2) Tri-n-butyl p C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [1	)hosphate (1 .26-73-8]	rbp);	<i>Trans. Faraday</i> 510 - 518.	Soc., <u>1964</u> , 60,
(3) Carbon tetrac [56-23-5]	hloride; C	c1 <sub>4</sub> ;		
(4) Water; H <sub>2</sub> O; [	7732-18-5]			
VARIABLES:			PREPARED BY:	
Composition at 29	98 K		A. Sozanski; S.	Siekierski
EXPERIMENTAL VALU	JES:			
The UO,	(NO <sub>2</sub> ) - [	СН, (СН, ),0	$J_{3}PO - CCl_{4} - H_{2}O$	O System <sup>a</sup>
-			Equilibrium with	
compositoron	or organic	111450 111 1		002(1103)210120
UO <sub>2</sub> (NC	$(1_{3})_{2}$	H20	ccl4	TBP
			t. mol fract.	mol fract.
0.320	1.87	0 0394	0.000	0.640
0.272		0.0354		0.523
0.234	1.41	0.0199		0.455
0.189	1.14			0.379
				0.304
0 100	0.939 0.743	0.0067	0.632	0.241
	calculated	by the con	mpilers as moles	of uranvl
<sup>a</sup> Molalities	1 kg of t	he mixture		of uranyl Cl <sub>4</sub> , H <sub>2</sub> O and TBP.
<sup>a</sup> Molalities nitrate per	1 kg of th	by the con he mixture UXILIARY IN	Consisting of Consisting of Construction	Cl <sub>4</sub> , H <sub>2</sub> O and TBP.
<sup>a</sup> Molalities nitrate per	1 kg of th	he mixture	Consisting of Consisting of Construction	of uranyl Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS:
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me	r 1 kg of th AN /PROCEDURE: ethod was us	he mixture UXILIARY I sed. The	Consisting of Consisting of Construction	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS:
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were	r 1 kg of th Al /PROCEDURE: ethod was us weighed and	he mixture UXILIARY I sed. The d then	CONSISTING OF CONFORMATION	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS:
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2	PROCEDURE: weighed and 25°C for a particular	he mixture UXILIARY I sed. The d then period of	Consisting of Construction NFORMATION SOURCE AND PURING Nothing specifi	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS:
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co	PROCEDURE: weighed and 25°C for a pontent of ti	he mixture UXILIARY II sed. The d then period of he organic	Consisting of Construction NFORMATION SOURCE AND PURING Nothing specifi	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS:
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi	PROCEDURE: weighed and pontent of ti .ned by rees	he mixture UXILIARY IN sed. The d then period of he organic xtraction	Consisting of Construction NFORMATION SOURCE AND PURING Nothing specifi	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS:
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow	PROCEDURE: weighed and S <sup>C</sup> for a pontent of the ned by rees- wed by a des-	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity	Consisting of Construction NFORMATION SOURCE AND PURING Nothing specifi	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS:
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow determination (1)	PROCEDURE: weighed and Solution of the ned by rees wed by a des . The wates	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity r content	Consisting of Construction NFORMATION SOURCE AND PURING Nothing specifi	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS:
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow determination (1) of the organic ph by the Karl Fisch	PROCEDURE: PROCEDURE: weighed and So C for a pontent of the ned by ree: yed by a der the water hase was dener titration	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity r content termined on, or	Consisting of Construction NFORMATION SOURCE AND PURING Nothing specifi	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS: ied.
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow determination (1) of the organic ph by the Karl Fisch from the weight 1	PROCEDURE: PROCEDURE: weighed and So C for a pontent of the ned by ree: yed by a der the water hase was der her titration	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity r content termined on, or	consisting of Consisting of Construction NFORMATION SOURCE AND PURITY Nothing specify ESTIMATED ERROR	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS: ied.
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow determination (1) of the organic ph by the Karl Fisch	PROCEDURE: PROCEDURE: weighed and So C for a pontent of the ned by ree: yed by a der the water hase was der her titration	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity r content termined on, or	consisting of Construction	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. <b>FY OF MATERIALS:</b> ied.
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow determination (1) of the organic ph by the Karl Fisch from the weight 1	PROCEDURE: PROCEDURE: weighed and So C for a pontent of the ned by ree: yed by a der the water hase was der her titration	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity r content termined on, or	consisting of Consisting of Construction NFORMATION SOURCE AND PURITY Nothing specify ESTIMATED ERROR	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS: ied.
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow determination (1) of the organic ph by the Karl Fisch from the weight 1	PROCEDURE: PROCEDURE: weighed and So C for a pontent of the ned by ree: yed by a der the water hase was der her titration	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity r content termined on, or	consisting of Consisting of Construction NFORMATION SOURCE AND PURITY Nothing specify ESTIMATED ERROR	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS: ied.
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow determination (1) of the organic ph by the Karl Fisch from the weight 1	PROCEDURE: PROCEDURE: weighed and So C for a pontent of the ned by ree: yed by a der the water hase was der her titration	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity r content termined on, or	consisting of Consisting of Construction NFORMATION SOURCE AND PURITY Nothing specify ESTIMATED ERROR Nothing specify REFERENCES:	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS: ied. pecified.
<sup>a</sup> Molalities nitrate per METHOD/APPARATUS/ The isothermal me components were equilibrated at 2 2 days. Uranyl co phase was determi with water follow determination (1) of the organic ph by the Karl Fisch from the weight 1	PROCEDURE: PROCEDURE: weighed and So C for a pontent of the ned by ree: yed by a der the water hase was der her titration	he mixture UXILIARY IN sed. The d then period of he organic xtraction nsity r content termined on, or	consisting of Construction NFORMATION SOURCE AND PURITY Nothing specify ESTIMATED ERROR Nothing sy REFERENCES: 1. Kapustinsky;	Cl <sub>4</sub> , H <sub>2</sub> O and TBP. TY OF MATERIALS: ied. pecified.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9]</pre>	Lerner, M. W.; Petretic, G.
(2) Tri-n-butyl phosphate (TBP C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	); Report, <u>1951</u> , Decl. 1955, CF-51-12-43.
(3) Nitric acid; HNO <sub>3</sub> ; [7697-3	7-2]
(4) Kerosine; [8008-20-6]	
(5) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES: Composition at 300 K	PREPARED BY: A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
The $UO_2(NO_3)_2$ - $(CH_3(CH_2))$	3 <sup>0)</sup> 3 <sup>PO</sup> - HNO <sub>3</sub> - Kerosine - H <sub>2</sub> O System
Composition of	Saturated Solutions at 27 <sup>0</sup> C
	Equilibrium concentration of uranium
hno <sub>3</sub> a	Aqueous Phase Organic Phase <sup>b</sup>
mol/dm <sup>3</sup>	g/cm <sup>3</sup> g/dm <sup>3</sup>
0 0.5	616.3 102.0 575.2 100.9
1.0	553.3 99.5
3.0	430.4 97.9 362.9 96.1
it was felt that the use affect the nitric acid co	e equal to the volume of unsaturated TF of this slightly smaller volume would o ncentration in the TBP, and for is concentration is so low that the vol
AUXI	LIARY INFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used Calculated amounts of nitric a were placed in 50 mL cylinders brought up to the 25 mL mark gradually with either a satura solution of uranyl nitrate hex hydrate in water, or with wate that a few crystals of uranium	cid and $UO_2(NO_3)_2.6H_2O.$ 2. TBP, Commercial Solvents Con 25% solution made up to volu with kerosine (Gulfspray napththa, d = 0.754 at 27°C)
remained undissolved when the mark was reached. 25 mL of 25%	TBP ESTIMATED ERROR:
saturated with uranium salt we added, and the cylinder was sh	aken Soly: Nothing specified.
for 15 min in the water bath. the phases had separated and c suitable aliquots for analyses	leared, Temp: Precision $\pm 0.5$ K. were
removed from each layer by pip The uranium in higher concentr was determined gravimetrically ignition to U.O. at 1000°C. An were carried out polarographic	ations REFERENCES: by alyses

COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Gresky, A. T.; Mansfield, R. G. Report, <u>1960</u> , CF-60-7-108, p. 46.			
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]				
(3) Di-2-phenylbutane phosphonate; (DSBPP) C <sub>20</sub> H <sub>27</sub> O <sub>3</sub> P;				
(4) Sec-butylbenzene; C <sub>10</sub> H <sub>14</sub> ; [135-98-8]				
(5) Water; H <sub>2</sub> O; [7732-18-5]				
VARIABLES:	PREPARED BY:			
One temperature: Room (compilers)	A. Sozanski; S. Siekierski			
EXPERIMENTAL VALUES:				
The solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O in C <sub>6</sub> H <sub>5</sub> CH(CH <sub>3</sub> )CH <sub>2</sub> CH <sub>3</sub> at room temperatur	1.03 mol/dm <sup>3</sup> (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO in e was reported to be 0.496 mol/dm <sup>3</sup> .			
COMMENTS AND/OR ADDITIONAL DATA:				
Assuming 10% volume increase of the to a soluble TBP complex with the fo	organic phase, the value corresponds rmula UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .2.0(TBP).			
Solubility of UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .6H <sub>2</sub> O in 1.12 mol/dm <sup>3</sup> [CH <sub>3</sub> CH <sub>2</sub> CH(C <sub>6</sub> H <sub>5</sub> )CH <sub>2</sub> O] <sub>2</sub> P( in CH <sub>3</sub> CH <sub>2</sub> CH(C <sub>6</sub> H <sub>5</sub> )CH <sub>3</sub> was reported to be 492 mol/dm <sup>3</sup> .				
COMMENTS AND/OR ADDITIONAL DATA:				
A small amount of crystallization oc but resolution was affected by warmin				
Assuming an organic volume increase corresponds to the complex $UO_2(NO_3)_2$				
AUXILIARY I	NFORMATION			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:			
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	Nothing specified.			
determined in the organic phase. No additional information was given.	ESTIMATED ERROR:			
	Nothing specified.			
	REFERENCES:			

COMPONEN	ITS:			ORIGINAL ME	EASUREMEN	TS:	
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]				Fedorov, Yu. S.; Zil'berman, B. Ya.			
(2) Tri- C <sub>12</sub> H	-n-butyl pho 4 <sub>27</sub> 0 <sub>4</sub> P; [126	sphate (TB) 5-73-8]	Radiokhim.				
	cic acid; HN		37-2]	<i>Sov. Radi</i> 30-34.	ochem.,	<u>1986</u> , 26	,
(4) Wate	er; H <sub>2</sub> O; [77	/32-18-5]					
VARIABLE	S:			PREPARED BY	:		
Composit	tion at 293	к		S. L. Phil	llips		
EXPERIME	ENTAL VALUES	5:					
	The UO <sub>2</sub> (N	$(0_3)_2 - (C_4)$	н <sub>9</sub> 0) <sub>3</sub> ро -	• нио <sub>3</sub> – н <sub>2</sub> с	) System	at 20 <sup>0</sup> C	
				turated Sol			
	Aqueous Pha	Ise		Organic	Phase		
HNO <sub>3</sub>	UO2(NO3)2	н <sub>2</sub> 0	HNO <sub>3</sub>	UO2(NO3)2	, н <sub>2</sub> 0	Density	TBP
mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	mol/dm	$n^3 \text{ mol/dm}^3$	mol/dm <sup>3</sup>	g/cm <sup>3</sup>	mol/d
0	2.40 1.07	44	0	1.60	0.16	1.475	
5.7 8.7	1.07	42	0.34	1.58	0.24	1.474	3.11 2.98
10.3	1.44	32 29	1.50	1.61 1.48	0.65	1.471	2.98
12.5	1.07	26	2.3	1.46	1.04	1.485	1.92
15.1 <sup>a</sup> Equ	1.28 Milibrium so	16 Dlid phase n	3.8 uranyl ni			1.475	2.59
				trate hexah			
-		olid phase n	uranyl ni	trate hexah	ydrate.		
a <sub>Equ</sub>		olid phase n AUX	uranyl ni	trate hexah (Cor	nydrate.	n the ne	xt pag
<sup>a</sup> Equ METHOD/2 A dissol	APPARATUS/PR	AUX ROCEDURE:	uranyl ni ILIARY IN h TBP	trate hexan (Cor FORMATION	ydrate. htinued o PURITY O	n the ne F MATERI	xt paga
<sup>a</sup> Equ METHOD/A A dissol was prep period c uranyl r	APPARATUS/PR Vate of UO pared by dis of several h	AUX AUX ROCEDURE: (NO <sub>3</sub> ) 2 with solving ov hours purifi-	uranyl ni ILIARY IN h TBP er a ied the	trate hexal (Cor FORMATION SOURCE AND	pydrate.	n the ne F MATERI as purif	xt pag
A dissol was prep period c uranyl r TBP, up salt. Tr in the c	APPARATUS/PR Lvate of UO pared by dis of several h hitrate hexa to equilibr he concentra organic phas	AUX: AUX: COCEDURE: (NO <sub>3</sub> ), with solving over buydrate in hydrate in tium with th ation of UO se during	uranyl ni ILIARY IN er a ied the he solid 2 <sup>(NO</sup> 3)2	(Cor (FORMATION SOURCE AND 1. UO <sub>2</sub> (NO <sub>3</sub> )	PURITY O 2.6H2O w hing spe	n the ne F MATERI as purif	xt pag ALS:
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COMPONENTS:		ORIGINAL MEASU	JREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) [15905-86-9]	2'	Fedorov, Yu. S	5.; Zil'berman, B. Ya.
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> <sup>H</sup> 27 <sup>O</sup> 4 <sup>P</sup> ; [126-73-8]		Radiokhim., <u>1986</u> , 28, 37-42.	
(3) Nitric acid; HNO <sub>3</sub> ; [7697	3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]		hem., <u>1986</u> , 26,
<pre>(4) Carbon tetrachloride; CC [56-23-5]</pre>	14;		
(5) Water; H <sub>2</sub> O; [7732-18-5]			
EXPERIMENTAL VALUES: (Contin	ued)	••••••••••••••••••••••••••••••••••••••	
The $UO_2(NO_3)_2 - (C_4H_9O_3)_2$	) <sub>3</sub> PO - HNO	$D_3 - CC1_4 - H_2O$	System at 20 <sup>0</sup> C
		urated Solution	
Aqueous Phase		Organic Phase	9
HNO3	UO2(NO3)	2 HNO <sub>3</sub>	Initial TBP
mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	mol/dm <sup>3</sup>
4.4 7.1 10.1	1.04 1.05 1.05 1.02	0.13 0.29 0.95	2.13
2.1 4.9 8.4 12.6	0.53 0.53 0.53 0.52 0.50	0.023 0.068 0.23 0.82	1.08
4.5 7.6 10.7	0.28 0.28 0.27 0.28	0.38 0.090 0.28	0.57
9.8 12.3	0.097 0.092 0.092	0.087 0.157	0.20
Equilibrium solid phase	υο <sub>2</sub> (Νο <sub>3</sub> ) <sub>2</sub>	2.6H2O (compile	er).

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Ochkin, A. V.; Obruchnikov, A. V.; Smelov, V. S.; Chubukov, V. V.
(2) Nitrosoruthenium nitrate; RuNO(NO <sub>3</sub> ) <sub>3</sub>	Radiokhim., <u>1989</u> , 31, 143-147.
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Sov. Radiochem., <u>1990</u> , 759-763.
(4) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	
(5) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 293 K	S. L. Phillips
EXPERIMENTAL VALUES:	
In the system 3 mol/dm <sup>3</sup> HNO <sub>3</sub> , 1.1 the concentration of uranium in conditions of saturation is report	the organic phase under the organic phase under the organic phase under the state of the second seco
AUXILIARY II	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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	<ol> <li>Uranyl nitrate (pure) was recrystallized from water.</li> <li>TBP, nothing specified.</li> </ol>
aqueous solutions was determined with Arsenazo III (1). Uranium content	ESTIMATED ERROR:
in the uranyl nitrate extract was determined by back-extraction with	Nothing specified.
five (1:1) portions of distilled water.	
	REFERENCES:
	<ol> <li>Markov, Y.V.; Vinogradov, A.V. Elinson, S.V., et al. Methods of Uranium Determination, Atomizdat, Moscow (<u>1960</u>). (in Russian).</li> </ol>

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Uranyl nitrate; UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [15905-86-9]	Nikolaev, A. V.; Yakovlev, I. I.; Dyadin, Yu. A.
(2) Dibutyl butyl phosphonate; C <sub>12</sub> H <sub>27</sub> O <sub>2</sub> P; [78-46-6]	Solvent Extraction Chemistry, Proc. Intl. Conf., Gothenburg,
(3) Water; H <sub>2</sub> O; [7732-18-5]	1966. (Dryssen, D.; Liljenzin, J. O.; Rydberg, J., eds.). North- Holland Publishing Co., Amsterdam, 1967, pp. 312 - 321.
VARIABLES:	PREPARED BY:
Composition and temperature	A. Sozanksi; S. Siekierski
EXPERIMENTAL VALUES:	
The $UO_2(NO_3)_2 - CH_3(CH_2)_2CH_2OPC$	$(CH_2(CH_2)_2CH_3)_2 - H_2O$ System
The experimental results are giv phase diagrams.	en in the form of two triangular
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	Nothing specified.
	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES:
	[ [
	l

COMPONENTS:	EVALUATOR:		
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	S. Siekierski Department of Radiochemistry		
(2) Water; H <sub>2</sub> O; [7732-18-5]	Institute of Nuclear Research Warsaw, Poland		
	S. L. Phillips Camatx/Basic Data		
	Orinda, CA 94563 USA		

## 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 <sub>3</sub> ) <sub>4</sub> .12H <sub>2</sub> O	696,2425	[61443-54-7]	Nitric acid, thorium, (4+)salt,dodecahydrate
Th(NO <sub>3</sub> ) <sub>4</sub> .6H <sub>2</sub> O	588.1501	[23739-44-8]	Nitric acid, thorium, (4+)salt, hexahydrate
Th(NO <sub>3</sub> ) <sub>4</sub> .5.5H <sub>2</sub> O	579.1424	[61443-54-7]	Nitric acid, thorium, (4+)salt, 5.5-hydrate
Th(NO <sub>3</sub> ) <sub>4</sub> .5H <sub>2</sub> O	570.1347	[14767-04-5]	Nitric acid, thorium, (4+)salt, pentahydrate
Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O	552.1193	[13470-07-0]	Nitric acid, thorium, (4+)salt, tetrahydrate
Th(NO <sub>3</sub> ) <sub>4</sub> .3H <sub>2</sub> O	534.1039	[87174-21-8]	Nitric acid, thorium, (4+)salt, trihydrate
$Th(NO_3)_4.2H_2O$	516.0885	[61443-54-7]	Nitric acid, thorium, (4+)salt, dihydrate
$Th(NO_3)_4.H_2O$	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)

COMPONENTS:	EVALUATOR:
(1) Thorium nitrate; Th(NO3)4; [13823-29-5]	S. Siekierski Department of Radiochemistry
(2) Water; H <sub>2</sub> O; [7732-18-5]	Institute of Nuclear Research Warsaw, Poland
	S. L. Phillips Camatx/Basic Data Orinda, CA 94563 USA

CRITICAL EVALUATION: when 1 mass % of HNO<sub>3</sub> 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  $Th(NO_3)_A$  - H<sub>2</sub>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 Th(NO3)4 - H20 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  $Th(NO_3)_A$  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  $Th(NO_3)_4$  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, Th(NO<sub>2</sub>), 5.5H<sub>2</sub>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.

There appear to be several reasons for these discrepencies. 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 HNO3. Nakashima and Zimmer (14) determined the value of the first hydrolysis constant in relation to their study of the extractability of  $Th(NO_3)_4$  in dodecane by tributylphosphate (TBP) as 7.59 x  $10^{-5}$ . The solid crystallized from these (continued on the next page)

COMPONENTS: (1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	EVALUATOR: S. Siekierski Department of Radiochemistry
(2) Water; H <sub>2</sub> O; [7732-18-5]	Institute of Nuclear Research Warsaw, Poland
	Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA

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 Th $(NO_3)_4.4H_2O$ , the main constituent of the commercially available salt of thorium nitrate, is very resistant to transformation to the stable pentaor 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  $Th(NO_3)_4.nH_2O$  hydrates.

ThO <sub>2</sub>	H <sub>2</sub> O	T/K	Value of n assigned	
mass <sup>2</sup> %	mašs %		in Ref.	Ref.
45.7 <u>+</u> 0.1	17.5 <u>+</u> 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 <u>+</u> 0.1	15.79 <u>+</u> 0.1	298.15	5 (1 mass % HNO <sub>2</sub> )	7,8
45.6 <u>±</u> 0.2	17.3 <u>±0</u> .2	298.15	5 (without HNO, )	7,8
35.21		293.15	6 (without $HNO_3^3$ )	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<sub>3</sub> 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; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5] (2) Water; H <sub>2</sub> O; [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

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  $Th(NO_3)_4 - HNO_3 - H_2O$ , 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.

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.

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

(continued on the next page)

COMPONENTS:	EVALUATOR:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ;	S. Siekierski
[13823-29-5]	Department of Radiochemistry
(2) Water; H <sub>2</sub> O; [7732-18-5]	Institute of Nuclear Research
	Warsaw, Poland Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA

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  $Th(NO_3)_4 - HNO_3 - H_2O(7,8)$ . 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.

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  $Th(NO_3)_4 - H_2O$  system given by Marshall et al. (5), the existence of a lower hydrate seems very probable although only two data points have been reported.

## The Solubility of Th(NO,), at Temperatures Below 385K

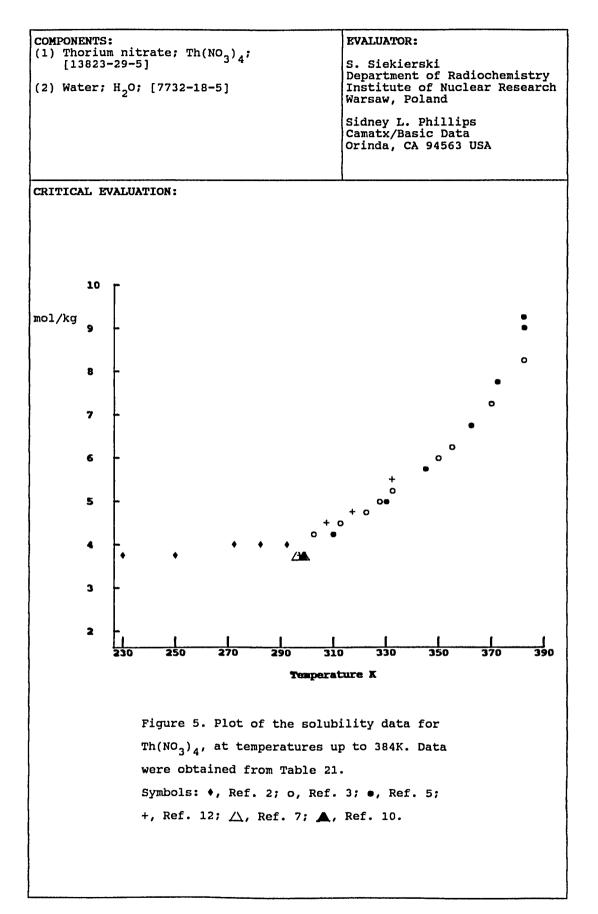
The solubility values used in this work are in Table 21, and plotted in Figure 5. The five data points reported by Misciattelli (2) have been rejected because the small increase in solubility in the temperature range of 229.7K to 293.2K appears to be incompatible with the changes in the solubility at 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 (continued on the next page)

COMPONENTS:	EVALUATOR:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ;	S. Siekierski
[13823-29-5]	Department of Radiochemistry
(2) Water; H <sub>2</sub> O; [7732-18-5]	Institute of Nuclear Research
	Warsaw, Poland Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA

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

		202 00	officer minut	3'4' 2'	···201	
1	Solubility	,	S	olubility		
Т/К	mol/kg	Ref.	T/K	mol/kg	Ref.	
*229.65	3.70	2	327.65	4.810	5 3 12 3 5	
*251.15	3.73	2	331.90	4.91	3	
*273.15	3.87	2	*333.15	5.475	12	
283.15	3.90	2 2 2 2	333.70	5.00	3	
*293.15	3.713	10	345.15	5.745	5	
*293.15	3.97	2	350.70	5.78	3	
298.15	3.723	7	355.50	6.12	3	
298.15	3.737	12	363.35	6.740	3 3 5 3 5	
302.90	4.08	3	372.30	7.09	3	
*308.15	4.346	12	372.85	7.633	5	
310.45	4.243	5 3	382.50 <sub>a</sub>	8.08	3 5 5	
313.30	4.33	3	*383.55h	8.944	5	
*318.15	4.677	12	*383.55 <sup>a</sup> *384.05 <sup>b</sup>	9.177	5	
323.15	4.66	3				
<sup>a</sup> The hexahydrate	(pentahydr	ate)	> tetrahydra	te transi	tion point (	(4).
<sup>b</sup> Metastable equil:	lbrium if	the tran	sition tempe	rature is	383.6K.	
*Not used in fitt:	ing to Eq	1.	(co	ntinued o	n the next p	page)

Table 21. The solubility of  $Th(NO_3)_4$  in water for temperatures below 385K, for the system  $Th(NO_3)_4.5H_2O - H_2O$ .



COMPONENTS: (1) Thorium nitrate; Th(NO <sub>2</sub> ) <sub>4</sub> ;	EVALUATOR:
[1] [13823-29-5]	S. Siekierski
(2) Water; H <sub>2</sub> O; [7732-18-5]	Department of Radiochemistry Institute of Nuclear Research Warsaw, Poland
	Sidney L. Phillips Camatx/Basic Data Orinda, CA 94563 USA

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  $35^{\circ}$ C,  $45^{\circ}$ C and at  $60^{\circ}$ 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,

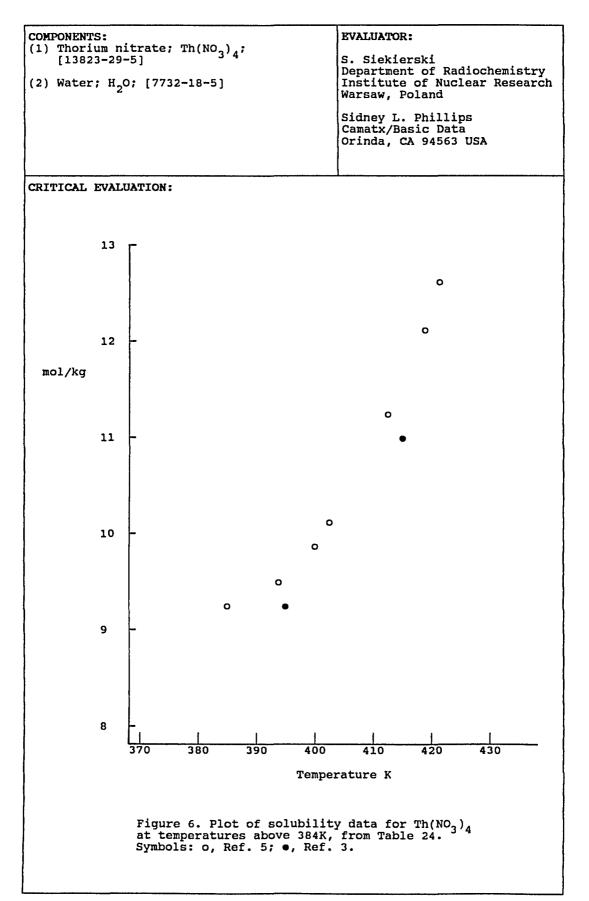
$$Y = \ln (m/m_{o}) - (m/m_{o} - 1) = a + b/T + c \ln (T) + d (T)$$
(1)

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  $Th(NO_3)_4.5H_2O$ .

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.

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 discrepency 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

COMPONENT			EVALU	JATOR:		
[1382	<ol> <li>Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</li> <li>Water; H<sub>2</sub>O; [7732-18-5]</li> </ol>		Depar Insti	S. Siekierski Department of Radiochemist Institute of Nuclear Resea Warsaw, Poland		
			Camat	ey L. Phillips x/Basic Data la, CA 94563 U		
CRITICAL	EVALUATION:					
temperatu	re interval fr	om 293.2K to	about 385K,	then its cong	ruent	
melting t	emperature car	be calculat	ed by extrapt	plating the pe	ntahydı	
branch up	to the solubi	lity value 1	1.10 mol/kg.	The congruent	meltir	
temperatu	re determined	in this mann	er is about 3	91K. However,	if the	
Table 22	2. Coefficients thorium nitz Equation 1.	s and standar ate based on	d deviations fitting of t	for the solut he data in Ta	bility o ble 21	
	Coefficie Equation	ent in Val 1 coe		Standard deviation		
	a		.8202	0.01137	Ē	
	b c	1222	2.375	3.711 0.001969	-	
	d <sup>m</sup> o	-0.	2.375 0.3000 01234 10	0.001969 3.54 x 1 0.2013	.0 <sup>-5</sup>	
	0					
Table	-	melting poin		ity of Th(NO	,	
Table	e 23. Recommend in water	led values fo for temperat		an 384K, from"	)4	
	e 23. Recommend in water	ded values fo for temperat 1, with n =	r the solubil ures less that	an 384K, from <sup>-</sup> 5H <sub>2</sub> O.	) <sub>4</sub> ility	
	e 23. Recommend in water Equation	ded values fo for temperat 1, with n =	or the solubil cures less that 5: Th(NO3)4.5	an 384K, from <sup>-</sup> 5H <sub>2</sub> O.	ility	
Solub T/K 223.15	e 23. Recommend in water Equation pility mol/kg 2.24	led values for for temperat 1, with n = Solub $\overline{T/K}$ 293.15	or the solubil sures less that 5: Th(NO <sub>3</sub> ) <sub>4</sub> .5 bility $\frac{\text{mol/kg}}{3.67}$	an 384K, from $3H_2O$ . Solub T/K 343.15	mol/F	
Solub T/K 223.15 233.15 243.15	e 23. Recommend in water Equation Dility <u>mol/kg</u> <u>2.24</u> 2.38 2.54	ded values for for temperat 1, with n = Solub T/K 293.15 298.15 303.15	by the solubil sures less that 5: Th(NO <sub>3</sub> ) <sub>4</sub> .5 bility $\frac{\text{mol/kg}}{3.67}$ $3.81$ $3.97$	an 384K, from $_{2}^{\text{SH}}$ Solut $_{T/K}$	ility mol/k 5.50 5.75 6.01	
Solub T/K 223.15 233.15 243.15 253.15	e 23. Recommend in water Equation Dility <u>mol/kg</u> 2.24 2.38 2.54 2.73	ded values for for temperat 1, with n = Solub $\overline{T/K}$ $\overline{293.15}$ 298.15 303.15 308.15	$\frac{1}{3.67}$	an 384K, from $3H_2O$ . Solub T/K 343.15 348.15 353.15 358.15	mol/k mol/k 5.50 5.79 6.01 6.29	
Solub T/K 223.15 233.15 243.15 253.15 263.15	e 23. Recommend in water Equation bility <u>mol/kg</u> 2.24 2.38 2.54 2.73 2.93	led values for for temperat 1, with n = Solub $\overline{T/K}$ 293.15 298.15 303.15 308.15 313.15	br the solubil cures less that $5: Th(NO_3)_4.5$ bility mol/kg 3.67 3.81 3.97 4.12 4.29	an 384K, from <sup>3H</sup> 2O. <i>T/K</i> 343.15 348.15 353.15 358.15 363.15	mol/k 5.50 5.79 6.01 6.29 6.61	
Solub T/K 223.15 233.15 243.15 253.15	e 23. Recommend in water Equation Dility <u>mol/kg</u> 2.24 2.38 2.54 2.73	ded values for for temperat 1, with n = Solub $\overline{T/K}$ $\overline{293.15}$ 298.15 303.15 308.15	$\frac{1}{3.67}$	an 384K, from $3H_2O$ . Solub T/K 343.15 348.15 353.15 358.15	mol// 5.50 5.79 6.01 6.29 6.61	
Solub T/K 223.15 233.15 243.15 253.15 263.15 273.15	e 23. Recommend in water Equation pility <u>mol/kg</u> 2.24 2.38 2.54 2.73 2.93 3.15	led values fo for temperat 1, with n = Solub T/K 293.15 298.15 303.15 303.15 313.15 318.15 323.15 328.15	or the solubil cures less that 5: Th(NO <sub>3</sub> ) <sub>4</sub> .5 oility mol/kg 3.67 3.81 3.97 4.12 4.29 4.47 4.65 4.85	$\begin{array}{c} \text{in 384K, from} \\ \text{Solub} \\ \text{Solub} \\ \hline \\ $	mol/k 5.50 5.75 6.01 6.29 6.61 6.95 7.34 7.79	
Solub T/K 223.15 233.15 243.15 253.15 263.15 273.15	e 23. Recommend in water Equation pility <u>mol/kg</u> 2.24 2.38 2.54 2.73 2.93 3.15	led values for for temperat 1, with n = Solub T/K 293.15 298.15 303.15 308.15 313.15 318.15 323.15	or the solubil sures less that 5: Th(NO <sub>3</sub> ) <sub>4</sub> .5 bility mol/kg 3.67 3.81 3.97 4.12 4.29 4.47 4.65	$ \begin{array}{r} \text{in 384K, from} \\ \text{Solub} \\ \text{Solub} \\ \hline T/K \\ \hline 343.15 \\ 343.15 \\ 348.15 \\ 353.15 \\ 358.15 \\ 363.15 \\ 368.15 \\ 368.15 \\ 373.15 \\ \end{array} $	mol/J mol/J 5.50 5.79 6.00 6.29 6.63 7.39 7.39 7.39 8.33	
Solub T/K 223.15 233.15 243.15 253.15 263.15 273.15 283.15	e 23. Recommend in water Equation pility <u>mol/kg</u> 2.24 2.38 2.54 2.73 2.93 3.15	led values for for temperat 1, with n = Solub T/K 293.15 298.15 303.15 308.15 313.15 318.15 323.15 328.15 333.15 338.15	br the solubil cures less that 5: Th(NO <sub>3</sub> ) <sub>4</sub> .5 bility mol/kg 3.67 3.81 3.97 4.12 4.29 4.47 4.65 4.85 5.05 5.27	an 384K, from <sup>3H</sup> 20. Solut T/K 343.15 348.15 358.15 363.15 363.15 368.15 373.15 378.15 383.15 393.15	mol/} 5.50 5.79 6.01 6.29 6.61 6.95 7.34 7.79 8.33 10.29	
Solub T/K 223.15 233.15 243.15 253.15 263.15 273.15 283.15 hexahydra	e 23. Recommend in water Equation oility 2.24 2.38 2.54 2.73 2.93 3.15 3.39	led values fo for temperat 1, with n = Solub T/K 293.15 298.15 303.15 308.15 313.15 318.15 323.15 328.15 333.15 338.15 .1ibrated sol	br the solubil cures less that $5: Th(NO_3)_4.5$ bility mol/kg 3.67 3.81 3.97 4.12 4.29 4.47 4.65 4.85 5.05 5.27 d over this	In 384K, from H <sub>2</sub> O. Solut T/K 343.15 343.15 348.15 353.15 358.15 363.15 368.15 373.15 373.15 378.15 383.15 383.15 393.15	mol/} 5.50 5.79 6.01 6.29 6.61 6.29 7.34 7.34 7.79 8.33 10.29 ure ran	
Solub T/K 223.15 233.15 243.15 253.15 263.15 273.15 283.15 hexahydra then the	e 23. Recommend in water Equation oility <u>mol/kg</u> 2.24 2.38 2.54 2.73 2.93 3.15 3.39 ate is the equi	Hed values for for temperation is solubing the second sec	br the solubil cures less that $5: Th(NO_3)_4.5$ bility mol/kg 3.67 3.81 3.97 4.12 4.29 4.47 4.65 4.85 5.05 5.27 d over this	In 384K, from H <sub>2</sub> O. Solut T/K 343.15 343.15 348.15 353.15 358.15 363.15 368.15 373.15 373.15 378.15 383.15 383.15 393.15	ility mol// 5.50 5.79 6.01 6.29 6.61 6.95 7.34 7.79 8.33 10.29 ure rar	
Solub T/K 223.15 243.15 243.15 253.15 263.15 273.15 283.15 hexahydra then the incongrue	e 23. Recommend in water Equation oility <u>mol/kg</u> 2.24 2.38 2.54 2.73 2.93 3.15 3.39 ate is the equi congruent melt	led values for for temperat 1, with n = Solub $\overline{T/K}$ 293.15 298.15 303.15 308.15 313.15 318.15 323.15 328.15 333.15 338.15 .1ibrated sol cing point is .nt.	br the solubil tures less that $5: Th(NO_3)_4.5$ bility mol/kg 3.67 3.81 3.97 4.12 4.29 4.47 4.65 4.65 5.05 5.27 d over this about 386K,	an 384K, from H <sub>2</sub> O. Solub T/K 343.15 343.15 353.15 353.15 368.15 368.15 373.15 373.15 378.15 383.15 393.15 same temperat and coincides	mol/J 5.50 5.79 6.02 6.29 6.61 7.30 7.79 8.33 10.29 ure rai	
Solub T/K 223.15 233.15 243.15 263.15 273.15 263.15 hexahydra then the incongrue <u>The Solub</u>	e 23. Recommend in water Equation oility <u>mol/kg</u> 2.24 2.38 2.54 2.73 2.93 3.15 3.39 ate is the equi congruent melt ent melting poi	led values for for temperat 1, with n = Solub $\overline{T/K}$ 293.15 298.15 303.15 308.15 313.15 318.15 323.15 328.15 333.15 338.15 .librated sol ing point is .nt. $D_3)_4$ at Tempe	or the solubil sures less that $5: Th(NO_3)_4.5$ oility mol/kg 3.67 3.81 3.97 4.12 4.29 4.47 4.65 4.85 5.05 5.27 id over this about 386K,	an 384K, from H <sub>2</sub> O. Solut T/K 343.15 348.15 353.15 358.15 363.15 363.15 363.15 363.15 378.15 373.15 373.15 373.15 393.15 same temperat and coincides	mol// 5.50 5.79 6.01 6.29 6.61 6.99 7.34 7.79 8.33 10.29 ure rar	
Solub T/K 223.15 243.15 243.15 253.15 263.15 273.15 283.15 hexahydra then the incongrue <u>The Solub</u> The publi	e 23. Recommend in water Equation oility <u>mol/kg</u> <u>2.24</u> 2.38 2.54 2.73 2.93 3.15 3.39 ate is the equi congruent melt ent melting poi	Hed values for for temperation 1, with n = Solub T/K 293.15 298.15 303.15 308.15 313.15 318.15 328.15 338.15 338.15 .1ibrated sol ting point is .nt. D <sub>3</sub> ) <sub>4</sub> at Tempe ties are comp	or the solubil cures less that 5: Th(NO <sub>3</sub> ) <sub>4</sub> .5 oility mol/kg 3.67 3.81 3.97 4.12 4.29 4.47 4.65 4.85 5.05 5.27 d over this about 386K, eratures above	an 384K, from H <sub>2</sub> O. Solub T/K 343.15 348.15 353.15 358.15 368.15 368.15 373.15 373.15 373.15 373.15 373.15 373.15 393.15 same temperat and coincides 384K 2.24, and are	mol/J 5.50 5.79 6.01 6.29 6.61 7.34 7.34 7.35 7.35 7.35 7.35 7.35 7.35 7.35 7.35	



COMPONENTS:	EVALUATOR:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ;	S. Siekierski
[13823-29-5]	Department of Radiochemistry
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Institute of Nuclear Research
(3) Water: H <sub>2</sub> O; [7732-18-5]	Warsaw, Poland
(3) Water; H <sub>2</sub> O; [7732-18-5]	

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  $Th(NO_3)_4 - HNO_3 - H_2O$  to zero  $HNO_3$  concentration results in a solubility of metastable  $Th(NO_3)_4.4H_2O$ 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.

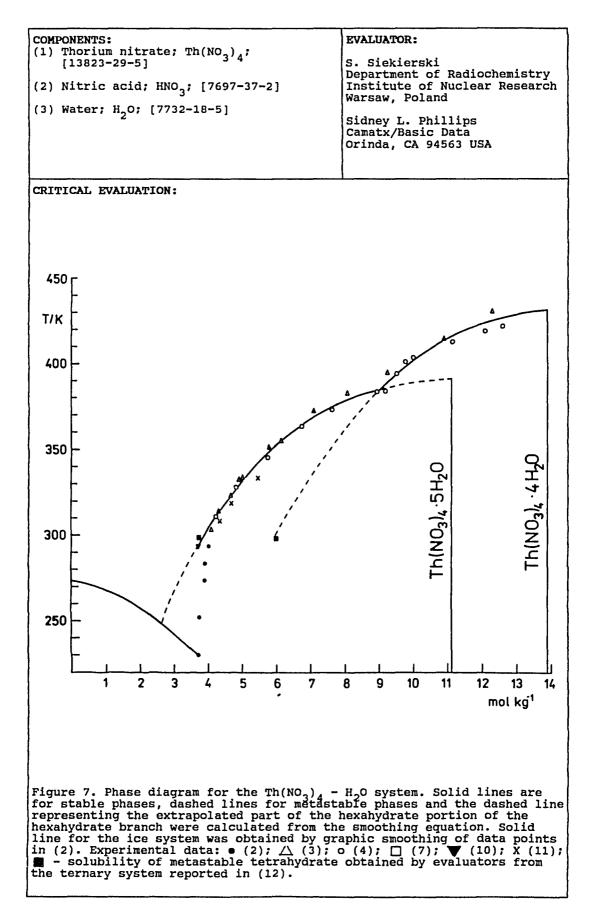
# TERNARY SYSTEMS

# The Th(NO<sub>3</sub>)<sub>4</sub> - HNO<sub>3</sub> - H<sub>2</sub>O System

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 Th(NO<sub>3</sub>)<sub>4</sub> - HNO<sub>3</sub> - H<sub>2</sub>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<sub>3</sub> obtained by extrapolation to zero HNO<sub>3</sub> concentration, is in very good agreement with the solubility of 5.9 mol/kg obtained by extrapolating the stable tetrahydrate branch in the Th(NO<sub>3</sub>)<sub>4</sub> - H<sub>2</sub>O system.

# The Th(NO<sub>3</sub>)<sub>4</sub> - Al(NO<sub>3</sub>)<sub>3</sub> - H<sub>2</sub>O System

The ternary system was studied at 298.15K by Kurnakova and Nikolaev (10). The solubility data included the saturation concentration of  $Th(NO_3)_4$ (continued on the next page)



OMPONENTS: L) Thorium ni [13823-29-	trate; -5]	Th(NO <sub>3</sub> ) <sub>4</sub>	i	s. s	UATOR: Siekierski artment of		nemistr
2) Water; H <sub>2</sub> C	Water; H <sub>2</sub> O; [7732-18-5]		Inst  Wars	itute of aw, Polar	Nuclear		
				Cama	ey L. Phi tx/Basic da, CA 94	Data	
RITICAL EVAL	JATION:			[	·		
Table 24.	The sol Th(NO <sub>3</sub> )	ubility 4• <sup>4H</sup> 2 <sup>O</sup> -	data for T H <sub>2</sub> O.	h(NO <sub>3</sub> ) <sub>4</sub>	in the bi	inary sys	stem
Solu	bility		-	5	Solubility	Y	
-	ol/kg	Ref.		T/K	mol/kg	Ref	•
384.05 <sup>a</sup>	.177	5		415.0	10.9 12.09	3	-
		5 3		419.15	12.09	5 5	
394.65 9 401.15 9	2.759	3 5		431.0	12.60 12.3	э 3	
403.65 10	0.06	5				•	
412.65 11	1.16	5					
<sup>a</sup> This point	. was as	sumed to	belong to	both th	e pentahy	vdrate a	nd the
tetrahydra	ate bran	ches. (E	Evaluators)				
Table 25.			coefficient ng the data				
		n fittir		in Tabl	.e 24 to 1	Equation	
	based o fficient a	n fittir V -5140	ng the data Value	in Tabl Standard	e 24 to 1 Deviatio	Equation	
	based o fficient a b c	n fittir V -5140 173750	ng the data Value	in Tabl Standard C 1	e 24 to 1 Deviatio	Equation on —	
	based o fficient a b c d	n fittir -5140 173750 855 -1	ng the data Value 0.514 0.11 0.612 0.0507	in Tabl Standard C 1	e 24 to 1 Deviatio	Equation on —	
Coe1	based o ficient a b c d <sup>m</sup> o	n fittir -5140 173750 855 -1 13	ng the data /alue .514 .11 .612 .0507 .88 mol/kg	in Tabl Standard C 1	e 24 to 1 Deviatio	Equation on —	
	based o ficient a b c d <sup>m</sup> o	n fittir -5140 173750 855 -1 13	ng the data /alue .514 .11 .612 .0507 .88 mol/kg	in Tabl Standard C 1	e 24 to 1 Deviatio	Equation on —	
Coef	based o fficient a b c d m o error of . Recomm	n fittir -5140 173750 855 -1 13 the est	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl Standard C 1 C 1 C 1 C C	e 24 to 1 1 Deviatio .95 .000796 .177 x 10 .268	Equation  0 <sup>-5</sup>	1.
Coef	based o fficient a b c d m o error of . Recomm	n fittir -514C 17375C 855 -1 13 the est ended sc cients i	ng the data Value .514 .11 .6612 .0507 .88 mol/kg	in Tabl	e 24 to 1 1 Deviatio .95 .000796 .177 x 10 .268	Equation  0 <sup>-5</sup>	1.
Coef  aStandard e Table 26	based o fficient a b c d m o error of . Recomm coeffi Solubi	n fittir -514C 17375C 855 -1 13 the est ended sc cients i	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl	e 24 to 3 Deviation .00479 .95 .000796 .177 x 10 .268 ed from Eco	Equation  0 <sup>-5</sup>	1.
Coef aStandard e Table 26.	based o fficient a b c d m o error of solubi	n fittir -514C 17375C 855 -1 13 the est ended sc cients i lity mol/kg 9.22	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl Standard C 1 C 1 C 1 C 1 C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C C 1 C	e 24 to 3 Deviation 0.00479 .95 0.000796 .177 x 10 0.268 ed from Eco pility mol/kg 10.48	Equation  0 <sup>-5</sup>	1.
Coef aStandard of Table 26.	based o fficient a b c d m o error of solubi F/K 33.15 38.15	n fittir -514C 17375C 855 -1 13 the est ended sc cients i lity mol/kg 9.22 9.17	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl Standard C 1 C C 1 C C C C C C C C C C C C C	e 24 to 3 Deviation 0.00479 .95 0.000796 .177 x 10 0.268 ed from Eco pility mol/kg 10.48 11.08	Equation  0 <sup>-5</sup>	1.
Coef aStandard of Table 26.	based o fficient a b c d m o error of solubi 7/K 33.15 38.15 33.15	n fittir -514C 17375C 855 -1 13 the est ended sc cients i lity 9.22 9.17 9.29	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl Standard C 1 S 1 S 4 1 S 4 1 S 1 S 4 1 S S S S S S S S S S S S S	e 24 to 3 Deviation 0.00479 .95 0.000796 .177 x 10 0.268 ed from Economic pility mol/kg 10.48 11.08 11.74	Equation  0 <sup>-5</sup>	1.
Coef a Standard of Table 26.	based o fficient a b c d m o error of solubi F/K 33.15 38.15	n fittir -514C 17375C 855 -1 13 the est ended sc cients i lity mol/kg 9.22 9.17	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl Standard C 1 C C 1 C C C C C C C C C C C C C	e 24 to 3 Deviation 0.00479 .95 0.000796 .177 x 10 0.268 ed from Eco pility mol/kg 10.48 11.08	Equation  0 <sup>-5</sup>	1.
Coef a Standard of Table 26.	based o fficient a b c d m o error of Solubi 7/K 33.15 38.15 38.15 38.15 38.15	n fittir -5140 173750 855 -1 13 the est ended so cients i lity 9.22 9.17 9.29 9.57	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl Standard C 1 C 1 C 1 C C 1 C C C C C C C C C C	e 24 to 3 a Deviatio 0.00479 .95 0.000796 .177 x 10 0.268 ed from Ec pility mol/kg 10.48 11.08 11.74 12.36 12.61 12.15	Equation  0 <sup>-5</sup>	1.
Coef a Standard of Table 26.	based o fficient a b c d m o error of Solubi 7/K 33.15 38.15 38.15 38.15 38.15	n fittir -5140 173750 855 -1 13 the est ended so cients i lity 9.22 9.17 9.29 9.57	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl Standard () () () () () () () () () ()	e 24 to 1 Deviation 0.00479 .95 .000796 .177 x 10 0.268 ed from Economic pility mol/kg 10.48 11.08 11.74 12.36 12.61	Equation  0 <sup>-5</sup>	1.
Coef a Standard of Table 26.	based o fficient a b c d m o error of Solubi 7/K 33.15 38.15 38.15 38.15 38.15	n fittir -5140 173750 855 -1 13 the est ended so cients i lity 9.22 9.17 9.29 9.57	ng the data Value .514 .11 .612 .0507 .88 mol/kg imate.	in Tabl Standard C 1 C 1 C 1 C C 1 C C C C C C C C C C	e 24 to 3 a Deviatio 0.00479 .95 0.000796 .177 x 10 0.268 ed from Ec pility mol/kg 10.48 11.08 11.74 12.36 12.61 12.15	Equation	1. 1 with

.

COMPONENTS: EVALUATOR: (1) Thorium nitrate; Th(NO3),; [13823 - 29 - 5]S. Siekierski (2) Nitric acid; HNO; [7697-37-2](3) Aluminum nitrate; Al(NO<sub>3</sub>); Department of Radiochemistry Institute of Nuclear Research [13473-90-0] Warsaw, Poland (4) Copper nitrate; Cu(NO2); Sidney L. Phillips [3251-23-8] (5) Ferric nitrate; Fe(NO<sub>3</sub>)<sub>3</sub>; Camatx/Basic Data Orinda, CA 94563 USA [10421 - 48 - 4](6) Uranyl nitrate; UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [15905-86-9] (7) Water; H<sub>2</sub>O; [7732-18-5] 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  $Th(NO_3)_A$  in systems with four components. These studies are summarized as follows: Quaternary system components T/K Solid phases Ref.  $Th(NO_3)_4$ -Cu(NO<sub>3</sub>)<sub>2</sub>-HNO<sub>3</sub>-H<sub>2</sub>O 298.2 A + B + C10 B + D  $Th(NO_3)_4$ -Fe(NO<sub>3</sub>)<sub>3</sub>-HNO<sub>3</sub>-H<sub>2</sub>O 293.2 10  $Th(NO_3)_4 - UO_2(NO_3)_2 - HNO_3 - H_2O$ A + E + F298.2 11  $Th(NO_3)_4 - Al(NO_3)_3 - HNO_3 - H_2O$  298.2, 323.3 13  $A=Th(NO_3)_4.4H_2O; B=Th(NO_3)_4.6H_2O; C=Cu(NO_3)_2.3H_2O; D=Fe(NO_3)_3.9H_2O;$  $E=UO_{2}(NO_{3})_{2}.6H_{2}O; F=UO_{2}(NO_{3})_{2}.4H_{2}O.$ The quaternary systems with  $Cu(NO_3)_2$  and  $Fe(NO_3)_3$  were studied by Kurnakova and Nikolaev (10) who fixed the nitric acid at 1.5 mol/dm<sup>3</sup> of HNO3. A high concentration of Cu(NO3)2 resulted in dehydration of Th(NO3)4.6H20 to Th(NO3)4.4H20. A system with uranyl nitrate was studied by Nikolaev et al. (11). The solid phases were assigned the formulas Th(NO3)4.4H20, UO2(NO3)2.6H20 and UO2(NO3)2.4H20. The tetrahydrate was dominant at the lower concentrations. Phillips and Huber (13) studied the solubility of Th(NO3)4 at temperatures of 298.5K and 323.2K. They did not identify the solid phases. SOLID PHASES The structure of the crystalline solid Th(NO<sub>3</sub>)<sub>4</sub>.4H<sub>2</sub>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  $H_2^0$  molecules are associated with the Th atom.

(continued on the next page)

COMPONENTS:	EVALUATOR:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	S. Siekierski
(2) Nitric acid; HNO <sub>2</sub> ; [7697-37-2]	Department of Radiochemistry
(3) Aluminum nitrate; Al(NO <sub>3</sub> );	Institute of Nuclear Research
[13473-90-0]	Warsaw, Poland
(4) Copper nitrate; Cu(NO <sub>3</sub> ) <sub>2</sub> ;	·
	Sidney L. Phillips
(5) Ferric nitrate; Fe(NO <sub>3</sub> ) <sub>3</sub> ;	Camatx/Basic Data
[10421-48-4]	Orinda, CA 94563 USA
(6) Uranyl nitrate; UO2(NO2)2;	
[15905-86-9]	
(7) Water; H_O; [7732-18-5]	

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2. Misciattelli, P. Gazz. Chim. Ital. 1930, 60, 833.

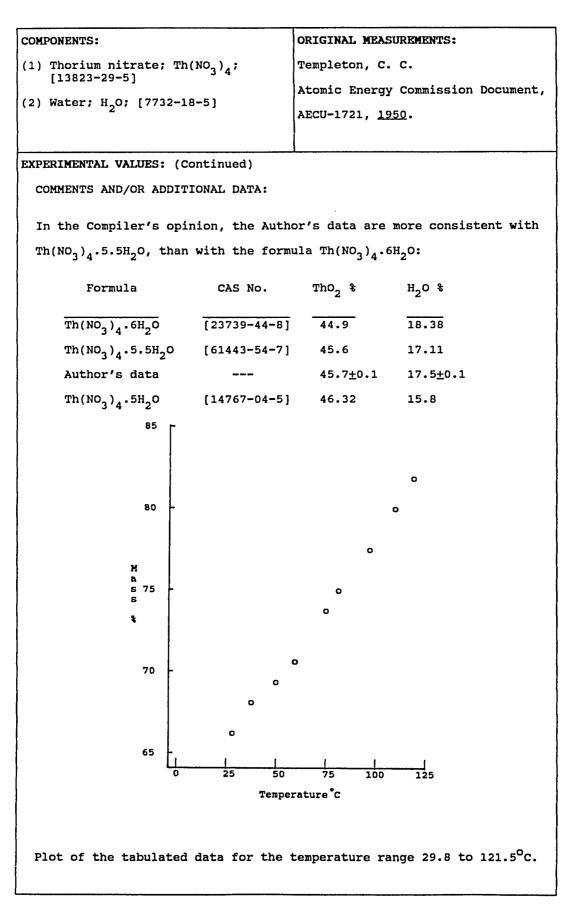
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COMPONE	NTIC •	· · · · · · · · · · · · · · · · · · ·		ORTGIN	AT. MEASUR	MENTS .	· · · · · · · · · · · · · · · · · · ·	
		to, Th/NO	<b>.</b>		ORIGINAL MEASUREMENTS: Misciattelli, P.			
<pre>(1) Thorium nitrate; Th(NO3);     [13823-29-5]</pre>				Í				
(2) Water; H <sub>2</sub> O; [7732-18-5]				Gazz.	Chim. Ita.	1. <u>1930</u> , 6	833-838.	
							·····	
VARIABLES:					ED BY:			
T/K = 2	29 - 293			L. Fuk	s; S. Siel	cierski		
EXPERIM	ENTAL VALU	ES: So	lubility	of Th(N	0 <sub>3</sub> ) <sub>4</sub> in wa	ater <sup>a</sup>		
		NO3)4				10 <sub>3</sub> ) <sub>4</sub>		
t/°c	mass %	mol/kg	Solid Phase		mass %	mol/kg	Solid Phase	
-0.2	1.0	0.021	ice "	-13.5	46.2	1.80	A	
-0.5 -1.0	2.0 5.2	0.040 0.110		-15.0 -16.6	47.7 49.8	1.90 2.07	А А	
-1.5	9.0	0.210	11	-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	11	-25.0	55.7	2.62	A	
-4.0	20.0	0.521		-28.6	58.0	2.88	A	
-4.6 -5.4	23.5 26.4	0.640 0.747		-31.3	59.2 60.6	3.02 3.20	A A	
	27.3	0.782	11		62.0	3.40	Ä	
-6.0	27.3 33.0	1.030		1010			••	
-6.6	37.0		н	-43.5	64.0	3.70	в	
-9.0	41.0	1.450	11 11	-22.0	64.2 <sup>D</sup>	3.73	В	
	43.0	1.570	18	0.0	65.0 <sup>5</sup>	3.87	В	
-12.2	44.5	1.670	п	10.0 20.0	64.0 64.2b 65.0b 65.2b 65.6	3.90 3.97	B B	
a Mol	alities, m	ol/kg, ca	lculated	by the	compilers			
b Iso	thermal me	thod.						
c <sub>Sol</sub>	id phase:	A = ice; B	= Th(NO	3)4.6H20				
			XILIARY			<u> </u>		
METHOD/	APPARATUS/	PROCEDURE:		SOURC	E AND PUR	TY OF MAT	ERIALS:	
Synthetic and isothermal methods were used. Thorium nitrate hexahydrate was analyzed using procedure described by Fuhse (1) and Jacoby (2).				as used. cy which	This cont	ained 47% ded to a	of ThO <sub>2</sub> , mixture of	
				ESTIM	ESTIMATED ERROR:			
				Nothi	Nothing specified.			
				REFER	REFERENCES :			
					1. Fuhse, O. Z. angew. Chem. <u>1897</u> , 10, 116.			
					2. Jacoby, R. Dissertat. No. 77, Berlin <u>1901</u> .			

COMPONENTS:			ORIGINAL MEASUREMENTS:		
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]			Templeton, C. C.		
			Atomic Energy Commission Document,		
(2) Water;	H <sub>2</sub> 0; [773	2-18-5]	AECU-1721, <u>1950</u> .		
VARIABLES:			PREPARED BY:		
T/K = 302 -	431		A. Sozanski; S. Siekierski		
EXPERIMENTAL VALUES:		Composition of	Saturated Solutions <sup>a</sup>		
	Th ( N	10 <sub>3</sub> ) <sub>4</sub>			
+ 100		mol/kg	Solid Phase <sup>b</sup>		
	mass <del>t</del>				
29.8	66.2 67.5	4.08	A or B		
40.1	67.5	4.33	A or B		
50.0	69.1 70.2	4.66	A or B		
		4.91	A or B		
60.5 77.6	70.6 73.5	5.00 5.78	A or B A or B		
82.4		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	с		
158.0	85.5	12.3	c		
<sup>a</sup> Molalit:	ies, mol/	kg, calculated by	the compilers.		
<sup>b</sup> Solid pl	hases: A	= $\text{Th}(NO_3)_4 \cdot 6H_2O_4$	$B = Th(NO_3)_4 \cdot 5 \cdot 5H_2O_1$		
	с	= $\text{Th}(NO_3)_4 \cdot 4H_2O_1$			
			(continued on the next page)		
		AUXILIARY II	VFORMATION		
METHOD/APPARATUS/PROCEDURE:			SOURCE AND PURITY OF MATERIALS:		
Synthetic a	nd analyt	ical methods were	Th(NO <sub>3</sub> ) <sub>4</sub> .5H <sub>2</sub> O, General Chemical Baker <sup>3</sup> & Adamson Reagent Grade. As		
used (1). S	olutions	were placed in a	Baker & Adamson Reagent Grade. As		
constant ter	mperature	bath, and gently	usual, the solid corresponded to		
agitated for	r at leas	t two days. For	about 4.3 molecules of hydrated		
		$30^{\circ}C$ and $60^{\circ}C$ ,	water.		
measurements analytical			ESTIMATED ERROR:		
determined	by ianiti	on of a solution			
sample to the	horia. Th	O <sub>2</sub> , and the	Solubility: Nothing specified. Over		
		mined by the Karl			
Fischer met	hod. Abov	e 70°C, the	average of two or more replicates.		
synthetic method was used. Samples of known composition were weighed, mixed					
		tubes. The temp-	the analytical method, and $\pm 0.5K$		
		ance of the last	for the synthetic method.		
by slowly r	ising th	r was determined			
by slowly raising the bath tempera- ture while agitating the sample. The			REFERENCES:		
sample was a	agitated	at least 2 hours			
between tem	perature	increases.	1. Marshall, W. L.		
			Pure Appl. Chem. <u>1985</u> , 57, 283- 301.		



COMPONENTS: 0			ORIGINAL MEASUREMENTS:		
			Marshall, W. Secoy, C. H.	L.; Gill, J. S.;	
(2) Water; H <sub>2</sub> O; [7732-18-5] J				J. Am. Chem.	<i>Soc.</i> <u>1951</u> , 73, 4991 4992
VARIABL	ES:		I	PREPARED BY:	
T/K = 310 - 484				L. Fuks; S.	Siekierski
EXPERIM	ENTAL VAL	UES:		9	
			lon of Sat	turated Solu	tions"
	Th	(NO <sub>3</sub> ) <sub>4</sub>			Method of
t∕°c	mass %	mol/kg	Solid	Phase <sup>d</sup>	Determination
37.3	67.07	4.243		A	analytical
54.5	69.78	4.810		A	ĩ
72.0	73.39 76.39	5.745		ł	11
90.2	76.39	6.740		A	11
99.7	78.56	7.633		A	11
110.4	81.11	8.944		4	17
110.9	81.50	9.177	2	7	11
111.0 <sup>b</sup>			۸۰	ŀВ	
			27.0		
	82.01		E	3	analytical
128.0	82.41 82.85	9.759	H	3	synthetic
			E	3	analytical
139.5	84.27	11.16	E		11
146.0	85.30	12.09	E		11
149.0	85.81	12.60	E	3	u
151.0 <sup>C</sup>			BH	+C	
159.0 211.0	87.41 91.82	14.46 23.38	C		synthetic "
			(	continued o	n the next page)
		TXUA	( LIARY INF		n the next page)
METHOD/2	APPARATUS	AUXI /PROCEDURE:		FORMATION	n the next page) PURITY OF MATERIALS:
Synthet used. A	ic (1) an nalytical	/PROCEDURE: d analytical method: Tho	methods	FORMATION SOURCE AND CP grade th	PURITY OF MATERIALS: orium nitrate tetra-
Synthet used. An nitrate the pres	ic (1) an nalytical solution sence of	/PROCEDURE: d analytical method: Tho s were stirre excess solid	methods prium ed in for 40	FORMATION SOURCE AND CP grade th	<b>PURITY OF MATERIALS:</b> orium nitrate tetra- m Maywood Company use
Synthet used. An nitrate the pre- min. Af duplicat were tal method: known co	ic (1) an nalytical solution sence of ter the s te sample ken and a Th(NO <sub>3</sub> ) <sub>4</sub> ompositio	/PROCEDURE: d analytical method: Tho s were stirre excess solid olid had sett s of clear so nalyzed. Synt - water mixt ns were slowl	methods orium ed in for 40 :led, olution thetic cures of y heated	FORMATION SOURCE AND CP grade th hydrate fro ESTIMATED E Temperature method was synthetic m deviation f	<b>PURITY OF MATERIALS:</b> orium nitrate tetra- m Maywood Company use
Synthet used. An nitrate the pre- min. Af duplicative were tail method: known co until co temperative	ic (1) an nalytical solution sence of ter the s te sample ken and a Th(NO <sub>3</sub> )4 ompositio omplete d ture was	/PROCEDURE: d analytical method: Tho s were stirre excess solid olid had sett s of clear so nalyzed. Synt - water mixt ns were slowl issolution. T probably dete	methods orium ed in for 40 led, lution thetic cures of y heated the rmined	FORMATION SOURCE AND CP grade th hydrate fro ESTIMATED E Temperature method was synthetic m deviation f $\pm 0.15$ %.	PURITY OF MATERIALS: orium nitrate tetra- m Maywood Company use RROR: control for analytic $\pm 0.05^{\circ}$ C, and for the ethod, $\pm 1^{\circ}$ C. Maximum
Synthet used. An nitrate the pre- min. Af duplicar were tal method: known ca until co temperativisually solid pl	ic (1) an nalytical solution sence of ter the s te sample ken and a Th( $NO_3$ ) ompositio omplete d ture was y (compil hase, as	/PROCEDURE: d analytical method: Tho s were stirre excess solid olid had sett s of clear so nalyzed. Synt - water mixt ns were slowl issolution. T probably dete ers). Samples well as those	methods brium ed in for 40 cled, blution chetic cures of cy heated the ermined s of the e of the	FORMATION SOURCE AND CP grade th hydrate fro ESTIMATED E Temperature method was synthetic m deviation f $\pm 0.15$ %. REFERENCES:	PURITY OF MATERIALS: orium nitrate tetra- m Maywood Company use RROR: $\pm 0.05^{\circ}$ C, and for the ethod, $\pm 1^{\circ}$ C. Maximum or ThO <sub>2</sub> duplicates wa
Synthet used. An nitrate the pre- min. Af duplicar were tal method: known ca until ca until ca temperar visually solid pl saturate	ic (1) an nalytical solution sence of ter the s te sample ken and a Th( $NO_3$ ) ompositio omplete d ture was y (compil hase, as ed solutio	/PROCEDURE: d analytical method: Tho s were stirre excess solid olid had sett s of clear so nalyzed. Synt - water mixt ns were slowl issolution. T probably dete ers). Samples	methods orium ed in for 40 cled, olution chetic cures of the ermined s of the of the ted at	FORMATION SOURCE AND CP grade th hydrate fro ESTIMATED E Temperature method was synthetic m deviation f $\pm 0.15$ %.	PURITY OF MATERIALS: orium nitrate tetra- m Maywood Company use RROR: $\pm 0.05^{\circ}$ C, and for the ethod, $\pm 1^{\circ}$ C. Maximum or ThO <sub>2</sub> duplicates wa

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COMPONENTS:	ORIGINAL MEASUREMENTS:		
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</pre>	Marshall, W. L.; Gill, J. S.; Secoy, C. H.		
(2) Water; H <sub>2</sub> O; [7732-18-5]	J. Am. Chem. Soc. <u>1951</u> , 73, 4991 - 4992.		

<sup>a</sup>Molalities calculated by the compilers.

<sup>b</sup>Intersection temperature for the incongruent melting point of the hexahydrate is  $111.3\pm0.4$  °C.

<sup>C</sup>Intersection temperature for the incongruent melting point of the tetrahydrate.

<sup>d</sup>Solid phases:  $A = Th(NO_3)_4 \cdot 6H_2O$ ,  $B = Th(NO_3)_4 \cdot 4H_2O$ ,

 $C = Th(NO_3)_4 \cdot xH_2O.$ 

COMPONENTS: (1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5] (2) Water; H <sub>2</sub> O; [7732-18-5]	ORIGINAL MEASUREMENTS: Marshall, W. L.; Gill, J. S.; Secoy, C. H. Oak Ridge National Laboratory Report ORNL-925, <u>1951</u> , p. 279 - 290.
VARIABLES:	PREPARED BY:
T/K = 310 - 484	A. Sozanski; S. Siekierski

## EXPERIMENTAL VALUES:

The Solubility of Thorium Nitrate in Water Versus Temperature<sup>a</sup>

ļ	Th	(NO3)4	Density	
t∕°c	mass %	mol/kg	g/cm <sup>3</sup>	Solid Phase
37.3	67.07	4.243	2.09	AC
54.5	69.78	4.810	2.17	Α,
72.0	73.39	5.745	2.23	Ad
90.2	76.39	6.740	2.37	Α
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	В
120.2			2.57	В
120.6	82.01	9.496	2.54	В
128.0	82.41	9.759		B_
129.5			2.59	Be
130.5	82.85	10.06	2.53	В
139.5	84.27	11.16	2.70	В
159.0	87.41	14.46	2.75	В
211.0	91.82	23.38	2.86	?

(continued on the next page)

## AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Isothermal method used up to 125 <sup>0</sup> C.	Th $(NO_3)_4$ .4H <sub>2</sub> O, CP grade from the
Thorium nitrate solutions were	Maywood Company was used.
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 <sub>2</sub> (900 <sup>°</sup> C). Solid phase samples were obtained by direct sampling of the solid, drying between filter papers, and igniting to ThO <sub>2</sub> . Solubility data above 125 <sup>°</sup> C were obtained by the synthetic method in quartz tubing.	ESTIMATED ERROR: Solubility: Duplicate samples deviated approximately by about ±0.015%. Temperature: Nothing specified. REFERENCES: None.

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Thorium nitrate; Th(NO3)4; [13823-29-5]	Marshall, W. L.; Gill, J. S.; Secoy, C. H.		
(2) Water; H <sub>2</sub> O; [7732-18-5]	Oak Ridge National Laboratory Report, ORNL-925, <u>1951</u> , 279 - 290.		

<sup>a</sup>Molalities calculated by the compilers. <sup>b</sup>Solid phases:  $A = Th(NO_3)_4.6H_2O$ ,  $B = Th(NO_3)_4.4H_2O$ . <sup>C</sup>81.18 mass % Th(NO\_3)\_4 in the solid phase. Theoretical value for Th(NO\_3)\_4.6H\_2O is 81.62 mass %. <sup>d</sup>80.82 mass % Th(NO\_3)\_4 in the solid phase. <sup>e</sup>85.84 mass % Th(NO\_3)\_4 in the solid phase. Theoretical value for Th(NO\_3)\_4.4H\_2O is 86.97 mass %.

COMMENTS AND/OR ADDITIONAL DATA

An initial hydrolytic decomposition temperature was determined between  $115^{\circ}C$  and  $130^{\circ}C$ ; 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.

COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Thorium nitrate; Th(NO3),;	Apelblat, A.; Azoulay, D.; Sahar, A.	
[13823-29-5]	J. Chem. Soc. Faraday Trans. I <u>1973</u> , 69, 1618 - 1623.	
(2) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES:	PREPARED BY:	
T/K = 278 - 333	A. Sozanski; S. Siekierski	
EXPERIMENTAL VALUES:	мана на предо на пред	
The solubility, c, increases linearly to the equation,	with temperature, <sup>O</sup> C, according	
c, $mol/dm^3 = 2.615 + 0.010$ ( t	. – 25 )	
The following table of solubilities w this equation:	as calculated by the compilers from	
$Th(NO_3)_4$	Density	
t/ <sup>O</sup> C mol/dm <sup>3</sup> mc	j/kg g/cm <sup>3</sup>	
35 2.715 4. 45 2.815 4.	74         1.955           35         1.928           68         1.953           47         1.965	
The densities $d(t)$ , were calculated h in the source paper. $d(25^{\circ}C) = 0.9973 + 0.3877C - 0.008$		
	_	
$d(35^{\circ}C) = 0.9941 + 0.3953C - 0.018$ $d(45^{\circ}C) = 0.9903 + 0.3992C - 0.020$		
$d(45^{\circ}C) = 0.9903 + 0.3992C - 0.020$ $d(60^{\circ}C) = 0.9832 + 0.3972C - 0.022$		
AUXILIARY IN	FORMATION	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	
The isothermal method was used. The	$Th(NO_3)_4.5H_2O$ supplied by Merck was	
concentration of thorium was deter- mined by complexometric titration with EDTA, using xylenol orange as	used without further purification.	
the indicator (1). Some samples were analyzed gravimetrically. Results by	ESTIMATED ERROR:	
both methods were consistent with each other. The authors did not report their measured solubilities,	Nothing specified.	
but instead reported smoothed data in the form of the above equations.	REFERENCES :	
	1. E. Y. Welcher	
	The Analytical Uses of EDTA, Van Nostrand, N.Y. ( <u>1958</u> ).	

COMPONEN	rs:			ORIGINAL MEASUR	EMENTS:	
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>;     [13823-29-5]</pre>				Ferraro, J. R.; Katzin, L. I.		
<pre>(2) Nitric acid; HNO<sub>3</sub>; [7697-37-2] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>			Report, ANL-501	4, <u>1953</u> .		
	2					
VARIABLE				PREPARED BY:	· · · · · · · · · · · · · · · · · · ·	
Composit	ion at 298	ĸ		A. Sozanski; S.	Siekierski	
EXPERIMEN	NTAL VALUES	:			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
	The	$Th(NO_3)_4$	- нио <sub>з</sub> -	H <sub>2</sub> O System at	25 <sup>0</sup> C	
		Composition	n of sat	urated solution	s <sup>a</sup>	
Th	(NO <sub>3</sub> ) <sub>4</sub>	1	HNO <sub>3</sub>	H <sub>2</sub> 0	Solid <sub>b</sub>	
mass %	mol/kg	mass %	mol/kg	mass %	Phase	
64.12	3.723	0	0	35.88	A + hydrolyzed sal	
63.61	3.685	0.43	0.19		A	
62.71	3.621	1.21	0.53	2 36.08	A	
60.78	3.527	3.32	1.47		Α	
55.34	3.196	8.59	3.78		A	
52.03	2.995	11.78	5.16		A	
47.10	2.657 2.411	15.98	6.86		A	
		21.97			A	
41.24 35.16	2.370 2.064	22.52 29.36	9.86 13.13		A A	
00110	2.004	25100	10.10		n the next page)	
			JARY IN	FORMATION		
METHOD/AI	PARATUS/PR			τ	ITY OF MATERIALS:	
mha iaati	nermal meth	od upc	3		O Dakon ( )damaan	
Mixtures were satu	of water a rated with	nd nitric a thorium ni	acid trate	(chloride, 0.0 0.01% max.)	0, Baker & Adamson 03% max.; sulfate,	
at temper	atures aro	und 70 <sup>0</sup> C ar	nd the			
solutions	s were then atted bath	equilibrat	ed in a	$ 2. Th(NO_3)_4, t$	he anhydrous nitrate s described in	
minimum c	of 48 hours anhydrous n	. In the lo	ow water	Reference 1.	s described in	
anhydrous to prepar	s thorium n re the solu	itrate were tions. The	e used method	3. Nitric acid, General Chemical Division, 70%, sp. grav. 1.42.		
of Schreinemakers was used. Thorium determined by ignition to ThO <sub>2</sub> . Water measured by Karl Fischer titration. Nitric acid was determined by			. Water	r 4. Anhydrous nitric acid, General Chemical Division.		
Nitric acid was determined by difference. Solids used for purposes of identification by X-ray powder				ESTIMATED ERRO	R:	
	were dried			Solubility: no	thing specified.	
2	-			Temperature: p	recision to ±0.03K.	
				REFERENCES:		
				1. Ferraro, J. Unpublished		

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO3)4; [13823-29-5]	Ferraro, J. R.; Katzin, L. I.
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Report, ANL-5014, <u>1953</u> .
(3) Water; H <sub>2</sub> O; [7732-18-5]	

# The $Th(NO_3)_4$ - $HNO_3$ - $H_2O$ system at 25°C Composition of saturated solutions<sup>a</sup>

mass %         mol/kg         mass %         mol/kg         mass %         mol/kg         mass %         Phase           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           28.67         3.374         53.63         48.08         17.70         A+B           27.93         3.513         55.51         53.20         16.56         B           23.46         4.459         65.58         94.96         10.96         B           23.46         4.459         65.58         94.96         10.96         B </th <th colspan="2"><math>Th(NO_3)_4</math></th> <th></th> <th>нио<sub>з</sub></th> <th>H<sub>2</sub>O</th> <th>Solid</th>	$Th(NO_3)_4$			нио <sub>з</sub>	H <sub>2</sub> O	Solid
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         28.67       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	mass %	mol/kg	mass %	mol/kg	mass %	Phase
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         28.67       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	30.11	1.935	37.48	18.35	32.41	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         28.67       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	29.57	1.927	38.46	19.09	31.97	А
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	28.76	1.892	39.58	19.84	31.66	Α
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	25.87	2.118	48.69	30.37	25.44	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	26.04	2.184	49.12	31.38	24.84	
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	26.93	2.723	52.47	40.42	20.60	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	27.95	3.076	53.12	44.53	18.93	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	28.85	3.282	52.84	45.80	18.31	A
27.933.51355.5153.2016.56B25.953.89760.1868.8613.87B23.464.45965.5894.9610.96B22.915.0667.66114.009.43B21.115.4970.88140.008.01B21.177.3372.81192.006.02B	28.27	3.270	53.72	47.34	18.01	A
25.953.89760.1868.8613.87B23.464.45965.5894.9610.96B22.915.0667.66114.009.43B21.115.4970.88140.008.01B21.177.3372.81192.006.02B	28.67	3.374	53.63	48.08	17.70	A+B
23.464.45965.5894.9610.96B22.915.0667.66114.009.43B21.115.4970.88140.008.01B21.177.3372.81192.006.02B	27.93	3.513	55.51	53.20	16.56	В
22.915.0667.66114.009.43B21.115.4970.88140.008.01B21.177.3372.81192.006.02B	25.95	3.897	60.18	68.86	13.87	В
21.11         5.49         70.88         140.00         8.01         B           21.17         7.33         72.81         192.00         6.02         B	23.46	4.459	65.58	94.96	10.96	В
21.17 7.33 72.81 192.00 6.02 B	22.91	5.06	67.66	114.00	9.43	В
	21.11	5.49	70.88	140.00	8.01	В
	21.17	7.33	72.81	192.00	6.02	В
22.45 13.1 73.98 329.00 3.57 C or D	22.45	13.1	73.98	329.00	3.57	C or D
22.51 13.9 74.11 348.00 3.38 "	22.51	13.9	74.11	348.00	3.38	u –
24.48 28.8 73.75 661.00 1.77 "	24.48	28.8	73.75	661.00	1.77	17
21.19 8.33 73.51 220.00 5.30 "	21.19	8.33	73.51	220.00	5.30	11
21.07 9.05 74.08 242.00 4.85 "	21.07	9.05	74.08	242.00	4.85	11

<sup>a</sup>Molalities, mol/kg, and mass of HNO<sub>3</sub> calculated by the compilers.

<sup>b</sup>Solid phases:

 $A = Th(NO_{3})_{4} \cdot 5H_{2}O$   $B = Th(NO_{3})_{4} \cdot 4H_{2}O$   $C = Th(NO_{3})_{4} \cdot 2HNO_{3}$  $D = Th(NO_{3})_{4} \cdot N_{2}O_{5}$ 

COMMENTS AND/OR ADDITIONAL DATA:

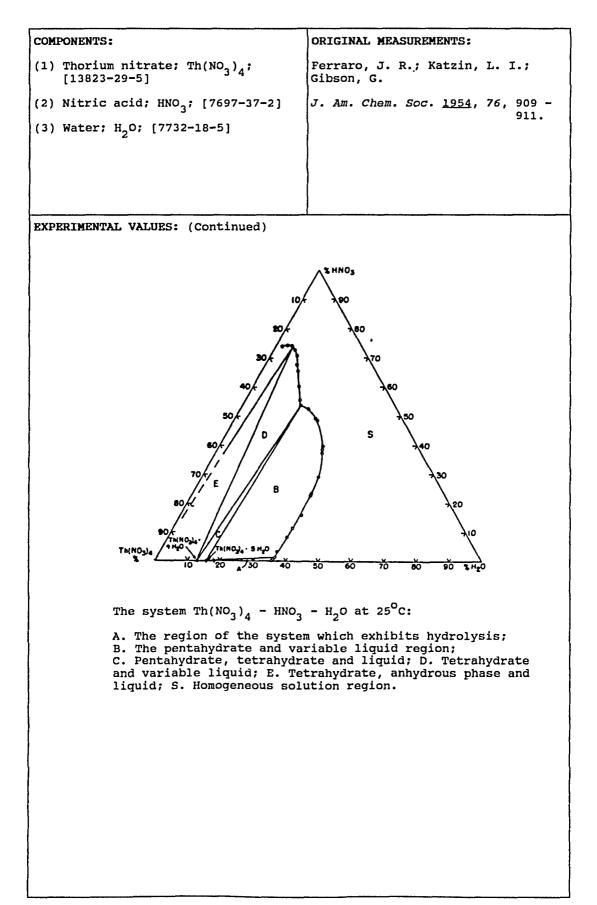
In the original paper, results of an analysis of the solid phases and the phase diagram are given. For solutions containing less than 1% of HNO<sub>3</sub>, the solid phase contains partially hydrolyzed salt.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</pre>	Ferraro, J. R.; Katzin, L. I.; Gibson, G.
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	J. Am. Chem. Soc. <u>1954</u> , 76, 909-911.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 298 K	L. Fuks; S. Siekierski
	l
EXPERIMENTAL VALUES:	l

The  $Th(NO_3)_4 - HNO_3 - H_2O$  ternary system at 25°C is presented in the form of a triangular phase diagram which is shown on the next page. The invariant liquid of the pentahydrate - tetrahydrate pair is at 17.17 %  $H_2O$  and 28.56 %  $Th(NO_3)_4$ ; and that of the tetrahydrate-anhydrous pair is at 5.10 %  $H_2O$  and 21.13 %  $Th(NO_3)_4$ .

(continued on the next page)

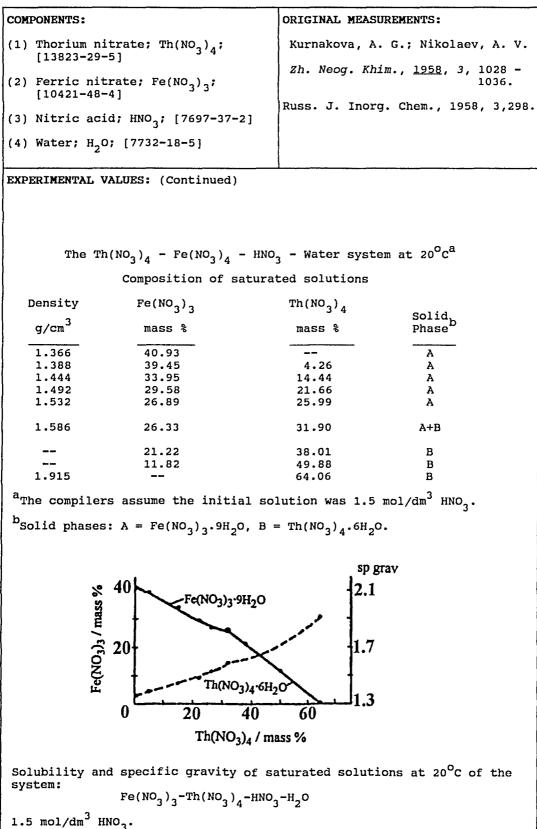
AUXILIARY IN	FORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Mixtures of water and nitric acid were saturated with thorium nitrate at about 70°C, and the solutions were then equilibrated in a bath at 25°C for a minimum period of 48 hours. In low water region, anhydrous nitric acid and anhydrous thorium nitrate were used to prepare the solutions. The method of wet residues (1) was used. Thorium nitrate was determined by ignition to ThO <sub>2</sub> , water by Karl	<ol> <li>Thorium nitrate, Th(NO<sub>3</sub>), 4H<sub>2</sub>O, Baker &amp; Adamson Reagent Grade. The hydrated water exceeded that for a tetrahydrate. An analysis showed 47.15% ThO<sub>2</sub>, 15.90% H<sub>2</sub>O.</li> <li>HNO<sub>3</sub>, General Chemical Division, 70%, sp. gr. 1.42; and, anhydrous HNO<sub>3</sub>, General Chemical Division, "total acidity 100% minimum."</li> </ol>
Fischer titration (2). Nitric acid	ESTIMATED ERROR:
estimated by difference.	Solubility: Nothing specified, but probably <u>+</u> 0.1%
	Temperature: Precision $\pm 0.03$ K.
	REFERENCES:
	<ol> <li>Schreinemakers, F. A. H. Z. physik. Chem. <u>1893</u>, 11, 81.</li> <li>Smith, D. M.; Bryant, W. M. D.; Mitchell, J. J. Am. Chem. Soc., <u>1939</u>,61,2407.</li> </ol>



COMPONENTS:	· · · · · · · · · · · · · · · · · · ·		ORIGINAL MEASUREMENTS:
			Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A.
(2) Nitric a	acid; HNO <sub>3</sub> ;	[7697-37-2]	] Izv. Sib. Otdel. Akad. Nauk SSSR
(3) Water; H	4 <sub>2</sub> 0; [7732-	-18-5]	$\frac{1966}{129}$ - 131.
VARIABLES:			PREPARED BY:
Composition	at 298 K		L. Fuks; S. Siekierski
EXPERIMENTAL	VALUES:		
	The Th(1	$(0_3)_4 - HNO_3$	- H <sub>2</sub> O System at 25 <sup>0</sup> C
	Compos	ition of Sat	turated Solutions <sup>a</sup>
Density	Th()	10 <sub>3</sub> ) <sub>4</sub>	ниоз
g/cm <sup>3</sup>	mass %	mol/kg	mass % mol/kg Solid Phase <sup>b</sup>
2.134		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		4.090	22.18 13.40
	45.00 43.19	3.793 3.552	30.29 19.45 A 31.48 19.72
1.822 1.756	35.29	3.112	41.09 27.61
1.709	29.33	3.362	52.50 45.86
	28.42	4.027	56.88 61.41 A
_		calculated	d by the compilers.
			Y INFORMATION
		······	
were equilit at 25°C usin Equilibrium hours. Analy the componen volumetric r titrated pot potassium hy oxalate; tho	nal method nvestigate orated in a og a magnet was attair vsis for th nts was car nethod. Nit centiometri vdroxide ar orium was c	was used. d composition a glass vessed ic stirrer. de content of ried out by cric acid was cally using d ammonium letermined by	el 2. Nitric acid was obtained from potassium nitrate. Sulfuric acid was C. P. grade. the s
		lenol orange	E ESTIMATED ERROR:
as the indic	cator (1).		Solubility: Nothing specified.
			Temperature: Precision $\pm 0.05$ K.
			REFERENCES:
			1. Tchernikov, Yu. A.; Lukianov, V. F.; Kozlova, A. V.
			Zavod. Lab. <u>1960</u> , 26, 921. (in Russian).

COMPONENTS:			ORIGI	NAL MEASURE	MENTS:	
(1) Thorium [13823-2	nitrate; 1 9-5]	$rh(NO_3)_4;$			; Nikolaev,	
(2) Aluminum	nitrate;	Al(NO <sub>2</sub> ) <sub>2</sub> ;	Zh. No	eorg. Khim.	<u>1958</u> , 3, 10	028-1036.
[13473-9	0-0]	5 5	Russ.	J. Inorg.	Chem. <u>1958</u> ,	3, 298.
(3) Water; H	2 <sup>0; [7732-</sup>	-18-5]				
VARIABLES:			ł	RED BY:		
Composition	at 293 K		L. Ful	ks; S. Siek	ierski	
EXPERIMENTAL	VALUES:					
	The Th(NO	$_{4}$ - Al(NO	<sub>3</sub> ) <sub>3</sub> - H <sub>2</sub> O s	system at 2	20 <sup>0</sup> C	
	Compos	sition of sa	aturated so	olutions <sup>a</sup>		
Density	Th ( )	10 <sub>3</sub> ) <sub>4</sub>	Al(1	NO <sub>3</sub> ) <sub>3</sub>	Solid <sub>b</sub>	
g/cm <sup>3</sup>	mass %	mol/kg	mass %	mol/kg	Phase	
1.400		0.4239		3.213	A A	
1.550	29.13	1.1264	22.88	2.328	A	
1.731	43.42	2.208	15.62	1.790	A+B	
1 015	64.06	2 71 2			B B	
		lated by th = Al(NO <sub>3</sub> ) <sub>3</sub> ,	-		н <sub>2</sub> о.	
Solubility a at 20°C of s of the syste Al(NO <sub>3</sub> ) <sub>3</sub> -Th( Specific gra	aturated s m: NO <sub>3</sub> ) <sub>4</sub> -H <sub>2</sub> O	c gravity	Al Neuron States Al	Al(NO <sub>3</sub> ) <sub>3</sub> .9H		sp grav 1.8 -1.4
			0		40 60 3)4 / mass %	

COMPONENTS: (1) Thorium ni [13823-29-	trate; Th(NO <sub>3</sub> ) <sub>4</sub> ; 5]		G.; Nikolaev, A. V	
(2) Copper nit [3251-23-8	rate; Cu(NO <sub>3</sub> ) <sub>2</sub> ; }		m. <u>1958</u> , 3, 1028 <b>-</b> 1	
(3) Nitric aci	d; HNO <sub>3</sub> ; [7697-37-2]	Russ. J. Inorg	. Chem., <u>1958</u> , 3,	298.
(4) Water; H <sub>2</sub> O	; [7732-18-5]			
VARIABLES: Composition at	298 and 293 K	PREPARED BY: L. Fuks; S. Si	ekierski	
EXPERIMENTAL V	ALUES:		<u>,, , , , , , , , , , , , , , , , , , ,</u>	
The Th	$(NO_3)_4 - Cu(NO_3)_2 -$	HNO3 - H20 system	at 25 <sup>0</sup> C <sup>a</sup>	
	Composition of sat			
Densiţy g/cm	Cu(NO <sub>3</sub> ) mass %	Th(NO <sub>3</sub> ) mass %	Solid Phase	
1.709	56.47		A	
1.725 1.778	53.64 51.01	5.36 9.02	A A	
1.798	48.56	11.65	A+B	
1.785	46.35	14.27	В	
1.772 1.787	40.42 29.06	19.36 29.27	B B	
1.707	29.00	23.21	В	
1.823	20.21	39.51	B+C	
1.874	14.55	46.00	С	
1.896 1.931	4.60	56.84 64.06	C C	
<sup>a</sup> The comp HNO <sub>3</sub> .	ilers assume that th		-	
<sup>b</sup> Solid ph	ases: $A = Cu(NO_3)_2.3$	$H_0O_1 B = Th(NO_0)$	.4H_O,	
	$C = Th(NO_3)_4 \cdot 6$		2 ·	
	5 -	L	nued on the next pa	age)
	AUXILIAR	Y INFORMATION: No	ching specified	
of saturated	d specific gravity solutions at 25°C	Cu(NO <sub>3</sub> ) <sub>2</sub> ·3	H <sub>2</sub> O	
of the system	:	50 - TI	n(NO <sub>3</sub> )4·4H <sub>2</sub> O	2.0
Cu(NO <sub>3</sub> ) <sub>2</sub> -Th(No	о <sub>3</sub> ) <sub>4</sub> -нио <sub>3</sub> -н <sub>2</sub> о	Cu(NO <sub>3</sub> ) <sub>2</sub> /mass %		1.9
1.5 mol/dm <sup>3</sup> H	<sup>NO</sup> 3.	(CON CONTRACTOR	× ]	1.8
Specific grav	ity		) <sub>3)4-6H20</sub>	1.6
			-314 01120	
		0 Th()	30 60 1O <sub>3</sub> ) <sub>4</sub> / mass %	
			J	



r							
COMPONEN					L MEASUREME		
	ium nitra 23-29-5]	te; Th(NO	3 <sup>)</sup> 4;		7, A. V.; Ry ev, Yu. A.	yabinin,	A. I.;
(2) Uran [159	yl nitrat 05-86-9]	e; UO <sub>2</sub> (NO	3 <sup>)</sup> 2 <sup>;</sup>		b. Otdel. A 29 - 131.	kad. Nauk	SSSR
(3) Nitr	ic acid;	HNO <sub>3</sub> ; [769	97-37-2]				
(4) Wate	r; H <sub>2</sub> 0; [	7732-18-5	]				
VARIABLE Composit	S: ion at 29	8K		PREPAREI L. Fuks	D BY: ; S. Siekie:	rski	
EXPERIME	NTAL VALU The Th(NO	ES: 3 <sup>)</sup> 4 - UO <sub>2</sub>	(NO <sub>3</sub> ) <sub>2</sub> - ні	NO <sub>3</sub> - H <sub>2</sub> 0	) System at	25 <sup>0</sup> c <sup>a</sup>	
			n of Satura		-		
Density		0.)	<b>ም ከ ( N</b> O	١	нио		Solid_
g/cm <sup>3</sup>	mass %	mol/kg	mass % i	noI/kg	HNO <sub>3</sub> mass % 1	mol/kg	Phase
1,725	47.22	2.684	2.33	0.109	5.80	2.06	i
1.726	47.22 42.56	2.459	8.11	0.385	5.40	1,95	A
1.738	37.93 28.39	2.190	12.36		5.75	2.08	
1.771	28.39	1.645	22.42		5.40	1.96	11
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	в
1.884	13.59	0.939	44.38	2.517	5.30	2.29	Ĩ
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	с
1.886	5.15 2.30	0.180	60.00	3.848	5.22	2.55	
2.129			67.40	5.032	4.70	2.67	
<sup>a</sup> The con	mpilers a	ssume the	initial co	oncentrat	ion of HNO	3 was 1.5	м.
<sup>b</sup> Molalit	ties, mol,	/kg, calcu	lated by t	he compi	lers.	-	
<sup>C</sup> Solid p	phases: A	$= UO_2(NO_2)$	3)2.6H20; H	$B = UO_2(N)$	10 <sub>3</sub> ) <sub>2</sub> .4H <sub>2</sub> O;	C = Th(N)	0 <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> 0
			JXILIARY IN	IPODMARTO			
				· 1 · · · · · · · · · · · · · · · · · ·			
METHOD/AI	PPARATUS/I	PROCEDURE	1		AND PURITY		
		thod was a			grade twi		
studied vessels a	were equi at 25°C. 1	mposition librated : Equilibriu	in glass ım was	2. Nitz	ric acid obt $SO_A$ of C.P.	tained fr purity.	om KNO <sub>3</sub>
of the co	omponents	6 hours. A was carri thod. The	led out by	L	TED ERROR: Lity: nothing	ng specif	ied.
acid was	titrated	potention	netrically		-		]
presence	of added	droxide, : ammonium	oxalate.	Tempera	ature: prec	1510N ±0.	100N.
		DTA with y		REFEREN			
		uranium wi			ernikov, Yu		ianov, V.
		and bariu fonate (2)			zlova, A. V. <i>Lab. <u>1960</u>,</i> n).		(In
					KOV, V. K.; 1, S. V.; K]		
				Moiseev	7, I. V.		
					n - Methods an), Moscow		
				-4	······		

			Ţ				
COMPONENTS:			ORIGINAL MEASUREMENTS:				
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]			Phillips, J. F.; Huber, H. D.				
(2) Aluminum nitrate; Al(NO <sub>3</sub> ) <sub>3</sub> ; [13473-90-0]			Report,	<u>1968</u> , BNWL-	-240.		
(3) Nitr	ic acid; H	HNO <sub>3</sub> ; [769	97-37-2]				
(4) Wate	r; H <sub>2</sub> 0; [	7732-18-5	ן נ				
VARIABLE	s:			PREPAREI	D BY:		
Composit	ion at 298	8K and 32:	зк	A. Sozar	nski; S. Sie	ekierski	
EXPERIME Th	NTAL VALUI e Th(NO3)	ES: 4 - Al(NO	<sub>3</sub> ) <sub>3</sub> - нио <sub>3</sub>	- н <sub>2</sub> о sy	stem at 25 <sup>c</sup>	C and 5	0°c
	Co	omposition	n of Satura	ted Solu	utions <sup>a</sup>		
	Al(N0	<sup>2</sup> 3 <sup>3</sup>	Th(NO <sub>3</sub>	)4	H	<sup>10</sup> 3	
t∕°c	mol/dm <sup>3</sup>	g/dm <sup>3</sup>	mol/dm <sup>3</sup>	g/dm <sup>3</sup>	mol/dm <sup>3</sup>	g/dm <sup>3</sup>	
25	0.30	64	1.94	931	2.77	175	
	0.30		1.49		6.40	400	
	0.30	64 130	0.93 1.74	446	9.83	619	
					2.60	160	
	0.60 0.60	130 130	1.47 1.19	706 571	5.03 6.40	317 403	
	0.00	190	1.50		2.70	170	
	0.90	190 190	1.43	686	3.10	195	
		190	1.29	619	3.60	227	
	0.90	190	0.67	322	5.76	363	
			(	continue	ed on the ne	ext page	)
		A	JXILIARY IN	FORMATIC	DN		
	PPARATUS/I			SOURCE	AND PURITY	OF MATE	RIALS:
calculat	hermal met ed amount nitric ac	of solid	aluminum	Nothing	g specified.		
approxim	ate amount	t of thor:	ium nitrate				
were add		nL flask.	Distilled	ESTIMAT	ED ERROR:		
the solu	s added to tion shake	en overnig	ght at a	Nothing	g specified.	•	
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		REFERENCES:					
		None.					
concentr	ation was	measured	by x-ray	}			
	ence until um no long		centration ased.				
Nitric a	cid was de	etermined	by	(			
titratio	n with soo	lium hydro	oxide after				
	g with pot						
	determine						
400°C.	L CTUQ UICI		itue at				
				1			
				1			
				1			
				1			
				1			

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Phillips, J. F.; Huber, H. D.
(2) Aluminum nitrate; Al(NO <sub>3</sub> ) <sub>3</sub> ; [13473-90-0]	Report, <u>1968</u> , BNWL-240.
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	
(4) Water; H <sub>2</sub> O; [7732-18-5]	

The Th(NO<sub>3</sub>)<sub>4</sub> - Al(NO<sub>3</sub>)<sub>3</sub> - HNO<sub>3</sub> - H<sub>2</sub>O system at 25<sup>o</sup>C and 50<sup>o</sup>C Composition of saturated solutions<sup>a</sup>

	A1(NO <sub>3</sub> ) <sub>3</sub>		$Th(NO_3)_4$		HNO <sub>3</sub>	
t∕°c	mol/dm <sup>3</sup>	g/dm <sup>3</sup>	mol/dm <sup>3</sup>	g/dm <sup>3</sup>	mol/dm <sup>3</sup>	g/dm <sup>3</sup>
50	0.30	64	2.20	1056	2.20	140
	0.30	64	2.11	1013	3.05	192
	0.30	64	1.66	797	6.00	380
	0.30	64	1.38	662	9.60	600
	0.60	130	2.05	984	2.20	140
	0.60	130	1.59	763	5.30	330
	0.60	130	1.38	662	8.00	500
	0.90	190	1.90	912	1.41	89
	0.90	190	1.77	850	2.30	140
	0.90	190	1.51	725	4.50	284
	0.90	190	1.35	648	5.62	354

<sup>a</sup>Concentrations,  $g/dm^3$ , calculated by the compilers.

COMMENTS AND/OR ADDITIONAL DATA:

No attempt was made to identify the solid phase.

COMPONENTS: (1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	EVALUATOR: S. L. Phillips
(2) Various organics	Camatx/Basic Data Orinda, CA 94563 USA
(3) Water; H <sub>2</sub> O; [7732-18-5]	
CRITICAL EVALUATION:	

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.

The System  $Th(NO_3)_4$  - Organics

The most comprehensive data on the solubility of  $Th(NO_3)_4$  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.

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.

It is not at all clear that equilibrium was attained in every case in the

COMPONENTS: (1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	EVALUATOR: S. L. Phillips
(2) Various organics	Camatx/Basic Data Orinda, CA 94563 USA
(4) Water; H <sub>2</sub> O; [7732-18-5]	
CRITICAL EVALUATION:	

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  $25^{\circ}C$  with Th(NO<sub>3</sub>)<sub>4</sub>.4H<sub>2</sub>O.

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  $Th(NO_3)_4$  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.

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).

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.

(continued on the next page)

OMPONENTS: 1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]		Phillips		
2) Various organics		Camatx/Basic Data Orinda, CA 94563 USA		
3) Water; H <sub>2</sub> O; [7732-18-5]				
RITICAL EVALUATION: (Continued)				
Table 27. Solubility of thori	um nitrate in ord	anic solvents		
in equilibrium with thorium nitrate (1)	an aqueous phase			
Organic solvent	Solubility mol/kg	Water mass %		
	······			
2-Butanol 2-Butanol	2.044 1.985	15.75 15.20		
4-Methyl-2-pentanone	1.840	12.15		
4-Methyl-2-pentanone Diethyl ether	1.773 1.610	11.90 12.38		
Ethylene glycol diethyl				
ether	2.845	16.30		
Ethylene glycol dibutyl ether	0.8700	5.75		
Diethylene glycol diethyl ether	2.817	16.12		
Diethylene glycol dibutyl				
ether Tributyl phosphate	1.690 1.4880	8.90 0.58		
Dibutyl butyl phosphonate	1.7090	1.00		
Tributyl phosphite	2.0510	7.06		
COMMENT AND/OR ADDITIONAL DA	TA:			
For tributyl phosphate, Wend	llandt found solu	pilities of 1.53 an		
1.55 mol/kg at 298 K (14). H 299.5 K (8).	ealy and McKay fo	ound 1.49 mol/kg at		

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COMPONENTS:

(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>;

(13823-29-5]

(2) Tri-n-butyl phosphate (TBP);

C<sub>12</sub>H<sub>27</sub>O<sub>4</sub>P; [126-73-8]

EVALUATOR:

S. L. Phillips

Camatx/Basic Data

Orinda, CA 94563 USA
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#### CRITICAL EVALUATION:

The System Th(NO3) - Tributyl Phosphate

Data for the binary system  $Th(NO_3)_4 - (C_4H_9O)_3PO$  were obtained from two sources for this evaluation (1,8); however, all values for temperatures above 25<sup>o</sup>C are from Healy and McKay (8). Their data show a ratio of water/nitrate = 0.06 at 26.4<sup>o</sup>C, but do not otherwise indicate the water content in the TBA phase.

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.

## The System Th(NO3)4-Tributyl Phosphate-Nitric Acid

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,  $Th(NO_3)_4 \cdot 4H_2O$ , and the pentahydrate,  $Th(NO_3)_4 \cdot 5H_2O$ . 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  $Th(NO_3)_4$  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  $Th(NO_3)_4$ - $HNO_3$ - $H_2O$  system, and included in the phase diagram in (11).

	EVALUATOR: S. L. Phillips Camatx/Basic Data Orinda CA 04563 USA
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Orinda, CA 94563 USA

CRITICAL EVALUATION:

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Table 28. Solubility of thorium nitrate in TBP, (CH<sub>3</sub>(CH<sub>2</sub>)<sub>3</sub>O)<sub>3</sub>PO

t∕°c	T/K	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg	H <sub>2</sub> 0 mass %	Ref.
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

(1) Thorium (		EVAL	LUATOR:	
[13823-29	nitrate; Th <sub>2</sub> (N 9-5]	Car	L. Phillips matx/Basic Da inda, CA 9456	
(2) Tributyl [126-73-)	phosphate; C <sub>1</sub> B]	2 <sup>H</sup> 27 <sup>O</sup> 4 <sup>P</sup> ;		
RITICAL EVA	LUATION:			
Table 29.	Coefficients f	or the solubilit	cy equation	
	Coefficient	Value	σ	
	a	-311.948	0.004	-
	b	8670.79	1.47	
	С	53.698	0.00073	
	đ	- 0.08023	0.0000125	5
Table 30. S	Smoothed value:	s of the solubil	ity of thori	um nitrate
Table 30. S	Smoothed values in TBP, calcula	s of the solubil ated from the so	ity of thori Dubility equ	um nitrate ation
Table 30. S	Smoothed values in TBP, calcula	s of the solubil ated from the so Th(NO <sub>3</sub> ) <sub>4</sub>	ity of thori olubility equ	um nitrate ation Th(NO <sub>3</sub> ) <sub>4</sub>
Table 30. S	Smoothed value: in TBP, calcul T/K	ated from the so	ity of thori olubility equ T/K	ation
Table 30. S	in TBP, calcul	ated from the so Th(NO <sub>3</sub> ) <sub>4</sub>	olubility equ	Th(NO <sub>3</sub> ) <sub>4</sub>
Table 30. 5	in TBP, calcul T/K	ated from the so Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg	T/K	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg
Table 30. s	T/K 773	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.43	T/K 373	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.84
Table 30. S	T/K 7/K 273 283	ated from the so Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.43 1.44	T/K 773 383	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.84 1.86
Table 30. S	in TBP, Calcul <i>T/</i> K 273 283 293	ated from the so Th(NO <sub>3</sub> ) <sub>4</sub> <u>mol/kg</u> <u>1.43</u> 1.44 1.47	T/K 773 383 393	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.84 1.86 1.87
Table 30. s	in TBP, calcul <i>T/K</i> 273 283 293 303	ated from the so Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.43 1.44 1.47 1.51	T/K 373 383 393 403	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.84 1.86 1.87 1.87
Table 30.	T/K T/K 273 283 293 303 313	ated from the so Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.43 1.44 1.47 1.51 1.55	T/K 373 383 393 403 413	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.84 1.86 1.87 1.87 1.87
Table 30.	in TBP, calcul <i>T/</i> K 273 283 293 303 313 323	ated from the so Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.43 1.44 1.47 1.51 1.55 1.61	T/K 373 383 393 403 413	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.84 1.86 1.87 1.87 1.87
Table 30. s	in TBP, calcul <i>T/K</i> 273 283 293 303 313 323 333	ated from the so Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.43 1.44 1.47 1.51 1.55 1.61 1.66	T/K 373 383 393 403 413	Th(NO <sub>3</sub> ) <sub>4</sub> mol/kg 1.84 1.86 1.87 1.87 1.87

COMPONENTS:	EVALUATOR:							
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	S. L. Phillips Camatx/Basic Data							
(2) Various organics	Orinda, CA 94563 USA							
(3) Water; H <sub>2</sub> O; [7732-18-5]								
CRITICAL EVALUATION:								
REFERENC	CES							
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COMPONENTS:		ORIGINAL MEASUREMENTS:			
[13823-29- (2) Tri-n-buty	5] 34	ORIGINAL MEASUREMENTS: Healy, T. V.; McKay, H. A. C. Trans. Faraday Soc. <u>1956</u> , 52, 633- 642.			
VARIABLES:		PREPARED BY:	<u> </u>		
Temperature: 2	73 to 403 K	L. Fuks; S. Siekiersk	i		
EXPERIMENTAL V	ALUES:				
Th	$e Th(NO_3)_4 - (CH_3(CH_2)_3)$	0) <sub>3</sub> PO - H <sub>2</sub> O System			
	Composition of Satura	ted Solutions			
	$Th(NO_3)_4$	Mole Ratio <sup>a</sup>	Solvation		
t∕°c	mol/kg TBP/ni	trate water/nitrate	number <sup>b</sup>		
<sup>b</sup> From TBP di METHOD/APPARAT Solubility det by shaking the nitrate with T a thermostat, TBP phase. Analysis for w Karl Fischer t	1.49 2. 1.56 2. 1.60 2. 1.71 2. 1.80 2. 1.86 2. 1.87 2. 1.87 2. 1.87 2. . H.; Swift, E. H.; Tod lution data. AUXILIARY IN	01 01 d, R., unpublished dat FORMATION SOURCE AND PURITY OF 1. Thorium nitrate wa grade. 2. The TBP was purif: described in Reference	MATERIALS: as of A. R. ied as		
		REFERENCES: 1. Alcock, K.; Grimle Healy, T. V.; Kenn McKay, H. A. C.; <i>Trans. Faraday Soc</i> 39 - 47.	nedy, J.;		

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</pre>	Schulz, W. W.; Voiland, E. E.
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> <sup>H</sup> 27 <sup>O</sup> 4 <sup>P</sup> ; [126-73-8]	Report, HW-32417, <u>1954</u> .
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 299 K	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	<u>*************************************</u>
The solubility of thorium nitrate in the solubility of the solubility of the solution of the s	water-saturated TBP was reported as
250 g/dm <sup>3</sup> of thorium.	
AUXILIARY IN	FORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Single batch of pure TBP in contact	Nothing specified.
with an aqueous solution containing	
thorium nitrate was made. After	
equilibration, the organic phase was	ESTIMATED ERROR:
analyzed.	
	Nothing specified.
	REFERENCE:
	None.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO3)4;	Wendlandt, W. W.; Bryant, J. M.
[13823-29-5]	J. Phys. Colloid Chem. <u>1956</u> , 60,
(2) Tri-n-butyl phosphate; C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	1145 - 1146.
(3) Water, H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: About 299K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of Th(NO3)4.4H20 in	tri-n-butyl phosphate, C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P,
is reported to be 42.4 and 42.6 g	of the anhydrous thorium nitrate per
100 g of solution. The compilers c	ompute these values to be 1.53 and
1.55 mol/kg of the mixture consist.	ing of the tri-n-butyl phosphate
and water.	
AUXILIARY IN	ΓΩΡΑΠΤΟΝ
	· · · · · · · · · · · · · · · · · · ·
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Twenty-five grams of the hydrated salt were added to 20 mL of the tri-n-butyl phosphate, and then	Th(NO <sub>3</sub> ).4H <sub>2</sub> O was of reagent grade quality.
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	Tri-n-butyl phosphate was a commercial product, and was not purified.
solution of metal nitrate salt, and an organic phase containing the	ESTIMATED ERROR:
dissolved metal salt. The organic phase was separated, centrifuged, and analyzed for the metal salt content.	probably 0.15 mass %
The metal ion concentration after	(compilers). Temperature: <u>+</u> 1K
reextraction in the phosphate/benzene and water system, was determined by	REFERENCES:
a standard procedure (1,2).	<ol> <li>Scott, W. W. Standard Methods of Chemical Analysis," Vol. 1, Van Nostrand, Inc., N.Y. 1946.</li> </ol>
	2. Lundell, G.E.F.; Bright, H.A.; Hoffman, J. I. "Applied Inorganic Chemistry," J. Wiley & Sons, N.Y. 1953.

$ \begin{bmatrix} 13823-29-5 \end{bmatrix} & 3^{4} \\ [Yyabinin, \lambda. I. \\ [2) Nitric acid; HNO_3; [7697-37-2] \\ [3) Tri-n-butyl phosphate (TBP); \\ C_{12}H_27O_4^{P;} [126-73-8] \\ [4] Water; H_20; [7732-18-5] \\ \hline VARTABLES: \\ Composition at 298 K \\ \hline EXPERIMENTAL VALUES: \\ The Th(NO_3)_4 - (CH_3(CH_2)_3O)_3PO - HNO_3 - H_2O System Composition of the Equilibrium Phases \\ \hline Aqueous Phase \\ \hline Composition of the Equilibrium Phases \\ \hline Aqueous Phase \\ \hline Composition of the Equilibrium Phases \\ \hline Aqueous Phase \\ \hline Composition of the Equilibrium Phases \\ \hline Aqueous Phase \\ \hline Th(NO_3)_4 & HNO_3 & Density \\ I & 2.56 & 1.24 & 1.960 \\ I.22 & 1.24 & 1.821 & 1.19 & 1.24 &3.1 & 1.1 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &2.9 & 1.2 \\ 0.27 & 0.27 & 1.106 & 0.51 & 0.19 &3.2 & 1.2 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &3.1 & 1.2 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &3.1 & 1.2 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &3.1 & 1.2 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &3.1 & 1.2 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &3.1 & 1.2 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &3.1 & 1.2 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &3.1 & 1.2 \\ 0.28 & 0.38 & 1.113 & 0.60 & 0.25 &3.1 & 1.2 \\ 0.21 & 1.42 & 1.821 & 1.36 & 1.24 & 0.52 &2.9 & 1.2 \\ 0.31 & 2.57 & 1.202 & 0.89 & 0.56 &3.0 & 1.4 \\ 2.11 & 3.16 & 1.853 & 1.24 & 0.52 &2.9 & 1.2 \\ 0.31 & 2.57 & 1.202 & 0.89 & 0.56 &3.0 & 1.4 \\ 0.51 & 0.19 &3.2 & 1.2 \\ 0.16 & 0.65 & 1.085 & 0.39 & 0.46 &3.2 & 1.3 \\ 1II & 1.63 & 4.57 & 1.740 & 1.09 & 0.58 & 0.50 & 3.0 & 1.2 \\ 0.16 & 0.65 & 1.085 & 0.39 & 0.46 &3.2 & 1.3 \\ 1II & 1.63 & 4.57 & 1.740 & 1.08 & 0.70 & 0.60 & 3.0 & 1.2 \\ 0.12 & 3.60 & 1.173 & 0.73 & 0.36 & 0.66 & 3.1 & 1.2 \\ 0.12 & 0.60 & 1.173 & 0.73 & 0.36 & 0.66 & 3.1 & 1.2 \\ 0.12 & 0.60 & 1.173 & 0.73 & 0.36 & 0.66 & 3.1 & 1.2 \\ 0.12 & 0.60 & 1.173 & 0.73 & 0.36 & 0.66 & 3.1 & 1.2 \\ 0.12 & 0.60 & 1.173 & 0.73 & 0.36 & 0.66 & 3.1 & 1.2 \\ 0.12 & 0.60 & 1.173 & 0.73 & 0.36 & 0.66 & 3.1 & 1.2 \\ 0.12 & 0.44 & 1.251 & 1.020 & 0.76 & 0.49 & 3.1 & 1.2 \\ 0.12 & 0.60 & 1.173 & 0.73 & 0.36 & 0.66 & 3.1 & 1.$	COMPO	ONENTS:				ORIG	INAL MEAS	UREMEN	rs:	
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]       Dokl. Akad. Nauk SSSR, 1961, 152, 806 - 808 (Eng.).         (3) Tri-n-butyl phosphate (TBP); Cl <sub>2</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]       Dokl. Akad. Nauk SSSR, 1961, 152, 806 - 808 (Eng.).         (4) Water; H <sub>2</sub> O; [7732-18-5]       PREPARED BY: L. Fuks; S. Siekierski         VARIABLES: Composition at 298 K       PREPARED BY: L. Fuks; S. Siekierski         EXPERIMENTAL VALUES:       The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - HNO <sub>3</sub> - H <sub>2</sub> O System Composition of the Equilibrium Phases         Aqueous Phase       Organic Phase         Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> Density       Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> HNO <sub>3</sub> HO <sup>2</sup> TBP <sup>4</sup> Den mol/dm <sup>3</sup> g/cm <sup>3</sup> I       2.12       1.24       1.821       1.19       1.24       3.1         0.21       1.220       1.422       1.04       0.26	(1) 7	Fhorium ni	itrate; Th -51	n(NO <sub>3</sub> ) <sub>4</sub> ;		Nikolaev, A. V.; Afanas'ev, Yu. A.; Ryabinin, A. T.				
(3) Tri-n-butyl phosphate (TBP); Cl <sub>2</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]       152, 806 - 808 (Eng.).         (4) Water; H <sub>2</sub> O; [7732-18-5]       PREPARED BY: L. Fuks; S. Siekierski         VARIABLES: Composition at 298 K       PREPARED BY: L. Fuks; S. Siekierski         EXPERIMENTAL VALUES: The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - HNO <sub>3</sub> - H <sub>2</sub> O System Composition of the Equilibrium Phases         Aqueous Phase       Organic Phase         Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> Density       Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>8</sup> Den Mol/dm <sup>3</sup> g/cm <sup>3</sup> I       2.56         1.2       1.26         0.28       0.38         0.28       0.38         0.27       0.27         0.27       0.27         0.27       1.150         0.28       0.38         0.12       1.62         0.57       1.16         0.57       1.16         0.57       1.22         0.31       2.57         0.55       0.39         0.14       0.28         0.21       1.82         1.15       4.57         1.29       0.44         1.20       1.42         1.21       1.42         1.22       1.42         1.23       1.12      <				] _			SR. 196	3.		
$ \begin{array}{c c} C_{12}H_{27}O_4P; \ [126-73-8] \\ \hline (4) \ Water; \ H_20; \ [7732-18-5] \\ \hline \\ $	5									
VARTABLES:       PREPARED BY:         Composition at 298 K       L. Fuks; S. Siekierski         EXPERIMENTAL VALUES:         The Th $(NO_3)_4$ - $(CH_3(CH_2)_3O)_3PO$ - HNO_3 - H_2O System Composition of the Equilibrium Phases         Aqueous Phase         Organic Phase         Th $(NO_3)_4$ HNO_3         and/dm <sup>3</sup> Th $(NO_3)_4$ HNO_3         2.56         1.2         2.12         1.24         1.25         2.56         1.20         1.21         1.20         1.25         0.25         2.12         1.20         0.21         0.22         0.25         2.12         0.23         1.20         0.25         2.12         1.20         0.25         2.12         1.21         0.25 <td col<="" td=""><td colspan="3">C<sub>12</sub>H<sub>27</sub>O<sub>4</sub>P; [126-73-8]</td><td></td><td></td><td></td><td></td><td></td></td>	<td colspan="3">C<sub>12</sub>H<sub>27</sub>O<sub>4</sub>P; [126-73-8]</td> <td></td> <td></td> <td></td> <td></td> <td></td>	C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]								
Composition at 298 K       L. Fuks; S. Siekierski         EXPERIMENTAL VALUES:         The Th $(NO_3)_4 - (CH_3(CH_2)_3O)_3PO - HNO_3 - H_2O System Composition of the Equilibrium Phases         Aqueous Phase         Organic Phase         Th(NO_3)_4 HNO_3 Density         Th(NO_3)_4 HNO_3 H_2O TBP4 Density         Th(NO_3)_4 HNO_3 Density         Th(NO_3)_4 HNO_3 Density         Th(NO_3)_4 HNO_3 H_2O TBP4 Density         Th(NO_3)_4 HNO_3 H_2O TBP4 Density         Th(NO_3)_4 HNO_3 H_2O TBP4 Density         Th(NO_3)_4 HNO_3 Density         Th(NO_3)_4 HNO_3 Density         Th(NO_3)_4 HNO_3 Density         Th(NO_3)_4 HNO_3 Density         Th(NO_3)_4 HNO3         Density         Th(NO_3)_4 HA$	(4) Water; H <sub>2</sub> O; [7732-18-5]									
Composition at 298 K EXPERIMENTAL VALUES: The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - HNO <sub>3</sub> - H <sub>2</sub> O System Composition of the Equilibrium Phases Aqueous Phase Organic Phase Organic Phase Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> Density Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> M <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> M <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> M <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> M <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> M <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> M <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> HNO <sub>3</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> O TBP <sup>4</sup> Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> O Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> H <sub>2</sub> O Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> H <sub>2</sub> O Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> H <sub>2</sub> O Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> H <sub>2</sub> O Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> H <sub>2</sub> Den Th(NO <sub>3</sub> ) <sub>4</sub> H <sub>2</sub> H <sub>2</sub> Den Th(NO <sub>3</sub>	VARIA	ABLES:						iekiers	ski	
$\begin{array}{c c} The \ Th(NO_3)_4 - (CH_3(CH_2)_3O)_3PO - HNO_3 - H_2O \ System \\ Composition of the Equilibrium Phases \\ \hline \\ \hline \\ Aqueous \ Phase \ Organic \ Phase \\ \hline \\ \hline \\ Aqueous \ Phase \ Organic \ Phase \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ HNO_3 \ H_2O \ TBP^a \ Density \\ \hline \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ Density \\ \hline \\ \hline \\ Th(NO_3)_4 \ HNO_3 \ HO(3)^2 \ HO(3)^2$	Compo	osition at	298 K							·····
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	EXPER	RIMENTAL V	VALUES:							
Aqueous PhaseOrganic PhaseTh(NO3)4 HNO3 DensityTh(NO3)4 HNO3 H2O TBP <sup>a</sup> DensityTh(NO3)4 HAO TBP <sup>a</sup> DensityTh(NO3)4 H2O TBP <sup>a</sup> DensityTh(NO3)6 Th(A12100 Table)The extractions were carried out in graduated tubes. Thorium determined by titration with Trilon B, using xylenol crange indicator. Nitric acid measured by potentiometric titration with KOH in the presence of anmonium coxalate. Solid phase identified as Th(NO2)4.4H,O by Schreinemakers method of residues (1).Solubility: nothing specified. Temperature: Precision ±0.05K.			The Th	$(NO_3)_4 - (C)_3$	н <sub>3</sub> (С	H <sub>2</sub> ) <sub>3</sub> 0	) <sub>3</sub> ро – ни	о <sub>3</sub> – н	2 <sup>0</sup> Syst	em
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			Comp	position of	the	Equi	Librium P	hases		
Raymol/dm3g/cm3mol/dm3mol/dm3g/cm3I2.561.241.9601.250.252.91.1.021.221.4221.040.263.11.0.350.741.1500.760.263.11.0.280.381.1130.600.253.11.0.270.271.1060.510.193.21.3112.443.111.9781.260.643.01.60.270.271.1060.510.193.21.30.270.271.060.510.193.21.30.270.271.060.510.193.21.30.270.271.060.510.193.21.30.123.161.3171.020.643.01.60.573.161.3171.020.613.11.20.312.571.2020.890.563.01.20.160.651.0850.390.463.21.30.160.651.0850.390.463.21.30.123.601.1730.730.960.683.11.20.123.601.1730.730.960.683.11.20.123.601.1		Aq	lueous Pha	ase			Org	anic Pl	nase	
I 2.56 1.24 1.960 1.25 0.25 2.9 1.4 2.12 1.24 1.821 1.19 1.24 3.1 1.1 1.02 1.20 1.422 1.04 0.26 3.1 1.1 0.35 0.74 1.150 0.76 0.26 3.1 1.1 0.28 0.38 1.113 0.60 0.25 3.1 1.1 0.27 0.27 1.106 0.51 0.19 3.2 1.3 II 2.44 3.11 1.978 1.26 0.64 3.0 1.4 2.11 3.16 1.853 1.24 0.52 2.9 1.1 0.57 3.16 1.317 1.02 0.44 2.9 1.1 0.57 3.16 1.317 1.02 0.44 2.9 1.1 0.31 2.57 1.202 0.89 0.56 3.0 1.1 0.21 1.82 1.136 0.72 0.61 3.1 1.1 0.16 0.65 1.085 0.39 0.46 3.2 1.3 III 1.63 4.57 1.740 1.09 0.58 0.50 3.0 1.1 1.15 4.57 1.581 1.08 0.70 0.60 3.0 1.2 0.65 4.52 1.397 1.02 0.67 0.51 3.0 1.2 0.30 4.46 1.258 0.90 0.76 0.49 3.1 1.3 0.12 3.60 1.173 0.73 0.96 0.68 3.1 1.2 0.17 0.11 1.113 0.44 1.51 1.32 3.2 1.1 (continued on the next provided of residues (1).		$\overline{\mathrm{Th}(\mathrm{NO}_3)_4}$	ниоз	Density	Th()	NO3)4	ниоз	<sup>H</sup> 2 <sup>O</sup>	TBP <sup>a</sup>	Densityb
2.121.241.8211.191.243.11.11.021.201.4221.040.263.11.10.350.741.1500.760.263.11.10.280.381.1130.600.253.11.10.270.271.1060.510.193.21.3112.443.111.9781.260.643.01.42.113.161.8531.240.522.91.20.573.161.3171.020.442.91.20.573.161.3171.020.613.11.20.312.571.2020.890.563.01.20.312.571.2020.890.563.11.20.160.651.0850.390.463.21.30.160.651.0850.390.463.21.30.154.571.5811.080.700.603.01.20.654.521.3971.020.670.513.01.20.123.601.1730.730.960.683.11.20.123.601.1730.730.960.683.11.20.072.111.1130.441.511.323.21.10.741.	Ray	mol/d	1m <sup>3</sup>	g/cm <sup>3</sup>		mo	1/dm <sup>3</sup>	mol,	/dm <sup>3</sup>	g/cm <sup>3</sup>
1.021.201.4221.040.263.11.10.350.741.1500.760.263.11.10.280.381.1130.600.253.21.10.270.271.1060.510.193.21.1112.443.111.9781.260.643.01.42.113.161.8531.240.522.91.20.573.161.3171.020.442.91.20.312.571.2020.890.563.01.20.160.651.0850.390.463.21.30.160.651.0850.390.463.21.31111.634.571.7401.090.580.503.01.30.160.651.0850.900.760.493.11.30.654.521.3971.020.670.513.01.30.123.601.1730.730.960.683.11.30.123.601.1730.730.960.683.11.30.072.111.1130.441.511.323.21.10.072.111.1130.441.511.323.21.10.123.601.170.730.960.683.11.20.	I									1.410
$\begin{array}{cccccccccccccccccccccccccccccccccccc$										1.352
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$										1.248
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.28							3.1	1.197
2.113.161.8531.240.522.91.0.573.161.3171.020.442.91.30.312.571.2020.890.563.01.30.211.821.1360.720.613.11.20.160.651.0850.390.463.21.11.154.571.5811.090.580.503.01.31.154.571.5811.080.700.603.01.30.654.521.3971.020.670.513.01.30.304.461.2580.900.760.493.11.30.123.601.1730.730.960.683.11.20.072.111.1130.441.511.323.21.1AUXILIARY INFORMATIONMUXILIARY INFORMATIONMETHOD/APPARATUS/PROCEDURE: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 Th(NO_3)_4.4H_0 by Schreinemakers method of résidues (1).Solubility: nothing specified. Temperature: Precision $\pm 0.05K$ .		0.27	0.27	1.106	0	.51	0.19		3.2	1.163
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	II									1.447
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$										1.397
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$										1.346
$\begin{array}{cccccccccccccccccccccccccccccccccccc$										1.239
1.15       4.57       1.581       1.08       0.70       0.60       3.0       1.33         0.65       4.52       1.397       1.02       0.67       0.51       3.0       1.33         0.30       4.46       1.258       0.90       0.76       0.49       3.1       1.33         0.12       3.60       1.173       0.73       0.96       0.68       3.1       1.2         0.07       2.11       1.113       0.44       1.51       1.32       3.2       1.1         0.07       2.11       1.113       0.44       1.51       1.32       3.2       1.1         AUXILIARY INFORMATION         METHOD/APPARATUS/PROCEDURE:         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 Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of residues (1).       Solubility: nothing specified. Temperature: Precision $\pm 0.05K$ .										1.141
1.15       4.57       1.581       1.08       0.70       0.60       3.0       1.33         0.65       4.52       1.397       1.02       0.67       0.51       3.0       1.33         0.30       4.46       1.258       0.90       0.76       0.49       3.1       1.33         0.12       3.60       1.173       0.73       0.96       0.68       3.1       1.2         0.07       2.11       1.113       0.44       1.51       1.32       3.2       1.1         0.07       2.11       1.113       0.44       1.51       1.32       3.2       1.1         AUXILIARY INFORMATION         METHOD/APPARATUS/PROCEDURE:         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 Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of residues (1).       Solubility: nothing specified. Temperature: Precision $\pm 0.05K$ .	III	1.63	4.57	1.740	1.	.09	0.58	0.50	3.0	1.361
$\begin{array}{cccccccccccccccccccccccccccccccccccc$										1.373
0.12 $3.60$ $1.173$ $0.73$ $0.96$ $0.68$ $3.1$ $1.2$ $0.07$ $2.11$ $1.113$ $0.44$ $1.51$ $1.32$ $3.2$ $1.1$ (continued on the next pAUXILIARY INFORMATIONMETHOD/APPARATUS/PROCEDURE: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 Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of residues (1). $0.73$ $0.96$ $0.68$ $3.1$ $1.2$ AUXILIARY INFORMATIONAUXILIARY INFORMATIONMETHOD/APPARATUS/PROCEDURE:Th(NO <sub>3</sub> ) <sub>4</sub> , HNO <sub>3</sub> : nothing specif Th(NO <sub>3</sub> ) <sub>4</sub> , HNO <sub>3</sub> : nothing specif TBP: twice distilled under vac prior to use.ESTIMATED ERROR:Solubility: nothing specified.		0.65		1.397	1.	.02	0.67	0.51	3.0	1.350
$0.07$ $2.11$ $1.113$ $0.44$ $1.51$ $1.32$ $3.2$ $1.11$ (continued on the next pAUXILIARY INFORMATIONMETHOD/APPARATUS/PROCEDURE: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 Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of residues (1).SOURCE AND PURITY OF MATERIALS SOURCE AND PURITY of MATERIALS Th(NO <sub>3</sub> ) <sub>4</sub> , HNO <sub>3</sub> : nothing specif TBP: twice distilled under vac prior to use.ESTIMATED ERROR:Solubility: nothing specified. Temperature: Precision $\pm 0.05K$ .								0.49	3.1	1.317
(continued on the next pAUXILIARY INFORMATIONMETHOD/APPARATUS/PROCEDURE:SOURCE AND PURITY OF MATERIALSThe 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 Th(NO3)4.4H2O by Schreinemakers method of residues (1).SOURCE AND PURITY OF MATERIALS Th(NO3)4, HNO3: nothing specified. TBP: twice distilled under vac prior to use.ESTIMATED ERROR: Solubility: nothing specified. Temperature: Precision ±0.05K.										1.254
AUXILIARY INFORMATIONMETHOD/APPARATUS/PROCEDURE:SOURCE AND PURITY OF MATERIALSThe 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 Th(NO3)4.4H2O by Schreinemakers method of residues (1).SOURCE AND PURITY OF MATERIALS Th(NO3)4, HNO3: nothing specified. TBP: twice distilled under vac prior to use.ESTIMATED ERROR: Solubility: nothing specified. Temperature: Precision ±0.05K.		0.07	2.11	1.113	0.	.44				1.162 xt page)
METHOD/APPARATUS/PROCEDURE:SOURCE AND PURITY OF MATERIALSThe 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 Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of residues (1).Th(NO <sub>3</sub> ) <sub>4</sub> , HNO <sub>3</sub> : nothing specified. TBP: twice distilled under vac prior to use.ESTIMATED ERROR: Solubility: nothing specified. Temperature: Precision $\pm 0.05$ K.				AUXILIARY	ואד ע	TORMA				
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 Th(NO <sub>3</sub> ) <sub>4</sub> , HNO <sub>3</sub> : nothing specified. <b>ESTIMATED ERROR:</b> Solubility: nothing specified. The presence of ammonium oxalate. Solid phase identified as Th(NO <sub>3</sub> ) <sub>4</sub> , HNO <sub>3</sub> : nothing specified. <b>ESTIMATED ERROR:</b> Solubility: nothing specified. The presence of ammonium oxalate. Solid phase identified as Th(NO <sub>3</sub> ) <sub>4</sub> , HNO <sub>3</sub> : nothing specified. <b>ESTIMATED ERROR:</b> Solubility: nothing specified. The presence of ammonium oxalate. Solid phase identified as Th(NO <sub>3</sub> ) <sub>4</sub> , HNO <sub>3</sub> : nothing specified.	MEMUA	יינטעע/ טע							Mampin	TATC
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 Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of résidues (1). TBP: twice distilled under vac prior to use. ESTIMATED ERROR: Solubility: nothing specified. Temperature: Precision ±0.05K.		•	•							
xylenol orange indicator. Nitric acid measured by potentiometric titration with KOH in the presence of ammonium oxalate. Solid phase identified as Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of résidues (1). ESTIMATED ERROR: Solubility: nothing specified. Temperature: Precision ±0.05K.	gradu	ated tube	es. Thoriu	um determine	ed	$Th(NO_3)_4$ , $HNO_3$ : nothing specified.				
measured by potentiometric titration with KOH in the presence of ammonium oxalate. Solid phase identified as Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of résidues (1). ESTIMATED ERROR: Solubility: nothing specified. Temperature: Precision ±0.05K.	by titration with Trilon B, using					stilled	l under	vacuum		
oxalate. Solid phase identified as Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O by Schreinemakers method of résidues (1). Solubility: nothing specified. Temperature: Precision ±0.05K.	measured by potentiometric titration			-						
method öf résidues (1). Temperature: Precision ±0.05K.	oxalate. Solid phase identified as									
REFERENCES:	Th(NO <sub>2</sub> ),.4H <sub>2</sub> O by Schreinemakers			Solubility: nothing specified. Temperature: Precision $\pm 0.05$ K.						
						REFE	ENCES:			
1. Schreinemakers, F. A. H. Z. physik. Chem., <u>1893</u> , 11,										

COMPONENTS:	ORIGINAL MEASUREMENTS:				
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Nikolaev; A. V.; Afanas'ev, Yu. A.; Ryabinin, A. I.				
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Dokl. Akad. Nauk SSSR, <u>1963</u> , 152, 806 - 808 (Eng.).				
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	152, 555 555 (Eng.).				
(4) Water; H <sub>2</sub> O; [7732-18-5]					

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

	Aqueous Phase			Organic Phase					
	$Th(NO_3)_4$	HNO3	Density	$\overline{\mathrm{Th}(\mathrm{NO}_3)}_4$	ниоз	H <sub>2</sub> O	TBPa	Density	
Ray	mol/dr	" <sup>3</sup> ———	g/cm <sup>3</sup>	mo	1/dm <sup>3</sup>	mol	/dm <sup>3</sup>	g/cm <sup>3</sup>	
IV	1.77	6.60	1.806	1.08	1.58		2.9	1.389	
	1.00	6.87	1.563	1.02	1.23		2.9	1.362	
	0.43	6.87	1.362	0.95	1.15		3.0	1.330	
	0.17	6.26	1.250	0.81	1.23		2.9	1.296	
	0.05	4.24	1.150	0.58	1.31		3.1	1.218	
v	1.48	9.07	1.763	1.01	2.29		2.8	1.374	
	0.66	9.11	1.493	0.88	1.95		2.8	1.336	
	0.36	9.17	1.393	0.83	1.92		2.9	1.307	
	0.26	8.88	1.357	0.80	1.86		2.9	1.298	
	0.048	7.56	1.248	0.61	1.96		2.8	1.234	
VI	1.13	11.50	1.700	0.90	3.16		2.5	1.360	
	0.83	11.76	1.611	0.81	3.21	1.33	2.7	1.335	
	0.59	11.86	1.541	0.78	2.91	1.28	2.75	1.313	
	0.22	11.30	1.394	0.69	2.74		2.8	1.276	
	0.14	11.10	1.365	0.66	2.77		2.8	1.266	
	0.05	10.50	1.334	0.54	2.78	1.10	2.9	1.229	
	0.038	9.96	1.305	0.53	2.69		3.0	1.222	
VII	0.85	14.4	1.662	0.85	4.57		2.4	1.363	
	0.81	14.3	1.639	0.82	4.39		2.5	1.360	
	0.59	14.4	1.576	1.78	4.21		2.5	1.340	
	0.23	14.4	1.458	0.66	3.89		2.7	1.288	
	0.052	13.5	1.381	0.51	3.72		2.8	1.238	
VIII	0.99	15.6	1.704					1.399	
	0.82	15.5	1.644					1.38	
	0.61	15.8	1.586					1.352	
	0.12	15.1	1.432					1.268	
a <sub>Tł</sub>	ne concent	ration o	f TBP was	calculated	by the a	authors	•		
~Pł	nase inver	csion was	observed	along rays	I - IV.				

Composition of the Equilibrium Phases

COMPONEI	NTS:		·····	ORIGINAL	MEASUREMENTS	:	
(1) Tho	rium nitrat	e: Th(NC	) ) -	Nikolaev, A. V.; Ryabinin, A. I.;			
[138	823-29-5]		3'4'	Afanas'ev, Yu. A.			
(2) Nit:	ric acid; H	NO <sub>3</sub> ; [76	97-37-2]	Radiokhim	., <u>1966</u> , 8,	421-426.	
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> <sup>H</sup> 27 <sup>O</sup> 4 <sup>P</sup> ; [126-73-8]				Sov. Radi	ochem., <u>1966</u>	, 390-394.	
(4) Wate	(4) Water; H <sub>2</sub> O; [7732-18-5]						
VARIABLI	ES:		<u>, , , , , , , , , , , , , , , , , , , </u>	PREPARED	BY:		
Composition at 298 K				S. L. Phi	llips		
EXPERIM	ENTAL VALUE	5:					
	Th	e Th(NO3	) <sub>4</sub> - (CH <sub>3</sub> (C	H <sub>2</sub> ) <sub>3</sub> 0) <sub>3</sub> PO	- нно <sub>3</sub> - н <sub>2</sub> о	System	
		Composi	tion of the	Equilibri	um Phases		
	Aq	ueous Ph	ase		ribution ficient	Organic Phase	
}	Th(NO <sub>3</sub> ) <sub>4</sub>	HNO3	Density	Th	Н	Density	
Radian	mol/di	" <sup>3</sup>	g/cm <sup>3</sup>			g/cm <sup>3</sup>	
II	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	
				( co	ntinued on the	he next page)	
	·····	A	UXILIARY IN	FORMATION			
	APPARATUS/PI	ROCEDURE	:	SOURCE AND PURITY OF MATERIALS:			
Nothing	specified.			Th(NO3)4, HNO3: nothing specified.			
				TBP: noth	ing specifie	d.	
				ESTIMATED	ERROR:		
					y: nothing spre: nothing spre:		
				REFERENCE	S:		
				1			

COMPONENTS:	ORIGINAL MEASUREMENTS:					
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Nikolaev; A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A.					
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Radiokhim., <u>1966</u> , 8, 421-426.					
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	<i>Sov. Radiochem., <u>1966</u>, 390-394.</i>					
(4) Water; H <sub>2</sub> O; [7732-18-5]						

The	$Th(NO_3)_4$	-	(CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> 0) <sub>3</sub> PO	-	hno <sub>3</sub>	-	<sup>н</sup> 20		System
-----	--------------	---	---	---	------------------	---	-----------------	--	--------

	Aqueous Phase				Distribution Coefficient		
	$\overline{\mathrm{Th}(\mathrm{NO}_3)_4}$	HNO3	Density	Th	Н	Density	
Radian	mol/d	-	g/cm <sup>3</sup>			g/cm <sup>3</sup>	
		·				······	
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	

Composition of the Equilibrium Phases

COMPONENTS:		ORIGINAL MEASUREMENTS:					
(1) Thorium nit [13823-29-5	trate; Th(NO <sub>3</sub> ) <sub>4</sub> ;	Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A.					
(2) Tri-n-butyl C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P;	l phosphate; [126-73-8]	Radiokhim. <u>1970</u> , 12, 326 - 335.					
(3) Nitric acid	l; HNO <sub>3</sub> ; [7697-37-2]	Sov. Radiochem. <u>1970</u> , 296 - 302.					
(4) Water; H <sub>2</sub> 0;	; [7732-18-5]						
VARIABLES:		PREPARED BY:					
Composition at	298 K	S. L. Phillips					
EXPERIMENTAL V	ALUES:						
The The	$(NO_3)_4 - (C_4H_9O)_3PO -$	HNO <sub>3</sub> - H <sub>2</sub> O system at 25 <sup>0</sup> C					
hno <sup>3</sup>	Th(NO <sub>3</sub> ) <sub>4</sub> in aqueous phase	Partition Coefficient					
mol/dm <sup>3</sup>	mol/dm <sup>3</sup>						
0.5	0.2 0.5 0.8 1.0 1.5	1.9 1.6 1.0 1.2 0.7					
2.0	0.2 0.5 0.8 1.0 1.5	 1.8 1.0 1.3 0.75					
3.0	0.2 0.5 0.8 1.0 1.5	 1.95 1.0 1.4 0.75					
4.0	0.2 0.5 0.8 1.0 1.5	1.9 1.35 1.0 0.73					
5.0	0.2 0.5 0.8 1.0 1.5	4.5 2.0 1.3 1.0 0.71 (continued on the next page)					
AUXILIARY INFORMATION							
METHOD/APPARATL	JS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:					
No information	given.	No information given.					
		ESTIMATED ERROR:					
		Nothing specified.					
		REFERENCES: None.					

omponents:		ORIGINAL MEASUREMENTS:				
1) Thorium ni [13823-29-	trate; Th(NO <sub>3</sub> ) <sub>4</sub> ; 5]	Nikolaev, A. V.; Ryabinin, A. I.; Afanas'ev, Yu. A.				
2) Tri-n-buty C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P;	1 phosphate; [126-73-8]	Radiokhim. <u>1970</u> , 12, 326 - 335.				
3) Nitric aci	d; HNO <sub>3</sub> ; [7697-37-2]	Sov. Radiochem., <u>1970</u> , 296-302.				
4) Water; H <sub>2</sub> O	; [7732-18-5]					
XPERIMENTAL V	ALUES: (Continued)	<u>}</u>				
The Th	$(NO_3)_4 - (C_4H_9O)_3PO -$	HNO <sub>3</sub> - H <sub>2</sub> O system at 25 <sup>0</sup> C				
ниоз	Th(NO <sub>3</sub> ) in aqueous phase					
mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	Partition Coefficient				
6.0	0.2	3.3 1.9				
	0.8	1.9				
	1.0 1.5	1.0 0.7				
8.0	0.2 0.5	3.7 1.7				
	0.8	1.1				
	1.0 1.5	1.0 0.70				
11.0	0.2	3.4 1.55				
	0.8 1.0	1.05 0.85				
The <sup>d</sup> HNO <sub>3</sub>	Th(NO <sub>2</sub> ), in	- H <sub>2</sub> O system at 25 <sup>0</sup> C				
-	aqueous phase	Partition				
mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	Coefficient				
1.5	0.15 0.2	3.3 2.9				
	0.3	2.5				
	0.5 0.7	1.75 1.47				
	0.8	1.22				
	1.0 1.2	1.0 0.88				
	1.2	0.74				

COMPONENTS:	ORIGINAL MEASUREMENTS:					
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [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 <sub>3</sub> ; [7697-37-2]	Zh. Strukt. Khim. <u>1988</u> , 30, 774 - 787.					
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Sov. Radiochem., <u>1988</u> , 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 HNO<sub>3</sub> into a 30 vol. % solution of TBP,  $24\pm1$  °C

	Com	posit	ion a	nd Prop	erties c	of Dilue	ent <sup>a</sup>	in homogened extract		
Paraffin	nP	iP	Ar	bp	dens.	visc.	mp	Th	HNO <sub>3</sub>	
	00	%	90	°c	g/cm <sup>3</sup>	cP	°c	g/dm <sup>3</sup>	mol/dm <sup>3</sup>	
nC <sub>6</sub>	100			68.7	0.655	0.292	-95.3	(55)	0.24	
nC <sub>7</sub>	100		*** *** *** ***	98.4	0.680	0.390	-90.6	(49)	0.23	
nCg	100			125.7	0.698	0.514	-56.8	(52)	0.24	
<sup>nC</sup> 10	100			174.1	0.726	0.854	-29.7	46	0.28	

(continued on the next page)

Concentration,

#### AUXILIARY INFORMATION

#### METHOD/APPARATUS/PROCEDURE:

Studies were carried out at room temperature  $(22-25^{\circ}C)$  with 3 mol/dm<sup>3</sup> HNO, in equilibrium aqueous phase. A 1<sup>°</sup>mL aliquot of the extractant equilibrated to given concentration of acid, was placed in a separatory funnel. A 1 mL solution of HNO , 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 HNO, 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  $\pm 3$  K.

**REFERENCES:** 

1. Rybak, B. M.

Analysis of Petroleum and Products, Goskhimizdat, Moscow (<u>1962</u>). In Russian.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [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 <sub>3</sub> ; [7697-37-2]	Zh. Strukt. Khim. <u>1988</u> , 30, 774 - 787.
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Sov. Radiochem., <u>1988</u> , 734-787.
(4) Various isoparaffinic diluents	

	Comp	ositi	on an	d Propei	cties o	f the D	iluent <sup>a</sup>	in home	tration ogeneous tract
Paraffin	nP	iP	Ar	bp	dens.	visc.	mp	Th	HNO <sub>3</sub>
	8	*	8	°c	g/cm <sup>3</sup>	ср	°c	g/dm <sup>3</sup>	mol/dm <sup>3</sup>
nC <sub>12</sub>	100			216.3	0.745	1.365	- 9.6	31	0.44
nC <sub>14</sub>	100			253.5	0.759	1.889	5.9	15	0.52
ic <sub>8</sub>		100			0.692			(53)	0.24
iC <sub>10</sub> ,mix.		100	<1.3	175-180	0.736	1.25		(59)	0.30
iC <sub>11</sub> ,mix.		100	<1.3	196-201	0.751	1.30	(-97)-53	40	0.38
iC <sub>12</sub> ,mix.		100	<1.3	210-216	6 0.760	1.56	(-94)-35	35	0.39
iC <sub>13</sub> ,mix.		100	<1.3	270.5	0.782		(-73)-29	25	0.56
ic <sub>14</sub> ,mix.		100	<1.3	253.6	0.764	2.17	-16	28	0.50
ic <sub>15</sub> ,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 <sub>11</sub> +C <sub>12</sub>									
fr. RED1	100			203-214				32	0.38
nC <sub>14</sub> +C <sub>15</sub>									
fr. RED1	100			260				36	0.36
ic <sub>11</sub> +c <sub>12</sub>									
fr. iRED		100		180-213				40	0.37
ic <sub>13</sub>									
fr. iRED		100		210-230				35	0.41
						(0	Continued of	on the n	ext page)

(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [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 <sub>3</sub> ; [7697-37-2]	Zh. Strukt. Khim. <u>1988</u> , 30, 774 - 787
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Sov. Radiochem., <u>1988</u> , 734-787.
(4) Various isoparaffinic diluents	

	Com	posit	ion a	nd Prope	erties d	of the D:	i]uent <sup>a</sup>	Concenti in homo exti	
Paraffin	nP	iP	Ar	bp	dens.	visc.	mp	Th	HNO <sub>3</sub>
	90	%	8	°c	g/cm <sup>3</sup>	ср	°c	g/cm <sup>3</sup>	mol/dm <sup>3</sup>
iC <sub>13</sub> +C <sub>14</sub>									
fr. iRED		100		230-240	)			36	0.44
iC <sub>14</sub> +C <sub>15</sub>		100		240-260	)			30	0.48
RED1	100				754	2.02	-4.0	22	0.49
iC <sub>12</sub> +nC <sub>12</sub>	50	50						35	
iC <sub>12</sub> +mC <sub>12</sub>	25	75						32	)
iC <sub>12</sub> +nC <sub>12</sub>	75	25						30	
iC <sub>10</sub> +nC <sub>10</sub>	50	50						43	
iC <sub>10</sub> +nC <sub>14</sub>	50	50						37	
iC <sub>14</sub> +nC <sub>14</sub>	50	50						25	

<sup>a</sup>Notation: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.

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	МсКау, Н. А. С.
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	International Conference on the Peaceful Uses of Atomic Energy,
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Geneva, <u>1956</u> , 7, 314 - 317.
(4) Kerosine; [8008-20-6]	
(5) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Various concentrations.	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The limits of solubility of Th(NO3)	4 in the TBP/kerosine system are
presented in the source document on	ly in the form of a diagram.
AUXILIARY IN	FORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	Nothing specified.
REFERENCES:	ESTIMATED ERROR:
None.	Nothing specified.

r					
COMPONENTS:	ORIGINAL MEASUREMENTS:				
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Nakashima, T.; Zimmer, E.; Merz, E.				
	Solvent Extr. Ion Exch. <u>1984</u> , 2, 635 - 658.				
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	<u>1201</u> , 2, 035 030.				
(4) Dodecane; C <sub>12</sub> H <sub>26</sub> ; [112-40-3]					
(5) Water; H <sub>2</sub> O; [7732-18-5]					
VARIABLES:	PREPARED BY:				
T/K = 298	S. L. Phillips				
EXPERIMENTAL VALUES:					
The solubility data are given in the	form of a mathematical equation				
which describes the distribution rati	o, K, for the reaction				
$Th^{++++} + 4NO_3 + 3TBP = Th(NO_3)$	4.(TBP) <sub>3</sub>				
$K = [Th(NO_3)_4.(TBP)_3]/[TH^{++++}][NO_3^{-}][TBP]^3$					
$\log K = C_1 / I + C_2 + C_3 I +$	$\log K = C_1/I + C_2 + C_3I + C_4I \log T + C_5/I^{1/2}$				
$C_1 = 0.0534 \pm 0.11$	$C_1 = 0.0534 \pm 0.11$				
$C_2 = 0.6882 \pm 0.76$					
$C_3 = 1.108 \pm 0.31$					
C <sub>4</sub> = 0.2756±0.55					
In the equation, I is the ionic str	In the equation, I is the ionic strength in the aqueous phase.				
AUXILIARY IN	FORMATION				
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:				
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	Nothing specified.				
25 <sup>°</sup> C for 15 min. The volume ratio of aqueous to organic phases was 1.0. Samples of both phases were analyzed	ESTIMATED ERROR:				
immediately after phase separation. Thorium was determined by titration	Solubility: nothing specified.				
with diethylentriaminepentaacetic acid (DTPA) at pH2, using xylenol	Temperature: Precision ±0.1K.				
orange as the indicator. Nitric acid titrated with standard 0.01 mol/dm <sup>3</sup>	REFERENCES:				
NaOH, in the presence of potassium oxalate.	None.				

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COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>;     [13823-29-5]</pre>	Gresky, A. T.; Mansfield, R. G.
<pre>(2) Di-2-phenylbutane phosphonate; (DSBPP); C<sub>20</sub>H<sub>27</sub>O<sub>3</sub>P;</pre>	in, Report, CF-60-7-108, 46 ( <u>1960</u> )
(3) 2-Phenylbutane; C <sub>10</sub> H <sub>14</sub> ; [135-98-8]	
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: room (compilers)	A. Sozanski; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of Th(NO3)4.4H20 in 1	.12 mol/dm $^3$ of the phosphonate DSBPP
$(CH_3CH_2CH(C_6H_5)CH_2O)_2P(H)O, in 2-phe$	nylbutane,
CH <sub>3</sub> CH <sub>2</sub> CH(C <sub>6</sub> H <sub>5</sub> )CH <sub>3</sub> is reported to be	_
COMMENTS AND/OR ADDITIONAL DATA:	
COMMENTS AND/OR ADDITIONAL DATA: A small amount of crystallization oc resolution was effected by warming. of 10%, the solubility value corresp Th(NO_) .2.8(DSBPP).	Assuming an organic volume increase
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp $Th(NO_3)_4.2.8(DSBPP).$	Assuming an organic volume increase onds to a complex with composition
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp Th(NO <sub>3</sub> ) <sub>4</sub> .2.8(DSBPP). AUXILIARY I	Assuming an organic volume increase onds to a complex with composition NFORMATION
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp Th(NO <sub>3</sub> ) <sub>4</sub> .2.8(DSBPP). AUXILIARY I METHOD/APPARATUS/PROCEDURE:	Assuming an organic volume increase onds to a complex with composition NFORMATION SOURCE AND PURITY OF MATERIALS:
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp Th(NO <sub>3</sub> ) <sub>4</sub> .2.8(DSBPP). AUXILIARY I METHOD/APPARATUS/PROCEDURE: Isothermal method used. The organic	Assuming an organic volume increase onds to a complex with composition NFORMATION
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp Th(NO <sub>3</sub> ) <sub>4</sub> .2.8(DSBPP). AUXILIARY I METHOD/APPARATUS/PROCEDURE: Isothermal method used. The organic phase of 1.12 mol/dm <sup>3</sup> DSBPP in sec-	Assuming an organic volume increase onds to a complex with composition NFORMATION SOURCE AND PURITY OF MATERIALS: Nothing specified.
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp Th(NO <sub>3</sub> ) <sub>4</sub> .2.8(DSBPP). AUXILIARY I METHOD/APPARATUS/PROCEDURE: Isothermal method used. The organic phase of 1.12 mol/dm <sup>3</sup> DSBPP in sec- butylbenzene was equilibrated with	Assuming an organic volume increase onds to a complex with composition NFORMATION SOURCE AND PURITY OF MATERIALS:
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp Th(NO <sub>3</sub> ) <sub>4</sub> .2.8(DSBPP). AUXILIARY I METHOD/APPARATUS/PROCEDURE: Isothermal method used. The organic phase of 1.12 mol/dm <sup>3</sup> DSBPP in sec- butylbenzene was equilibrated with crystalline Th(NO <sub>3</sub> ) <sub>4</sub> .6H <sub>2</sub> O to effect	Assuming an organic volume increase onds to a complex with composition NFORMATION SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR:
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp Th(NO <sub>3</sub> ) <sub>4</sub> .2.8(DSBPP). AUXILIARY I METHOD/APPARATUS/PROCEDURE: Isothermal method used. The organic phase of 1.12 mol/dm <sup>3</sup> DSBPP in sec- butylbenzene was equilibrated with crystalline Th(NO <sub>3</sub> ) <sub>4</sub> .6H <sub>2</sub> O to effect thorium saturation of the organic	Assuming an organic volume increase onds to a complex with composition NFORMATION SOURCE AND PURITY OF MATERIALS: Nothing specified.
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp $Th(NO_3)_4.2.8(DSBPP).$ AUXILIARY I METHOD/APPARATUS/PROCEDURE: Isothermal method used. The organic phase of 1.12 mol/dm <sup>3</sup> DSBPP in sec- butylbenzene was equilibrated with crystalline $Th(NO_3)_4.6H_2O$ to effect thorium saturation of the organic reagent. After centrifugation, the	Assuming an organic volume increase onds to a complex with composition NFORMATION SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Nothing specified.
A small amount of crystallization of resolution was effected by warming. of 10%, the solubility value corresp Th(NO <sub>3</sub> ) <sub>4</sub> .2.8(DSBPP). AUXILIARY I METHOD/APPARATUS/PROCEDURE: Isothermal method used. The organic phase of 1.12 mol/dm <sup>3</sup> DSBPP in sec- butylbenzene was equilibrated with crystalline Th(NO <sub>3</sub> ) <sub>4</sub> .6H <sub>2</sub> O to effect thorium saturation of the organic	Assuming an organic volume increase onds to a complex with composition NFORMATION SOURCE AND PURITY OF MATERIALS: Nothing specified. ESTIMATED ERROR: Nothing specified. REFERENCES:


Ukraintsev, E. V.
Radiokhim. <u>1965</u> , 7, 641 - 648. Sov. Radiochem., <u>1967</u> , 7, 641-647.
PREPARED BY: A. Sozanski; S. Siekierski
S P

EXPERIMENTAL VALUES:

The solubility of Th(NO<sub>3</sub>) in the system comprised of the organics  $C_{11}H_{24}O_3P$  and  $C_8H_{10}$ , as a function temperature and composition is given in the following table.

DAMP :	in xylene		$Th(NO_3)_4$ ,	mol/dm	3
			T/	К	
Vol %	mol/dm <sup>3</sup>	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

AUXILIARY INFORMATION SOURCE AND PURITY OF MATERIALS: METHOD/APPARATUS/PROCEDURE: Th(NO<sub>3</sub>)<sub>4</sub>.4H<sub>2</sub>O, was twice crystallized. The isothermal method was used. The organic solvent with DAMP was mixed with thorium nitrate tetrahydrate for 2. Diisoamyl methyl phosphonate was redistilled at 130°C at 7 torr, 150 hours. When a mixture of DAMP and p-xylene was used, equilibrium attained after 3 hours. Thorium was and then washed with 5% solution determined in the organic phase by of Na<sub>2</sub>CO<sub>2</sub>, and finally water. precipitation with oxalate. ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision  $\pm 1K$  at  $20^{\circ}C$ ,  $\pm 3K$  at  $90^{\circ}C$ . **REFERENCES:** None.

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COMPONENTS: (1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	ORIGINAL MEASUREMENTS: Mikhlin, E. B.; Berezkina, V. V.; Mikhailichenko, A. I.				
(2) Aluminum nitrate; Al(NO <sub>3</sub> ) <sub>3</sub> ; [13473-90-0]	Radiokhim. <u>1984</u> , 26, 440 - 445.				
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Translated from: Sov. Radiochem. 1985, 421 - 426.				
(4) Various organic phosphates					
(5) m-Xylene; C <sub>8</sub> H <sub>10</sub> ; [108-38-3]					
(6) Water; H <sub>2</sub> O; [7732-18-5]					
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 <sup>3</sup> , respectively, achieved when the extractant is 1 and 2 mol/dm <sup>3</sup> in tri-n-butylphosphate (TBP). The stoichiometry of the thorium in the extracted phase is indicated to be Th(NO <sub>3</sub> ) <sub>4</sub> .3TBP. The data are given in the form of the following table:					
Distribution coefficie Extractant	ents (D) of thorium <u>Concentration of HNO , mol/dm<sup>3</sup></u> 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				
Comment: source document gives the d instead of D, which appears to be a					
AUXILIARY IN	FORMATION				
METHOD/APPARATUS/PROCEDURE: The distribution of Th(NO <sub>3</sub> ) <sub>4</sub> was studied at 25°C by mixing components for 10 min; m-xylene used as diluent. 1.67 mol/dm Al(NO <sub>3</sub> ) <sub>3</sub> 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, diisooctyl- methyl phosphate, petroleum sulfoxides with 10.1% sulfoxide sulfur and 360 average molecular weight, trialkylbenzylammonium nitrate, m-xylene, Th(NO <sub>3</sub> ) <sub>4</sub> and Al(NO <sub>3</sub> ) <sub>3</sub> : source and purity were not specified. ESTIMATED ERROR: Solubility: nothing specified. Temperature: precision ±0.5 - 1K. REFERENCES: 1. Zarubina,Yu.S.; Merisov, Yu. I.; Petrova, E.I. Tsyet Metall 1975 3 44-46				
	Tsvet. Metall. <u>1975</u> , 3, 44-46. 2. Kondrat'eva,T.M.;Merisov,Yu.I.; Petrova, E. I. Zavod. Lab. <u>1975</u> , 10, 1183-1185.				

COMPONENTS: (1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5] (2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7] (3) Water; H <sub>2</sub> O; [7732-18-5] VARIABLES: Composition: T/K = 273.15 and 293.15K EXPERIMENTAL VALUES:	ORIGINAL MEASUREMENTS: Misciattelli; P. Gazz. Chim. Ital. <u>1930</u> , 60, 833 - 838. PREPARED BY: L. Fuks; S. Siekierski		
The $Th(NO_3)_4 - CH_3CH_2$	OCH <sub>2</sub> CH <sub>3</sub> - H <sub>2</sub> O System		
Composition of Sat T/K =			
Water Phase <sup>a</sup>	Ether phase <sup>a</sup>		
Ether $H_2O$ $Th(NO_3)_4$	Ether H <sub>2</sub> O Th(NO <sub>3</sub> ) <sub>4</sub>		
SP <sup>D</sup> 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         B       5.21       28.89       65.90       4.026         B             C	41.36       13.99       44.65       1.680         41.27       12.78       45.95       1.771         54.50       10.50       35.00       1.122         94.20        5.80       0.128		
T/K =	293K		
A        35.00       65.00       3.869         B       1.92       32.50       65.53       3.960         B            B            C            C            C            C            C            C            C	$\begin{array}{cccccccccccccccccccccccccccccccccccc$		
<sup>a</sup> Mol/kg, of the mixture consisting o	of water and ether (compilers).		
<sup>b</sup> Solid phase: $A = Th(NO_3)_4 \cdot 6H_2O; B =$	$Th(NO_3)_4.H_2O; C = Th(NO_3)_4.$		
<sup>C</sup> Value corrected from original appare	ently erroneous 88.01% (compilers).		
AUXILIARY IN	FORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:		
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. Ether was determined gasometrically, after converting to CO <sub>2</sub> , using CaCl <sub>2</sub> .	at 110°C for several days in order to obtain the anhydrous salt. The salt was analyzed for ThO <sub>2</sub> and N <sub>2</sub> O <sub>5</sub> content. ESTIMATED ERROR:		
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 <sub>2</sub> .	Nothing specified. REFERENCES: None.		

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Wells, R. C.
[13023-23-2]	J. Washington Acad. Sci. 1930, 20, 146 - 148.
(2) Diethyl ether;	140 - 140.
C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: About 293K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of hydrated thorium	nitrate in diethyl ether, (C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> 0,
at about 293K is reported to be 1.1	252
of solution. The compilers compute	
anhydrous nitrate per liter of solu	tion.
The solubility of the residue dried	
of the thorium oxide in 10 mL of so	
value to be 66.7 g of anhydrous tho	_
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AUXILIARY IN	FORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. The solubility experiments were done by	Nothing specified.
covering a few grams of the nitrate	
with about 20 mL of ether in small stoppered flasks, agitating the	
flasks from time to time, and then allowing them to stand at about 20°C	
at least overnight.	
Then, 10 mL of the solution were	ESTIMATED ERROR:
withdrawn, filtered, evaporated, and the resulting salt ignited to the	Solubility: nothing specified.
oxide and weighed. The remaining salt was freed from ether, dissolved in	Temperature: nothing specified.
water, a few drops of nitric acid added, followed by evaporation to	
dryness at 150 <sup>0</sup> C, and again dissolved in ether.	REFERENCES:
	No references.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<ul> <li>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</li> <li>(2) Various alcohols</li> <li>(3) Water; H<sub>2</sub>O; [7732-18-5]</li> </ul>	Templeton, C. C.; Hall, N. F. J. Phys. Colloid Chem. <u>1947</u> , 51, 1441 - 1449.
VARIABLES:	PREPARED BY:
One temperature: 298 K	A. Sozanski; S. Siekierski

#### EXPERIMENTAL VALUES:

The solubility of  $Th(NO_3)_4$  in various alcohols is reported as grams of the anhydrous salt in IOO g of solution. The compilers have also converted this quantity to units of molality, mol/kg.

	$Th(NO_3)_4$		
Alcohol		mass %	mol/kg (compilers)
Methyl alcohol; CH <sub>4</sub> O; [67-56-1]		65.7	3.99
Ethyl alcohol; C <sub>2</sub> H <sub>6</sub> O; [64-17-5]		55.6	2.61
Ethyl alcohol; 95%; C <sub>2</sub> H <sub>6</sub> O; [64-17-5	]	56.0	2.65
Propyl alcohol; C <sub>3</sub> H <sub>8</sub> 0; [71-23-8]		47.0	1.85
Isopropyl alcohol; C <sub>3</sub> H <sub>8</sub> O; [67-63-0]		44.4	1.66
Allyl alcohol; C <sub>3</sub> H <sub>6</sub> O; [107-18-6]		45.8	1.76
Butyl alcohol; C <sub>4</sub> H <sub>10</sub> O; [71-36-3]		44.6	1.68
Isobutyl alcohol; C <sub>4</sub> H <sub>10</sub> O; [78-92-2]		39.9	1.38
	(cont	inued on t	the next page)
AUXILIARY IN	FORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND	PURITY O	F MATERIALS:
The isothermal method was used. The appropriate weight of hydrated salt	1. Th(NO <sub>3</sub> ) analyze	$4^{4H}_{2O}$ was	s Baker's C.P.
and the solvent were mixed in a test tube. The contents were equilibrated by end-over-end agitation for a five		anic solve "practica	ents were of al" grade.
day period. The contents were allowed to settle, and a portion pipetted for	ESTIMATED	ERROR:	· · · · · · · · · · · · · · · · · · ·
weighing. The solvent was removed by evaporation or burning. The residue was ignited, and thorium measured as ThO <sub>2</sub> .	Solubility	±0.2% fo a boilin over 100	cric errors, or solvents with og point (b.p.) OC; $\pm 0.45$ % for s with b.p. from 100°C.
	Temperatur	e: ±0.05 1	κ.

**REFERENCES:** 

None.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5] (2) Various alcohols</pre>	Templeton, C. C.; Hall, N. F. J. Phys. Colloid Chem. <u>1947</u> , 51, 1441 - 1449.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

 $Th(NO_3)_4^a$ 

	<sup>111</sup> ( <sup>NO</sup> 3 <sup>4</sup> )	
Alcohol	mass %	mol/kg (compilers)
3-Methyl-1-butanol; C <sub>5</sub> H <sub>12</sub> O; [123-51-3] <sup>b</sup> (isoamyl alcohol)	37.8	1.27
Hexyl alcohol; C <sub>6</sub> H <sub>14</sub> O; [111-27-3]	33.4	1.04
Cyclohexanol; C <sub>6</sub> H <sub>12</sub> O; [108-93-0]	35.9	1.17
1,6-Hexanediol; C <sub>6</sub> H <sub>14</sub> O <sub>2</sub> ; [629-11-8] <sup>C</sup> (hexamethylene glycol)	13.5	0.33
Benzyl alcohol; C <sub>7</sub> H <sub>8</sub> O; [100-51-6]	20.9	0.55
m-Cresol; C <sub>7</sub> H <sub>8</sub> O; [108-39-4]	0.10 <sup>d</sup>	0.18
Glycerol; C <sub>3</sub> H <sub>8</sub> O <sub>3</sub> ; [56-81-5] <sup>C</sup>	46.5	1.75
Ethylene chlorohydrin; C <sub>2</sub> H <sub>5</sub> ClO; [107-07-3]	44.4	1.66
Ethylene glycol; C <sub>2</sub> H <sub>6</sub> O <sub>2</sub> ; [107-21-1]	44.4	1.66
Diethylene glycol; C <sub>4</sub> H <sub>10</sub> O <sub>3</sub> ; [111-46-6]	47.3	
<sup>a</sup> Molalities calculated by the compilers. <sup>b</sup> Agitated over 20 days at 25 <sup>0</sup> C. Solubilit 4 days. <sup>C</sup> Very viscous solution.	ty became cons	stant after
<sup>d</sup> ThO <sub>2</sub> content, per 100 mL of solution.		
	(Continued or	n the next page)

[13823-29-5]	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F.
(2) Various esters	J. Phys. Colloid Chem. <u>1947</u> , 51, 1441 - 1449.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

The solubility of  $Th(NO_3)_4.4H_2O$  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	$Th(NO_3)_4^{a,b}$	
	mass %	mol/kg (compilers)
Ethyl formate; C <sub>3</sub> H <sub>6</sub> O <sub>2</sub> ; [109-94-4]	32.5	1.00
Methyl acetate; C <sub>3</sub> H <sub>6</sub> O <sub>2</sub> ; [79-20-9]	50.0	2.08
Diethyl carbonate; C <sub>4</sub> H <sub>10</sub> O <sub>3</sub> ; [105-58-8]	8.9	0.20
Ethyl propionate; C <sub>5</sub> H <sub>10</sub> O <sub>2</sub> ; [105-37-3]	67.1	4.25
Ethyl acrylate; C <sub>5</sub> H <sub>8</sub> O <sub>2</sub> ; [140-88-5]	12.6	0.30
Ethyl butyrate; C <sub>6</sub> H <sub>12</sub> O <sub>2</sub> ; [105-54-4]	56.9	2.75
Ethyl caproate; C <sub>8</sub> H <sub>16</sub> O <sub>2</sub> ; [123-66-0]	28.6	0.83
Methyl salicylate; C <sub>8</sub> H <sub>8</sub> O <sub>3</sub> ; [119-36-8]	2.4	0.05
Ethyl benzoate; C <sub>9</sub> H <sub>10</sub> O <sub>2</sub> ; [93-89-0]	6.3	0.14
Ethyl acetate; C <sub>4</sub> H <sub>8</sub> O <sub>2</sub> ; [141-78-6]	43.4	1.60
Ethyl phenylacetate; C <sub>10</sub> H <sub>12</sub> O <sub>2</sub> ; [101-97-3]	18.4	0.47

<sup>a</sup>Highest observed value reported. True equilibrium was not obtained. <sup>b</sup>Molalities calculated by the compilers.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</pre>	Templeton, C. C.; Hall, N. F.
(2) Various ethers	J. Phys. Colloid Chem. <u>1947</u> , 51, 1441 - 1449.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

The solubility of  $Th(NO_3)_4.4H_2O$  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	$Th(NO_3)_4$	
	mass %	mol/kg (compilers)
Ethylene glycol monomethyl ether <sup>a</sup> (methyl cellosolve); C <sub>3</sub> H <sub>8</sub> O <sub>2</sub> ; [109-86-4]	59.2	3.02
Diethyl ether <sup>a</sup> ; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	42.8	1.56
Ethylene glycol monoethyl ether <sup>a</sup> (ethyl cellosolve); C <sub>4</sub> H <sub>10</sub> O <sub>2</sub> ; [110-80-5]	54.6	2.50
Diethylene glycol <sup>a</sup> ; C <sub>4</sub> H <sub>10</sub> O <sub>3</sub> [111-46-6]	47.3	1.87
Dioxane <sup>a</sup> (1,4-dioxane); C <sub>4</sub> H <sub>8</sub> O <sub>2</sub> ; [123-91-1]	42.9	1.57
Dibutyl ether <sup>b</sup> ; C <sub>8</sub> H <sub>18</sub> O; [142-96-1]	2.69 0.53 0.33	0.0576 0.0111 0.0069
Isoamyl ether <sup>b</sup> ; C <sub>10</sub> H <sub>22</sub> O; [544-01-4]	1.12 0.14 0.14	0.0236 0.0029 0.0029

<sup>a</sup>Highest observed value is reported. A true equilibrium is not obtained. The solution becomes unmanageably viscous.

<sup>b</sup>Values determined 1, 2 and 4 days after cessation of agitation.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Templeton, C. C.; Hall, N. F.
(2) Various ketones	J. Phys. Colloid Chem. <u>1947</u> , 51, 1441 - 1449.
(3) Water; H <sub>2</sub> O; [7732-18-5]	

The solubility of  $Th(NO_3)_4.4H_2O$  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.

Th(NO <sub>3</sub> ) <sub>4</sub>	
mass %	mol/kg (compilers)
59.3	3.04
42.20	1.52
55.7	2.62
28.5	0.83
20.8	0.55
36.68	1.21
31.06	
18.9	0.49
37.06	1.23
	mass % 59.3 42.20 55.7 28.5 20.8 36.68 31.06 18.9

<sup>a</sup>High observed value was reported. True equilibrium was not attained because the solution became unmanageably viscous, or the solution solidified.

,	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F.
	J. Phys. Colloid Chem. <u>1947</u> , 51, 1441 - 1449.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
EXPERIMENTAL VALUES: (Continued)	
The solubility of $Th(NO_3)_4 \cdot 4H_2O$ in given in units of grams of equivalent The compilers have converted this up $Th(NO_3)_4$ per 100 mL of solution.	various hydrocarbons is nt ThO <sub>2</sub> per 100 mL of solution. nit to <sup>°</sup> equivalent grams of
· · · · · · · · · · · · · · · · · · ·	Thorium in solution g/(100 mL)
Organic	$\overline{\text{ThO}_2}$ $\overline{\text{Th}(\text{NO}_3)_4}$
Methylene chloride; CH <sub>2</sub> Cl <sub>2</sub> ; [75-09-2]	0.00 0.00
Carbon tetrachloride; CCl <sub>4</sub> ; [56-23-5]	0.05 0.09
Ethylene dichloride; C <sub>2</sub> H <sub>2</sub> Cl <sub>2</sub> ; [540-59-6	0] 0.05 0.09
Methyl chloroform; C <sub>2</sub> H <sub>3</sub> Cl <sub>3</sub> ; [71-55-6]	0.01 0.02
Trichloroethylene; C <sub>2</sub> HCl <sub>3</sub> ; [79-01-6]	0.02 0.04
Ethyl bromide; C <sub>2</sub> H <sub>5</sub> Br; [74-96-4]	0.02 0.04
Chlorobenzene; C <sub>6</sub> H <sub>5</sub> Cl; [108-90-7]	0.03 0.05
p-Chlorotoluene; CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> CH <sub>3</sub> ; [106-43-4	] 0.00 0.00
Bromobenzene; C <sub>6</sub> H <sub>5</sub> Br; [108-86-1]	0.00 0.00
Ethylene chlorohydrin; C <sub>2</sub> H <sub>5</sub> ClO; [107-0]	7-3] 44.4
Chloroform; CHCl <sub>3</sub> ; [67-66-3]	0.01 0.01
Aniline; C <sub>6</sub> H <sub>7</sub> N; [62-53-3]	0.04 0.07
o-Toluidine; C <sub>7</sub> H <sub>9</sub> N; [95-53-4]	0.09 0.20
Dimethylaniline; C <sub>8</sub> H <sub>11</sub> N; [121-69-7]	0.07 0.10
Nitrobenzene; C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub> ; [98-95-3]	0.02 0.04
Toluene; C <sub>7</sub> H <sub>8</sub> ; [108-88-3]	0.02 0.04
Piperidine; C <sub>5</sub> H <sub>11</sub> N; [110-89-4]	0.01 0.02
Isoquinoline; C <sub>9</sub> H <sub>7</sub> N; [119-65-3] <sup>a</sup>	10.5 g/(100 g)
Petroleum ether; [8032-32-4]	0.03 0.05
Turpentine;	0.04 0.07
2-Pentene; C <sub>5</sub> H <sub>10</sub> ; [109-68-2]	0.00 0.00
Benzene; C <sub>6</sub> H <sub>6</sub> ; [71-43-2]	0.00 0.00
Tetrahydronapththalene; C <sub>10</sub> H <sub>12</sub> ; [119-64	4-2] 0.00 0.00
<sup>a</sup> Mass % = 10.5. The highest observed va equilibrium is not established because	alue is reported. True e the solution solidifies.

	P			
COMPONENTS:	ORIGINAL MEASUREMENTS:			
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Yaffe, L.			
(2) Various ethers	Can. J. Res. <u>1949</u> , 27B, 638 - 645.			
(3) Water; H <sub>2</sub> O; [7732-18-5]				
VARIABLES:	PREPARED BY:			
One temperature: 293 K	L. Fuks; S. Siekierski			
EXPERIMENTAL VALUES:				
Solubility is expressed as grams of $Th(NO_3)_4.4H_2O$ per 100 cm <sup>3</sup> of the solvent ether.				
	$Th(NO_3)_4.4H_2O$			
Ether	g/(100 cm <sup>3</sup> )			
Ethylene glycol ethyl ether; C <sub>4</sub> H <sub>10</sub> O <sub>2</sub> ; [110-20-5] 6.8 (ethyl cellosolve)				
Dimethyldioxane; C <sub>6</sub> H <sub>12</sub> O <sub>2</sub> ;	30.0			
Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	17.0			
Ethyl hexyl cellosolve; C <sub>10</sub> H <sub>22</sub> O <sub>2</sub> ;	6.9			
Dibutyl cellosolve; C <sub>10</sub> H <sub>22</sub> O <sub>2</sub> ;	6.4			
Dibutyl carbitol; C <sub>9</sub> H <sub>20</sub> O <sub>3</sub> ; [112-73-2] 8.8				
	(continued on the next page)			
AUXILIARY IN	FORMATION			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:			
The isothermal method was used. A 25 cm portion of the solvent and a few grams of the $Th(NO_3)_4 \cdot 4H_2O$ were placed in a sealed centrifuge tube	1. Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O, Baker's C.P. analyzed. The maximum impurities were <0.1% of rare earths.			
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	2. The organic solvent was of "practical" grade, or better.			
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	Temperature: precision <u>+</u> 0.05K.			
receptacle, the solvent evaporated, and the residue ignited to ThO <sub>2</sub> .	REFERENCES:			

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO3),;	Yaffe, L.
[13823-29-5] 5 4	Can. J. Res. <u>1949</u> , 27B, 638 - 645.
(2) Various ethers	
(3) Water; H <sub>2</sub> O; [7732-18-5]	
EXPERIMENTAL VALUES: (Continued)	
	$Th(NO_3)_4.4H_2O$
Ether	g/(100 cm <sup>3</sup> )
Pentyl ether; C <sub>10</sub> H <sub>22</sub> O; [693-65-2	0.02
Hexyl ether; C <sub>12</sub> H <sub>26</sub> 0; [112-58-3]	0.084
Dichloroisopropyl ether; C <sub>6</sub> H <sub>12</sub> Cl	-2 <sup>0;</sup> 0.40
Isoamyl ether; C <sub>10</sub> H <sub>22</sub> O; [544-01-	-4] <0.1
Amylphenol ether; C <sub>11</sub> H <sub>16</sub> 0;	п
p-tert-Amyl methyl ether; C <sub>2</sub> H <sub>5</sub> C(	CH <sub>3</sub> ) <sub>2</sub> OCH <sub>3</sub> ; [994-05-8] "
B-Bromoethyl ethyl ether; BrCH <sub>2</sub> C	н <sub>о</sub> ос <sub>о</sub> н <sub>5</sub> ; [592-55-2] "
- F-Bromopropyl phenyl ether; C <sub>6</sub> H,	O(CH <sub>2</sub> ) <sub>3</sub> Br; [588-63-6] "
Methyl phenyl ether; C <sub>6</sub> H <sub>5</sub> OCH <sub>3</sub> ; [	100-66-3] "
o-Chloroisopropyl ether; [ClCH <sub>2</sub> C	H(CH <sub>3</sub> )] <sub>2</sub> O; [108-60-1] "
m-Cresyl methyl ether; CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> OC	
o-Cresyl methyl ether;	н
p-Cresyl methyl ether;	11
B,B'-Dichloroisopropyl ether; (ClCH <sub>2</sub> CH <sub>2</sub> ) <sub>2</sub> O; [111-44-4]	I
B,B'-Dichloroethyl ether; (ClCH <sub>2</sub> [111-44-4]	cH <sub>2</sub> Cl) <sub>2</sub> O; "
$\Gamma,\Gamma$ -dichloroisopropyl ether;	n
1-8 Epoxy p-menthane;	n
Eugenol methyl ether; H <sub>2</sub> C=CHCH <sub>2</sub> C	6 <sup>H</sup> 3(OCH3)2; [93-15-2] "
Resorcinol dimethyl ether; C <sub>6</sub> H <sub>4</sub> (	OCH <sub>3</sub> ) <sub>2</sub> ; [151-10-0] "
	(Continued on the next page)

COMPONENTS:	ORIGINAL MEAS	UREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</pre>	Yaffe, L. Can. J. Res.	<u>1949</u> , 27B, 638 - 645
(2) Various alcohols		
(3) Water; H <sub>2</sub> O; [7732-18-5]		
EXPERIMENTAL VALUES: (Continued)	<u> </u>	
Alcohol		$\frac{\text{Th}(N\rho_{\beta})_{4} \cdot 4H_{2}O}{g/(100 \text{ cm}^{3})}$
Triethylene glycol dichloride; [112-26-5]	C <sub>6</sub> H <sub>12</sub> Cl <sub>2</sub> O <sub>2</sub> ;	8.2
Dibutoxytetraethylene glycol; C <sub>16</sub> H <sub>34</sub> 0 <sub>5</sub> ; [112-98-1]		75,9
Isobutyl carbinol; C <sub>5</sub> H <sub>12</sub> O; [123-51-3]		30.0
Diethylcarbinol; C <sub>5</sub> H <sub>12</sub> O; [584-02-1]		9.1
Amyl alcohol; C <sub>5</sub> H <sub>12</sub> O; [71-41-0]		7.3
2-Ethyl-1-butyl alcohol; C <sub>6</sub> H <sub>14</sub> O; [97-95-0]		9.0
Capryl alcohol; C <sub>8</sub> H <sub>18</sub> O; [111-87-5]		8.1
B,F-Dibromopropyl alcohol; C <sub>3</sub> H <sub>6</sub> Br <sub>2</sub> O; [93-13-6]		4.8
Undecanol; C <sub>11</sub> H <sub>24</sub> O; [112-42-5]		5.5
Tetradecanol; $C_{14}H_{30}O; [112-72-1]$		0.37

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OMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>1) Thorium nitrate; Th(NO3); [13823-29-5]</pre>	Yaffe, L.
2) Various ketones, esters, nitrate	Can. J. Res. <u>1949</u> , 27B, 638 - 645.
3) Water; H <sub>2</sub> O; [7732-18-5]	
XPERIMENTAL VALUES: (Continued)	
Solubility is expressed as grams of organic solvent.	$Th(NO_3)_4.4H_2O$ per 100 cm <sup>3</sup> of the
	Th(NO <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O
Ketone or Ester	g/(100 cm <sup>3</sup> )
Methyl isobutyl ketone; C6H120; [	108-10-1] 26.0
Methyl amyl ketone; C <sub>7</sub> H <sub>14</sub> O; [110-4	43-0] 17.0
Diisopropyl ketone; C <sub>7</sub> H <sub>14</sub> O; [565-4	80-0] 6.6
85% Methyl ethyl ketone; C,H <sub>8</sub> O; [ <sup>*</sup> 15% Xylene; C <sub>8</sub> H <sub>10</sub> ; [1330-20-7]	78-93-3] and 75.0
Ethyl acetylglycollate; C <sub>6</sub> H <sub>10</sub> O <sub>4</sub> ;	30.0
Butyl acetate; C <sub>6</sub> H <sub>12</sub> O <sub>2</sub> ; [123-86-4]	] 6.5
Isopropyl acetate; C <sub>5</sub> H <sub>10</sub> O <sub>2</sub> ; [108-	21-4] 20.0
Amyl formate; C <sub>6</sub> H <sub>12</sub> O <sub>2</sub> ; [638-49-3]	30.0
Butyl propionate; C <sub>7</sub> H <sub>14</sub> O <sub>2</sub> ; [540-4]	2-1] 27.5
Isoamyl acetate; C <sub>7</sub> H <sub>14</sub> O <sub>2</sub> ; [123-92-	-2] 18.0
Isobutyl acetate; C <sub>6</sub> H <sub>12</sub> O <sub>2</sub> ; [110-19	9-0] 16.0
Isoamyl oxalate;	<0.1
Benzyl butyrate; CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> COOCH <sub>2</sub> C	<sub>6</sub> H <sub>5</sub> ; [103-37-7] "
Butyl cellosolve oleate;	u u
Ethyl laurate; $CH_3(CH_2)_{10}COOCH_2CH_2$	3; [106-33-2] "
Ethyl myristate; $CH_3(CH_2)_{12}COOC_2H_2$	5; [124-06-1] "
Linalyl acetate; CH <sub>3</sub> COOC(CH=CH <sub>2</sub> )(( [115-95-7]	CH <sub>3</sub> )CH <sub>2</sub> CH <sub>2</sub> =C(CH <sub>3</sub> ) <sub>2</sub> ; "
Phenylethyl benzoate; C <sub>6</sub> H <sub>5</sub> COOCH <sub>2</sub> Cl	H <sub>2</sub> C <sub>6</sub> H <sub>5</sub> ; [94-47-3] "
	) <sub>2</sub> ; [939-48-0] "
Isopropyl benzoate; C <sub>6</sub> H <sub>5</sub> COOCH(CH <sub>3</sub>	

Components;	ORIGINAL MEASUREMENTS:		
(1) Thorium nitrate; Th(NO3)4; [13823-29-5]	Yaffe, L.		
(2) Various esters and other organics	Can. J. Res. <u>1949</u> , 27B, 638 - 645.		
(3) Water; H <sub>2</sub> O; [7732-18-5]			

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Amyl acetate; $C_7H_{14}O_2$ ; [628-63-7] N-butyl sebacate; $C_{18}H_{34}O_4$ ; [109-43-3] Vinyl acetate; $C_4H_6O_2$ ; [108-05-4]	9.2 2.1 2.5 4.3
Vinyl acetate; $C_4H_6O_2$ ; [108-05-4]	2.5
	4.3
Amyl butyrate; C <sub>9</sub> H <sub>18</sub> O <sub>2</sub> ; [540-18-1]	
Isoamyl formate; C <sub>6</sub> H <sub>12</sub> O <sub>2</sub> ; [35073-27-9]	20.0
Amyl valerianate; C <sub>10</sub> H <sub>20</sub> O <sub>2</sub> ; [2173-56-0]	4.2
Butyl oxalate; $C_{10}H_{18}O_4$ ; [2050-60-4]	0.03
Isoamyl caproate; C <sub>11</sub> H <sub>22</sub> O <sub>2</sub> ; [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 <sub>3</sub> NO <sub>2</sub> ; [75-52-5]	0.04
Triglycol dichloride; C <sub>6</sub> H <sub>12</sub> C <sub>12</sub> O <sub>2</sub> ; [112-26-5]	8.2
Tetrabutyl urea; C <sub>17</sub> H <sub>36</sub> N <sub>2</sub> ; [4559-86-8]	6.0
Butyl aldehyde; C <sub>4</sub> H <sub>8</sub> O; [123-72-8]	0.49

296

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>;       [13823-29-5]</pre>	Yaffe, L.
<ul><li>(2) Various substituted hydrocarbons</li></ul>	Can. J. Res. <u>1949</u> , 27B, 638 - 645.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
EXPERIMENTAL VALUES: (Continued)	
	$Th(NO_3)_4 \cdot 4H_2O_2$
Substituted Hydrocarbon	g/(100 cm <sup>3</sup> )
Isoamyl bromide; C <sub>5</sub> H <sub>11</sub> Br; [107-8]	
m-Chloroethylbenzene; C <sub>g</sub> H <sub>9</sub> Cl; [6] (2-Chloroethyl)benzene	22-24-2]
x-Dichloro-x-diethylbenzene	"
Benzyl chloride; C <sub>7</sub> H <sub>7</sub> Cl; [100-44-	-7]
Carbon tetrachloride; CCl <sub>4</sub> ; [56-3	23-5] "
1-Choloro-1-nitropropane	11
2-Chloro-2-nitropropane; C <sub>3</sub> H <sub>8</sub> ClN	0 <sub>2</sub> ; [594-71-8] "
1-Chloro-1-nitroethane	"
Chloroform; CHCl <sub>3</sub> ; [67-66-3]	n
o-Dichlorobenzene; C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> ; [95-	50-1] "
1,1-Dichloro-1-nitropropane;	n
Ethylene dibromide; C <sub>2</sub> H <sub>4</sub> Br <sub>2</sub> ; [100	6-93-4] "
Ethylene Iodide; ICH <sub>2</sub> CH <sub>2</sub> I; [624-	73-7] "
Tetrabromomethane; CBr <sub>4</sub> ; [558-13-	-4] "
1,1,2,2-Tetrachloroethane; Cl <sub>2</sub> CH	CHCl <sub>2</sub> ; [79-34-5] "
Trichloroethylene; ClCH=CCl <sub>2</sub> ; [79	9-01-6] "
Diethylamine; C <sub>4</sub> H <sub>11</sub> N; [109-89-7]	11
Diethyleneamine; C <sub>4</sub> H <sub>10</sub> N <sub>2</sub> ; [110-8	5-0] "
Hydroxyethylethylenediamine; H <sub>2</sub> NG [111-41-1]	сн <sub>2</sub> сн <sub>2</sub> инсн <sub>2</sub> сн <sub>2</sub> он; "
Tripentylamine; (C <sub>5</sub> H <sub>11</sub> ) <sub>3</sub> N; [621-	77-2] "
Triethanolamine; C <sub>6</sub> H <sub>15</sub> O <sub>3</sub> N; [102-	71-6] "
Piperidine; C <sub>5</sub> H <sub>11</sub> N; [110-89-4]	n

Components:	ORIGINAL MEASUREMENTS:
<ol> <li>Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</li> <li>Various hydrocarbons and substituted hydrocarbons;</li> <li>Water; H<sub>2</sub>O; [7732-18-5]</li> </ol>	Yaffe, L. <i>Can. J. Res.</i> <u>1949</u> , 27B, 638 - 645.
EXPERIMENTAL VALUES: (Continued) Hydrocarbon and unsubstituted hy	ydrocarbon $Th(NO_3)_4.4H_2O$ g/(100 cm <sup>3</sup> )
Quinoline; C <sub>9</sub> H <sub>7</sub> N; [91-22-5]	<0.1
B-Hydroxy-o-toluidine; H <sub>2</sub> NC <sub>6</sub> H <sub>3</sub> () [2835-99-6]	сн <sub>3</sub> )он; "
2-Bromopyridine; C <sub>5</sub> H <sub>4</sub> BrN; [109-6	D4-6] "
Diamylphenol;	17
2-Chloro-4,6-di-tert-amylphenol	; "
x-Triisopropyltoluene;	**
1-Pentene; C <sub>5</sub> H <sub>10</sub> ; [109-67-1]	11
Benzene; C <sub>6</sub> H <sub>6</sub> ; [71-43-2]	"
p-Isopropyltoluene; C <sub>10</sub> H <sub>14</sub> ; [99-	-87-6] "
Linalool; C <sub>10</sub> H <sub>17</sub> O; [78-70-6]	"
Isopentane; C <sub>5</sub> H <sub>12</sub> ; [78-78-4]	11
Petroleum ether; [8032-32-4]	**
Toluene; C <sub>7</sub> H <sub>8</sub> ; [108-88-3]	"
Turpentine;	"

COMPONENTS:	ORIGINAL MEASUREMENTS:		
<ol> <li>Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5]</li> <li>Mixtures of rare earth nitrates</li> <li>Various alcohols</li> </ol>	Templeton, C. C.; Hall, N. F. J. Phys. Colloid Chem. <u>1950</u> , 54, 954 - 957.		
(4) Water; H <sub>2</sub> O; [7732-18-5] VARIABLES: One temperature: Room temperature One composition of thorium and rare earth nitrates	PREPARED BY: L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES:	L		
earth nitrates. The mixed rare ear relative composition (percentage as			
Dy, 1.0; Ho, 0.3; Er, 0.5; Tm,	0.1; Yb, 0.5; Y, 10.0; Ce, 0.0. Th(NO <sub>3</sub> ) <sub>4</sub>		
Alcohol	mass % mol/kg (compilers)		
Methyl alcohol; CH <sub>4</sub> 0; [67-56-1]	36.0 1.17		
Propyl alcohol; C <sub>3</sub> H <sub>8</sub> O; [71-23-8]	39.6 1.37		
Isoamyl alcohol; C <sub>5</sub> H <sub>11</sub> O; [123-51	-3] 36.1 1.18		
Hexyl alcohol; C <sub>6</sub> H <sub>14</sub> O; [111-27-3	] 32.7 1.01 (Continued on the next page)		
AUXILIARY IN	FORMATION		
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 <sub>3</sub> ) <sub>4</sub> .4H <sub>2</sub> O was chemically pure, J. T. Baker Chemical Co. 2. All solvents were "practical" grade. ESTIMATED ERROR: Nothing specified. REFERENCES: None.		

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO3)4; [13823-29-5]	Templeton, C. C.; Hall, N. F.
	J. Phys. Colloid Chem. <u>1950</u> , 54, 954 - 957.
(2) Mixtures of rare earth nitrates	
(3) Various ketones and ester	
(4) Water; H <sub>2</sub> O; [7732-18-5]	

The solubility of  $Th(NO_3)_4$ .4H<sub>2</sub>O in various ketones is reported in units of mass of the anhydrous salt<sup>2</sup> 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.

	<sup>1</sup> <sup>1</sup> <sup>1</sup> <sup>1</sup> <sup>1</sup> <sup>3</sup> <sup>1</sup> 4		
Ketones/Ester	mass %	mol/kg (compilers)	
Acetone; C <sub>3</sub> H <sub>6</sub> O ; [67-64-1]	45.7	1.75	
Methyl ethyl ketone; C <sub>4</sub> H <sub>8</sub> O; [78-93-3] (2-butanone)	46.0	1.77	
Methyl isobutyl ketone; C <sub>6</sub> H <sub>16</sub> O; [108-10-1]	38.5	1.30	
Methyl amyl ketone; C <sub>7</sub> H <sub>14</sub> O; [110-43-0]	35.1	1.13	
Methyl hexyl ketone; C <sub>8</sub> H <sub>15</sub> O; [111-13-7]	30.2		
Ethyl butyrate; C <sub>3</sub> H <sub>7</sub> COOC <sub>2</sub> H <sub>5</sub> ; [105-54-4]	30.5		

Th(NO<sub>3</sub>)

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COMPONENTS: (1) Thorium nitrate; Th(1 [13823-29-5]	10 <sub>3</sub> ) <sub>4</sub> ;	ORIGINAL MEASUREMENTS: Templeton, C. C.			'S:
		Atomic Energy Commission Docume AECU-1721, <u>1950</u> .		sion Document,	
(2) 1-Hexanol; C <sub>6</sub> H <sub>14</sub> O; [:		ł			
(3) 2-Octanone; C <sub>6</sub> H <sub>16</sub> O;	[111-13-7]				
(4) Water; H <sub>2</sub> O; [7732-18-	-5]			·	
VARIABLES:		PREP	ARED BY:		
One temperature: 298 K		A. S	ozanski;	S. Siek	ierski
EXPERIMENTAL VALUES:					
The solubility of $Th(NO_3)_4$ is reported as the mass of the anhydrous $Th(NO_3)_4$ in 100 g of solution at 25°C. The solubility in units of molality, mol/kg, is defined as moles of anhydrous $Th(NO_3)_4$ per kg of a mixture consisting of the organic constituent, plus water.					the anhydrous in units of $(O_3)_4$ per kg is water.
Organic		umber		Th ( )	10 <sub>3</sub> ) <sub>4</sub>
solvent		ydrat water:		mass %	mol/kg
1-Hexanol, сн <sub>3</sub> сн <sub>2</sub> сн <sub>2</sub> сн <sub>2</sub> сн <sub>2</sub> сн <sub>2</sub> он		4.3 5.0		33.5 32.8	1.05 1.02
2-Octanone, CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CCH <sub>3</sub> COCH <sub>3</sub>	2 <sup>a</sup> 3b 3b	4.3 4.3 5.0		31.3 30.7 32.3	0.949 0.923 0.994
<sup>a</sup> Practical grade. <sup>b</sup> Practical grade subjected two NaHSO <sub>3</sub> precipitations, and one middle fraction distillation.					precipitations,
	AUXILIARY IN	FORMA	NOI		
METHOD/APPARATUS/PROCEDU	RE:	SOUR	E AND P	URITY OF	MATERIALS:
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.		<ol> <li>Th(NO<sub>3</sub>)<sub>4</sub>.4H<sub>2</sub>O, General Chemical Co., Baker and Adamson. The number of water molecules in the hydrate of two preparations was 4.3 and 5.0.</li> </ol>			
		2. 1-Hexanol, Eastman Kodak Co., was twice distilled, the middle fraction was retained. Solvent distilled from magnesium; final water content was 0.0024%.			
		ESTI	ATED ER	ROR:	
		res		the aver	specified. The age of two or
		Temperature: precision $\pm 0.05$ K.			
			REFERENCES: None.		

<pre>COMPONENTS: (1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5] (2) Various oxygenated organics (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	ORIGINAL MEASUREMENTS: Templeton, C. C.; Hall, N. F. Can. J. Res. <u>1950</u> , 28B, 156 - 160.
VARIABLES:	PREPARED BY:
T/K = 298	L. Fuks; S. Siekierski

# EXPERIMENTAL VALUES:

Solubility of  $Th(NO_3)_4.4H_2O$  is reported as the mass of the anhydrous  $Th(NO_3)_4$  in 100 g of solution at 25°C. The solubility in units of molality, mol/kg, is defined as moles of anhydrous  $Th(NO_3)_4$  per kg of a mixture consisting of the organic constituent plus water.

Organic	$Th(NO_3)_4$	
organito	mass %	mol/kg
Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	42.8	
Isoamyl alcohol; C <sub>6</sub> H <sub>14</sub> O; [123-51-3]	37.8	1.27
Methyl hexyl ketone; C <sub>8</sub> H <sub>16</sub> O; [111-13-7]	31.06	0.94
Methyl amyl ketone; C <sub>7</sub> H <sub>14</sub> O; [110-43-0]	36.7	
Methyl isobutyl ketone; C6H12O; [108-10-1]	42.2	
Diisopropyl ketone; C <sub>7</sub> H <sub>14</sub> O; [565-80-0]	20.8	

#### AUXILIARY INFORMATION

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5] (2) Nitromethane; CH<sub>3</sub>NO<sub>2</sub>; [75-52-5] (3) Water; H<sub>2</sub>O; [7732-18-5]</pre>	Warner, R. K. Australian J. Appl. Sci. <u>1953</u> ,4, 427-443.
VARIABLES:	PREPARED BY:
T/K = 293	L. Fuks; S. Siekierski

# EXPERIMENTAL VALUES:

The system consisting of nitromethane and water saturated with solid  $Th(NO_3)_4.4H_2O$  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.

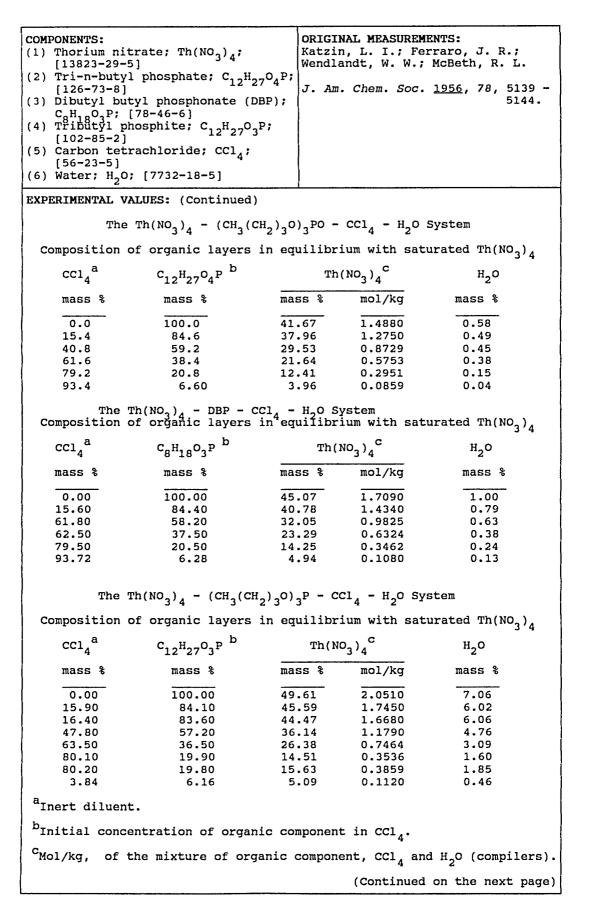
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COMPONENTS:	ORIGINAL MEASUREMENTS:	
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Katzin, L. I.; Ferraro, J. R.; Wendlandt, W. W.; McBeth, R. L.	
	J. Am. Chem. Soc. <u>1956</u> , 78, 5139 -	
[78-92-2] (3) Carbon tetrachloride; CCl <sub>4</sub> ; [56-23-5]	5144.	
(4) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES:	PREPARED BY:	
Composition at 298 K	A.Sozanski; S.Siekierski; P.Persoff	
EXPERIMENTAL VALUES:		
The $Th(NO_3)_4$ - $CH_3CH_2CH(OH)$	H)CH <sub>3</sub> - CCl <sub>4</sub> - H <sub>2</sub> O System	
Composition of organic layers in eq	uilibrium with saturated $Th(NO_3)_4$	
ccl <sub>4</sub> <sup>a</sup> c <sub>4</sub> H <sub>10</sub> o <sup>b</sup>	$\operatorname{Th}(\operatorname{NO}_3)_4^{C}$ $\operatorname{H}_2^{O}$	
mass % mass % ma	ss % mol/kg mass %	
	2.044 15.75	
	3.67 1.313 11.45	
	7.76 0.8005 7.53 3.83 0.6517 6.18	
	2.13 0.5920 5.95	
667 333 15	7 D 7 D 7 7 3 A 66	
66.7 33.3 16	5.83 0.4215 4.42 8.03 0.182 2.03	
80.0 20.0 8	3.03 0.182 2.03	
91.0 9.0 1		
<sup>a</sup> Inert diluent. <sup>b</sup> Initial concentrat		
<sup>C</sup> Mol/kg, of the mixture of 2-butar	col, CCl <sub>4</sub> and $H_2^0$ (compilers).	
	(Continued on the next page)	
AUXILIARY IN	IFORMATION	
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	SOURCE AND PURITY OF MATERIALS: 1. Thorium nitrate was a commercial reagent hydrated salt. Composition was checked by ignition to ThO <sub>2</sub> , and by Karl Fischer H <sub>2</sub> O titration.	
CCl <sub>4</sub> served as an inert diluént. Where necessary, saturated aqueous	2. Organic solvents, reagent grade.	
thorium nitrate was added to ensure the presence of an excess aqueous	ESTIMATED ERROR:	
phase. The mixtures were allowed to settle, and the organic layer was centrifuged. Samples were taken for	Solubility: nothing specified. Error in thorium determination of 0.5 to 1% (compilers).	
analysis. Water was determined by Karl Fischer titration, and thorium	Temperature: precision $\pm 2$ K.	
analyzed by the modified fluoride indicator titration technique (1).	REFERENCES:	
Correction was made to the water content for the solubility of water	1. Banerjee, G.	
in the absence of the salt.	Z. anal. Chem. <u>1955</u> , 146, 417.	
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COMPONENTS: ORIGINAL MEASUREMENTS: (1) Thorium nitrate; Th(NO3)4; Katzin, L. I.; Ferarro, J. R.; Wendlandt, W. W.; McBeth, R. L. [13823-29-5] (2) Isobutyl alcohol;C<sub>4</sub>H<sub>10</sub>O;[78-92-2] (3) 4-Methyl-2-pentanone (hexone); J. Am. Chem. Soc. 1956, 78, 5139 -(4) Diethyl ether;  $C_4H_10$ ; [60-29-7] (5) Carbon tetrachloride;  $CCl_4$ ; 5144. [56-23-5] (6) Heptane; C<sub>7</sub>H<sub>16</sub>; [142-82-5] (7) Water; H<sub>2</sub>O; [7732-18-5] EXPERIMENTAL VALUES: (Continued) The Th(NO<sub>3</sub>)<sub>4</sub> - CH<sub>3</sub>CH<sub>2</sub>CH(OH)CH<sub>3</sub> - CH<sub>3</sub>(CH<sub>2</sub>)<sub>5</sub>CH<sub>3</sub> - H<sub>2</sub>O System Composition of organic layers in equilibrium with saturated  $Th(NO_3)_A$  $C_7H_{16}^{a}$ C4H100 b  $Th(NO_3)_4^C$ н,о mass % mass % mass % mol/kq mass % 0.0 100.0 48.80 1.985 15.20 10.2 89.8 42.93 1.567 13.42 77.7 22.3 38.05 1.279 11.00 28.6 71.4 34.64 1.104 10.20 36.2 63.8 phase separation The  $Th(NO_3)_4$  -  $CH_3CH(CH_3)CH_2COCH_3$  -  $CCl_4$  -  $H_2O$  System Composition of organic layers in equilibrium with saturated  $Th(NO_3)_A$ c<sub>6</sub>H<sub>12</sub>o<sup>b</sup> ccl<sub>4</sub><sup>a</sup> Th(NO3)4C н,о mol/kg mass % mass % mass % mass % 0.0 100.0 46.90 1.840 12.15 0.0 100.0 45.98 1.773 11.90 16.5 38.22 83.5 0.9902 9.46 28.3 71.7 0.9830 32.06 7.88 39.7 60.3 24.18 0.6643 6.03 39.7 60.3 23.48 0.6392 5.66 8.81 0.201 56.8 43.2 2.24 66.5 33.5 2.32 0.0495 1.27 74.8 0.43 25.2 0.0090 0.53 79.9 0.00 20.1 0.00 0.36 The  $Th(NO_3)_4$  -  $CH_3CH_2OCH_2CH_3$  -  $CCl_4$  -  $H_2O$  System Composition of organic layers in equilibrium with saturated Th(NO3)4 cci,a C4H100 b  $Th(NO_3)_4^{C}$ H20 mass % mass % mass % mol/kg mass % 100.0 0.0 43.59 12.38 1.610 0.914 29.3 76.7 30.50 7.75 46.3 53.7 6.62 0.148 1.66 63.7 36.3 1.12 0.0235 0.38 <sup>a</sup>Inert diluent. <sup>b</sup>Initial concentration of organic in the inert diluent. <sup>b</sup>Mol/kg of the mixture of the organics and  $H_2^0$  (compilers). (Continued on the next page)

C <sub>6</sub> H <sub>14</sub> O <sub>2</sub> ; [6 (3) Ethylene gl C <sub>10</sub> H <sub>22</sub> O <sub>2</sub> ; (4) Diethylene C <sub>8</sub> H <sub>18</sub> O <sub>3</sub> ; [1 (5) Diethylene C <sub>12</sub> H <sub>26</sub> O <sub>3</sub> ; [ (6) Carbon tetr [56-23-5] (7) Water; H <sub>2</sub> O;	) ycol diethyl eth 29-14-1] ycol dibutyl eth 12-36-7] glycol dibutyl et 112-73-2] achloride; CCl <sub>4</sub> ; [7732-18-5]	er; Wendl J. Am ther; ther;	andt, W. W.;	ENTS: rraro, J. R.; McBeth, R. L. <u>1956</u> , 78, 5139 - 5144.
The Th	LUES: (Continued $(NO_3)_4 - C_2H_5OCH$ f organic layers	2 <sup>CH</sup> 2 <sup>OC</sup> 2 <sup>H</sup> 5 -		
ccl <sub>a</sub> a	C <sub>6</sub> H <sub>14</sub> O <sub>2</sub> <sup>b</sup>		0 <sub>3</sub> ) <sub>4</sub> <sup>C</sup>	H <sub>2</sub> O
mass %	mass %	mass %	·	mass %
0.0	100.0 82.4	57.73 50.15	2.845 2.096	16.30 13.50
The T	$h(NO_3)_4 - C_4H_9OC$	н <sub>2</sub> сн <sub>2</sub> ос <sub>4</sub> н <sub>9</sub> -	ссі <sub>4</sub> - н <sub>2</sub> о	system
Composition o	f organic layers	in equilibr	ium with sat	urated $Th(NO_3)_4$
ccl <sub>4</sub> <sup>a</sup>	C <sub>10</sub> H <sub>22</sub> O <sub>2</sub> <sup>b</sup>	Th(N	0 <sub>3</sub> ) <sub>4</sub> <sup>C</sup>	н <sub>2</sub> 0
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 57.3	61.2 42.7	5.17 1.45	0.114 0.0306	1.22 0.40
The Th(NO	3) <sub>4</sub> - C <sub>2</sub> H <sub>5</sub> OCH <sub>2</sub> CH	2 <sup>0CH</sup> 2 <sup>CH</sup> 2 <sup>OC</sup> 2 <sup>H</sup>	5 - CC1 <sub>4</sub> - H	2 <sup>0</sup> System
Composition o	f organic layers	in equilibr	ium with sat	urated $Th(NO_3)_4$
ccl <sub>4</sub> <sup>a</sup>	с <sub>8</sub> н <sub>18</sub> 03 <sup>b</sup>	Th(N	0 <sub>3</sub> ) <sub>4</sub> <sup>C</sup>	н <sub>2</sub> о
mass %	mass %	mass %	mol/kg	mass %
0.0 14.8	100.0 85.2	57.49 52.47	2.817 2.295	16.12 14.15
	<sub>3</sub> ) <sub>4</sub> - C <sub>4</sub> H <sub>9</sub> OCH <sub>2</sub> CH f organic layers			-
ccı <sub>4</sub> ª	c <sub>12</sub> H <sub>26</sub> 03 <sup>b</sup>	Th(N	0 <sub>3</sub> )4 <sup>C</sup>	H <sub>2</sub> O
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
				material in CCl <sub>4</sub> .
<sup>C</sup> Mol/kg, of m	ixture of organic	c material i	n CCl <sub>4</sub> and H (Continued	2 <sup>0</sup> (compilers) on the next page)

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COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>; [13823-29-5] (2) Isobutyl alcohol;C<sub>4</sub>H<sub>10</sub>O;[78-92-2] (3) Methylisobutyl ketóne; C<sub>6</sub>H<sub>12</sub>O; [108-10-1] (4) Tri-n-butyl phosphate; C<sub>12</sub>H<sub>27</sub>O<sub>4</sub>P; [126-73-8] (5) Water; H<sub>2</sub>O; [7732-18-5]</pre>	5144.

The  $Th(NO_3)_4$  -  $(CH_3(CH_2)_3O)_3PO$  -  $CH_3CH_2CH(OH)CH_3$  -  $H_2O$  System Composition of organic layers in equilibrium with saturated  $Th(NO_3)_4$ 

с <sub>4</sub> н <sub>10</sub> 0 <sup>а</sup>	с <sub>12</sub> <sup>н</sup> 27 <sup>0</sup> 4 <sup>р b</sup>	<b>Th</b> (1	$NO_3)_4^C$	н <sub>2</sub> о
mass %	mass %	mass %	mol/kg	mass %
21.3	78.7	42.8	1.56	3.00
45.0	55.0	43.1	1.58	6.70
55.2 71.2	44.8 28.8	43.0 43.4	1.57 1.60	8.32 11.08

The  $Th(NO_3)_4 - (CH_3(CH_2)_3O)_3PO - CH_3CH(CH_3)CH_2COCH_3 - H_2O$  System Composition of organic layers in equilibrium with saturated  $Th(NO_3)_4$ 

с <sub>6<sup>н</sup>12</sub> 0 <sup>а</sup>	с <sub>12</sub> н <sub>27</sub> 0 <sub>4</sub> р <sup>b</sup>	Th(N	0 <sub>3</sub> ) <sub>4</sub> <sup>C</sup>	н <sub>2</sub> 0
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

<sup>a</sup>Non-inert (reactive) diluent.

<sup>b</sup>Initial concentration of 2-butanol and methylisobutyl ketone.

<sup>C</sup>Molalities calculated by the compilers as mol/kg of the organics, and water.

[13823-29-5]	$[13823-29-5] \qquad \qquad$
$C_{12}H_{27}O_{4}P; [126-73-8]$ (3) Dibutyl butyl phosphonate (DBP); $C_{8}H_{18}O_{3}P; [78-46-6]$ (4) Tetrachloromethane; CCl <sub>4</sub> ; [56-23-5] (5) Tributyl phosphite; C <sub>12</sub> H <sub>27</sub> O <sub>3</sub> P; [102-85-2] (6) Water; H <sub>2</sub> O; [7732-18-5] EXPERIMENTAL VALUES: (Continued) The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_{4}^{a} C_{12}H_{27}O_{4}P^{b}}{\frac{Th(NO_{3})_{4}C}{2}} \frac{H_{2}O}{\frac{CCl_{4}}{46.8}} \frac{mass \%}{53.2} \frac{mass \%}{26.81} \frac{mol/kg}{0.7630} \frac{mass \%}{0.37}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub>	$C_{12}H_{27}O_{4}P; [126-73-8] $ (3) Dibuty1 buty1 phosphonate (DBP); $C_{8}H_{18}O_{3}P; [78-46-6] $ (4) Tetrachloromethane; CCl <sub>4</sub> ; [56-23-5]  (5) Tributy1 phosphite; C <sub>12</sub> H <sub>27</sub> O <sub>3</sub> P; [102-85-2]  (6) Water; H <sub>2</sub> O; [7732-18-5] EXPERIMENTAL VALUES: (Continued) The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_4^{\ a} C_{12}H_{27}O_4^{\ p}^{\ b} }{2 46.8 53.2 26.81 0.7630 0.37} $ $\frac{The Th(NO_3)_4 - DBP - CCl_4 - H_2O System }{0.37} $ Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{Cl_4^{\ a} C_{8}H_{18}O_3P^{\ b} }{2 46.5 53.5 28.65 0.8364 0.53} $ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_4^{\ a} C_8H_{18}O_3P^{\ b} }{2 47.3 52.7 27.30 0.78} $ The NO <sub>3</sub> / <sub>4</sub> $\frac{TOCL_4^{\ a} C_8H_{18}O_3P^{\ b} }{0.42} $
$C_{8}H_{18}O_{3}P; [78-46-6]$ (4) Tetrachloromethane; CCl <sub>4</sub> ; [56-23-5] (5) Tributyl phosphite; C <sub>12</sub> H <sub>27</sub> O <sub>3</sub> P; [102-85-2] (6) Water; H <sub>2</sub> O; [7732-18-5] EXPERIMENTAL VALUES: (Continued) The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> <sup>C</sup> H <sub>2</sub> O CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> <sup>C</sup> H <sub>2</sub> O CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> <sup>C</sup> H <sub>2</sub> O CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> <sup>C</sup> H <sub>2</sub> O The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub>	$\begin{array}{c} C_{8}H_{18}O_{3}P; \ [78-46-6] \\ (4) \ \text{Tetrachloromethane}; \ CCl_{4}; \\ [56-23-5] \\ (5) \ \text{Tributyl phosphite}; \ C_{12}H_{27}O_{3}P; \\ [102-85-2] \\ (6) \ \text{Water}; \ H_{2}O; \ [7732-18-5] \\ \hline \end{array}$ $\begin{array}{c} \text{EXPERIMENTAL VALUES: (Continued)} \\ \text{The Th}(NO_{3})_{4} - (CH_{3}(CH_{2})_{3}O)_{3}PO - CCl_{4} - H_{2}O \ \text{System} \\ \text{Composition of organic layers in equilibrium with saturated Th}(NO_{3})_{4} \\ \hline CCl_{4}^{a} \ C_{12}H_{27}O_{4}P^{b} \ \text{Th}(NO_{3})_{4}^{C} \ H_{2}O \\ \hline \frac{t/^{O}C}{2} \ \text{mass } \$ \ \text{mass } \$ \ \text{mass } \$ \ \text{mol/kg} \ \text{mass } \$ \\ \hline \text{The Th}(NO_{3})_{4} - DBP - CCl_{4} - H_{2}O \ \text{System} \\ \hline \text{Composition of organic layers in equilibrium with saturated Th}(NO_{3})_{4} \\ \hline \frac{t/^{O}C}{2} \ \frac{46.8}{46.5} \ 53.5 \ 28.65 \ 0.8364 \ 0.53 \\ \hline \text{The Th}(NO_{3})_{4} - DBP - CCl_{4} - H_{2}O \ \text{System} \\ \hline \text{Composition of organic layers in equilibrium with saturated Th}(NO_{3})_{4} \\ \hline \frac{CCl_{4}^{a}}{2} \ C_{8}H_{18}O_{3}P^{b} \ \text{Th}(NO_{3})_{4}^{C} \\ \hline \frac{t/^{O}C}{2} \ \text{mass } \$ \ \text{mass } \ \ \text{mass } \ \text{mass } \ \ \text{mass } \$
$[56-23-5]$ (5) Tributyl phosphite; $C_{12}H_{27}O_{3}P$ ; $[102-85-2]$ (6) Water; $H_{2}O$ ; $[7732-18-5]$ EXPERIMENTAL VALUES: (Continued) The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> C H <sub>2</sub> O $\frac{CCl_{4}^{a} C_{12}H_{27}O_{4}P^{b} Th(NO_{3})_{4}^{C} H_{2}O}{\frac{t/^{O}C}{2} 46.8 53.2 26.81 0.7630 0.37}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> C H <sub>2</sub> O	$[56-23-5]$ (5) Tributyl phosphite; $C_{12}H_{27}O_{3}P$ ; $[102-85-2]$ (6) Water; $H_{2}O$ ; $[7732-18-5]$ EXPERIMENTAL VALUES: (Continued) The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_{4}^{a} C_{12}H_{27}O_{4}P^{b}}{2 46.8 53.2 26.81 0.7630 0.37}$ $\frac{t/^{O}C}{2 46.5 53.5 28.65 0.8364 0.53}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_{4}^{a} C_{8}H_{18}O_{3}P^{b} Th(NO_{3})_{4}^{C} H_{2}O 0.53}{The Th(NO_{3})_{4} C H_{2}O 0.53}$
[102-85-2] (6) Water; H <sub>2</sub> O; [7732-18-5] EXPERIMENTAL VALUES: (Continued) The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> <sup>C</sup> H <sub>2</sub> O CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> <sup>C</sup> H <sub>2</sub> O $\frac{t/^{O}C}{2}$ mass % mass % mass % mol/kg mass % $\frac{1}{2}$ 46.8 53.2 26.81 0.7630 0.37 45 46.5 53.5 28.65 0.8364 0.53 The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> )	[102-85-2]   10   11   0   0   0   0   0   0   0
EXPERIMENTAL VALUES: (Continued) The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> <sup>C</sup> H <sub>2</sub> O $\frac{t/^{O}C}{2}$ mass % mass % mass % mol/kg mass % $\frac{1}{2}$ 46.8 $\frac{53.2}{53.5}$ 28.65 0.8364 0.53 The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> )	EXPERIMENTAL VALUES: (Continued) The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> CCl <sub>4</sub> <sup>a</sup> C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> C H <sub>2</sub> O $\frac{t/^{O}C}{2}$ mass $\frac{1}{46.8}$ $\frac{1}{53.2}$ $\frac{1}{26.81}$ $\frac{1}{0.7630}$ $\frac{1}{0.37}$ 45 46.5 53.5 28.65 0.8364 0.53 The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> CCl <sub>4</sub> <sup>a</sup> C <sub>8</sub> H <sub>18</sub> O <sub>3</sub> P <sup>b</sup> Th(NO <sub>3</sub> ) <sub>4</sub> C H <sub>2</sub> O $\frac{t/^{O}C}{2}$ mass $\frac{1}{47.3}$ $\frac{1}{52.7}$ $\frac{1}{27.30}$ $\frac{1}{0.78}$ $\frac{1}{0.42}$
Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) $CCl_{4}^{a} C_{12}H_{27}O_{4}P^{b} Th(NO_{3})_{4}^{c} H_{2}O$ $\frac{t/^{O}C}{2} \text{ mass } \text{ mol/kg} \text{ mass } \text{ mass } \text{ mass } \text{ mol/kg}$ $\frac{1}{2} \frac{46.8}{46.5} \frac{53.2}{53.5} \frac{26.81}{28.65} \frac{0.7630}{0.8364} \frac{0.37}{0.53}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> )	The Th(NO <sub>3</sub> ) <sub>4</sub> - (CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> O) <sub>3</sub> PO - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\begin{array}{c} CCl_4^{\ a} & C_{12}H_{27}O_4P^{\ b} & Th(NO_3)_4^{\ C} & H_2O \\ \hline t/^{O}C & mass \% & mass \% & mass \% & mol/kg & mass \% \\ \hline \frac{2}{2} & 46.8 & 53.2 & 26.81 & 0.7630 & 0.37 \\ 45 & 46.5 & 53.5 & 28.65 & 0.8364 & 0.53 \end{array}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\begin{array}{c} CCl_4^{\ a} & C_8H_{18}O_3P^{\ b} & Th(NO_3)_4^{\ C} & H_2O \\ \hline t/^{O}C & mass \% & mass \% & mass \% & mol/kg & mass \% \\ \hline 2 & 47.3 & 52.7 & 27.30 & 0.78 & 0.42 \end{array}$
Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) $\begin{array}{c} CCl_4^{a} & C_{12}H_{27}O_4^{P} & Th(NO_3)_4^{C} & H_2O \\ \hline t/^{O}C & mass \% & mass \% & mass \% & mol/kg & mass \% \\ \hline 2 & 46.8 & 53.2 & 26.81 & 0.7630 & 0.37 \\ 45 & 46.5 & 53.5 & 28.65 & 0.8364 & 0.53 \end{array}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> )	Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $CCl_4^{a} C_{12}H_{27}O_4P^{b} Th(NO_3)_4^{c} H_2O$ $\frac{t/^{O}C}{2} \text{ mass \$} \text{ mass \$} \text{ mass \$} mass \$ mass \$} mass \$ mass \$} mol/kg mass \$}$ $\frac{t/^{O}C}{2} \frac{46.8}{46.5} \frac{53.2}{53.5} \frac{26.81}{28.65} \frac{0.7630}{0.8364} \frac{0.37}{0.53}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $CCl_4^{a} C_8H_{18}O_3P^{b} Th(NO_3)_4^{c} H_2O$ $\frac{t/^{O}C}{2} \frac{mass \$}{47.3} \frac{mass \$}{52.7} \frac{mass \$}{27.30} \frac{mol/kg}{0.78} \frac{mass \$}{0.42}$
$\begin{array}{c} \text{CCl}_{4}^{a} & \text{C}_{12}\text{H}_{27}\text{O}_{4}\text{P}^{b} & \text{Th}(\text{NO}_{3})_{4}^{c} & \text{H}_{2}\text{O} \\ \\ \hline t/^{\text{O}}\text{C} & \text{mass } \$ & \text{mass } \$ & \text{mass } \$ & \text{mol/kg} & \text{mass } \$ \\ \hline \hline 2 & 46.8 & 53.2 & 26.81 & 0.7630 & 0.37 \\ \hline 45 & 46.5 & 53.5 & 28.65 & 0.8364 & 0.53 \end{array}$ $\begin{array}{c} \text{The Th}(\text{NO}_{3})_{4} - \text{DBP} - \text{CCl}_{4} - \text{H}_{2}\text{O} \text{ System} \\ \hline \text{Composition of organic layers in equilibrium with saturated Th}(\text{NO}_{3})_{4} \end{array}$	$\begin{array}{ccccccc} & & & & & & & & & & & & & & & &$
$\frac{t/^{O}C}{2}  \frac{\text{mass } \$}{46.8}  \frac{\text{mass } \$}{53.2}  \frac{\text{mass } \$}{26.81}  \frac{\text{mol/kg}}{0.7630}  \frac{\text{mass } \$}{0.37}$ $45  46.5  53.5  28.65  0.8364  0.53$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> )	$\frac{t/^{O}C}{2}  \frac{\text{mass } \$}{46.8}  \frac{\text{mass } \$}{53.2}  \frac{\text{mass } \$}{26.81}  \frac{\text{mol/kg}}{0.7630}  \frac{\text{mass } \$}{0.37}$ $\frac{45}{45}  46.5  53.5  28.65  0.8364  0.53$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_{4}^{a}  C_{8}H_{18}O_{3}P^{b}  Th(NO_{3})_{4}^{c}  H_{2}O}{Th(NO_{3})_{4}^{c}  H_{2}O}$ $\frac{t/^{O}C}{2}  \frac{\text{mass } \$}{47.3}  \frac{\text{mass } \$}{52.7}  \frac{\text{mass } \$}{27.30}  \frac{\text{mol/kg}}{0.78}  \frac{\text{mass } \$}{0.42}$
$\frac{2}{45} + \frac{46.8}{46.5} + \frac{53.2}{53.5} + \frac{26.81}{28.65} + \frac{0.7630}{0.8364} + \frac{0.37}{0.53}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> )	$\frac{1}{2} \frac{1}{46.8} \frac{53.2}{53.5} \frac{1}{26.81} \frac{1}{0.7630} \frac{1}{0.37} \frac{1}{0.37}$ The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_4^{a} C_8H_{18}O_3P^{b} Th(NO_3)_4^{C} H_2O}{\frac{t/^{O}C}{2} \frac{1}{47.3} \frac{1}{52.7} \frac{1}{27.30} \frac{1}{0.78} \frac{1}{0.78} \frac{1}{0.42}$
The Th $(NO_3)_4$ - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th $(NO_4)$	The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_4^{a}}{C_8^{H}} \frac{C_8^{H}H_8^{O_3^{P}}}{C_8^{H}H_8^{O_3^{P}}} \frac{Th(NO_3)_4^{C}}{Th(NO_3)_4^{C}} \frac{H_2^{O}}{H_2^{O}}$ $\frac{t/^{O}C}{2} \frac{mass \%}{47.3} \frac{mass \%}{52.7} \frac{mass \%}{27.30} \frac{mol/kg}{0.78} \frac{mass \%}{0.42}$
The Th $(NO_3)_4$ - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th $(NO_4)$	The Th(NO <sub>3</sub> ) <sub>4</sub> - DBP - CCl <sub>4</sub> - H <sub>2</sub> O System Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $\frac{CCl_4^{a}}{C_8^{H}} \frac{C_8^{H}H_8^{O_3P}}{C_8^{H}H_8^{O_3P}} \frac{Th(NO_3)_4^{C}}{Th(NO_3)_4} \frac{H_2^{O_3P}}{H_2^{O_3P}} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} \frac{H_2^{O_3P}}{Th(NO_3)_4} \frac{Th(NO_3)_4}{Th(NO_3)_4} Th(NO_3)$
	$\frac{t/^{0}C}{2}  \frac{mass \ \%}{47.3}  \frac{mass \ \%}{52.7}  \frac{mass \ \%}{27.30}  \frac{mol/kg}{0.78}  \frac{mass \ \%}{0.42}$
	2 47.3 52.7 27.30 0.78 0.42
	2         47.3         52.7         27.30         0.78         0.42           45         47.4         52.6         31.20         0.94         0.50
2 47.3 52.7 27.30 0.78 0.42 45 47.4 52.6 31.20 0.94 0.50	
The $Th(NO_3)_4$ - $(CH_3(CH_2)_3O)_3P$ - $CCl_4$ - $H_2O$ System	The $Th(NO_3)_4$ - $(CH_3(CH_2)_3O)_3P$ - $CCl_4$ - $H_2O$ System
	The $Th(NO_3)_4$ - $(CH_3(CH_2)_3O)_3P$ - $CCl_4$ - $H_2O$ System Composition of organic layers in equilibrium with saturated $Th(NO_3)_4$
	Composition of organic layers in equilibrium with saturated $Th(NO_3)_4$
Composition of organic layers in equilibrium with saturated Th(NO.	Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $CCl_4^{a} C_{12}H_{27}O_3P^{b} Th(NO_3)_4 H_2O$
Composition of organic layers in equilibrium with saturated Th(NO, $CCl_4^a C_{12}H_{27}O_3P^b Th(NO_3)_4 H_2O$	Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $CCl_{4}^{a} C_{12}H_{27}O_{3}P^{b} Th(NO_{3})_{4} H_{2}O$ $\frac{t/^{O}C}{2} \text{ mass } \text{ mol/kg} \text{ mass }  mas$
Composition of organic layers in equilibrium with saturated Th(NO. $CCl_{4}^{a} C_{12}H_{27}O_{3}P^{b} Th(NO_{3})_{4} H_{2}O$ $\frac{t/^{O}C}{2} \text{ mass } \$ \text{ mass } \$ \text{ mass } \$ \text{ mass } \$ \text{ mol/kg} \text{ mass } \$$ $\frac{100}{2} \frac{100}{48.0} \frac{100}{52.0} \frac{100}{31.94} \frac{100}{0.9776} \frac{100}{3.38}$	Composition of organic layers in equilibrium with saturated Th(NO <sub>3</sub> ) <sub>4</sub> $ \begin{array}{c} CCl_4^{a} & C_{12}H_{27}O_3P^{b} & Th(NO_3)_4 & H_2O \\ \hline t/^{O}C & mass \% & mass \% & mass \% & mol/kg & mass \% \\ \hline \hline 2 & 48.0 & 52.0 & 31.94 & 0.9776 & 3.38 \\ 45 & 48.6 & 51.4 & 33.87 & 1.0670 & 4.05 \end{array} $

ORIGINAL MEASUREMENTS: Verstegen, J. M. P. J. J. Inorg. Nucl. Chem. <u>1964</u> , 26, 1589 - 1599.
1369 - 1399.
PREPARED BY:
A. Sozanski; S. Siekierski
CHCl <sub>3</sub> - H <sub>2</sub> O System at 294K
ated solutions
N0 <sub>3</sub> H <sub>2</sub> 0
mol/dm <sup>3</sup>
0.046
0.044 0.043
e in the pure diluent have been ine nitrate phase. (Continued on the next page)
NFORMATION
SOURCE AND PURITY OF MATERIALS:
1. Thorium nitrate, hydrate, BDH, "AR" grade.
2. The (C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> N was purified as described in Reference (3).
n 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. <i>Trans. Faraday Soc.</i> <u>1962</u> , 58, 1878.
<ol> <li>Verstegen, J.M.P.J. J. Inorg. Nucl. Chem. <u>1964</u>, 26, 1085.</li> </ol>
<ol> <li>Verstegen, J.M.P.J.; Katelaar, J.A.A. Trans. Faraday Soc. <u>1961</u>, 57, 1527.</li> </ol>

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	OR	ORIGINAL MEASUREMENTS:	
<pre>(1) Thorium nitrate; Th(NO<sub>3</sub>)<sub>4</sub>;   [13823-29-5]</pre>		rstegen, J. M. P. J.	
(2) Tri-n-octylamine nitrate; C <sub>24</sub> H <sub>52</sub> N <sub>2</sub> O <sub>3</sub> ; [1116-76-3]		J. Inorg. Nucl. Chem. <u>1964</u> , 26, 1589 - 1599.	
(3) Dodecane; C <sub>12</sub> H <sub>26</sub> ; [1	12-40-3]		
(4) 1-Octanol; C <sub>6</sub> H <sub>18</sub> O; [111-87-5]			
(5) Nitrobenzene; C <sub>6</sub> H <sub>5</sub> NO	1		
(6) Water; H <sub>2</sub> O; [7732-18	-		
EXPERIMENTAL VALUES: (Co	ntinued)		
The Th(NO <sub>3</sub> ) - (C <sub>p</sub> H <sub>1</sub>	$_{7}$ ) <sub>2</sub> N.HNO <sub>2</sub> - CH <sub>2</sub> (	сн <sub>2</sub> ) <sub>10</sub> сн <sub>3</sub> - сн <sub>3</sub> (сн <sub>2</sub> ) <sub>6</sub> сн <sub>2</sub> он - н <sub>2</sub> о	
System, at 294K <sup>a</sup>			
Com	position of satu	ated solutions	
$\operatorname{Th}(\operatorname{NO}_3)_{4}^{b}$	,c (C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> N.1	ino <sub>3</sub> H <sub>2</sub> 0 <sup>C</sup>	
5 1	01/3	mol/dm <sup>3</sup>	
0.0042	0.100		
0.0045 0.0052	0.050		
<sup>a</sup> Modified dodecane (6 v	ol왂 1-octanol) a:	the diluent.	
<sup>b</sup> The values of the thor been subtracted from t	ium nitrate solu hose in the amin	pility in the pure diluent have	
		miterate phases	
<sup>C</sup> Concentration measured		-	
<sup>C</sup> Concentration measured The Th( $NO_3$ ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub>	in the light par 7)3 <sup>N.NO</sup> 3 - C <sub>6</sub> H5 <sup>N4</sup>	rt of the organic phase. D <sub>2</sub> - H <sub>2</sub> O System at 294K	
<sup>C</sup> Concentration measured The Th( $NO_3$ ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub> Composit	in the light par <sub>7</sub> ) <sub>3</sub> N.NO <sub>3</sub> - C <sub>6</sub> H <sub>5</sub> N4 ion of saturated	ot of the organic phase. D <sub>2</sub> - H <sub>2</sub> O System at 294K solutions	
<sup>C</sup> Concentration measured The Th(NO <sub>3</sub> ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub> Composit Th(NO <sub>3</sub> ) <sub>4</sub> <sup>a</sup>	in the light part $_{7})_{3}$ N.NO <sub>3</sub> - C <sub>6</sub> H <sub>5</sub> N ion of saturated (C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> N.HN	of the organic phase. $D_2 - H_2O$ System at 294K solutions $D_3 = H_2O$	
<sup>C</sup> Concentration measured The Th(NO <sub>3</sub> ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub> Composit Th(NO <sub>3</sub> ) <sub>4</sub> <sup>a</sup> mol/dm <sup>3</sup>	in the light part $_{7})_{3}$ N.NO <sub>3</sub> - C <sub>6</sub> H <sub>5</sub> N ion of saturated (C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> N.HNC mol/dm <sup>3</sup>	of the organic phase. $D_2 - H_2O$ System at 294K solutions $D_3 = \frac{H_2O}{mol/dm^3}$	
<sup>C</sup> Concentration measured The Th(NO <sub>3</sub> ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub> Composit Th(NO <sub>3</sub> ) <sub>4</sub> <sup>a</sup> mol/dm <sup>3</sup> $\overline{0.049}$ 0.023	in the light part $_{7})_{3}N.NO_{3} - C_{6}H_{5}N_{6}$ ion of saturated $(C_{8}H_{17})_{3}N.HNC_{mol/dm}^{3}$ $-\frac{0.100}{0.050}$	of the organic phase. $D_2 - H_2O$ System at 294K solutions $D_3 \qquad H_2O$ mol/dm <sup>3</sup> $\overline{0.017}$ 0.014	
<sup>C</sup> Concentration measured The Th(NO <sub>3</sub> ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub> Composit Th(NO <sub>3</sub> ) <sub>4</sub> <sup>a</sup> mol/dm <sup>3</sup> $\overline{0.049}$	in the light part $_{7})_{3}N.NO_{3} - C_{6}H_{5}Nd$ ion of saturated $(C_{8}H_{17})_{3}N.HNd$ $mol/dm^{3}$ 	of the organic phase. $D_2 - H_2O$ System at 294K solutions $D_3 \qquad H_2O$ mol/dm <sup>3</sup> $\overline{0.017}$	
<sup>C</sup> Concentration measured The Th(NO <sub>3</sub> ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub> Composit Th(NO <sub>3</sub> ) <sub>4</sub> <sup>a</sup> mol/dm <sup>3</sup> $\overline{0.049}$ 0.023 0.014	in the light part $_{7})_{3}N.NO_{3} - C_{6}H_{5}N_{4}$ ion of saturated $(C_{8}H_{17})_{3}N.HNO_{17}$ $mol/dm^{3}$ 0.100 0.050 0.025	The organic phase. $D_2 - H_2O$ System at 294K solutions $D_3 \qquad H_2O$ mol/dm <sup>3</sup> $\overline{0.017}$ 0.014	
<sup>C</sup> Concentration measured The Th(NO <sub>3</sub> ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub> Composit Th(NO <sub>3</sub> ) <sub>4</sub> <sup>a</sup> mol/dm <sup>3</sup> $\overline{).049}$ 0.023 0.014	in the light part $_{7})_{3}N.NO_{3} - C_{6}H_{5}N_{6}$ ion of saturated $(C_{8}H_{17})_{3}N.HNG$ mol/dm <sup>3</sup> 0.100 0.050 0.025 drated Th(NO <sub>3</sub> ) <sub>4</sub>	The organic phase. $D_2 - H_2O$ System at 294K solutions $D_3 \qquad H_2O$ mol/dm <sup>3</sup> 0.017 0.014 0.014 In the $C_6H_5NO_2 - H_2O$ system is	
<sup>C</sup> Concentration measured The Th(NO <sub>3</sub> ) <sub>4</sub> - (C <sub>8</sub> H <sub>1</sub> Composit Th(NO <sub>3</sub> ) <sub>4</sub> <sup>a</sup> mol/dm <sup>3</sup> $\overline{0.049}$ 0.023 0.014 The solubility of hy reported to be 0.000 <sup>a</sup> The values of the th	in the light part $_{7})_{3}N.NO_{3} - C_{6}H_{5}N_{4}$ ion of saturated $(C_{8}H_{17})_{3}N.HNC_{mol/dm^3}$ 0.100 0.025 drated Th(NO_{3})_{4} 20 mol/dm <sup>3</sup> , at 25 orium nitrate so	The organic phase. $D_2 - H_2O$ System at 294K solutions $D_3 \qquad H_2O$ mol/dm <sup>3</sup> 0.017 0.014 0.014 In the $C_6H_5NO_2 - H_2O$ system is	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Verstegen, J. M. P. J. J. Inorg. Nucl. Chem. <u>1964</u> , 26,
(2) Tri-n-octylamine nitrate; C <sub>24</sub> H <sub>52</sub> N <sub>2</sub> O <sub>3</sub> ; [1116-76-3]	1589 - 1599.
(3) Benzene; C <sub>6</sub> H <sub>6</sub> ; [71-43-2]	
(4) Chloroform; CHCl <sub>3</sub> ; [67-66-3]	
(5) 1,2-Dichorobenzene; C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> ; [95-50-1]	
(6) Water; H <sub>2</sub> O; [7732-18-5]	

1. The Th(NO<sub>3</sub>)<sub>4</sub> -  $(C_8H_{17})_3N.HNO_3 - C_6H_6 - H_2O$  System at 294 K Composition of saturated solutions

$Th(NO_3)_4^a$	(C8H17)3N.HNO3	н <sub>2</sub> 0
mol/dm <sup>3</sup>	mol/dm <sup>3</sup>	mol/dm <sup>3</sup>
0.0060 <sup>b</sup>	0.100	0.021 <sup>b</sup>
0.0055 <sup>b</sup>	0.050	0.021 <sup>b</sup>
0.0057	0.025	0.024

<sup>a</sup>The values of the thorium nitrate solution in the pure diluent have been subtracted from those in the amine nitrate phase.

<sup>b</sup>Concentration measured in the light part of the organic phase.

- 2. The solubility of hydrated  $Th(NO_3)_4$  in the system  $CHCl_3 H_2O$  is reported to be 0.00000070 mol/dm<sup>3</sup> at 294K.
- 3. The solubility of hydrated  $Th(NO_3)_4$  in the systems  $C_6H_4Cl_2 H_2O_6H_6 H_2O_6$  and  $C_6H_6 H_2O_6$  at 294K was reported to be as follows:

The Th(NO<sub>3</sub>)<sub>4</sub> - C<sub>6</sub>H<sub>4</sub>Cl<sub>2</sub> - H<sub>2</sub>O System 1 x 10<sup>-5</sup> mol/dm<sup>3</sup>

The Th(NO<sub>3</sub>)<sub>4</sub> - C<sub>6</sub>H<sub>6</sub> - H<sub>2</sub>O System 7 x 10<sup>-5</sup> mol/dm<sup>3</sup>

COMPONENTS:	ORIGINAL MEASUREMENTS:	
	Marcus, Y.; Kertes, A. S.	
(1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	Ion Exchange and Solvent Extraction	
(2) Ethanol; C <sub>2</sub> H <sub>6</sub> O; [64-17-5]	of Metal Complexes, J. Wiley	
(3) Diethyl ether; C <sub>4</sub> H <sub>10</sub> 0; [60-29-7]	& Sons, London, <u>1969</u> .	
(4) 2-Propanone; C <sub>3</sub> H <sub>6</sub> O; [67-64-1]		
VARIABLES:	PREPARED BY:	
Temperature: Room temperature	L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:	· · · · · · · · · · · · · · · · · · ·	
The solubility of $Th(NO_3)_4$ in the	three organic components is given	
in the following table.		
Component	Th(NO3)4, mol/kg	
C <sub>2</sub> H <sub>5</sub> OH	2.65	
C <sub>2</sub> H <sub>5</sub> OC <sub>2</sub> H <sub>5</sub>	1.56	
CH <sub>3</sub> COCH <sub>3</sub>	3.03	
AUXILIARY INF	FORMATION	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	
Nothing specified.	Nothing specified.	
ESTIMATED ERROR:	REFERENCES:	
Nothing specified.	None.	

COMPONENTS: (1) Thorium nitrate; Th(NO <sub>3</sub> ) <sub>4</sub> ; [13823-29-5]	ORIGINAL MEASUREMENTS: Vdovenko, V. M.; Statsevich, V. P.; Suglobov; D. N.	
(2) Diethyl ether; C <sub>4</sub> H <sub>10</sub> O; [60-29-7]	Radiokhim. <u>1972</u> , 14, 136 - 140.	
(3) Cyclohexane; C <sub>6</sub> H <sub>12</sub> ; [110-82-7]	Sov. Radiochem., <u>1972</u> , 14, 138.	
(4) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES: Composition at 298 K	PREPARED BY: A. Sozanski; S. Siekierski	
EXPERIMENTAL VALUES:		
Solubility of Th(NO3)4.5H20 in the m	ixture CH3CH2OCH2CH3 - CH2(CH2)4CH2	
at 298K. The concentrations, g/dm <sup>3</sup> ,		
were calculated by the compilers.		
сн <sub>а</sub> сн <sub>2</sub> осн <sub>2</sub> сн <sub>3</sub>	Th(NO <sub>3</sub> ) <sub>4</sub>	
mol/dm <sup>3</sup> g/dm <sup>3</sup> mc	l/dm <sup>3</sup> g/dm <sup>3</sup>	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	00065       0.31         00190       0.912         00174       0.835         00364       1.75         436       20.9         0760       36.5         158       75.8         246       118.0	
	(Continued on the next page)	
AUXILIARY IN	FORMATION	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	
The isothermal method was used. An excess of the $Th(NO_3)_4$ .5H <sub>2</sub> O, ether, and cyclohexane were placed in a sealed ampoule, and shaken for 7 to a hours at 25°C. The mixture was allowed to settle. The thorium content was determined by gravimetric analysis.	<ul><li>was distilled once more prior to use.</li><li>3. Cyclohexane and other diluents</li></ul>	
The Th(NO <sub>2</sub> ) <sub>4</sub> .5H <sub>2</sub> O in the inert	were purified before use (1).	
diluent (cyclohéxane) was considered to be virtually insoluble.	ESTIMATED ERROR:	
	Solubility: nothing specified.	
	Temperature: precision <u>+</u> 0.05K.	
	REFERENCES:	
	<ol> <li>Vaisberger, λ; Proskauer, E.; Riddik, D.; Tups, E.</li> <li>Organicheskie Rastvoriteli.</li> <li>Moskva, <u>1958</u>.</li> </ol>	

COMPONENTS: (1) Thorium nit:			MEASUREMENTS:
(1) Thorium nit:		IORTGINAT	- MCASUKEMENTS:
	rate; Th(NO3)4;	Vdovenko	; V. M.; Statsevich, V.P.;
[13823-29-5	]	Suglobov	7; D. N.
(a) Distbul stb		Radiokhi	lm. <u>1972</u> , <i>14</i> , 136 - 140.
(2) Dietnyl etn (3) Chloroform:	er; C <sub>4</sub> H <sub>10</sub> O; [60-2 CHCl <sub>3</sub> ; [67-66-3]	Sov Rad	liochem., <u>1972</u> , 14, 138.
(3) Carbon totr:	achloride; CCl <sub>4</sub> ;	50V. Aau	1100 nem., <u>1972</u> , 14, 198.
[56-23-5]	4		
(5) 1-Chlorobut	ane; C.H.Cl;		
[109-69-3]	4-9		
(6) Water; H <sub>2</sub> O;	[7732-18-5]	}	
EXPERIMENTAL VAL	LUES: (Continued	l)	
The solubility	of $Th(NO_3)_4.5H_2O_1$	) in the mixtur	ce CH <sub>3</sub> H <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub> - CHCl <sub>3</sub> is
given at 298K.	The concentratio	ons, g/dm <sup>3</sup> , of	both ether and thorium
nitrate were c	alculated by the	compilers.	
CH3CH2OCI	H <sub>2</sub> CH <sub>3</sub>	Th (NC	$(3)_{4}$
mol/dm <sup>3</sup>	g/dm <sup>3</sup>	mol/dm <sup>3</sup>	g/dm <sup>3</sup>
2.40	178	0.00182	0.874
3.80	282	0.00892	4.28
4.57	339	0.0148	7.10
	402	0.0316 15.2	
5.43	100	0.0310	
5.43 6.60	489	0.0676	32.5
6.60 9.12 Solubility of Th at 298K is given	489 676 n(NO <sub>3</sub> ) <sub>4</sub> .5H <sub>2</sub> O in t n in the followin	0.0676 0.263 The mixture CH <sub>3</sub> ng table. The c	
6.60 9.12 Solubility of T at 298K is given were calculated	489 676 n(NO <sub>3</sub> ) <sub>4</sub> .5H <sub>2</sub> O in t n in the followin by the compilers	0.0676 0.263 The mixture CH <sub>3</sub> ng table. The c	32.5 126.0 GCH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub> - CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> CH <sub>2</sub> CJ concentrations, g/dm <sup>3</sup> ,
6.60 9.12 Solubility of Th at 298K is given	489 676 n(NO <sub>3</sub> ) <sub>4</sub> .5H <sub>2</sub> O in t n in the followin by the compilers	0.0676 0.263 The mixture CH <sub>3</sub> ng table. The c	32.5 126.0 GCH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub> - CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> CH <sub>2</sub> CJ concentrations, g/dm <sup>3</sup> ,
6.60 9.12 Solubility of Th at 298K is given were calculated CH <sub>3</sub> CH <sub>2</sub> OCH mol/dm <sup>3</sup>	$\frac{489}{676}$ n(NO <sub>3</sub> ) <sub>4</sub> .5H <sub>2</sub> O in t n in the followin by the compilers $\frac{I_2CH_3}{g/dm^3}$	0.0676 0.263 The mixture CH <sub>3</sub> ng table. The c	32.5 126.0 $_{3}^{CH_{2}OCH_{2}CH_{3}} - CH_{3}(CH_{2})_{2}^{CH_{2}CH$
6.60 9.12 Solubility of Th at 298K is given were calculated CH <sub>3</sub> CH <sub>2</sub> OCH mol/dm <sup>3</sup>	$\frac{489}{676}$ n(NO <sub>3</sub> ) <sub>4</sub> .5H <sub>2</sub> O in t n in the followin by the compilers $\frac{I_2CH_3}{g/dm^3}$	0.0676 0.263 The mixture CH <sub>3</sub> og table. The c  Th(NC mol/dm <sup>3</sup>	$\frac{32.5}{126.0}$ $(CH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2C)$ concentrations, g/dm <sup>3</sup> , $\frac{93^3}{g/dm^3}$
$6.60$ 9.12 Solubility of That 298K is given were calculated $CH_3CH_2OCH$ mol/dm <sup>3</sup>	489 676 $n(NO_3)_4.5H_2O$ in t in the followin by the compilers $f_2CH_3$	$0.0676$ $0.263$ The mixture CH <sub>3</sub> $d = table. The c$ $Th (NC)$ $mol/dm3$ $\overline{0.00085}$	32.5 126.0 $_{3}^{CH_{2}OCH_{2}CH_{3}} - CH_{3}(CH_{2})_{2}^{CH_{2}CH$
6.60 9.12 Solubility of TM at 298K is given were calculated $CH_{3}CH_{2}OCH$ $mol/dm^{3}$ $1.38$ 1.70 2.88	$\frac{489}{676}$ n(NO <sub>3</sub> ) <sub>4</sub> .5H <sub>2</sub> O in t n in the followin by the compilers $\frac{f_2CH_3}{g/dm^3}$	0.0676 0.263 The mixture CH <sub>3</sub> og table. The c  Th(NC mol/dm <sup>3</sup>	$32.5$ $126.0$ $GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2C$ concentrations, g/dm <sup>3</sup> , $\frac{0_3}{4}$ $\frac{g/dm^3}{0.41}$
6.60 9.12 Solubility of TM at 298K is given were calculated $CH_{3}CH_{2}OCH$ $mol/dm^{3}$ $1.38$ 1.70 2.88	$489 676 n(NO3)4.5H2O in t n in the followin by the compilers \frac{f_2CH_3}{\frac{g/dm^3}{\frac{102}{126}}}$	0.0676 0.263 The mixture CH <sub>3</sub> og table. The c Th(NC mol/dm <sup>3</sup> 0.00085 0.00170	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CC \\ concentrations, g/dm3, \\ \frac{0^3}{4} \\ \frac{g/dm^3}{0.41} \\ 0.816 \\ \end{bmatrix}$
$6.60$ 9.12 Solubility of That 298K is given were calculated $\frac{CH_3CH_2OCH}{mol/dm^3}$ 1.38 1.70	$489 676 n(NO3)4.5H2O in t n in the followin by the compilers \frac{f_2CH_3}{\frac{g/dm^3}{\frac{102}{126}}}$	0.0676 0.263 The mixture CH <sub>3</sub> ag table. The c  Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CI \\ concentrations, g/dm3, \\ \frac{0^3}{4} \\ \frac{g/dm^3}{0.41} \\ 0.816 \\ 4.80 \\ \end{bmatrix}$
$6.60$ 9.12 Solubility of TH at 298K is given were calculated $CH_3CH_2OCH$ mol/dm <sup>3</sup> 1.38 1.70 2.88 5.31 6.92	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in t} \\ n \text{ in the followin} \\ by the compilers \\ \frac{1}{2}CH_3 \\ \hline \frac{g/dm^3}{102} \\ 126 \\ 213 \\ 394 \\ 513 \\ \hline \end{array}$	0.0676 0.263 The mixture CH <sub>3</sub> ag table. The c  Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0176 1.190	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CI \\ concentrations, g/dm3, \\ \frac{0_3)_4}{g/dm^3} \\ \frac{10.41}{0.816} \\ 4.80 \\ 37.3 \\ \end{array}$
6.60 9.12 Solubility of That 298K is given were calculated $CH_3CH_2OCH$ $mol/dm^3$ 1.38 1.70 2.88 5.31 6.92 Solubility of 7	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in t} \\ n \text{ in the followin} \\ by the compilers \\ \frac{H_2CH_3}{g/dm^3} \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in} \\ \end{bmatrix}$	0.0676 0.263 The mixture CH <sub>3</sub> og table. The c Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 the mixture CH	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CI \\ concentrations, g/dm3, \\ \frac{0_3)_4}{g/dm^3} \\ \hline 0.41 \\ 0.816 \\ 4.80 \\ 37.3 \\ 91.2 \\ \end{bmatrix}$
6.60 9.12 Solubility of That 298K is given were calculated $CH_3CH_2OCH$ $mol/dm^3$ $1.38$ 1.70 2.88 5.31 6.92 Solubility of C	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in t} \\ n \text{ in the followin} \\ by the compilers \\ \frac{H_2CH_3}{g/dm^3} \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in} \\ \end{bmatrix}$	0.0676 0.263 The mixture $CH_3$ ing table. The constraints Th (NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 The mixture CH , of both ethe	$32.5 126.0 GCH2OCH2CH3 - CH3(CH2)2CH2Cl concentrations, g/dm3, \frac{0_{3}^{3}}{4} \frac{g/dm^{3}}{0.41} 0.816 4.80 37.3 91.2 H_{3}CH_{2}OCH_{2}CH_{3} - CCl_{4} at$
6.60 9.12 Solubility of That 298K is given were calculated $CH_3CH_2OCH$ $mol/dm^3$ $1.38$ 1.70 2.88 5.31 6.92 Solubility of C	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in the followin} \\ by the compilers \\ 42^{CH_3} \\ \hline g/dm^3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in entrations, g/dm}^3 \\ d \text{ by the compiler} $	0.0676 0.263 The mixture $CH_3$ ing table. The constraints Th (NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 The mixture CH , of both ether s.	$32.5 126.0 GCH2OCH2CH3 - CH3(CH2)2CH2Cl concentrations, g/dm3, \frac{0_{3}^{3}}{4} \frac{g/dm^{3}}{0.41} 0.816 4.80 37.3 91.2 H_{3}CH_{2}OCH_{2}CH_{3} - CCl_{4} at$
$\begin{array}{r} 6.60\\ 9.12\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in t} \\ n \text{ in the followin} \\ by the compilers \\ 12CH_3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in} \\ entrations, g/dm^3 \\ i \text{ by the compiler} \\ 12CH_3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in} \\ n \text{ for the compiler} \\ n  for$	0.0676 0.263 The mixture $CH_3$ ing table. The constraints Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 The mixture CH , of both ether s. Th(N	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CJ \\ concentrations, g/dm3, \\ \frac{0_3)_4}{g/dm^3} \\ \frac{g/dm^3}{0.41} \\ 0.816 \\ 4.80 \\ 37.3 \\ 91.2 \\ H_3CH_2OCH_2CH_3 - CCl_4 \text{ at } \\ er \text{ and thorium nitrate} \\ \frac{10_3)_4}{g} \\ \frac{10_3}{3} \\ \frac{10_3}{3} \\ \frac{1}{3} \\ \frac{1}{3} \\ \frac{10_3}{3} \\ \frac{1}{3} \\ \frac{1}{3} \\ \frac{10_3}{3} \\ \frac{1}{3} \\ $
6.60 9.12 Solubility of TH at 298K is given were calculated CH <sub>3</sub> CH <sub>2</sub> OCH mol/dm <sup>3</sup> 1.38 1.70 2.88 5.31 6.92 Solubility of C 298K. The conce were calculated CH <sub>3</sub> CH <sub>2</sub> OCH mol/dm <sup>3</sup>	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in the followin} \\ by the compilers \\ 12CH_3 \\ \hline g/dm^3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in entrations, g/dm}^3 \\ d \text{ by the compiler} \\ H_2CH_3 \\ \hline g/dm^3 \\ \hline d m^3 \\ \hline d$	0.0676 0.263 The mixture $CH_3$ ag table. The constraints Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0176 1.190 the mixture CH , of both ether s. Th(N mol/dm <sup>3</sup>	$32.5$ $126.0$ $GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CD$ concentrations, g/dm <sup>3</sup> , $\frac{0_3)_4}{g/dm^3}$ $\frac{g/dm^3}{0.41}$ $0.816$ $4.80$ $37.3$ $91.2$ $H_3CH_2OCH_2CH_3 - CCl_4 \text{ at}$ for and thorium nitrate $\frac{10_3}{4}$ $\frac{g/dm^3}{g/dm^3}$
$\begin{array}{r} 6.60\\ 9.12\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in the followin} \\ by the compilers \\ 12CH_3 \\ \hline g/dm^3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in entrations, g/dm}^3 \\ d \text{ by the compiler} \\ 4_2CH_3 \\ \hline g/dm^3 \\ \hline 142 \\ \hline \end{cases}$	0.0676 0.263 The mixture $CH_3$ ag table. The c Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 the mixture CH , of both ether s. Th(N mol/dm <sup>3</sup> 0.00100	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CJ \\ concentrations, g/dm3, \\ \frac{0}{3} \\ \frac{g/dm^3}{0.41} \\ \frac{0.816}{4.80} \\ 37.3 \\ 91.2 \\ H_3CH_2OCH_2CH_3 - CCl_4 \\ at \\ er and thorium nitrate \\ \frac{10}{3} \\ \frac{g/dm^3}{1.480} \\ \end{array}$
$\begin{array}{r} 6.60\\ 9.12\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in the followin} \\ by the compilers \\ 12CH_3 \\ \hline g/dm^3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in entrations, g/dm}^3 \\ d \text{ by the compiler} \\ 142 \\ 166 \\ \hline g/dm^3 \\ \hline g/dm^3 \\ \hline 142 \\ 166 \\ \hline g/dm^3 \\ \hline$	0.0676 0.263 The mixture $CH_3$ ing table. The constraints Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 the mixture CH , of both ether s. Th(N mol/dm <sup>3</sup> 0.00100 0.00100 0.00100 0.00204	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CI \\ concentrations, g/dm3, \\ 0.3)_4 \\ \hline g/dm3 \\ \hline 0.41 \\ 0.816 \\ 4.80 \\ 37.3 \\ 91.2 \\ H_3CH_2OCH_2CH_3 - CCl_4 \text{ at} \\ er \text{ and thorium nitrate} \\ H_3CH_2OCH_2CH_3 - CCl_4 \text{ at} \\ er \text{ and thorium nitrate} \\ \hline 103)_4 \\ \hline g/dm3 \\ \hline 1.480 \\ 0.797 \\ \hline \end{array}$
$\begin{array}{r} 6.60\\ 9.12\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in the followin} \\ by the compilers \\ H_2CH_3 \\ \hline g/dm^3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in entrations, g/dm}^3 \\ Hoy the compiler \\ H_2CH_3 \\ \hline g/dm^3 \\ \hline 142 \\ 166 \\ 224 \\ \end{bmatrix}$	0.0676 0.263 The mixture CH <sub>3</sub> ag table. The c  Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 the mixture CH , of both ether s. Th(N mol/dm <sup>3</sup> 0.00100 0.00100 0.00204 0.00562	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2C1 \\ concentrations, g/dm3, \\ g/dm3 \\ \hline 0.41 \\ 0.816 \\ 4.80 \\ 37.3 \\ 91.2 \\ H_3CH_2OCH_2CH_3 - CCl_4 at \\ er and thorium nitrate \\ IO_3)_4 \\ \hline g/dm3 \\ \hline 1.480 \\ 0.797 \\ 2.70 \\ \end{bmatrix}$
$\begin{array}{r} 6.60\\ 9.12\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in t} \\ n \text{ in the followin} \\ by the compilers \\ H_2CH_3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in} \\ entrations, g/dm^3 \\ \hline 142 \\ 166 \\ 224 \\ 312 \\ \hline 12 \\ \hline 142 \\ 166 \\ 224 \\ 312 \\ \hline 142 \\ 166 \\ 224 \\ 312 \\ \hline 112 \\ \hline 11$	0.0676 0.263 The mixture $CH_3$ ing table. The c mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 the mixture CH , of both ether s. Th(N mol/dm <sup>3</sup> 0.00100 0.00100 0.00204 0.00562 0.0155	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CI \\ concentrations, g/dm3, \\ g/dm3 \\ \hline 0.41 \\ 0.816 \\ 4.80 \\ 37.3 \\ 91.2 \\ H_3CH_2OCH_2CH_3 - CCl_4 at \\ er and thorium nitrate \\ G(3)_4 \\ \hline g/dm3 \\ \hline 1.480 \\ 0.797 \\ 2.70 \\ 7.44 \\ \end{bmatrix}$
$\begin{array}{r} 6.60\\ 9.12\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	$489 \\ 676 \\ n(NO_3)_4.5H_2O \text{ in the followin} \\ by the compilers \\ H_2CH_3 \\ \hline g/dm^3 \\ \hline 102 \\ 126 \\ 213 \\ 394 \\ 513 \\ Th(NO_3)_4.5H_2O \text{ in entrations, g/dm}^3 \\ Hoy the compiler \\ H_2CH_3 \\ \hline g/dm^3 \\ \hline 142 \\ 166 \\ 224 \\ \end{bmatrix}$	0.0676 0.263 The mixture CH <sub>3</sub> ag table. The c  Th(NC mol/dm <sup>3</sup> 0.00085 0.00170 0.0100 0.0776 1.190 the mixture CH , of both ether s. Th(N mol/dm <sup>3</sup> 0.00100 0.00100 0.00204 0.00562	$32.5 \\ 126.0 \\ GCH_2OCH_2CH_3 - CH_3(CH_2)_2CH_2CI \\ concentrations, g/dm3, \\ g/dm3 \\ \hline 0.41 \\ 0.816 \\ 4.80 \\ 37.3 \\ 91.2 \\ H_3CH_2OCH_2CH_3 - CCl_4 at \\ er and thorium nitrate \\ IO_3)_4 \\ \hline g/dm3 \\ \hline 1.480 \\ 0.797 \\ 2.70 \\ \end{bmatrix}$

 COMPONENTS:
 (1) Thorium nitrate; Th(NO3);
 (1) Thorium nitrate; Th(NO3);
 (1) Thorium nitrate; Th(NO3);

 (1) Thorium nitrate; Th(NO3);
 (1) Thorium nitrate; Th(NO3);
 (1) Volume (1) Vo

EXPERIMENTAL VALUES: (Continued)

Solubility of  $Th(NO_3)_4.5H_2O$  in the mixture  $CH_3CH_2OCH_2CH_3 - C_6H_6$  at 298K. The concentrations,  $g/dm^3$ , of both ether and benzene were calculated by the compilers.

Th (	CH <sub>3</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub>	
/dm <sup>3</sup>	nol/dm <sup>3</sup> g/dm <sup>3</sup>	g/dm <sup>3</sup>
0562	1.98 147	2.70
0871	2.37 176	4.18
135	2.88 213	6.48
.86	2.82 209	8.93
987	4.85 359	47.4
)5	4.85 359	50.4
26	5.37 398	60.5
34	6.24 463	112.0
51	6.24 463	120.0
30	7.29 540	182.0

Solubility of  $Th(NO_3)_4.5H_2O$  in the mixture  $CH_3CH_2OCH_2CH_3 - C_6H_5Cl$  at 298K. The concentrations,  $g/dm^3$ , of both ether and thorium nitrate were calculated by the compilers.

сн <sub>3</sub> сн <sub>2</sub> осн <sub>2</sub> сн <sub>3</sub>		$Th(NO_3)_4$		
mol/dm <sup>3</sup>	g/dm <sup>3</sup>	mol/dm <sup>3</sup>	g/dm <sup>3</sup>	
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:	EVALUATOR:
(1) Plutonium nitrates	S. L. Phillips
(2) Neptunium nitrates	Camatx/Basic Data
(3) Americium nitrates	Orinda, CA 94563 USA
CRITICAL EVALUATION:	1

## INTRODUCTION

The published solubility data in this section cover the ternary systems (Pu, Np) nitrates - nitric acid - water (1-4), ternary systems with  $PuO_2(NO_3)_2$  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.

There are studies which support the existence of the two Pu(VI) phases  $PuO_2(NO_3)_2.6H_2O$  and  $PuO_2(NO_3)_2.3H_2O$  (13). Both crystalline hydrates lose water when left in a desiccator containing NaOH, to form the dihydrate  $PuO_2(NO_3)_2.2H_2O$ , or the anhydrous  $PuO_2(NO_3)_2$  (13). However, the hydrates can decompose due to the radioactivity of plutonium.

# BINARY SYSTEMS

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  $PuO_2(NO_3)_2$  in water by fitting data from Krevinskaia et al. in Table 31 to the equation log Pu = A + B [HNO<sub>3</sub>], and extrapolating to zero nitric acid concentration. The extrapolated solubility is 336 g/kg Pu. TERNARY SYSTEMS

The solubility of  $PuO_2(NO_3)_2$  apparently decreases with increasing  $HNO_3$ concentration (2). The solubility of  $NpO_2NO_3$  increased from 2.5 g/L in 0.5 mol/dm<sup>3</sup>  $HNO_3$ , to 8 g/L in 1 mol/dm<sup>3</sup>  $HNO_3$  and to 50 g/L in 5 mol/dm<sup>3</sup> (4). In the  $Np(NO_3)_4$ - $HNO_3$ - $H_2O$  system, LaChapelle et al. (4) reported a solubility of 80 g/L in 4 mol/dm<sup>3</sup>  $HNO_3$ , with an increase to 300 g/L 5M  $HNO_3$ . The only value for  $NpO_2(NO_3)_2$  is 38 g/L in 0.2 mol/dm<sup>3</sup>  $HNO_3$  (4). Feldman reported a solubility of  $Pu(NO_3)_4$  in 1.8 mol/dm<sup>3</sup>  $HNO_3$  at 25°C of 2.1-2.5 mol/dm<sup>3</sup> (1). Vogler et al. (3) published solubility data for mixtures of  $Pu(NO_3)_4$  and  $PuO_2(NO_3)_2$ . 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. COMPONENTS: (1) Plutonium nitrates

(2) Neptunium nitrates

(3) Americium nitrates

### EVALUATOR:

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

## CRITICAL EVALUATION:

## QUATERNARY SYSTEMS

 $Pu(NO_3)_4$  solubility in metal-nitric acid-water systems was reported by Anderson for the following nitrates (6):  $K_2Pu(NO_3)_6$ ,  $Rb_2Pu(NO_3)_6$ ,  $Cs_2Pu(NO_3)_6$ , and  $Tl_2Pu(NO_3)_6$ . 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 <sub>3</sub> ) <sub>4</sub>		
+ ethanol + 1.5N nitric acid + butex + 0.1N nitric acid + butex + kerosine + TBP	25 5.6 1.1 0.7	8 7 7 8 8 8
+ TBP + kerosine + nitric acid + dibutyl phosphate + pyridine + nitric acid + quinoline + nitric acid	 2 0.5	8 <sup>a,b</sup> 10 <sup>b</sup> 6 6
PuO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> + nitric acid + butex	0.67,0.54	7 <sup>c</sup>

<sup>a</sup>Aromatic-free. <sup>b</sup>Solubility is a function of the concentration of conditioning nitric acid. <sup>C</sup>After 2 days and 10 days of agitation, respectively, in 0.1M HNO<sub>3</sub>.

COMPONENTS:	· · · · · · · · · · · · · · · · · · ·		EVALUATOR:
(1) Plutonium	nitrates		S. L. Phillips
(2) Neptunium	nitrates		Camatx/Basic Data Orinda, CA 94563 USA
(3) Americium			
CRITICAL EVAL			ł
Table 31.	Solubility of (2). Value at	Pu in nit: 0 mol/dm	ric acid solutions at 298 K HNO <sub>3</sub> is extrapolated.
	HNO <sub>3</sub>	, mol/dm <sup>3</sup>	Pu, g/kg solution
		0 2 4 6	336.0 164.9 160.9 137.6
Table 32.	Solubility of	-	in monovalent metal nitrates
	at 301 K (6).	Press UNO	
	Metal Nitrate	Free HNO <sub>3</sub> mol/dm <sup>3</sup>	Pu solubility g/L
	CsNO3	6.5	3.4
	RbNO3	12	4.6
	кno <sub>з</sub>	12	18 (274 K)
	TINO <sub>3</sub>	12	26
Table 33.	Analytical dat Pu(NO <sub>3</sub> ) <sub>4</sub> -HNO <sub>3</sub> Precipitate	ta for prec -metal nitr	cipitates formed in the system cates (6). Plutonium
	Formula	1	Found, % Calculated, %
	Cs <sub>2</sub> Pu(NO <sub>3</sub> ) <sub>6</sub>		26.8 27.26
	Rb <sub>2</sub> Pu(NO <sub>3</sub> ) <sub>6</sub>		31.8 30.6
	Tl <sub>2</sub> Pu(NO <sub>3</sub> ) <sub>6</sub>		24.2 23.4
	$K_2^{Pu(NO_3)_6}$		29.7 34.7
<sup>a</sup> Contamir	nated with free	∍ KNO <sub>3</sub> .	

COMPONENTS:	EVALUATOR:	
(1) Plutonium nitrates	S. L. Phillips	
(2) Neptunium nitrates	Camatx/Basic Data Orinda, CA 94563 USA	
(3) Americium nitrates		
CRITICAL EVALUATION: (Continued)	J	
	ENGEC	
REFER		
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<ol> <li>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. Zh. Strukt. Khim., <u>1988</u>, 30, 774. Sov. Radiochem., <u>1989</u>, 734.</li> </ol>		
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COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Plutonyl nitrate; Pu02(N03)2;     [22853-0-5]</pre>	Feldman, B. C.
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Report HW-31000, <u>1955</u>
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 298 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The approximate solubility of p	lutonyl nitrate in about
1.8 mol/dm <sup>3</sup> HNO <sub>3</sub> solution at 25	<sup>0</sup> is reported to be 2.1 mol/L.
AUXILIARY II	NFORMATTON
	SOURCE AND PURITY OF MATERIALS:
METHOD/APPARATUS/PROCEDURE: Nothing specified.	Nothing specified.
Nothing Specifica.	Nothing specified.
	ESTIMATED ERROR:
	Nothing specified.
	noching specifica.
	REFERENCES:

COMPONENTS:		ORIGINAL MEASUREMENTS:		
1) Plutonyl nitrate; PuO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [22853-0-5]		Krevinskaia,M.Ye.; Nikol'skii,V.D.; Pozharskii, B.G.; Zastenker,Ye.Ye.		
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]		Radiokh	im., <u>1959</u> ,	1, 562-566.
(3) Water; H <sub>2</sub> O; [7732-18	-5]	Sov.Ra	diochem.,	<u>1960</u> , 1, 253-257.
VARIABLES: Nitric acid concentration	n at 298 K	PREPARE A. Soza	D BY: nski; S. S	iekierski
EXPERIMENTAL VALUES:			0	· · · · · · · · · · · · · · · · · · ·
	$_{3})_{2} - HNO_{3} -$			2
ниоз	Pu,	g/kg Sol	ution	-
mol/dm <sup>3</sup>	Radiometr	ic G	ravimetric	•
2	272.6		271.0	
4	163.0		164.9	
6 8	157.5 136.9		160.9 137.6	
Solubility of PuO2(NO3		ol/dm <sup>3</sup> H		liometric Method <sup>a</sup>
	-		, 1 kg Sol	-
David	g Pu		moles F	Pu02(N03)2
Days Equilibrated	mean	σ	mean	σ
1		.2	0.484	0.009
3		.0 .3	0.447 0.462	0.008 0.010
6		.0	0.404	0.004
10		.4	0.367	0.006
14		.5 .6	0.270	0.006
16	-	.9	0.267 0.271	0.002 0.004
18 21 <sup>b</sup>		.1	0.268	0.005
<sup>a</sup> The equilibrium solid phase is PuO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .HNO <sub>3</sub> .nH <sub>2</sub> O.			1 <sub>2</sub> 0.	
<sup>b</sup> Solubility after 21 days determined by the gravimetric method was 70 g/kg Pu in solution, or 0.287 mol/kg.			etric method was	
<sup>C</sup> Calculated by the compilers.				
	AUXILIARY I	NFORMATI	ON	
METHOD/APPARATUS/PROCEDU	RE:	SOURCE AND PURITY OF MATERIALS:		
Solubility dependence on	the HNO	$PuO_2(NO_3)_2.6H_2O$ obtained by the concentration of nitric acid solutions of $PuO_2$ over $P_2O_5$ at		
concentration was evalua	ted after 40			
hours equilibrium of each sample. The plutonium solubility was determined		(room temperature. Analyzed 47.4% Pu (theor. 47.51%), NO <sub>2</sub> , 24.4%.		
by both radiochemical and procedures. The valence		ESTIMATED ERROR:		
checked spectrophotometr	ically. The	Temp: $\pm 0.2$ K.		
was determined gravimetr.	ically. The	}		
nitrate by Devarda's method. Each solubility is the average of three separate experiments.		REFERENCES :		
L	<u></u>			

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Plutonyl nitrate; Pu0<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>; [22853-0-5]</pre>	Cunningham, B. B.
<pre>(2) Ammonium nitrate; NH<sub>4</sub>NO<sub>3</sub>; [6484-52-2]</pre>	<pre>"The Actinide Elements," (Seaborg, G.T.; Katz,J.J., eds.) Nat. Nucl. Energy Ser., Div. IV, Vol. 14A, McGraw-Hill Book Co.,</pre>
(3) Water; H <sub>2</sub> O; [7732-18-5]	New York ( <u>1954</u> ), p. 414.
VARIABLES:	PREPARED BY:
One temperature	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The concentration of plutonium in	the aqueous phase in equilibrium
with the solid phase as obtained b	y evaporation as described below
was about 500 g/L.	
AUXILIARY IN	FORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	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:	ORIGINAL MEASUREMENTS:	
<pre>(1) Plutonyl nitrate; Pu0<sub>2</sub>(N0<sub>3</sub>)<sub>2</sub>; [22853-0-5]</pre>	Dawson, J. K.	
(2) Diethylene glycol dibutyl ether (Butex); C <sub>12</sub> H <sub>26</sub> O <sub>3</sub> ; [112-73-2]	Report AERE C/M 92, <u>1950</u> .	
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]		
(4) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES:	PREPARED BY:	
One temperature: 298 K	L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:		
The solubility of PuO <sub>2</sub> (NO <sub>3</sub> ) <sup>a</sup> in diethylene glycol diethyl ether (butex) conditioned to 0.10 mol/L HNO <sub>3</sub> , was reported as 0.67 and 0.54 g of plutonium per liter of solution, after 2 and 10 days equilibration time, respectively.		
<sup>a</sup> The number of water molecules in both the initial and the final equilibrium solid hydrates were not specified (compilers).		
AUXILIARY INFORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF CHEMICALS:	
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	Nothing specified.	
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).	ESTIMATED ERROR: Soly: Not better than ±5 %. (Authors) Temp: Nothing specified. REFERENCES: 1. Mandelberg, C. J. AERE C/R 582 Report.	

Components:	ORIGINAL MEASUREMENTS:
<pre>(1) Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3]</pre>	Feldman, B. C.
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Report HW 31000, <u>1955</u> .
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
One temperature: 298 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of plutonium(IV) HNO <sub>3</sub> at 25 <sup>o</sup> C was reported to be	nitrate in approximately 1.8 mol/dm <sup>3</sup> about 2.1-2.5 mol/L.
AUXILIARY I	NFORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	Nothing specified.
	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES:
	1

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>;     [13823-27-3]</pre>	Anderson, H. H.
(2) Potassium nitrate; KNO <sub>3</sub> ; [7757-79-1]	Paper 6.220, in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Book Co., New York ( <u>1949</u> ).
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
T/K = 274 and 301	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of dipotassium plutonium(IV) hexanitrate, K <sub>2</sub> Pu(NO <sub>3</sub> ) <sub>6</sub> , 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. 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.	

	METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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 mol/dm <sup>3</sup> HNO <sub>2</sub> and cooled to 1 <sup>o</sup> C.	$K_2Pu(NO_3)_6$ , 29.7% of plutonium, found, was probably contaminated with free KNO <sub>3</sub> ; probably 86% of $K_2Pu(NO_3)_6$ and 14% of KNO <sub>3</sub> .	
	Slow horizontal rotations of the	ESTIMATED ERROR:
	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).	Nothing specified.
		REFERENCES:
		1. Anderson, H. H. Report ANL-4062.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Plutonium nitrate; Pu(NO3); [13823-27-3]</pre>	Anderson, H. H.
(2) Rubidium nitrate; RbNO <sub>3</sub> ; [13126-12-0]	Paper 6.220 in "The Transuranium Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Book Co., New York ( <u>1949</u> ).
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
<i>T/</i> K = 301	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of dirubidium plut	conium(IV) hexanitrate, Rb <sub>2</sub> Pu(NO <sub>3</sub> ) <sub>6</sub> ,
at 28 <sup>0</sup> C was reported to be 4.6 g,	2 5 5
liquor with the composition desc	ibed in the PROCEDURE.
AUXILIARY	NFORMATION
AUXILIARY 1 METHOD/APPARATUS/PROCEDURE:	NFORMATION SOURCE AND PURITY OF MATERIALS:
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 <sup>3</sup> HNO <sub>2</sub> at 28 <sup>o</sup> C. Slow horizonta	SOURCE AND PURITY OF MATERIALS: Rb_Pu(NO <sub>3</sub> ) <sub>6</sub> was found to contain 31.8 mass % of plutonium (calc. 30.6 mass %).
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 <sup>3</sup> HNO <sub>3</sub> at 28 <sup>o</sup> C. Slow horizontal rotations of the solution in a cone shaped centrifuge tube tended to	SOURCE AND PURITY OF MATERIALS: Rb_Pu(NO <sub>3</sub> ) <sub>6</sub> was found to contain 31.8 mass % of plutonium (calc. 30.6 mass %).
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 <sup>3</sup> HNO <sub>3</sub> at 28 <sup>o</sup> 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	SOURCE AND PURITY OF MATERIALS: Rb_Pu(NO <sub>3</sub> ), was found to contain 31.8 mass % of plutonium (calc. 30.6 mass %).
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 <sup>3</sup> HNO <sub>3</sub> at 28 <sup>o</sup> C. Slow horizontal rotations of the solution in a cone shaped centrifuge tube tended to give equilibrium solubility. The crystals were filtered by suction	SOURCE AND PURITY OF MATERIALS: Rb_Pu(NO <sub>3</sub> ) <sub>6</sub> was found to contain 31.8 mass % of plutonium (calc. 30.6 mass %). ESTIMATED ERROR:

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3] (2) Cesium nitrate; CsNO<sub>3</sub>; [7789-18-6] (3) Nitric acid; HNO<sub>3</sub>; [7697-37-2] (4) Water; H<sub>2</sub>O; [7732-18-5]</pre>	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> ).
VARIABLES:	PREPARED BY:
One temperature: 301 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	1
at 28 <sup>0</sup> C was reported to be about per liter of the mother liquor w PROCEDURE.	
AUXILIARY I	NEODWATTON
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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/dm <sup>3</sup> nitric acid. Slow horizontal rotations of the solution in a	Cs_Pu(NO_) was found to contain 26.6 mass % of plutonium and 31.0 mass % cesium (calc. 27.27 mass % and 30.5 mass %, respectively).
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	ESTIMATED ERROR: Nothing specified.
before chemical analysis (1).	REFERENCES: 1. Anderson, H. H. Report ANL-4062.

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COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3] (2) Thallium nitrate; TlNO<sub>3</sub>; [10102-45-1] (3) Nitric acid; HNO<sub>3</sub>; [7697-37-2] (4) Water; H<sub>2</sub>O; [7732-18-5]</pre>	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> ).
VARIABLES: One temperature: 301 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	<u> </u>

The solubility of dithallium(I) plutonium(IV) nitrate,  $Tl_2Pu(NO_3)_6$ , at 28<sup>o</sup>C was reported to be about 26 g of plutonium per liter of the mother liquor with the composition given in the PROCEDURE.

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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 HNO <sub>3</sub>	Tl <sub>2</sub> Pu(NO <sub>3</sub> ) <sub>6</sub> was found to contain 24.2 mass % of plutonium (calc. 23.4 mass %).
acid. Slow horizontal rotations of the solution in a centrifuge cone	ESTIMATED ERROR:
tended to given equilibrium in solubility. The crystals were filtered by suction on a sintered pyrex dish, washed with one drop of	Nothing specified.
95% ethyl alcohol, dried under vacuum at room temperature, heated for 15 minutes at 130°C, and then	REFERENCES :
analyzed (1).	1. Anderson, H. H.
	Report ANL-4062.

DRIGINAL MEASUREMENTS:
DRIGINAL MEASUREMENTS:
Dawson, J. K.; Elliott, R. M.
AERE Report C/M 113, <u>1951</u> .
PREPARED BY:
L. Fuks; S. Siekierski
yl alcohol, СН <sub>3</sub> СН <sub>2</sub> ОН, at 25 <sup>0</sup> С

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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	Pale-green plutonium nitrate of unknown degree of hydration was was prepared by vacuum evaporation at room temperature from a strong solution of Pu(IV) in HNO <sub>3</sub> . Ethanol was not purified.
action. Equilibrium between crystals and supernatant was attained fairly quickly, but the observations were	ESTIMATED ERROR:
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.	concentrated solutions, and of the radiation counting, with errors
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:	
<ol> <li>(1) Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3]</li> <li>(2) Kerosine; [8008-20-6]</li> <li>(3) Water; H<sub>2</sub>O; [7732-18-5]</li> </ol>	Dawson, J. K.; Elliott, R. M. AERE Report C/M 113, <u>1951</u> .	
Z VARIABLES:	PREPARED BY:	
<i>T/</i> K = 298	L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES: The solubility of Pu(NO <sub>3</sub> ) <sub>4</sub> in aromatic-free kerosine conditioned with 1.0 mol/dm <sup>3</sup> HNO <sub>3</sub> is reported to be 0.7 g/L at 25 <sup>O</sup> 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.		
AUXILIARY INFORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	

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.	Pale-green plutonium nitrate of unknown degree of hydration was prepared by vacuum evaporation at room temperature of a strong solution of Pu(IV) in nitric acid. kerosine was conditioned with 1.0 mol/dm nitric acid by shaking and filtering.
	The total inaccuracy of the results is about ±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.
	REFERENCES :

COMPONENTS:	ORIGINAL MEASUREMENTS:
<pre>(1) Plutonium nitrate; Pu(NO3); [13823-27-3]</pre>	Dawson, J. K.; Elliott, R. M.
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	AERE Report C/M 113, Harwell, <u>1951</u> .
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 298 K	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of Pu(NO <sub>3</sub> ) <sub>4</sub> in (C	H <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> O) <sub>3</sub> PO (TBP) as a
function of conditioning acidity	at 25 <sup>0</sup> C <sup>a</sup> is given as:
Conditioning	Pu(NO <sub>3</sub> ) <sub>4</sub>
Acidity mol/dm <sup>3</sup>	g/L
0.1 0.75	32.4 48.9
1.0	48.9 74.6
3.0	30.8
5.0	29.0
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution	
<sup>a</sup> The solvent consists of TBP and	of hydrated plutonium nitrate
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. AUXILIARY I	of hydrated plutonium nitrate NFORMATION
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid.	of hydrated plutonium nitrate
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. AUXILIARY I	of hydrated plutonium nitrate NFORMATION
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. AUXILIARY I METHOD/APPARATUS/PROCEDURE:	of hydrated plutonium nitrate NFORMATION SOURCE AND PURITY OF MATERIALS:
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. AUXILIARY I METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The solubilities were measured in small stoppered tubes which were immersed	of hydrated plutonium nitrate NFORMATION SOURCE AND PURITY OF MATERIALS: Pale-green plutonium nitrate of unknown degree of hydration was prepared by vacuum evaporation at
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. AUXILIARY I METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The solubilities were measured in small	of hydrated plutonium nitrate NFORMATION SOURCE AND PURITY OF MATERIALS: Pale-green plutonium nitrate of unknown degree of hydration was
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(IV) in nitric acid.
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(IV) in nitric acid. TBP was washed several times with
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. AUXILIARY I 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	of hydrated plutonium nitrate NFORMATION 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 Pu(IV) in nitric acid. TBP was washed several times with NaOH solutions and water, followed
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(IV) in nitric acid. TBP was washed several times with NaOH solutions and water, followed by redistillation. The TBP was
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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. ESTIMATED ERROR:
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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. ESTIMATED ERROR:
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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. ESTIMATED ERROR: The total inaccuracy of the results is about ±5% on the basis of pipetting small aliquots of
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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. ESTIMATED ERROR: The total inaccuracy of the results is about ±5% on the basis of pipetting small aliquots of concentrated solutions, and of the
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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	of hydrated plutonium nitrate NFORMATION 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 Pu(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. ESTIMATED ERROR: The total inaccuracy of the results is about ±5% on the basis of pipetting small aliquots of concentrated solutions, and of the radiation counting, with errors of
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<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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.	of hydrated plutonium nitrate NFORMATION 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 Pu(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. ESTIMATED ERROR: The total inaccuracy of the results is about ±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
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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.	of hydrated plutonium nitrate NFORMATION 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 Pu(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. ESTIMATED ERROR: The total inaccuracy of the results is about ±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
<sup>a</sup> The solvent consists of TBP and resulting from the dissolution and from the nitric acid. <b>AUXILIARY I</b> <b>METHOD/APPARATUS/PROCEDURE:</b> 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.	of hydrated plutonium nitrate NFORMATION 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 Pu(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. ESTIMATED ERROR: The total inaccuracy of the results is about ±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

COMPONENTS:	ORIGINAL MEASUREMENTS:		
(1) Plutonium nitrate; Pu(NO <sub>3</sub> ) <sub>4</sub> ; [13823-27-3]			
(2) Di-n-butyl phosphate (DBPA); C <sub>8</sub> H <sub>19</sub> O <sub>4</sub> P; [107-66-4]	Sokhina, L. P.; Rovnyi, S. I.; Goncharuk, L. V.; Bogdanov, F. A.		
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Radiokhim., <u>1988</u> , 30, 418-420.		
(4) Water; H <sub>2</sub> O; [7732-18-5]	Sov.Radiochem., <u>1989</u> , 30, 394-396.		
VARIABLES:	PREPARED BY:		
T/K = 293 to 373	S. L. Phillips		
EXPERIMENTAL VALUES:	I		
The solubility of Pu(NO <sub>3</sub> ) <sub>2</sub> (DBPA)			
function of temperature is given	by the equation		
S, mg/L = exp [AT + (B + DT + ET	<sup>2</sup> ) c]		
where:			
$A = 0.0383 \pm 0.004, B = 0.37 \pm 0.03,$			
$E = (0.34 \pm 0.11) \times 10^{-4}$ , T = temper-	ature, $t/^{\circ}C$ , $C = HNO_3$ , mol/dm <sup>3</sup> .		
AUXILIARY I	NFORMATION		
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:		
Plutonium in a nitric acid solution stabilized in +4 state with hydrogen peroxide at $60\pm5^{\circ}$ C in a 3 mol/dm <sup>-1</sup> 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	ESTIMATED ERROR:		
separated from the mother liquor by centrifuging, and washed two or three	Soly: Error did not exceed ±15%.		
times with 0.1 mol/dm <sup>3</sup> nitric acid. Solubility was determined (1). The plutonium content was measured	Temp: ±5 <sup>°</sup> C.		
radiometrically; DBPA was determined spectrophotometrically according to			
phosphorus.	REFERENCES :		
	1. Solovkin, A. S. Radiochim., <u>1982</u> , 24, 56.		

Components:	ORIGINAL MEASUREMENTS:						
<pre>(1) Plutonium nitrate; Pu(NO3); [13823-27-3]</pre>	Fedorov, Yu. S.; Zil'berman, B. Ya.						
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Radiokhim., <u>1988</u> , 30, 572-576. Sov. Radiochem., <u>1989</u> , 546-550.						
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]							
(4) Water; H <sub>2</sub> O; [7732-18-5]							
VARIABLES:	PREPARED BY:						
Nitric acid concentration at 293 K	S. L. Phillips						
EXPERIMENTAL VALUES:	1						
The distribution of $PuO_2(NO_3)_2$	between HNO, solutions and a						
	the presence of solid $UO_2(NO_3)_2$						
is given in the form of a figur							
The distribution of $Pu(NO_3)_4$ be							
	•						
30% solution of TBP in CCl <sub>4</sub> in the presence of solid $UO_2(NO_3)_2$ is given in the form of a figure.							
COMMENT AND/OR ADDITIONAL DATA:							
Plutonyl nitrate has a structure similar to that of uranyl nitrate							
AUXILIARY J	NEODWARTON						
	T						
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:						
The initial concentration of <sup>239</sup> Pu was 0.0002 mol/dm <sup>2</sup> . Content of Pu was determined radiometrically. No	Nothing specified.						
further details given, but the procedure probably followed that	ESTIMATED ERROR:						
	ESTIMATED ERROR:						
procedure probably followed that							

COMPONENTS: (1) Plutonium nitrate; Pu(NO <sub>3</sub> ) <sub>4</sub> ; [13823-27-3]	ORIGINAL MEASUREMENTS: Dawson, J. K.; Elliott, R. M.
<pre>(2) Tri-n-butyl phosphate (TBP); C<sub>12</sub>H<sub>27</sub>O<sub>4</sub>P; [126-73-8]</pre>	AERE Report C/M 113, <u>1951</u> .
(3) Kerosine; [8008-20-6]	
(4) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES: Composition at 298 K	PREPARED BY: L. Fuks; S. Siekierski
EXPERIMENTAL VALUES: The solubility of Pu(NO3)4 in 30%	TBP in aromatic-free kerosine
as a function of conditioning aci	d at 25 <sup>0</sup> C <sup>a</sup> is:
Conditioning Acidity mol/dm <sup>3</sup>	Pu(NO <sub>3</sub> ) <sub>4</sub> g/L
0.1 1.0 5.0	11.9 27.9 9.9
hydrated nlutonium nitrate and	d from the nitric acid
hydrated plutonium nitrate, and conditioning. AUXILIARY :	d from the nitric acid
conditioning.	
Conditioning. AUXILIARY : 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	INFORMATION 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 Pu(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.
Conditioning. AUXILIARY : 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	INFORMATION 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 Pu(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.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<ol> <li>(1) Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3]</li> <li>(2) Nitric acid; HNO<sub>3</sub>; [7697-37-2]</li> <li>(3) Tri-n-butyl phosphate (TBP);</li> </ol>	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. Zh. Strukt. Khim., <u>1988</u> , 30, 774 - 787. Sov. Radiochem., <u>1989</u> , 734-787.
C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8] (4) Various isoparaffinic diluents	
VARIABLES:	PREPARED BY:
T/K = 297	S. L. Phillips
EXPERIMENTAL VALUES:	
Effect of kind of isoparaffinic dilu from 3.0 mol/dm HNO <sub>3</sub> into a 30 vol.	
Composition and Propertie	Concentration, in homogeneous s of Diluent <sup>a</sup> extract
Paraffin nP iP Ar bp den	s. visc. mp Pu HNO <sub>3</sub>
%%% <sup>o</sup> cg/c	$m^3$ cP <sup>o</sup> C g/dm <sup>3</sup> mol/dm <sup>3</sup>
nC <sub>10</sub> 100 174.1 0.72	(continued on the next page)
AUXILIARY IN	FORMATION
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Studies were carried out at room temperature (22-25°C) with 3 mol/dm <sup>3</sup> HNO <sub>3</sub> 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 <sub>3</sub> with ca 100g/L Pu in 3 mol/dm <sup>3</sup> HNO <sub>3</sub> added. 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 <sup>3</sup> HNO <sub>2</sub> , the third phase was	chromatography; IR spectrometry, and PMR (1). The materials, HNO <sub>3</sub> , TBP were C. P. Nothing specified for $Pu(NO_3)_4$ . ESTIMATED ERROR: Temperature: precision ±3 K.
3 mol/dm <sup>3</sup> HNO <sub>3</sub> , the third phase was eliminated by back titration. The end point was a single phase.	Analysis of Petroleum and Products, Goskhimizdat, Moscow ( <u>1962</u> ).

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COMPONENTS	:					ORIGINAI	L MEASUREME	NTS:		
(1) Plutonium nitrate; Pu(NO <sub>3</sub> ) <sub>4</sub> ; [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		-	3; [76	597-37-	2]	Zh. Stri	ukt. Khim.,	<u>1988</u> , 3	30, 774 - 787.	
(3) Tri-n- C <sub>12</sub> H <sub>27</sub>				(TBP);		Sov. Rad	diochem., <u>1</u>	<u>989</u> , 734	-787.	
(4) Variou	s iso	paraf	finic	diluen	ts					
EXPERIMENT						of the l	Diluent <sup>a</sup>	in homo	ration, ogeneous ract	
Paraffin	nP	iP	Ar	bp				Pu	HNO,	
	8			°c			°c	g/dm <sup>3</sup>	د د	
nC <sub>12</sub>	100			216.3	0.74	1.36	5 - 9.6	55	0.4	
nC <sub>14</sub>	100			253.5	0.759	1.889	9 5.9	28	0.5	
iC <sub>10</sub> ,mix.		100	<1.3	175-18	0 0.73	36 1.25		108	0.3	
iC <sub>11</sub> ,mix.		100	<1.3	196-20	1 0.79	51 1.30	(-97)-53	79	0.3	
ic <sub>12</sub> ,mix.		100	<1.3	210-21	6 0.76	50 1.56	(-94)-35	61	0.3	
iC <sub>13</sub> ,mix.		100	<1.3	270.5	0.78	2	(-73)-29	39	0.5	
iC <sub>14</sub> ,mix.		100	<1.3	253.6	0.764	2.17	-16	42	0.5	
iC <sub>15</sub> ,mix.		100	<1.3	270.5	0.782	2		39	0.5	
i-RED1	55	45	0.6	190-30	0 0.75	54	-21	43	0.4	
iC <sub>14</sub> +C <sub>12</sub> fr. iRED		100		180-21	.3			94	0.3	
							(Continued	on the r	next page	

<ol> <li>(1) Plutonium nitrate, Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3]</li> <li>(2) Nitric acid; HNO<sub>3</sub>; [7697-37-2]</li> </ol>	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. Zh. Strukt. Khim., <u>1988</u> , 30, 774 - 787
(3) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Sov. Radiochem., <u>1989</u> , 734-787.
(4) Various isoparaffinic diluents	

EXPERIMENTAL VALUES: (Continued)

Concentration, in homogeneous extract

	Composition and Properties of the Diluent					Composition			iluent"		
Paraffin	nP	iP	Ar	bp	dens.	visc.	mp	Pu	HNO3		
	%	¥	જ	°c	g/cm <sup>3</sup>	ср	°c	g/cm <sup>3</sup>	mol/dm <sup>3</sup>		
ic <sub>13</sub> +c <sub>14</sub>		-									
fr. iRED	مت من ہے	100		230-24	0			67	0.44		
iC <sub>14</sub> +C <sub>15</sub>		100		240-26	0			55	0.48		
RED1	100				754	2.02	-4.0	<35	0.49		

<sup>a</sup>Notation: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:	ORIGINAL MEASUREMENTS:		
<ol> <li>Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3]</li> <li>Nitric acid; HNO<sub>3</sub>; [7697-37-2]</li> <li>Diethylene glycol dibutyl ether; (Butex); C<sub>12</sub>H<sub>26</sub>O<sub>3</sub>; [112-73-2]</li> <li>Water; H<sub>2</sub>O; [7732-18-5]</li> </ol>	Dawson, J. K. AERE C/M 92 Report, Harwell, <u>1950.</u>		
VARIABLES:	PREPARED BY:		
Time of equilibration	L. Fuks; S. Siekierski		

### EXPERIMENTAL VALUES:

The solubility of  $Pu(NO_3)_4$  in  $C_4H_9OCH_2CH_2OCH_2CH_2OC_4H_9$  at  $35^{O}C$ conditioned to 0.1 mol/dm<sup>3</sup> HNO, 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.

The solubility of plutonium(IV) at 25°C in butex conditioned with 1.5 mol/dm<sup>3</sup> HNO<sub>3</sub> was reported to be 5.6 g plutonium per liter of solution.

### 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 Temperature: Nothing specified. 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).

#### REFERENCES:

1. Mandelberg, C. J.

AERE C/R 582 Report.

COMPONENTS:	ORIGINAL MEASUREMENTS:
<ol> <li>Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3]</li> <li>Pyridine nitrate; C<sub>5</sub>H<sub>6</sub>N<sub>2</sub>O<sub>3</sub>; [110-86-1]</li> <li>Nitric acid; HNO<sub>3</sub>; [7697-37-2]</li> <li>Water; H<sub>2</sub>O; [7732-18-5]</li> </ol>	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> ).
VARIABLES: One temperature: 301 K	PREPARED BY: L. Fuks; S. Siekierski

EXPERIMENTAL VALUES:

The solubility of dipyridine plutonium(IV) hexanitrate 14(?) hydrate,  $(C_5H_5NH)_2Pu(NO_3)_6.14(?)H_2O$ , was reported to be approximately 2 g per liter of the mother liquor of the composition given in the PROCEDURE.

# AUXILIARY INFORMATION

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METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
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 mol/dm <sup>3</sup> HNO <sub>3</sub> . Slow rotations of the solution in a centrifuge cone tended to give equilibrium in	(C <sub>5</sub> H <sub>5</sub> NH) <sub>2</sub> Pu(NO <sub>3</sub> ) <sub>6</sub> .14(?)H <sub>2</sub> O was found to contain 23.4 mass % of plutonium (calc. 23.4 mass %). The crystals melted without decompo- sition at 110 <sup>°</sup> C.
 solubility. The crystals were filtered by suction under vacuum on a sintered pyrex dish, dried in vacuum at room temperature, dried under a	ESTIMATED ERROR: Nothing specified.
-	REFERENCES: 1. Anderson, H. H. Report ANL-4062.

COMPONENTS:	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 ( <u>1949</u> ).		
<pre>(1) Plutonium nitrate; Pu(NO<sub>3</sub>)<sub>4</sub>; [13823-27-3]</pre> (2) Quinoline nitrate; C <sub>9</sub> H <sub>8</sub> N <sub>2</sub> O <sub>3</sub> ; [91-22-5] (3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]			
(4) Water; H <sub>2</sub> O; [7732-18-5]			
VARIABLES:	PREPARED BY:		
One temperature: 301 K	L. Fuks; S. Siekierski		
EXPERIMENTAL VALUES: The solubility of diquinoline pl	utonium(IV) hexanitrate,		

 $(C_{9}H_{7}NH)_{2}Pu(NO_{3})_{6}$ , at 28<sup>o</sup>C was reported to be 0.50 g/L of plutonium of the mother liquor with the composition given in the PROCEDURE.

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF CHEMICALS:
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 <sup>2</sup> in HNO <sub>3</sub> . 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	(C <sub>9</sub> H <sub>7</sub> NH) <sub>2</sub> Pu(NO <sub>3</sub> ) <sub>6</sub> was found to contain 27.2 mass % of plutonium (calc. 27.4 mass %).
	ESTIMATED ERROR:
under vacuum at room temperature, and analyzed (1).	Nothing specified.
anaryzeu (1).	
	REFERENCES:
	1. Anderson, H. H. Report ANL-4062.

COMPONENTS: (1) Plutonium r (2) Di-n-butyl (DBHP); Cgl (3) Nitric acid (4) Water; H <sub>2</sub> O VARIABLES: T/K = 293 to 29	hydrogen ph 1 <sub>19</sub> 0 <sub>4</sub> P ; [10 1; HNO <sub>3</sub> ; [76 ; [7732-18-5	osphate 7-66-4] 97-37-2]	Sokhina, L Radiokhim.	F. A.; Belya . P.; Solovk , <u>1979</u> , <i>21</i> , chem., <u>1979</u> , :	in, A. S. 920-922.
EXPERIMENTAL VA Table 1. Th	The Pu(NO <sub>3</sub> ) Ne molar rat	5	HNO <sub>3</sub> - H <sub>2</sub> O S (HA) to Pu in ration.		es as a
Volume of solutions mixing, ml	before	Concenti decanta	ration in ates, g/L		io DBHP/Pu
Pu(III)	DBHP	Pu(III)	DBHP	Initial Solution	Precipitate
			mol/dm <sup>3</sup> HNO	······	
10 10 10 10 10	0.8 2.4 4.8 7.2 9.6	0.0025 .50 g/L, 1.9 0.40 0.31 0.16 0.10 0.03	1.66 2.12 2.07 2.30 5 mol/dm <sup>3</sup> HN 0.24 0.56 0.88 1.28 1.44 0 mol/dm <sup>3</sup> HN 0.34 0.64 1.14 1.73 2.02	33.6 03 1.00 3.00 6.00 8.98 11.9 03 1.00 3.19 6.00 8.86 11.9	3.03 2.73 2.66 3.40 2.63 3.02 6.20 5.83 6.09 6.22 3.40 6.00 6.55 6.02 6.33
		·····	(Con	tinued on th	e next page)
		AUXILIARY IN	NFORMATION		
METHOD/APPARATUS/PROCEDURE: The valence state of Pu(III) was monitored spectrophotometrically. PuA <sub>3</sub> or Pu <sub>3</sub> .3HA were precipitated from nitric acid solutions by mixing the solution of $Pu(NO_3)_3$ in $HNO_3$ , and DBHP solutions.		<ol> <li>Di-n-buty 98.8% put</li> <li>Pu(III) n reduction hydrazing or reduct nitrate</li> </ol>	-	phosphate, ared by H <sub>2</sub> O <sub>2</sub> with 6M HNO <sub>3</sub> drazine <sup>3</sup>	
REFERENCES:				g specified.	

COMPONENTS:		ORIGINAL M	EASUREMENTS	:	
<pre>(1) Plutonium nitrate; Pu(NO3);</pre>		Bogdanov, F. A.; Belyaeva, T. B.; Sokhina, L. P.; Solovkin, A. S.			
(2) Di-n-butyl hydrogen phosphate (DBHP); C <sub>8</sub> H <sub>19</sub> O <sub>4</sub> P; [107-66-4]		Radiokhim., <u>1979</u> , 21, 920-922.			
(3) Nitric ac	id; HNO <sub>3</sub> ; [76	597-37-2]	Sov. Radio	ochem., <u>1979</u>	<u>9</u> , <i>21</i> , 786.
(4) Water; H <sub>2</sub>	0; [7732-18-5	5]			
EXPERIMENTAL	VALUES: (Cont	inued)			
	·				
	The molar rat function of H			ln precipita	ates as a
Volume o	f initial	Concent	ration in	Molar ra	atio DBHP/Pu
solution mixing,	s before mL	decanta	ites, g/L	· · · · · · · · · · · · · · · · · · ·	
Pu(III)	DBHP	Pu(III)	DBHP	Initial Solution	Precipitate
HA = 7.	30 g/L, Pu =	0.50 g/L, 4.	.5 mol/dm <sup>3</sup> 1	ню <sub>з</sub>	. <del></del>
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 =3.0	0  g/L,  Pu = 1	.51 g/L, 6.0	) mol/dm H	10 <sub>3</sub>	
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		6.20
0.5 0.5	7.0 8.0	0.077 0.056	2.66 2.64	31.5 36.0	5.71 6.18
COMMENT	AND/OR ADDITI	ONAL DATA:			
6 mol/dm formed w The comp formula	<sup>4.5</sup> HNO <sub>3</sub> s solution of ith the ratic osition of th PuA <sub>3</sub> .3HA. The ght-violet po	HNO <sub>3</sub> with to of DBHP/Pu he precipitate precipitate	the ratio = in the prec te could be with the f	= 2-36, a pr cipitate clo represented formula PuA.	recipitate bse to 6. 1 by the , was a
	ght-violet po	wder; the Pu	1A <sub>3</sub> .3HA was	a resinous	material.
loose li					
loose II					
10050 II					
loose II					

		r	
COMPONENTS:		ORIGINAL MEASUREMENTS: Vogler, S.; Grosvenor, D. E.; Lewitz, N. M.	
(1) Plutonium nitrate; Pu(NO <sub>3</sub> ) <sub>4</sub> ; [13823-27-3]			<u>1972</u> , ANL-7917.
(2) Plutonyl nitrate; PuO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [22853-0-5]			
(3) Nitric acid; HNO <sub>3</sub> ; [76			
(4) Water; H <sub>2</sub> O; [7732-18-5	5]		······································
VARIABLES: Composition and temperature		PREPARED	) BY: nski; S. Siekierski
EXPERIMENTAL VALUES:			
The UO <sub>2</sub> (NO <sub>3</sub> )	2 - Pu(NO <sub>3</sub> )	а - нио <sub>3</sub>	- H <sub>2</sub> O System
Composi	tion of Satu	urated Sc	olutions <sup>b</sup>
	U	Pu	ниоз
t/ <sup>o</sup> c mol	./dm <sup>3</sup>	mol/dm <sup>3</sup>	mol/dm <sup>3</sup>
1.5 0.	.70	0.70	3.4
	28	0.34	2.0
5.3 0.		0.42	3.4
10.2 12.6 <sup>c</sup> 1.		0.28 0	3.4 3.4
13.2 1.		0.2	2.0
15.2 1.		0.34	3.4
15.5 1.		0.34	2.0
17.6 1.		0.28	4.8
18.0 1.		0.4	2.0
20.8 1.		0.34	4.8
<sup>a</sup> See Comments, next page.			
<sup>b</sup> Solid phase = $UO_2(NO_3)_2.6H_2O.$			
CExtrapolated from Dillon's data (1). (Continued on the next page)			
AUXILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE: Synthetic method used. Test solution prepared from stock solutions of 2.52 mol/dm <sup>3</sup> uranyl nitrate, 1.5 mol/dm <sup>3</sup> plutonium nitrate, 16 mol/dm <sup>3</sup> 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.			ND PURITY OF MATERIALS: g specified.
		Solubili determin solution Temperat	ty: Crystallization point ed 2 or 3 times for each
		1. Dillo	n, I. Private Communication,

COMI	PONENTS:	ORIGINAL MEASUREMENTS: Vogler, S.; Grosvenor, D. E.; Lewitz, N. M.
(1)	Plutonium nitrate; Pu(NO <sub>3</sub> ) <sub>4</sub> ; [13823-27-3]	Report, <u>1972</u> , ANL-7917.
(2)	Plutonyl nitrate; PuO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [22583-0-5]	
(3)	Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	
(4)	Water; H <sub>2</sub> O; [7732-18-5]	

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) Neptunyl nitrate; NpO_(NO_)_;	ORIGINAL MEASUREMENTS: LaChapelle, T. J.;Magnusson, L. B.; Hindman, J. C.			
(1) Neptunyl nitrate; NpO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ; [66320-31-8]	Paper 15.6 in "The Transuranium Elements," Nat. Nucl. Energy Ser.,			
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	Div. IV, Vol. 14B, McGraw-Hill Book Co., New York ( <u>1949</u> ), 1097-1110.			
(3) Water; H <sub>2</sub> O; [7732-18-5]				
VARIABLES:	PREPARED BY:			
One acid concentration	L. Fuks; S. Siekierski			
EXPERIMENTAL VALUES:				
The solubility of neptunyl nitrate	in 0.2 mol/dm <sup>3</sup> HNO was			
reported to be greater than 38 g/L	J			
The initial solid was neptunyl nit				
AUXILIARY IN	1			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:			
Nothing specified.	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 <sub>2</sub> NO <sub>3</sub> ;	ORIGINAL MEASUREMENTS: LaChapelle, T. J.;Magnusson, L. B. Hindman, J. C.
[17118-09-1]	Paper 15.6 in "The Transuranium
	Elements," Nat. Nucl. Energy Ser., Div. IV, Vol. 14B, McGraw-Hill Book Co., New York ( <u>1949</u> ),
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]	1097-1110.
(3) Water; H <sub>2</sub> O; [7732-18-5]	
VARIABLES:	PREPARED BY:
Three acid concentrations	L. Fuks; S. Siekierski
EXPERIMENTAL VALUES:	
The solubility of neptunium(V) in	n 0.5 mol/dm <sup>3</sup> HNO <sub>3</sub> was reported
to be at least 2.5 g/L. The solu	bility exceeds 8 g/L in 1 mol/dm <sup>3</sup>
HNO <sub>3</sub> , and is greater than 50 g/L	_
5	5
AUXILIARY I	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF CHEMICALS:
Nothing specified.	Neptunium(V) nitrate solution was
Nothing specified.	(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:	EVALUATOR:	
(1) Neptunium nitrate; Np(NO <sub>3</sub> ) <sub>4</sub> ; [25933-53-3]	LaChapelle, T.J.;Magnusson, L.B.; Hindman, J.C.	
(2) Nitric acid; HNO <sub>3</sub> ; [7697-37-2] (3) Water; H <sub>2</sub> O; [7732-18-5]	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:	PREPARED BY:	
Two acid concentrations	L. Fuks; S. Siekierski	
EXPERIMENTAL VALUES:		

The solubility of neptunium(IV) nitrate in approximately  $5 \text{ mol/dm}^3$ HNO<sub>3</sub> was reported to be at least 300 g/L. The solubility in 4 mol/dm<sup>3</sup> nitric acid was greater than 80 g/L.

The initial solid was neptunium(IV) nitrate hydrate of unknown water content.

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Nothing specified.	Neptunium(IV) nitrate solution was obtained by dissolving Np(IV) hydroxide in nitric acid at temperatures below 30°C. No additional information was given.
	ESTIMATED ERROR:
	Nothing specified.
	REFERENCES :

COMPONENTS:	ORIGINAL MEASUREMENTS:	
<pre>(1) Neptunyl nitrate; NpO2(NO3)2; [66320-31-8]</pre>	Fedorov, Yu. S.; Zil'berman, B. Ya.	
(2) Tri-n-butyl phosphate (TBP); C <sub>12</sub> H <sub>27</sub> O <sub>4</sub> P; [126-73-8]	Radiokhim., <u>1988</u> , 30, 572-576. Sov. Radiochem., <u>1989</u> , 546-550.	
(3) Nitric acid; HNO <sub>3</sub> ; [7697-37-2]		
(4) Water; H <sub>2</sub> O; [7732-18-5]		
VARIABLES:	PREPARED BY:	
T/K = 293	S. L. Phillips	
EXPERIMENTAL VALUES:		
The distribution of $NpO_2(NO_3)_2$	between HNO <sub>3</sub> solutions and a	
	the presence of solid UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	
is given in the form of a figur		
The distribution of NpO <sub>2</sub> NO <sub>3</sub> bet		
30% solution of TBP in CCl <sub>4</sub> in	5	
is given in the form of a figur		
The distribution of $Np(NO_3)_4$ be		
30% solution of TBP in $CCl_4$ in	0	
is given in the form of a figur		
COMMENTS AND/OR ADDITINAL DATA: The saturating solid phase was UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> .		
AUXILIARY I	NFORMATION	
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:	
The initial concentration of <sup>237</sup> Np was 0.0002 mol/dm <sup>2</sup> . Content of Np was determined radiometrically. No	Nothing specified.	
further details given, but the procedure probably followed that	ESTIMATED ERROR:	
used in prior study (1).	Nothing specified.	
	REFERENCES: 1. Fedorov,Yu.S.; Zil'berman,B.Ya. Radiokhim., <u>1986</u> , 28, 37.	

COMPONENTS:	<u> </u>	ORIGINAL MEA	SUREMENTS:
(1) Americium nitrate; Am(NO <sub>3</sub> ) [25933-53-3]	3'	Bogdanov, F	. A.; Belyaeva, T. B.; P.; Solovkin, A. S.
(2) Di-n-butyl hydrogen phosph (DBHP); C <sub>8</sub> H <sub>19</sub> PO <sub>4</sub> ; [107-66-	ate		<u>1979</u> , <i>21</i> , 920-922.
(3) Nitric acid; HNO <sub>3</sub> ; [7697-3		Sov. Radioc	hem., <u>1979</u> , 21, 786.
(4) Water; H <sub>2</sub> O; [7732-18-5]			
VARIABLES:		PREPARED BY:	
T/K = 293-296		S. L. Philli	ps
EXPERIMENTAL VALUES:		······	
The Am(NO <sub>3</sub> ) <sub>3</sub> -	DBHP - 1	нио <sub>3</sub> - н <sub>2</sub> о sy	stem
Table 1. The molar ratio of formed by mixing	of DBHP 3.0 mol	(HA) to Am in /L HNO <sub>3</sub> of DB	precipitates HP and Am(III)
Molar ratio of	Concent decant	ration in ates	
DBHP to Am in	DBHP g/L	Am(III) mg/L	Molar ratio DBHP/Am in precipitates
	0.063 0.42 1.76 3.41	0.75 0.002 0.001 0.001	3.2 2.8 3.2 3.1
Table 2. The solubility of as a function of	AmA <sub>3</sub> a HNO <sub>3</sub> co	t room temper ncentration	ature, 20-23 <sup>0</sup> C,
ниоз		AmA 3	
mol/dm <sup>3</sup>		mg/L	
0.01		24	
1.0 3.0		30 53	
6.0 11.6		87 200	
AUXILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE: SOURCE AND PURITY OF MATERIALS:			
Americium(III) di-n-butyl phosphate was obtained by mixing solutions of		98.8% pur	-
DBHP (6.4 g/L) and Am(III) (2.10 g/L) in a 3.0 mol/L HNO, solution. The resulting precipitate was a light pink amorphous powder.		2. Am(III) n specified	itrate, nothing •
REFERENCES :		ESTIMATED ER Nothing sp	
L		1	······································

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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 nitrateappears 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'-oxybishexane 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) E317, 345-348 + nitric acid + phosphoric acid, tributyl ester E317, 348 + water E317, 345-348 Nitric acid, americium salt (multicomponent) E317, 349 + nitric acid + phosphoric acid, dibutyl ester E317, 349 E317, 349 + water Nitric acid, plutonium salt (aqueous) + ethanol E316, 329 + kerosine E317, 330 E316-E319, 324 + nitric acid E317, 331 + phosphoric acid, tributyl ester Nitric acid, plutonium salt (multicomponent) + decane 335 + decane isomers 336 + diethylene glycol dibutyl ether 338 336 + dodecane + dodecane isomers 336 + hydrocarbons 336, 337 + kerosine 334 E316-E319, 325-328, + nitric acid 332-333, 335-344 + nitric acid, cesium salt E316, E317, 327 E316-E319, 325 + nitric acid, potassium salt E316, E317, 326 E316, E317, 328 + nitric acid, rubidium salt + nitric acid, thallium salt
+ pentadecane isomers 336 + phosphoric acid, dibutyl ester + phosphoric acid, tributyl ester E317, 332, 341, 342 E317, 333-337 + plutonium, bis(nitrato-O)dioxo-, (T-4)343, 344 + pyridine nitrate 339 + quinoline nitrate 340 + tetradecane 336 336 + tetradecane isomers + tridecane isomers 336 + undecane isomers 336 + water E316-E319, 324-334

> E259-E261, 294 E259-E261, 295 E259-E261, 287

E259-E261, 287

Nitric acid, thorium salt (aqueous)

+ acetic acid, butyl ester

+ acetic acid, ethenyl ester + acetic acid, ethyl ester + acetic acid, methyl ester

<pre>Nitric acid, thorium salt (aquecus)</pre>				
<pre>+ acetic acid, 2=methylpropyl ester E253=2261, 295 + acetic acid, pentyl ester E253=2261, 295 + isoanyl ether E253=2261, 296 + amylphenol ether E253=2261, 290 + benzenamine E253=2261, 290 + benzenamine E253=2261, 290 + benzenacic acid, ethyl ester E253=2261, 290 + benzoic acid, l=thyl ester E253=2261, 294 + benzoic acid, pentylethyl ester E253=2261, 294 + benzoic acid, phenylethyl ester E253=2261, 295 + bromobenzene E253=2261, 295 + bromochane E253=2261, 296 + 1-bromo-7=methylbutane E253=2261, 297 + butanoic acid, entyl ester E253=2261, 297 + butanoic acid, dityl ester E253=2261, 297 + chlorochanol E253=2261, 297 + 2-chloro-4, 6-ditertamylphenol E253=2261, 297 + 2-chloro-4, 6-ditertamylphenol E253=2261, 296 + 1-chloro-1-nitropropane E253=2261, 296 + 1-chloro-1-nitropropane E253=2261, 296 + 1-chloro-2-nitropropane E253=2261, 296 + 1-chloro-2-nitropropane E253=2261, 296 + diamylphenol E253=2261, 295 + diamylorachane E253=2261, 295 + diamylorachane E253=226</pre>	Nitric acid, thorium salt (aqueous)			
<pre>     Acetic Acid, pentyl ester E239-E261, 239     Acetophenone E239-E261, 239     Acetophenone E239-E261, 230     Acetophenone E239-E261, 232     Acetophenone E239-E261, 233     Acetophenone E239-E261, 234     Acetophenone E239-E261, 235     Acetophenone E239-E261, 239     Acetophenone E239-E261, 230     Acetoph</pre>	+ acetic acid, 1-methylethyl ester	E259-E261,	294	
<pre>     Acetic Acid, pentyl ester E239-E261, 239     Acetophenone E239-E261, 239     Acetophenone E239-E261, 230     Acetophenone E239-E261, 232     Acetophenone E239-E261, 233     Acetophenone E239-E261, 234     Acetophenone E239-E261, 235     Acetophenone E239-E261, 239     Acetophenone E239-E261, 230     Acetoph</pre>	+ acetic acid, 2-methylpropyl ester	E259-E261,	294	
<pre>+ iscampleter E259-E261, 282 + benzene</pre>	+ acetic acid, pentyl ester	E259-E261,	295	
<pre>+ amylphenol ether E259-2261, 290 + benzenemine E259-2261, 290 + benzene E259-2261, 297 + benzoic acid, ethyl ester E259-2261, 297 + benzoic acid, 1-methylethyl ester E259-2261, 294 + benzoic acid, 2-phenylethyl ester E259-2261, 294 + benzoic acid, phenylethyl ester E259-2261, 294 + benzoic acid, phenylethyl ester E259-2261, 294 + benzoic acid, phenylethyl ester E259-2261, 295 + l-bromobenzene E259-2261, 296 + l-bromo-2-ethoxyethane E259-2261, 296 + l-bromo-3-methylbutane E259-2261, 296 + l-bromopoxylbenzene E259-2261, 297 + butanoic acid, ethyl ester E259-2261, 297 + butanoic acid, diethyl ester E259-2261, 297 + butanoic acid, diethyl ester E259-2261, 297 + butyl carbitol E259-2261, 297 + carbonic acid, diethyl ester E259-2261, 297 + carbonic acid, diethyl ester E259-2261, 297 + 2-butanone E259-E261, 297 + 2-butanone E259-E261, 297 + carbonic acid, diethyl ester E259-E261, 297 + 2-chloro-4, 6-disertamylphenol E259-E261, 296 + 1-chloro-1-nitroptane E259-E261, 296 + 1-chloro-1-nitroptane E259-E261, 296 + 1-chloro-1-nitroptane E259-E261, 296 + 1-chloro-1-nitroptane E259-E261, 296 + cyclohexanon E259-E261, 297 + dibutyl carbitol E259-E261, 296 + 1,2-didhorobenzene E259-E261, 296 + 1,2-didhorobenzene E259-E261, 296 + 1,2-didhorobenzene E259-E261, 297 + dibutyl carbitol E259-E261, 296 + 1,2-didhorobenzene E259-E261, 297 + dibutyl carbitol E259-E261, 296 + 1,2-didhorobenzene E259-E261, 296 + 1,2-didhorobenzene E259-E261, 296 + 1,2-didhorobenzene E259-E261, 296 + 1,2-didhorobenzene E259-E261, 297 + dibutyl carbitol E259-E261, 297 + didhlorochenem E259-E261, 297 + didhlorochenem E259-E261, 291 + didhlorochenem E259-E261, 291 + didhlorochenem E259-E261, 291 + didhlorochenem E259-E261, 295 + didhlorochenem E259-E261, 291 + didhlorochenem E259-E261, 291 + di</pre>				
+ benzene         E259-E261, 290, 297           + benzene ceid, ethyl ester         E259-E261, 297           + benzoic acid, implyletyl ester         E259-E261, 297           + benzoic acid, l-methyletyl ester         E259-E261, 297           + benzoic acid, phenylethyl ester         E259-E261, 295           + benzoic acid, phenylmethyl ester         E259-E261, 295           + benzoic acid, phenylmethyl ester         E259-E261, 295           + benzoic acid, phenylmethyl ester         E259-E261, 295           + bormoethane         E259-E261, 295           + bromoethane         E259-E261, 295           + bromoethane         E259-E261, 295           + 1-bromo-3-methylbutane         E259-E261, 297           + butanoic acid, eptyl ester         E259-E261, 297           + butanoic acid, pentyl ester         E259-E261, 297           + butanoic acid, gentyl ester         E259-E261, 297           + butanoic acid, dithyl ester         E259-E261, 297           + butyl cellosolve oleate         E259-E261, 297           + butyl cellosolve oleate         E259-E261, 297           + chloromethylbenzene         E259-E261, 297           + chloromethylbenzene         E259-E261, 297           + chloromethylbenzene         E259-E261, 297           + chloromethylbenzene         E2				
<pre>+ benzene</pre>				
<pre>+ benzoic zcid, t-methylethyl ester E259-E261, 287 + benzoic zcid, 2-phenylethyl ester E259-E261, 284 + benzoic zcid, phenylmethyl ester E259-E261, 284 + benzoic zcid, phenylmethyl ester E259-E261, 286 + 1,2-bis (2-chloroethoxy) ethane E259-E261, 280 + bromobenzene E259-E261, 280 + bromoethane E259-E261, 280 + 1-bromo-2-ethoxyethane E259-E261, 287 + 1-bromo-2-ethoxyethane E259-E261, 287 + 1-bromo-2-ethoxyethane E259-E261, 287 + 1-bromo-2-ethoxyethane E259-E261, 287 + 1-bromo-2-methylbutane E259-E261, 287 + 1-bromo-2-methylbutane E259-E261, 287 + butanaic acid, pentyl ester E259-E261, 287 + butanoic acid, pentyl ester E259-E261, 287 + butanoic acid, pentyl ester E259-E261, 287 + butyl carbitol E259-E261, 287 + chlorobenzene E259-E261, 287 + chlorobenzene E259-E261, 287 + chloroethanol E259-E261, 286 + chloroethylbenzene E259-E261, 286 + cyclohexanol E259-E2</pre>		E259-E261,	290	0.07
<pre>+ benzoic zcid, t-methylethyl ester E259-E261, 287 + benzoic zcid, 2-phenylethyl ester E259-E261, 284 + benzoic zcid, phenylmethyl ester E259-E261, 284 + benzoic zcid, phenylmethyl ester E259-E261, 286 + 1,2-bis (2-chloroethoxy) ethane E259-E261, 280 + bromobenzene E259-E261, 280 + bromoethane E259-E261, 280 + 1-bromo-2-ethoxyethane E259-E261, 287 + 1-bromo-2-ethoxyethane E259-E261, 287 + 1-bromo-2-ethoxyethane E259-E261, 287 + 1-bromo-2-ethoxyethane E259-E261, 287 + 1-bromo-2-methylbutane E259-E261, 287 + 1-bromo-2-methylbutane E259-E261, 287 + butanaic acid, pentyl ester E259-E261, 287 + butanoic acid, pentyl ester E259-E261, 287 + butanoic acid, pentyl ester E259-E261, 287 + butyl carbitol E259-E261, 287 + chlorobenzene E259-E261, 287 + chlorobenzene E259-E261, 287 + chloroethanol E259-E261, 286 + chloroethylbenzene E259-E261, 286 + cyclohexanol E259-E2</pre>	+ benzene	E259-E261,	290,	297
<pre>+ benzoic acid, 2-phenylethyl ester E259-E261, 294 + benzoic acid, phenylmethyl ester E259-E261, 296 + 1,2-bis(2-chloroethoxy)ethane E259-E261, 290 + bromobenzene E259-E261, 290 + bromo-2-ethoxyethane E259-E261, 290 + 1-bromo-2-ethoxyethane E259-E261, 292 + 1-bromo-2-ethoxyethane E259-E261, 292 + 1-bromo-3-methylbutane E259-E261, 297 + butanai E259-E261, 297 + butanai E259-E261, 297 + butanai E259-E261, 297 + butanoic acid, ethyl ester E259-E261, 297 + butanoic acid, ethyl ester E259-E261, 297 + butanoic acid, ethyl ester E259-E261, 287 + butanoic acid, diethyl ester E259-E261, 297 + butyl carbonic acid, diethyl ester E259-E261, 296 + 1-chloro-4.methylbenzene E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + cyclohexanone E259-E261, 296 + diamylphenol E259-E261, 297 + dibutyl carbitol E259-E261, 296 + dichlorodenane E259-E261, 296 + dichloro</pre>	+ benzeneacetic acid, etnyl ester	E259-E261,	287	
<pre>+ benzoic acid, 2-phenylethyl ester E259-E261, 294 + benzoic acid, phenylmethyl ester E259-E261, 296 + 1,2-bis(2-chloroethoxy)ethane E259-E261, 290 + bromobenzene E259-E261, 290 + bromo-2-ethoxyethane E259-E261, 290 + 1-bromo-2-ethoxyethane E259-E261, 292 + 1-bromo-2-ethoxyethane E259-E261, 292 + 1-bromo-3-methylbutane E259-E261, 297 + butanai E259-E261, 297 + butanai E259-E261, 297 + butanai E259-E261, 297 + butanoic acid, ethyl ester E259-E261, 297 + butanoic acid, ethyl ester E259-E261, 297 + butanoic acid, ethyl ester E259-E261, 287 + butanoic acid, diethyl ester E259-E261, 297 + butyl carbonic acid, diethyl ester E259-E261, 296 + 1-chloro-4.methylbenzene E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + cyclohexanone E259-E261, 296 + diamylphenol E259-E261, 297 + dibutyl carbitol E259-E261, 296 + dichlorodenane E259-E261, 296 + dichloro</pre>	+ benzoic acid, etnyl ester	E259-E201,	201	
<pre>+ benzyi alcohol E259-E261, 294 + benzyi alcohol E259-E261, 295 + bromobenzene E259-E261, 290 + bromobenzene E259-E261, 290 + bromobenzene E259-E261, 290 + l-bromo-3-methylbutane E259-E261, 292 + l-bromopyridine E259-E261, 292 + l-bromopyridine E259-E261, 297 + butanoic acid, ethyl ester E259-E261, 297 + butanoic acid, pentyl ester E259-E261, 285 + l-butanoic acid, ethyl ester E259-E261, 287 + butanoic acid, pentyl ester E259-E261, 287 + butanoic acid, diethyl ester E259-E261, 287 + butanoid acid, diethyl ester E259-E261, 287 + butyl calbosolve oleate E259-E261, 287 + carbonic acid, diethyl ester E259-E261, 287 + carbonic acid, diethyl ester E259-E261, 287 + carbonic acid, diethyl ester E259-E261, 287 + chlorobenzene E259-E261, 287 + chlorobenzene E259-E261, 286 + c-chloro-4, 6-difertamylphenol E259-E261, 286 + c-chloro-4-methylbenzene E259-E261, 286 + 1-chloro-1-nitropropane E259-E261, 286 + cyclohexanol E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 286 + cyclohexanon E259-E261, 296 + 1,2-ditorodenzene E259-E261, 296 + dichlorodiethylene E259-E261, 296 + 1,2-ditorodenzene E259-E261, 296 + dichlorodiethylene E259-E261, 296 + dichlorodiethylene E259-E261, 296 + dichlorodiethylene E259-E261, 296 + dichlorodenzene E2</pre>	t benzoic acid 2-phenulethul ester	E259 - E201, E259 - E261	294	
<pre>+ benzy1 alcohol E259-E261, 286 + bromobenzene E259-E261, 290 + bromoethane E259-E261, 290 + 1-bromo-2-ethoxyethane E259-E261, 290 + 1-bromo-3-methylbutane E259-E261, 292 + 1-bromo-3-methylbutane E259-E261, 292 + 2-bromopyrodine E259-E261, 292 + butanoic acid, ethyl ester E259-E261, 295 + butanoic acid, pentyl ester E259-E261, 287 + butanoic acid, pentyl ester E259-E261, 287 + butanoic acid, pentyl ester E259-E261, 289 + butanoic acid, pentyl ester E259-E261, 289 + butanoic acid, diethyl ester E259-E261, 289 + z-butanone E259-E261, 287 + aboutyl carbitol E259-E261, 287 + carbonic acid, diethyl ester E259-E261, 287 + chlorobenzene E259-E261, 287 + chlorobenzene E259-E261, 287 + chlorobenzene E259-E261, 287 + 2-chloroc+1.anol E259-E261, 287 + 2-chloroc-4.6-ditertamylphenol E259-E261, 290 + 1-chloro-1-nitroethane E259-E261, 296 + 1-chloro-1-nitroethane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + chloromethylbenzene E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 2-chloro-2-nitropropane E259-E261, 296 + cyclohexanon E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + chloromethylbenzene E259-E261, 296 + chloromethylbenzene E259-E261, 296 + cyclohexanon E259-E261, 297 + diamylphenol E259-E261, 297 + diamylphenol E259-E261, 296 + 2,3-dibromo-thane E259-E261, 297 + diabutyl callocolve E259-E261, 291 + dichlorotehane E259-E261, 292 + dichlorotehane E259-E261, 296 + dichloromethane E259-E261, 296 + dichlorotehane E259-E261, 296 + dich</pre>	+ benzoic acid, z-phenylethyl ester	E259-E201, E259-E261	294	
+ 1,2-bis(2-chloroethoxy)ethane       E259-E261, 296         + bromobenzene       E259-E261, 290         + bromoethane       E259-E261, 292         + 1-bromo-2-ethoxyethane       E259-E261, 292         + 1-bromo-3-methylbutane       E259-E261, 297         + (3-bromopropoxy)benzene       E259-E261, 297         + butanal       E259-E261, 287         + butanoic acid, ethyl ester       E259-E261, 287, 299         + butanoic acid, ethyl ester       E259-E261, 287, 299         + butanoic acid, denyl ester       E259-E261, 287, 299         + butyl carbitol       E259-E261, 287, 299         + isobutyl carbitol       E259-E261, 287, 290         + carbonic acid, diethyl ester       E259-E261, 287         + chlorobenzene       E259-E261, 287         + chlorobenzene       E259-E261, 290         + 1-chloro-3-ethylbenzene       E259-E261, 290         + 1-chloro-1-nitroethane       E259-E261, 296         + 1-chloro-2-nitropropane       E259-E261, 296         + cyclohexanol       E259-E261, 296         + cyclohexanol       E259-E261, 297         + decanedioic acid, dibutyl ester       E259-E261, 296         + 1-chloro-2-nitropropane       E259-E261, 296         + 1,2-dibromoethane       E259-E261, 297         <	+ benzul alcohol	E259-E261,	286	
<pre>+ bromobenzene E259=E261, 290 + bromoothane E259=E261, 290 + 1-bromo-2-ethoxyethane E259=E261, 292 + 1-bromo-3-methylbutane E259=E261, 292 + 2-bromopyrojoxylbenzene E259=E261, 292 + 2-bromopyrojoxylbenzene E259=E261, 297 + butanal E259=E261, 297 + butanoic acid, ethyl ester E259=E261, 287, 299 + butanoic acid, ethyl ester E259=E261, 287, 299 + butyl carbitol E259=E261, 287 + carbonic acid, diethyl ester E259=E261, 287 + chlorobenzene E259=E261, 287 + 2-chloro-4,6-ditertamylphenol E259=E261, 286, 290 + 1-chloro-3-methylbenzene E259=E261, 286 + chloromethylbenzene E259=E261, 296 + 1-chloro-1-nitropropane E259=E261, 296 + 1-chloro-2-nitropropane E259=E261, 286 + cyclohexanone E259=E261, 286 + diamylphenol E259=E261, 286 + dichlorodenzene E259=E261, 286 + 1,2-dithorobenzene E259=E261, 286 + dichlorodenzene E259=E261, 286 + dichlorodenzene E259=E261, 286 + cyclohexanone E259=E261, 286 + cyclohexanone E259=E261, 286 + cyclohexanone E259=E261, 286 + cyclohexanone E259=E261, 286 + dichlorodenzene E259=E261, 296 + dichlorodenze</pre>				
+ bromeethane         E259-E261, 290           + 1-bromo-3-methylbutane         E259-E261, 292           + 1-bromo-3-methylbutane         E259-E261, 292           + (3-bromopropoxylbenzene         E259-E261, 297           + butanoic acid, ethyl ester         E259-E261, 297           + butanoic acid, ethyl ester         E259-E261, 287, 299           + butanoic acid, ethyl ester         E259-E261, 287           + butanoic acid, dentyl ester         E259-E261, 287           + butanoic acid, diethyl ester         E259-E261, 287           + butyl carbitol         E259-E261, 294           + carbonic acid, diethyl ester         E259-E261, 294           + carbonic acid, diethyl ester         E259-E261, 296           + 2-chloro-4, 6-ditertamylphenol         E259-E261, 296           + 2-chloro-4, 6-ditertamylphenol         E259-E261, 296           + 1-chloro-3-ethylbenzene         E259-E261, 296           + 1-chloro-1-nitropropane         E259-E261, 296           + 1-chloro-2-nitropropane         E259-E261, 296           + 2,3-dibromo-1-propanol         E259-E261, 296           + 1,2-dibromoethane         E259-E261, 297           + diamylphenol         E259-E261, 296           + 1,2-dibromoethane         E259-E261, 297           + dibutyl carbitol         E259-E261, 29				
+ 1-bromo-2-ethoxyethane       E259-E261, 292         + 1-bromo-3-methylbutane       E259-E261, 292         + 1-bromopropoxylbenzene       E259-E261, 292         + 2-bromopropoxylbenzene       E259-E261, 292         + butanal       E259-E261, 293         + butanoic acid, ethyl ester       E259-E261, 285         + 1-butanol       E259-E261, 285         + 1-butanol       E259-E261, 285         + 1-butanol       E259-E261, 287         + butyl carbitol       E259-E261, 287         + butyl cellosolve oleate       E259-E261, 287         + carbonic acid, diethyl ester       E259-E261, 287         + 2-chloro-4, 6-ditertamylphenol       E259-E261, 287         + 2-chloro-4-acit, diethylbenzene       E259-E261, 286         + 1-chloro-1-nitropropane       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 286         + cyclohexanol       E259-E261, 286         + cyclohexanone       E259-E261, 286         + cyclohexanone       E259-E261, 286         + cyclohexanone       E259-E261, 297         + dichlorodenzene       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + cyclohexanone       E259-E261, 297         + cyclohexanone       E259-E261, 296 <td></td> <td>•</td> <td></td> <td></td>		•		
+ 1-bromo-3-methylbutane       E259-E261, 296         + (3-bromopropoxy)benzene       E259-E261, 297         + 2-bromopyridine       E259-E261, 297         + butanoic acid, ethyl ester       E259-E261, 287, 299         + butanoic acid, pentyl ester       E259-E261, 285         + 1-butanol       E259-E261, 289, 299         + butanoic acid, ethyl ester       E259-E261, 289, 299         + 1-butanol       E259-E261, 287         + 2-butanone       E259-E261, 287         + 2-butanone       E259-E261, 287         + butyl carbitol       E259-E261, 287         + butyl carbitol       E259-E261, 297         + carbonic acid, diethyl ester       E259-E261, 296         + 2-chloro-4, 6-ditertamylphenol       E259-E261, 296         + 1-chloro-3-ethylbenzene       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + cyclohexanon       E259-E261, 296         + cyclohexanon       E259-E261, 296         + cyclohexanon       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + cyclohexanone       E259-E261, 296         + diamylphenol       E259-E261, 296         + dibutyl carbitol       E259-E261		•		
+ (3-bromopropxy)benzene       E259-E261, 292         + 2-bromopyridine       E259-E261, 297         + butanal       E259-E261, 287, 295         + butanoic acid, ethyl ester       E259-E261, 287, 299         + butanoic acid, pentyl ester       E259-E261, 289, 299         + 1-butanol       E259-E261, 289, 299         + 1 sobutyl carbitol       E259-E261, 289, 299         + 1 sobutyl carbitol       E259-E261, 280, 299         + 1 carbonic acid, diethyl ester       E259-E261, 280, 290         + 2-chloro-4, 6-ditertamylphenol       E259-E261, 280, 290         + 1-chloro-3-ethylbenzene       E259-E261, 296, 290         + 1-chloro-4-methylbenzene       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + 1-chloro-2-nitropropane       E259-E261, 296         + cyclohexanon       E259-E261, 296         + cyclohexanon       E259-E261, 296         + diamylphenol       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + dibutyl carbitol       E259-E261, 296         + 1,2-dihromothane       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + dibutyl carbitol       E259-E261, 296	-			
+ 2-bromopyridine       E259-E261, 297         + butanal       E259-E261, 295         + butanoic acid, epntyl ester       E259-E261, 287, 299         + butanoic acid, pentyl ester       E259-E261, 287         + butanoic       E259-E261, 287         + 2-butanone       E259-E261, 287         + 2-butanone       E259-E261, 297         + butyl cellosolve oleate       E259-E261, 297         + carbonic acid, diethyl ester       E259-E261, 296         + chlorobenzene       E259-E261, 296         + 2-chloro-4, 6-ditertamylphenol       E259-E261, 296         + chlorobenzene       E259-E261, 296         + chloro-3-ethylbenzene       E259-E261, 296         + chlorone+Tylbenzene       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + cyclohexanon       E259-E261, 296         + cyclohexanon       E259-E261, 296         + cyclohexanon       E259-E261, 296         + decanedioic acid, dibutyl ester       E259-E261, 297         + dibutyl cellosolve       E259-E261, 297         + dichlorodehane       E259-E261, 297				
<pre>butanal E259-E261, 295 + butanoic acid, ethyl ester E259-E261, 287, 299 + butanoic acid, pentyl ester E259-E261, 285 + 1-butanon E259-E261, 287 + butyl carbitol E259-E261, 287 + butyl cellosolve oleate E259-E261, 287 + carbonic acid, diethyl ester E259-E261, 287 + chlorobenzene E259-E261, 286, 290 + 2-chloro-4, 6-ditertamylphenol E259-E261, 286 + chloromethylbenzene E259-E261, 296 + 1-chloro-1-nitroethane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 1-chloro-2-nitropropane E259-E261, 296 + cyclohexanon E259-E261, 296 + decanedioic acid, dibutyl ester E259-E261, 296 + decanedioic acid, dibutyl ester E259-E261, 296 + decanedioic acid, dibutyl ester E259-E261, 296 + dibutyl carbitol E259-E261, 297 + dichloroethene E259-E261, 291 + dichloroethene E259-E261, 295 + 1,2-dichlorobenzene E259-E261, 295 + 1,2-dichloropenyl ether E259-E261, 295 + 1,2-dichloropenyl ether E259-E261, 295 + dichloromethane E259-E261, 296 + dichloromethyl ether E259-E261, 296 + dichloromethyl ether E259-E261, 296 + dichloromethyl ether E259-E261, 296 + dichloromethyl encore E259-E261, 296 + dichloromethyl ether E259-E261, 296</pre>				
<pre>+ butanoic acid, ethyl ester E259-E261, 287, 299 + butanoic acid, pentyl ester E259-E261, 285 + 1-butanol E259-E261, 285 + 2-butanone E259-E261, 287 + butyl cellesolve oleate E259-E261, 297 + butyl cellesolve oleate E259-E261, 297 + chlorobenzene E259-E261, 297 + 2-chloro-4, 6-ditertamylphenol E259-E261, 296 + 1-chloro-3-ethylbenzene E259-E261, 296 + 1-chloro-4-methylbenzene E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + cyclohexanon E259-E261, 296 + diamylphenol E259-E261, 296 + cyclohexanon E259-E261, 297 + dibutyl carbitol E259-E261, 297 + dibutyl carbitol E259-E261, 297 + dibutyl carbitol E259-E261, 296 + dichloroethane E259-E261, 296 + dichloroethane E259-E261, 295 + dichl</pre>				
<pre>+ butanoic acid, pentyl ester E259-E261, 295 + 1-butanon E259-E261, 285 + 2-butanone E259-E261, 287 + jsobutyl carbitol E259-E261, 294 + carbonic acid, diethyl ester E259-E261, 294 + carbonic acid, diethyl ester E259-E261, 297 + chlorobenzene E259-E261, 296 + 2-chloro-4,6-ditertamylphenol E259-E261, 296 + 1-chloro-3-ethylbenzene E259-E261, 296 + 1-chloro-1-nitroptane E259-E261, 296 + 1-chloro-2-nitroptane E259-E261, 296 + 2-chloro-2-nitroptane E259-E261, 296 + chloromethylbenzene E259-E261, 296 + 2-chloro-2-nitroptane E259-E261, 296 + chloromethylbenzene E259-E261, 296 + 2-chloro-2-nitroptane E259-E261, 296 + chloronethylbenzene E259-E261, 296 + 2-chloro-1-nitroptane E259-E261, 296 + chloro-1-nitroptane E259-E261, 296 + chloro-2-nitroptane E259-E261, 297 + diamylphenol E259-E261, 297 + diamylphenol E259-E261, 297 + diamylphenol E259-E261, 297 + dibutoxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dibutyl carbitol E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + dichlorodiethylbenzene E259-E261, 291 + dichlorodiethylphenyl monophenyl phosphate + dichlorodiethyl ether E259-E261, 295 + dichloroethane E259-E261, 290 + dichloroethyl ether E259-E261, 291 + dichloroethyl ether E259-E261, 295 + dichloroethyl ether E259-E261, 295 + dichloroethyl ether E259-E261, 290 + dichloroethyl ether E259-E261, 296 + dichyleneamine E259-E261, 2</pre>				299
+ 1-butanol       E259-E261, 285         + 2-butanone       E259-E261, 289, 299         + isobutyl carbitol       E259-E261, 297         + butyl cellosolve oleate       E259-E261, 297         + carbonic acid, diethyl ester       E259-E261, 297         + chlorobenzene       E259-E261, 297         + 2-chloro-4, 6-ditertamylphenol       E259-E261, 286, 290         + 1-chloro-3-ethylbenzene       E259-E261, 286, 290         + 1-chloro-3-ethylbenzene       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + cyclohexanol       E259-E261, 296         + cyclohexanol       E259-E261, 296         + decanedioic acid, dibutyl ester       E259-E261, 297         + diamylphenol       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + dichlorodiethylbenzene       E259-E261, 297         + dichlorodiethylbenzene       E259-E261, 297         + dichlorodiethylbenzene       E259-E261, 297         + dichlorodiethylbenzene       E259-E261, 296         + dichloror				
<pre>+ isobutyl carbitol E259-E261, 297 + butyl cellosolve oleate E259-E261, 287 + carbonic acid, diethyl ester E259-E261, 287 + chlorobenzene E259-E261, 287 + 2-chloro-4, 6-ditertamylphenol E259-E261, 286, 290 + 2-chloro-3-ethylbenzene E259-E261, 286 + chloromethylbenzene E259-E261, 296 + 1-chloro-4-methylbenzene E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + cyclohexanol E259-E261, 286 + cyclohexanol E259-E261, 286 + cyclohexanol E259-E261, 296 + decanedioic acid, dibutyl ester E259-E261, 296 + 2,3-dibromo-1-propanol E259-E261, 297 + 1,2-dibromo-1-propanol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dichlorodiethylbenzene E259-E261, 296 + 1,2-dichlorobenzene E259-E261, 296 + dichlorodiethylbenzene E259-E261, 296 + dichyle</pre>		•		
<pre>+ isobutyl carbitol E259-E261, 297 + butyl cellosolve oleate E259-E261, 287 + carbonic acid, diethyl ester E259-E261, 287 + chlorobenzene E259-E261, 287 + 2-chloro-4, 6-ditertamylphenol E259-E261, 286, 290 + 2-chloro-3-ethylbenzene E259-E261, 286 + chloromethylbenzene E259-E261, 296 + 1-chloro-4-methylbenzene E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + cyclohexanol E259-E261, 286 + cyclohexanol E259-E261, 286 + cyclohexanol E259-E261, 296 + decanedioic acid, dibutyl ester E259-E261, 296 + 2,3-dibromo-1-propanol E259-E261, 297 + 1,2-dibromo-1-propanol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dichlorodiethylbenzene E259-E261, 296 + 1,2-dichlorobenzene E259-E261, 296 + dichlorodiethylbenzene E259-E261, 296 + dichyle</pre>	+ 2-butanone			299
<pre>+ butyl cellosolve oleate E259-E261, 294 + carbonic acid, diethyl ester E259-E261, 297 + chlorobenzene E259-E261, 297 + 2-chloro-4,6-ditertamylphenol E259-E261, 296 + 2-chloro-4,6-ditertamylphenol E259-E261, 296 + 1-chloro-3-ethylbenzene E259-E261, 296 + chloromethylbenzene E259-E261, 296 + 1-chloro-1-nitroethane E259-E261, 296 + 1-chloro-1-nitropropane E259-E261, 296 + 2-chloro-2-nitropropane E259-E261, 296 + cyclohexanol E259-E261, 296 + cyclohexanol E259-E261, 296 + cyclohexanol E259-E261, 297 + diamylphenol E259-E261, 297 + diamylphenol E259-E261, 297 + dibutoxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 297 + dibutyl carbitol E259-E261, 297 + dibutoxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 295 + dichlorodethane E259-E261, 297 + dibutoytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 297 + dibutorytetraethylene glycol E259-E261, 297 + dibutorytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 296 + dichlorodethyle monophenyl phosphate E259-E261, 296 + dichlorodethyle ther E259-E261, 296 + dichlorodethyl ether E259-E261, 296 + dichlorodethyl ether E259-E261, 290 + dichlorodethyl ether E259-E261, 296 + dichlorodethane E259-E261, 296 + dicthyleneamine E259-E261, 296 + diethyleneamine E259-E261, 296 + dieth</pre>	+ <i>iso</i> butyl carbitol			
<pre>therein to the product between the produc</pre>	+ butyl cellosolve oleate	E259-E261,	294	
+ chlorobenzene       E259-E261, 290         + 2-chloro-4, 6-ditertamylphenol       E259-E261, 297         + 2-chloroethanol       E259-E261, 296         + 1-chloro-3-ethylbenzene       E259-E261, 296         + chloromethylbenzene       E259-E261, 296         + 1-chloro-1-nitroethane       E259-E261, 296         + 1-chloro-1-nitropopane       E259-E261, 296         + 1-chloro-1-nitropopane       E259-E261, 296         + cyclohexanone       E259-E261, 296         + cyclohexanone       E259-E261, 296         + cyclohexanone       E259-E261, 296         + decanedioic acid, dibutyl ester       E259-E261, 297         + 1,2-dibromoethane       E259-E261, 297         + dibutoxytetraethylene glycol       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + dibutoxytetraethylene glycol       E259-E261, 291         + dibutoxytetraethylene glycol       E259-E261, 291         + dichlorobenzene       E259-E261, 291         + dichlorodiethylbenzene       E259-E261, 295         + dichloroethane       E259-E261, 295         + dichlorobenzene       E259-E261, 296         + dichlorobenzene       E259-E261, 296         + dichloroethyl ether       E259-E261, 296         + dichloroethyl ether	+ carbonic acid, diethyl ester	E259-E261,	287	
+ 2-chloroethanol       E259-E261, 286, 290         + 1-chloro-3-ethylbenzene       E259-E261, 296         + chloromethylbenzene       E259-E261, 296         + 1-chloro-1-nitroethane       E259-E261, 296         + 1-chloro-1-nitroethane       E259-E261, 296         + 2-chloro-2-nitropopane       E259-E261, 296         + cyclohexanol       E259-E261, 296         + cyclohexanol       E259-E261, 296         + cyclohexanol       E259-E261, 296         + diamylphenol       E259-E261, 297         + 1, 2-dibromoethane       E259-E261, 297         + dibutsytetraethylene glycol       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + dibutyl carbitol       E259-E261, 297         + dibutyl carbitol       E259-E261, 291         + dichloroethane       E259-E261, 291         + dichloroethane       E259-E261, 296         + 1, 2-dichlorobenzene       E259-E261, 296         + 1, 2-dichlorobenzene       E259-E261, 296         + dichloroethane       E259-E261, 296				
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	+ 2-chloro-4,6-ditertamylphenol	E259-E261,	297	
+ chloromethylbenzene E259-E261, 296 + 1-chloro-4-methylbenzene E259-E261, 296 + 1-chloro-1-nitroethane E259-E261, 296 + 2-chloro-2-nitropropane E259-E261, 296 + cyclohexanol E259-E261, 286 - cyclohexanone E259-E261, 289 + decanedioic acid, dibutyl ester E259-E261, 295 + diamylphenol E259-E261, 297 + 1,2-dibromoethane E259-E261, 297 + dibutsytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dibutyl carbitol E259-E261, 291 + dibutyl carbitol E259-E261, 291 + dichlorobenzene E259-E261, 295 + dichlorobenzene E259-E261, 296 + diethylamine E259-E261, 296 + diphenylbane phosphonate E259-E261, 296 + diphe		E259-E261,	286,	290
+ 1-chloro-4-methylbenzene       E259-E261, 290         + 1-chloro-1-nitroethane       E259-E261, 296         + 1-chloro-1-nitropropane       E259-E261, 296         + 2-chloro-2-nitropropane       E259-E261, 296         + cyclohexanol       E259-E261, 295         + cyclohexanone       E259-E261, 295         + diamylphenol       E259-E261, 295         + diamylphenol       E259-E261, 297         + 1,2-dibromoethane       E259-E261, 297         + dibutoxytetraethylene glycol       E259-E261, 297         + dibutoxytetraethylene glycol       E259-E261, 297         + dibutyl calbosolve       E259-E261, 297         + dibutyl calbosolve       E259-E261, 297         + dichlorodiethylbenzene       E259-E261, 297         + dichlorodiethylbenzene       E259-E261, 295         + 1,2-dichlorobenzene       E259-E261, 296         + dichloroethene       E259-E261, 296         + dichloroethyl ether       E259-E261, 292         + dichloroethene       E259-E261, 296         + dichloroethene       E259-E261, 296 </td <td>+ 1-chloro-3-ethylbenzene</td> <td>E259-E261,</td> <td>296</td> <td></td>	+ 1-chloro-3-ethylbenzene	E259-E261,	296	
+       1-chloro-1-nitroethane       E259-E261, 296         +       1-chloro-1-nitropropane       E259-E261, 296         +       2-chloro-2-nitropropane       E259-E261, 286         +       cyclohexanon       E259-E261, 289         +       decanedioic acid, dibutyl ester       E259-E261, 295         +       diamylphenol       E259-E261, 297         +       1,2-dibromoethane       E259-E261, 297         +       dibutyl carbitol       E259-E261, 297         +       dibutyletatethylene glycol       E259-E261, 297         +       dibutyl carbitol       E259-E261, 297         +       dibutyl carbitol       E259-E261, 297         +       dibutyl carbitol       E259-E261, 291         +       dibutyl carbitol       E259-E261, 291         +       dibutyl carbitol       E259-E261, 295         +       1,2-dichlorobenzene       E259-E261, 295         +       1,2-dichlorobenzene       E259-E261, 296         +       dichloroethane       E259-E261, 296         +       dichloroethane       E259-E261, 292         +       dichloromethane       E259-E261, 292         +       dichlorophenyl monophenyl phosphate       E259-E261, 296         <	+ chloromethylbenzene	E259-E261,	296	
+ 1-chloro-1-nitropropane       E259-E261, 296         + 2-chloro-2-nitropropane       E259-E261, 286         + cyclohexanone       E259-E261, 289         + decanedioic acid, dibutyl ester       E259-E261, 295         + diamylphenol       E259-E261, 297         + 1,2-dibromoethane       E259-E261, 297         + 1,2-dibromoethane       E259-E261, 297         + dibutyl carbitol       E259-E261, 291         + dichorobenzene       E259-E261, 291         + dichlorobenzene       E259-E261, 295         + 1,2-dichlorobenzene       E259-E261, 296         + dichloroisopropyl ether       E259-E261, 290         + dichloroisopropyl ether       E259-E261, 292         + dichloroisopropyl ether       E259-E261, 296         + di (o-chlorophenyl) monophenyl phosphate       E259-E261, 296         + di (o-chlorophenyl) monophenyl phosphate       E259-E261, 296         + dithylamine       E259-E261, 296         + diethylene glycol       E259-E261, 296         + diethylene glyc	+ 1-chloro-4-methylbenzene	E259-E261,	290	
+ 2-chloro-2-nitropropane E259-E261, 296 + cyclohexanol E259-E261, 286 + cyclohexanone E259-E261, 289 + decanedioic acid, dibutyl ester E259-E261, 295 + diamylphenol E259-E261, 297 + 1,2-dibromoethane E259-E261, 297 + dibutoxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + dichlorobenzene E259-E261, 295 + 1,2-dichlorobenzene E259-E261, 296 + dichlorodiethylbenzene E259-E261, 296 + dichloroethene E259-E261, 290 + dichloromethane E259-E261, 290 + dichloromethane E259-E261, 290 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 290 + dicthylamine E259-E261, 296 + diethylamine E259-E261, 296 + diethylamine E259-E261, 296 + diethylamine E259-E261, 296 + diethyleneamine E259-E261, 296	+ 1-chloro-1-nitroethane	E259-E261,	296	
+ cyclohexanol E259-E261, 286 + cyclohexanone E259-E261, 289 + decanedioic acid, dibutyl ester E259-E261, 295 + diamylphenol E259-E261, 297 + 1,2-dibromoethane E259-E261, 297 + dibutoxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dibutyl carbitol E259-E261, 291 + dibutyl carbitol E259-E261, 291 + di (p-tert-butylphenyl) monophenyl phosphate E259-E261, 295 + 1,2-dichlorobenzene E259-E261, 296 + dichlorodiethylbenzene E259-E261, 296 + dichloroethene E259-E261, 290 + dichloroethene E259-E261, 292 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 296 + dichloroethene E259-E261, 292 + dichloromethane E259-E261, 296 + diethylamine E259-E261, 296 + diethylamine E259-E261, 296 + diethyleneamine E259-E261, 296 + diethyleneami	+ 1-chloro-1-nitropropane	E259-E261,	296	
+ cyclohexanone E259-E261, 289 + decanedioic acid, dibutyl ester E259-E261, 295 + diamylphenol E259-E261, 297 + 1,2-dibromoethane E259-E261, 297 + 2,3-dibromoo-1-propanol E259-E261, 297 + dibutxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + di (p-tert-butylphenyl) monophenyl phosphate E259-E261, 295 + 1,2-dichlorobenzene E259-E261, 296 + dichlorodiethylbenzene E259-E261, 296 + dichloroethene E259-E261, 292 + dichloroethene E259-E261, 292 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 296 + dichloromethane E259-E261, 296 + dichloromethane E259-E261, 296 + dichloromethane E259-E261, 296 + diethylamine E259-E261, 296 + diethylamine E259-E261, 296 + diethyleneamine E259-E261, 296 +	+ 2-chloro-2-nitropropane	E259-E261,	296	
+ decanedioic acid, dibutyl ester $E259-E261$ , 295 + diamylphenol $E259-E261$ , 297 + 1,2-dibromoethane $E259-E261$ , 297 + dibutomytetraethylene glycol $E259-E261$ , 297 + dibutyl carbitol $E259-E261$ , 297 + dibutyl carbitol $E259-E261$ , 291 + dibutyl cellosolve $E259-E261$ , 291 + di ( <i>p</i> -tert-butylphenyl) monophenyl phosphate + 1,2-dichlorobenzene $E259-E261$ , 296 + dichlorodiethylbenzene $E259-E261$ , 296 + dichloroethene $E259-E261$ , 292 + dichloroisopropyl ether $E259-E261$ , 292 + dichloromethane $E259-E261$ , 296 + diethylamine $E259-E261$ , 296 + diethyl carbitol $E259-E261$ , 296 + diethylanenine $E259-E261$ , 296 + diethyleneamine $E259-E261$ , 296 + diethylene glycol $E259-E261$ , 296 + diethylene glycol $E259-E261$ , 288 + 1,2-diiodoethane $E259-E261$ , 288 + 1,2-diiodoethane $E259-E261$ , 280 + diphenyl mono( <i>p</i> -tert-butylphenyl) phosphate	+ cyclohexanol			
<pre>+ diamylphenol E259-E261, 297 + 1,2-dibromoethane E259-E261, 296 + 2,3-dibromo-1-propanol E259-E261, 297 + dibutoxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + di (<i>p</i>-tert-butylphenyl) monophenyl phosphate</pre>				
+ diamylphenol E259-E261, 297 + 1,2-dibromoethane E259-E261, 297 + dibutoxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + di $(p-tert-butylphenyl)$ monophenyl phosphate + 1,2-dichlorobenzene E259-E261, 296 + dichlorodiethylbenzene E259-E261, 296 + dichloroethene E259-E261, 290 + dichloroisopropyl ether E259-E261, 292 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 296 + diethylamine E259-E261, 296 + diethylamine E259-E261, 296 + diethyleneamine E259-E261, 296 + diethylene glycol E259-E261, 296 + diethylene glycol E259-E261, 296 + diethylene glycol E259-E261, 296 + diet-2-phenylbutane phosphonate E259-E261, 296 + diphenyl mono(p-tert-butylphenyl) phosphate		E259-E261,	295	
+ 2,3-dibromo-1-propanol + 2,3-dibromo-1-propanol + dibutoxytetraethylene glycol + dibutyl carbitol + dibutyl carbitol + dibutyl cellosolve + di $(p-tert-butylphenyl)$ monophenyl phosphate = $259-E261$ , 295 + 1,2-dichlorobenzene + 1,2-dichlorobenzene + 1,2-dichlorobenzene + dichloroethyl benzene + dichloroethyl ether + dichloroisopropyl ether + dichloroisopropyl ether + dichloromethane + 1,1-dichloro-1-nitropropane + dichlorophenyl) monophenyl phosphate + 259-E261, 296 + diethylamine + diethyl carbitol + diethyl carbitol + diethyleneamine + diethyleneamine + 1,2-diiodoethane + 1,2-diiodoethane + 1,2-diiodoethane + diethyleneamine + 1,2-diiodoethane + 1,2-diiodoethane + 1,2-diiodoethane + 259-E261, 296 + diethyleneamine + 259-E261, 296 + 259-E261, 295 + 259-E261	+ diamylphenol	E259-E261,	297	
+ dibutoxytetraethylene glycol E259-E261, 297 + dibutyl carbitol E259-E261, 291 + dibutyl cellosolve E259-E261, 291 + di $(p-tert-butylphenyl)$ monophenyl phosphate E259-E261, 295 + 1,2-dichlorobenzene E259-E261, 296 + dichlorodiethylbenzene E259-E261, 290 + dichloroethene E259-E261, 290 + dichloroethyl ether E259-E261, 292 + dichloroisopropyl ether E259-E261, 292 + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 290 + 1,1-dichloro-1-nitropropane E259-E261, 296 + di $(o-chlorophenyl)$ monophenyl phosphate E259-E261, 295 + diethylamine E259-E261, 296 + diethyl carbitol E259-E261, 296 + diethylene glycol E259-E261, 296 + diphenyl mono $(p-tert-butylphenyl)$ phosphate E259-E261, 295				
+ dibutyl carbitol $E259-E261, 291$ + dibutyl cellosolve $E259-E261, 291$ + di (p-tert-butylphenyl) monophenyl phosphate $E259-E261, 295$ + 1,2-dichlorobenzene $E259-E261, 296$ + dichlorodiethylbenzene $E259-E261, 296$ + dichloroethene $E259-E261, 292$ + dichloroisopropyl ether $E259-E261, 292$ + dichloromethane $E259-E261, 292$ + dichloromethane $E259-E261, 292$ + dichloroophenyl) monophenyl phosphate $E259-E261, 296$ + di (o-chlorophenyl) monophenyl phosphate $E259-E261, 295$ + diethylamine $E259-E261, 296$ + diethyl carbitol $E259-E261, 296$ + diethyleneamine $E259-E261, 296$ + diethyleneamine $E259-E261, 296$ + diethyleneamine $E259-E261, 296$ + diethylene glycol $E259-E261, 296$ + die				
<pre>+ dibutyl cellosolve E259-E261, 291 + di(p-tert-butylphenyl) monophenyl phosphate</pre>				
+ di $(p-tert-butylphenyl)$ monophenyl phosphate E259-E261, 295 + 1,2-dichlorobenzene + dichlorodiethylbenzene + dichloroethene + dichloroethyl ether + dichloroisopropyl ether + dichloroisopropyl ether + dichloromethane E259-E261, 292 + dichloromethane E259-E261, 292 + dichloron-1-nitropropane + 1,1-dichloro-1-nitropropane + diethylamine E259-E261, 295 + diethylamine E259-E261, 296 + diethyl carbitol + diethyl carbitol + diethyleneamine E259-E261, 296 + diethylene glycol + 1,2-diiodoethane + 1,2-diiodoethane E259-E261, 296 + diethylene glycol + diethylene glycol + diethylene phosphonate + diphenyl mono(p-tert-butylphenyl) phosphate E259-E261, 295				
E259-E261, 295 + 1,2-dichlorobenzene E259-E261, 296 + dichlorodiethylbenzene E259-E261, 296 + dichloroethene E259-E261, 290 + dichloroethyl ether E259-E261, 292 + dichloroisopropyl ether E259-E261, 292 + dichloromethane E259-E261, 290 + 1,1-dichloro-1-nitropropane E259-E261, 296 + di (o-chlorophenyl) monophenyl phosphate E259-E261, 295 + diethylamine E259-E261, 295 + diethyl carbitol E259-E261, 296 + diethyl enemine E259-E261, 297 + diethylene glycol E259-E261, 296 + diethylene glycol E259-E261, 295			291	
+ 1,2-dichlorobenzene $E259-E261, 296$ $+ dichlorodiethylbenzene$ $E259-E261, 296$ $+ dichloroethene$ $E259-E261, 290$ $+ dichloroethyl ether$ $E259-E261, 292$ $+ dichloroisopropyl ether$ $E259-E261, 292$ $+ dichloromethane$ $E259-E261, 290$ $+ 1,1-dichloro-1-nitropropane$ $E259-E261, 296$ $+ diethylamine$ $E259-E261, 295$ $+ diethyl carbitol$ $E259-E261, 296$ $+ diethyleneamine$ $E259-E261, 297$ $+ diethylene glycol$ $E259-E261, 296$ $+ diethylene glycol$ $E259-E261, 296$ $+ di-2-phenylbutane phosphonate$ $E259-E261, 296$ $+ diphenyl mono(p-tert-butylphenyl) phosphate$ $E259-E261, 295$	+ di (p-tert-butylphenyl) monophenyl phosphat		205	
+ dichlorodiethylbenzene $E259-E261, 296$ + dichloroethene $E259-E261, 290$ + dichloroethyl ether $E259-E261, 292$ + dichloroisopropyl ether $E259-E261, 292$ + dichloromethane $E259-E261, 290$ + 1,1-dichloro-1-nitropropane $E259-E261, 296$ + di(o-chlorophenyl) monophenyl phosphate $E259-E261, 295$ + diethylamine $E259-E261, 296$ + diethyl carbitol $E259-E261, 296$ + diethyleneamine $E259-E261, 296$ + diethylene glycol $E259-E261, 296$ + diethylene glycol $E259-E261, 296$ + di-2-phenylbutane phosphonate $E259-E261, 296$ + diphenyl mono(p-tert-butylphenyl) phosphate $E259-E261, 295$	1 1 2 dichlenchen			
+ dichloroethene E259-E261, 290 + dichloroethyl ether E259-E261, 292 + dichloroisopropyl ether E259-E261, 292 + dichloromethane E259-E261, 290 + 1,1-dichloro-1-nitropropane E259-E261, 296 + di (o-chlorophenyl) monophenyl phosphate E259-E261, 295 + diethylamine E259-E261, 296 + diethyl carbitol E259-E261, 297 + diethyleneamine E259-E261, 296 + diethylene glycol E259-E261, 296 + diethylene glycol E259-E261, 288 + 1,2-diiodoethane E259-E261, 296 + di-2-phenylbutane phosphonate E259-E261, 280 + diphenyl mono( $p$ -tert-butylphenyl) phosphate E259-E261, 295				
+ dichloroethyl ether       E259-E261, 292         + dichloroisopropyl ether       E259-E261, 292         + dichloromethane       E259-E261, 290         + 1,1-dichloro-1-nitropropane       E259-E261, 296         + di(o-chlorophenyl) monophenyl phosphate       E259-E261, 295         + diethylamine       E259-E261, 296         + diethyl carbitol       E259-E261, 297         + diethyl neamine       E259-E261, 296         + diethylene glycol       E259-E261, 296         + diethylene glycol       E259-E261, 296         + di-2-phenylbutane phosphonate       E259-E261, 296         + diphenyl mono(p-tert-butylphenyl) phosphate       E259-E261, 295				
+ dichloroisopropyl ether E259-E261, 292 + dichloromethane E259-E261, 290 + 1,1-dichloro-1-nitropropane E259-E261, 296 + di(o-chlorophenyl) monophenyl phosphate E259-E261, 295 + diethylamine E259-E261, 296 + diethyl carbitol E259-E261, 297 + diethyleneamine E259-E261, 296 + diethylene glycol E259-E261, 296 + diethylene glycol E259-E261, 288 + 1,2-diiodoethane E259-E261, 296 + di-2-phenylbutane phosphonate E259-E261, 280 + diphenyl mono( $p$ -tert-butylphenyl) phosphate E259-E261, 295				
+ dichloromethane $E259-E261, 290$ + 1,1-dichloro-1-nitropropane $E259-E261, 296$ + di(o-chlorophenyl) monophenyl phosphate $E259-E261, 295$ + diethylamine $E259-E261, 296$ + diethyl carbitol $E259-E261, 297$ + diethyleneamine $E259-E261, 296$ + diethylene glycol $E259-E261, 296$ + diethylene glycol $E259-E261, 296$ + di-2-phenylbutane phosphonate $E259-E261, 296$ + diphenyl mono(p-tert-butylphenyl) phosphate $E259-E261, 295$	-			
+ 1,1-dichloro-1-nitropropane       E259-E261, 296         + di(o-chlorophenyl) monophenyl phosphate       E259-E261, 295         + diethylamine       E259-E261, 296         + diethyl carbitol       E259-E261, 297         + diethyleneamine       E259-E261, 296         + diethylene glycol       E259-E261, 296         + diethylene glycol       E259-E261, 296         + di-2-phenylbutane phosphonate       E259-E261, 296         + diphenyl mono(p-tert-butylphenyl) phosphate       E259-E261, 295		E259-E261,	292	
+ di(o-chlorophenyl) monophenyl phosphate E259-E261, 295 + diethylamine E259-E261, 296 + diethyl carbitol E259-E261, 297 + diethyleneamine E259-E261, 296 + diethylene glycol E259-E261, 288 + 1,2-diiodoethane E259-E261, 296 + di-2-phenylbutane phosphonate E259-E261, 280 + diphenyl mono( $p$ -tert-butylphenyl) phosphate E259-E261, 295				
<pre>+ diethylamine E259-E261, 296 + diethyl carbitol E259-E261, 297 + diethyleneamine E259-E261, 296 + diethylene glycol E259-E261, 288 + 1,2-diiodoethane E259-E261, 296 + di-2-phenylbutane phosphonate E259-E261, 280 + diphenyl mono(p-tert-butylphenyl) phosphate</pre>	+ i, i-atomioro-i-mitropropane	E250_E201,		
+ diethyl carbitol $E259-E261$ , 297+ diethyleneamine $E259-E261$ , 296+ diethylene glycol $E259-E261$ , 288+ 1,2-diiodoethane $E259-E261$ , 296+ di-2-phenylbutane phosphonate $E259-E261$ , 280+ diphenyl mono(p-tert-butylphenyl) phosphate $E259-E261$ , 295	+ di(d-chiolophenyi) monophenyi phosphate			
+ diethyleneamine E259-E261, 296 + diethylene glycol E259-E261, 288 + 1,2-diiodoethane E259-E261, 296 + di-2-phenylbutane phosphonate E259-E261, 280 + diphenyl mono( $p$ -tert-butylphenyl) phosphate E259-E261, 295		•		
+ diethylene glycol E259-E261, 288 + 1,2-diiodoethane E259-E261, 296 + di-2-phenylbutane phosphonate E259-E261, 280 + diphenyl mono(p-tert-butylphenyl) phosphate E259-E261, 295				
+ 1,2-diiodoethane + di-2-phenylbutane phosphonate + diphenyl mono(p-tert-butylphenyl) phosphate E259-E261, 295				
+ di-2-phenylbutane phosphonate E259-E261, 280 + diphenyl mono( <i>p-tert-</i> butylphenyl) phosphate E259-E261, 295				
+ diphenyl mono(p-tert-butylphenyl) phosphate E259-E261, 295				
E259-E261, 295			200	
	<pre>/ arbueniar mono(b-cerc-pacatbueniar) buosbuar</pre>		295	
	+ diisopropyl ketone	•		301
		2601)		

```
Nitric acid, thorium salt (aqueous)
         + 1,3-dimethoxybenzene
                                                          E259-E261, 292
         + 1,2-dimethoxy-4-(2-propenyl)benzene
                                                          E259-E261, 292
                                                          E259-E261, 290
         + dimethylbenzenamine
                                                          E259-E261, 297
         + dimethylbenzene
                                                          E259-E261, 281
         + 1,4-dimethylbenzene
                                                          E259-E261, 291
         + dimethyldioxane
         + 3,7-dimethyl-1,6-octadien-3-ol
                                                          E259-E261, 297
                                                         E259-E261, 294
         + 3,7-dimethyl-1,6-octadien-3-ol acetate
         + 2,4-dimethyl-3-pentanone
                                                          E259-E261, 294, 301
                                                          E259-E261, 288
         + 1,4-dioxane
         + dodecanoic acid, ethyl ester
                                                          E259-E261, 294
         + 1,8-epoxy-p-menthane
                                                          E259-E261, 292
         + ethanedioic acid, dibutyl ester E259-E261, 295
+ ethanedioic acid, bis(3-methylbutyl) ester E259-E261, 294
+ 1,2-ethanediol E259-E261, 286
                                                          E259-E261, 285
         + ethanol
         + ethyl acetylglycollate
                                                          E259-E261, 294
         + ethyl hexyl cellosolve
                                                          E259-E261, 291
                                                          E259-E261, 288, 291
         + ethylene glycol monoethyl ether
         + ethylene glycol monomethyl ether
                                                         E259-E261, 288
         + formic acid, ethyl ester
                                                         E259-E261, 287
         + formic acid, pentyl ester
                                                         E259-E261, 294
                                                          E259-E261, 289, 294,
         + 2-heptanone
                                                          299, 301
                                                          E259-E261, 286
         + 1,6-hexanediol
                                                         E259-E261, 287
E259-E261, 295
E259-E261, 286, 298,
         + hexanoic acid, ethyl ester
         + hexanoic acid, 3-methylbutyl ester
         + 1-hexanol
                                                          300
                                                         E259-E261, 287
         + 2-hydroxybenzoic acid, methyl ester
                                                          E259-E261, 297
         + hydroxy-o-toluidine
         + hydroxyethylethylenediamine
                                                          E259-E261, 296
                                                          E259-E261, 285, 298
         + methanol
                                                          E259-E261, 292
         + methoxybenzene
         + 1-methoxy-2-methylbenzene
                                                          E259-E261, 292
         + 1-methoxy-3-methylbenzene
                                                         E259-E261, 292
         + 1-methoxy-4-methylbenzene
                                                         E259-E261, 292
                                                         E259-E261, 292
E259-E261, 290, 297
E259-E261, 297
E259-E261, 297
E259-E261, 286, 298,
         + 2-methoxy-2-methylbutane
         + methylbenzene
         + 2-methylbutane
         + 3-methyl-1-butanol
                                                          301
                                                          E259-E261, 294
         + 3-methyl-1-butanol acetate
                                                          E259-E261, 295
         + 3-methyl-1-butanol formate
         + 2-(1-methylethyl)-1-methylbenzene
                                                         E259-E261, 297
                                                          E259-E261, 289, 294,
         + 4-methy1-2-pentanone
                                                          298, 301
         + 3-methylphenol
                                                          E259-E261, 286
         + 2-methyl-1-propanol
                                                          E259-E261, 285
                                                          E238, 248-252
         + nitric acid
         + nitric acid, aluminium salt
                                                          E238, 253
                                                          E259-E261, 294
         + nitric acid, butyl ester
         + nitrobenzene
                                                          E259-E261, 290
                                                          E259-E261, 295, 302
E259-E261, 292
E259-E261, 289, 299,
         + nitromethane
         + 1-octanol
         + 2-octanone
                                                           300, 301
         + 1,1'-oxybisbutane
                                                          E259-E261, 288
                                                          E259-E261, 292
         + 2,2'-oxybis(1-chloropropane)
         + 2,2'-oxybis(2-chloropropane)
                                                         E259-E261, 292
         + 1,1'-oxybisethane
                                                          E259-E261, 283, 284,
                                                          288, 291, 301
         + 2,2'-oxybisethanol
                                                          E259-E261, 286
         + 1,1'-oxybishexane
                                                          E259-E261, 292
         + 1,1'-oxybis(3-methylbutane)
                                                          E259-E261, 288, 292
         + 1,1'-oxybispentane
                                                          E259-E261, 292
```

Nitric acid, thorium sat	lt (aqueous)		
+ pentanoic ac:	id, pentyl ester	E259-E261	
+ 1-pentanol		E259-E261	,
+ 1-pentene		E259-E261	
+ 2-pentene		E259-E261	
+ pentoxybenzer		E259-E261	
+ petroleum et			, 290, 297
	acid, ethyl ester		•
+ 2-phenylbutar		E259-E261	•
+ phosphorous a + piperidine	acid, tributyl ethe		
+ piperialité + 1,2,3-propane	ot mi ol		., 290, 296
	id, butyl ester	E259-E261 E259-E261	•
	id, ethyl ester	E259-E261	
+ 1-propanol	id, etnyi ester		, 285, 298
+ 2-propanol		E259-E261	
+ 2-propanone			, 289, 299
	acid, ethyl ester	E259-E261	
+ 2-propen-1-0	l	E259-E261	
+ propiophenone		E259-E261	
+ quinoline		E259-E261	•
+ <i>iso</i> quinoline		E259-E261	
+ o-toluidine		E259-E261	•
+ tetrabromomet	thane	E259-E261	
+ tetrabutyl u	rea	E259-E261	, 295
+ 1,1,2,2-tetra	achloroethane	E259-E261	, 296
+ tetrachlorome	ethane	E259-E261	, 290, 296
+ tetradecanoid	c acid, ethyl ester	E259-E261	, 294
+ tetradecanol		E259-E261	
+ tetrahydrona		E259-E261	
+ triethanolam:		E259-E261	•
	glycol dichloride	E259-E261	
+ 1,1,1-trichld		E259-E261	
+ 1,1,2-trichld		E259-E261	
+ trichloromet			, 290, 296
	glycol dichloride	E259-E261	•
+ tri(1-metnyle + tripentylamin	ethyl)methylbenzene	E259-E261 E259-E261	
+ turpentine	ie		, 290, 297
+ undecanol		E259-E261	• •
+ water			, 240-247
Nitric acid, thorium sa	lt (multicomponent)	E220-E255	, 230 231
+ benzene	re (marcreomponenc)	311, 315	
+ 2-butanone		294	
+ chlorobenzene	9	315	
+ chlorobutane	-	314	
+ cyclohexane		313	
+ decane		275	
+ decane isomer		276, 277	
	thyl phosphonate	281	
+ dibutyl butyl		306, 308	
+ 1,2-dichlorob	penzene	311	
	lycol dibutyl ether	305	
	lycol diethyl ether		
+ di <i>iso</i> octylmet	chylphosphonate	282	
+ dimethylbenze	ene	294	
+ 1,4-dimethylk	penzene	281, 282	
+ dodecane		276, 279,	310
+ dodecane ison	ners	276, 277	
+ ethanol		312	
	col dibutyl ether	305	
	col diethyl ether	305	
+ heptane		275, 304	
+ hexane		275	
+ 1-hexanol		298	
+ hydrocarbon m	nixtures	276	
+ kerosine		278	

```
Nitric acid, thorium salt (multicomponent)
                                                              301, 304, 307
303, 304, 307
254-258, 269-279,
          + 4-methyl-2-pentanone
          + 2-methyl-1-propanol
          + nitric acid
                                                              282
                                                             E238, 257, 258, 282
          + nitric acid, aluminium salt
          + nitric acid, copper salt
+ nitric acid, ferric salt
                                                             E238, 254
                                                             E238, 255
          + nitric acid, trioctylamine sall.
                                                             309, 310, 311
                                                              310
          + nitrobenzene
          + octane
                                                              275
          + octane isomers
                                                              276
          + 1-octanol
                                                              310
          + 1,1'-oxybisethane
                                                              304, 312-315
                                                              276
          + pentadecane isomers
          + petroleum sulfonates
                                                              282
Nitric acid, thorium salt (multicomponent)
          + phosphoric acid, tributyl ester
                                                            E259-E265, 266, 267,
                                                              268-279, 282,
                                                              306-308
                                                              282
          + phosphoric acid, triisobutyl ester
                                                              306, 308
          + phosphorous acid, tributyl ester
          + 2-propanone
                                                              299, 312
                                                              303-306, 308, 314
          + tetrachloromethane
          + tetradecane
                                                              276
                                                              276, 277
309, 311, 314
          + tetradecane isomers
          + trichloromethane
          + tridecane isomers
                                                              276
          + undecane isomers
                                                              276
          + uranium, bis(nitrato-0)-dioxo-, (T-4)
                                                          E238, 256
Pentyl ether
          see 1,1'-oxybispentane
Plutonium, bis(nitrato-0)dioxo-, (T-4)- (aqueous)
                                                              E316-E319, 320, 321,
          + nitric acid
          + nitric acid, ammonium salt
                                                              E316-E319, 322
Plutonium, bis(nitrato-O)dioxo-, (T-4)- (multicomponent)
          + diethylene gylcol, dibutyl ether

+ nitric acid

E316-E319, 323

E316-E319, 323, 343,
                                                              344
          + nitric acid, plutonium salt
                                                              343, 344
          + water
                                                              E316-E319, 343, 344
Uranium, bis(nitrato-O)dioxo-, (T-4)- (aqueous)
          + acetic acid
                                                             E127, E128, 202
          + acetic acid, isoamyl ester
                                                             E127, E128, 143
                                                             E127, E128, 142, 144
          + acetic acid, butyl ester
                                                             E127, E128, 142
          + acetic acid, ethenyl ester
                                                             E127, E128,
          + acetic acid, ethyl ester
                                                             140-142, 144
          + acetic acid, 2-ethoxyethyl ester E127, E128, 143
+ acetic acid, 1-methylethyl ester E127, E128, 142
+ acetic acid, 2-methylpropyl ester E127, E128, 143
+ acetic acid, pentyl ester E127, E128, 143, 144
+ acetic acid, 2-phenylethyl ester E127, E128, 143
          + acetic acid, pentyl ester
+ acetic acid, 2-phenylethyl ester
+ benzeneacetic acid, methyl ester
                                                             E127, E128, 143
                                                             E127, E128, 170
          + 1,2-bis(chloroethoxy)ethane
                                                             E127, E128, 148
          + butanal
                                                             E127, E128, 139
          + 1-butanol
          + 2-butanol
                                                             E127, E128, 134
                                                             E127, E128, 145
          + butanoic acid, ethyl ester
          + butanoic acid, pentyl ester
                                                             E127, E128, 143
                                                             E127, 148, 149, 156
          + 2-butanone
                                                             E127, E128, 170
          + 4-butoxybutanol
          + 2-butoxyethanol acetate
                                                              E127, E128, 143
          + cyclohexanol
                                                              E127, E128, 139
```

Uranium,	bis(nitrato-0)dioxo-, (T-4)- (aqueous)	
	+ cyclohexanone	E127, E128, 148
	+ decanedioic acid, dibutyl ester	E127, E128, 143
	+ decanedioic acid, diethyl ester	E127, E128, 143
	+ 2,3-dibromo-1-propanol	E127, E128, 133
	+ dibenzyl ether	E127, E128, 181
	+ dibutyl butyl phosphonate	E127, E128, 224
	+ 2,2'-dichloroethoxyethane	E127, E128, 190
	+ 1,2-diethoxyethane	E127, E128, 177, 178
	+ 3,3-dimethy1-2-butanone	E127, E128, 155, 156
	+ dimethyl dioxane	E127, E128, 170
	+ 3,7-dimethyl-2,6-octadien-1-ol acetate	E127, E128, 143
	+ 5[R]-3,7-dimethy1-6-octenal	E127, E128, 148
	+ 2,4-dimethyl-3-pentanone	E127, E128, 148
	+ 1,4-dioxane	E127, E128, 181
	+ ethanol	E127, E128, 131, 139
	+ ethyl acetylglycolate	E127, E128, 142
	+ 2-ethyl-1-butanol	E127, E128, 133, 142
	+ 2-ethoxyethanol	E127, E128, 133
	+ 2-ethyl-1-hexanol	E127, E128, 139
	+ formic acid	E127, E128, 201
	+ formic acid, pentyl ester	E127, E128, 142
	+ furan	E127, E128, 181
	+ geraniol	E127, E128, 133
	+ 1-heptanol	E127, E128, 133, 139
	+ 2-heptanone	E127, E128, 148, 157
	+ hexanedioic acid, dibutyl ester	E127, E128, 143
	+ 1-hexanol	E127, E128, 139
	+ hexanoic acid, 3-methylbutyl ester	E127, E128, 143
	+ 2-hexanone	E127, E128, 156
	+ 2-hexoxyethanol	E127, E128, 133
	+ methanol	E127, E128, 131,
		132, 139
	+ 4-methoxybenzaldehyde	E127, E128, 148
	+ 3-methyl-1-butanol acetate	E127, E128, 143
	+ 2-methyl-1-butanol formate	E127, E128, 142
	+ 4-methoxy-4-butoxy-1-butanol	E127, E128, 133
	+ 3-methyl-1-butanol	E127, 134-135
	+ 2-methyl-1-pentanol	E127, E128, 133, 137
	+ 4-methyl-2-pentanol	E127, E128, 134
	+ 4-methyl-2-pentanone	E127, E128, 148,
		149, 153, 154, 157
	+ methyl phenyl ketone	E127, E128, 157
	+ 2-methyl-1-propanol	E127, E128, 134,
		136, 137
	+ 2-methyl-2-propanol	E127, E128, 138
	+ nitric acid	E19-E22, E24, 37-54
	+ nitric acid, aluminium salt	E23, 113-118
	+ nitric acid, ammonium salt	E22, E23, 55-57
		100-102
	+ nitric acid, barium salt	E23, 88, 89, 107
	+ nitric acid, beryllium salt	E23, 81, 82
	+ nitric acid, cadmium salt	E23, 92, 93
	+ nitric acid, calcium salt	E23, 85, 86, 105
	+ nitric acid, cesium salt	E22, E23, 76-78,
		103
	+ nitric acid, copper salt	E23, 109
	+ nitric acid, lithium salt	E22, E23, 58, 59
	+ nitric acid, magnesium salt	E23, 83, 84, 104
	+ nitric acid, mercury salt	E23, 94, 95
	+ nitric acid, potassium salt	E22, E23, 62-75
	+ nitric acid, plutonium salt	119, 120
	+ nitric acid, sodium salt	E22, E23, 60, 61
	+ nitric acid, strontium salt	E23, 87, 106
	+ nitric acid, thallium salt	E22, E23, 79, 80
	+ nitric acid, thorium salt	E23, 165, 166, 256
	+ nitric acid, zinc salt	E23, 90, 91, 108

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<pre>Uranium, bis(nitrato-O)dioxo-, (T-4)- (aqueous)</pre>			
<pre>+ nitrobensene</pre>			
206, 209, 211           + nitromethane         E127, E128, 205           + nitropropane         E127, E128, 203, 205           + 2-nitropropane         E127, E128, 203           + 1-otctanol         E127, E128, 203           + 1-octanol         E127, E128, 133           + 2-octanol         E127, E128, 133           + 2-octanol         E127, E128, 143           + oxalic acid, butyl ester         E127, E128, 143           + oxalic acid, uranyl salt         96, 110, 111           + 2.2'-coxybislc2-chloropropane)         E127, E128, 170           + 1,1'-oxybisbutane         E127, E128, 170           + 1,1'-oxybisbotane         E127, E128, 171           + 1,1'-oxybispentane         E127, E128, 171           + 1,1'-oxybisporpane         E127, E128, 133           + 1,2'-oxybisporpane         E127, E128, 133           + 2-propanone         E127, E128, 143           + 2-propanone	Uranium,	bis(nitrato-0)dioxo-, (T-4)- (aqueous)	
<pre>+ nitroethane E127, E126, 203, 205 + nitroethane E127, E126, 203, 205 + 2-nitropropane E127, E126, 203, 205 + nitrosoruthenium nitrate 223 + 1-octanol E127, E126, 133, 139 + 2-octanone E127, E126, 133, 139 + 2-octanone E127, E126, 130 + 0xalic acid, butyl ester E127, E126, 170, 111 + 2,2'-oxybis(2-chloropropane) E127, E126, 170, 111 + 2,2'-oxybis(2-chloropropane) E127, E126, 170, 111 + 2,2'-oxybis(2-chloropropane) E127, E126, 170, 172, 174, 175, 180-186, 189 + 1,1'-oxybisethane E127, E126, 171, 179 + 1,1'-oxybisethane E127, E126, 171, 179 + 1,1'-oxybisethane E127, E126, 171, 179 + 1,1'-oxybisethane E127, E126, 171 + 2,2'-oxybisethane E127, E126, 171 + 2,2'-oxybisethane E127, E126, 171 + 2,2'-oxybisethane E127, E126, 171 + 2,2'-oxybisethane E127, E126, 133, 139 + 3-pentanone E127, E126, 143 + propanoic acid, pentyl ester E127, E126, 143 + 2-propaynen E127, E126, 157 + 2-propaynen E127, E126, 157 + 2-propaynen E127, E126, 157 + 2-propaynen E127, E126, 158 + 2-propaynen E127, E126, 159 + 2000000000000000000000000000000000000</pre>		+ nitrobenzene	E127, E128, 203,
<pre>+ nitromethane E127, E126, 203, 205 + 1-nitropropane E127, E126, 203, 205 + 2-nitropropane E127, E126, 203 + 1-octanol E127, E126, 139 + 2-octanon E127, E126, 130 + 2-octanon E127, E126, 130 + 2-octanon E127, E126, 130 + cotalic acid, uranyl salt 96, 110, 111 + 2,2'-oxybis(2-chloropropane) E127, E126, 170 + 1,1'-oxybisbutane E127, E126, 170 + 1,1'-oxybisbutane E127, E126, 170, 110, 110 + 1,1'-oxybisbutane E127, E126, 170 + 1,1'-oxybisbutane E127, E126, 170 + 1,1'-oxybisbutane E127, E126, 171 + 1,1'-oxybisbutane E127, E126, 171 + 1,1'-oxybispentane E127, E126, 171 + 1,1'-oxybispentane E127, E128, 171 + 1,2'-oxybispentane E127, E128, 171 + 1,2'-oxybispentane E127, E128, 171 + 2,2'-oxybispentane E127, E128, 133 + 2-pentanol E127, E128, 133 + 2-pentanon E127, E128, 133, 139 + 3-pentanon E127, E128, 133, 139 + 3-pentanon E127, E128, 133 + 2-pentanone E127, E128, 133 + 2-pentanone E127, E128, 133 + 2-pentanone E127, E128, 133 + 2-pentanone E127, E128, 143 + propanoic acid, putyl ester E127, E128, 133 + 2-pentanone E127, E128, 143 + propanoic acid, putyl ester E127, E128, 143 + propanoic acid, putyl ester E127, E128, 139 + 2-propanone E127, E128, 131 + uranium oxide 97-99 + water E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + benzene 196, 196, 196, 207 + adechurylhenzene 207 + dodecane 196, 196, 207 + adechurylhenzene 207 + dodecane 207 +</pre>			208, 209, 211
<pre>+ nitromethame E127, E126, 203, 205 + 1-nitropropane E127, E126, 203, 205 + 2-nitropropane E127, E126, 203 + 1-octanol E127, E126, 139 + 2-octanon E127, E126, 139 + 2-octanon E127, E126, 130 + 2-octanon E127, E126, 143 + oxalic acid, vuranyl salt 96, 110, 111 + 2,2'-oxybis(2-chloropropane) E127, E126, 170 + 1,1'-oxybisbtane E127, E126, 170 + 1,1'-oxybisbtane E127, E126, 170 + 1,1'-oxybisptane E127, E126, 170 + 1,1'-oxybisptane E127, E126, 170 + 1,1'-oxybisptane E127, E126, 171 + 1,1'-oxybisptane E127, E126, 171 + 1,1'-oxybisptane E127, E126, 171 + 1,1'-oxybisptane E127, E126, 171 + 1,2'-oxybisptane E127, E126, 171 + 1,2'-oxybisptane E127, E126, 171 + 1,2'-oxybisptane E127, E128, 133 + 2-pontanon E127, E128, 143 + phosphoric acid, puntyl ester E127, E128, 143 + propanoic acid, yill ester E127, E128, 143 + propanoic acid, puntyl ester E127, E128, 139 + 2-proponon E127, E128, 131 + 2-propanon E127, E128, 131 + zuccinic acid, puntyl ester E127, E128, 131 + zuccinic acid, puntyl ester E127, E128, 131 + zuccinic acid, puntyl ester E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + dodocane 200 + nitric acid, uranyl salt, ditherate E121-E126 + nitric acid, uran</pre>		+ nitroethane	E127, E128, 205
<pre>+ 1-mitropropane E127, E128, 203, 205 + anttrosoruthenium nitrate 223 + li-octanol E127, E128, 133, 139 + 2-octanone E127, E128, 133, 139 + 2,2'-oxybis(2-chloropropane) E127, E128, 170, 111 + 2,2'-oxybis(2-chloropropane) E127, E128, 170, 172, 174, 175, 180-1164, 189 + 1,1'-oxybishetane E127, E128, 170, 172, 174, 175, 180-186, 189 + 1,1'-oxybishetane E127, E128, 171, 179 + 1,1'-oxybishetane E127, E128, 171, 179 + 1,1'-oxybishetane E127, E128, 171 + 2,2'-oxybispropane E127, E128, 171 + 2,2'-oxybispropane E127, E128, 171 + 2,2'-oxybispropane E127, E128, 133, 139 + 3-pentanoi E127, E128, 131, 139 + 3-pentanone E127, E128, 133, 139 + 3-pentanone E127, E128, 143 + propanoic acid, putyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 2-propanol E127, E128, 143 + 2-propanon E127, E128, 139 + 2-propanon E127, E128, 143 + 1-propanoic acid, pentyl ester E127, E128, 143 + 2-propanon E127, E128, 143 + 1-propanoic acid, pentyl ester E127, E128, 170 + 1-undecanol E127, E128, 171 + tristhylene glycol dichloride E127, E128, 171 + tristhylene E127, E128, 173 + uranium, bis(intrac-0)(incor, (T-4)- (multico</pre>		+ nitromethane	
<pre>+ 2-mitropropane E127, E128, 203 + nitrosoruthenium nitrate 223 + 1-octanol E127, E128, 139 + 2-octanone E127, E128, 139 + 2-octanone E127, E128, 139 + 2-octanone E127, E128, 143 + oxalic acid, uranyl salt 96, 110, 111 + 2,2'-oxybis(2-chloropropane) E127, E128, 170 + 1,1'-oxybisetane E127, E128, 170 + 1,1'-oxybisetane E127, E126, 170 + 1,1'-oxybisetane E127, E126, 171 + 1,1'-oxybisetane E127, E126, 171 + 1,1'-oxybisetane E127, E128, 128, 143 + 1,1'-oxybisetane E127, E128, 171 + 1,2'-oxybisetane E127, E128, 133, 139 + 3-pentanone E127, E128, 143 + 1-pentanol E127, E128, 143 + 1-pentanol E127, E128, 143 + phosphoric acid, pentyl ester E127, E128, 143 + phosphoric acid, jentyl ester E127, E128, 143 + propanoic acid, jentyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 139 + 2-proponone E127, E128, 131 + 2-</pre>			
<pre>+ nitrosoruthenium nitrate 223 + 1-octanol E127, E128, 133, 139 + 2-octanone E127, E128, 130, 139 + 2-octanone E127, E128, 130, 139 + 2-octanone E127, E128, 130, 111 + 2,2?-oxybis(2-ohloropropane) E127, E128, 170, 111 + 2,2?-oxybis(2-ohloropropane) E127, E128, 170, 171, 171, 1,1°-oxybisbutane E127, E128, 170, 172, 174, 167, 100, 161-164, 167-170, 172, 174, 175, 100-186, 189 + 1,1'-oxybishexane E127, E128, 171, 179 + 1,1'-oxybispentane E127, E128, 171 + 1,1'-oxybispentane E127, E128, 171 + 1,1'-oxybispentane E127, E128, 171 + 2,2'-oxybispentane E127, E128, 171 + 1,1'-oxybispentane E127, E128, 171 + 1,1'-oxybispentane E127, E128, 171 + 1,2'-oxybispentane E127, E128, 171 + 1,2'-oxybispentane E127, E128, 133, 139 + 3-pentanol E127, E128, 133, 139 + 3-pentanone E127, E128, 143 + propanoic acid, putyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + 1-propanol E127, E128, 139 + 2-propanon E127, E128, 131 + 2-propanon E127, E128, 133 + 2-propanon E127, E128, 133 + 2-propanon E127, E128, 133 + 2-propanon E127, E128, 131 + 2-propanon E127, E128, 133 + 2-propano</pre>		+ 2-nitropropane	
<pre>+ 1-cctanol E127, E128, 133, 139 + 2-cctanon E127, E128, 139 + 2-cctanon E127, E128, 143 + cxalic acid, uranyl salt 96, 110, 111 + 2,2'-oxybis(2-chloropropane) E127, E128, 170, + 1,1'-oxybisbutane E127, E128, 170, + 1,1'-oxybisbutane E127, E128, 170, - 1,1'-oxybisbutane E127, E128, 170, - 1,1'-oxybisbutane E127, E128, 171, + 1,1'-oxybispentane E127, E128, 143, 139 + 3-pentanon E127, E128, 133, 139 + 3-pentanon E127, E128, 133, 139 + 3-pentanon E127, E128, 143 + 1-pentanol E127, E128, 143 + 1-pentanol E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, tributyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + 1-propanoi acid, 2-methylpropyl ester E127, E128, 139 + 2-propanoi E127, E128, 131 + 1-undecanoi E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + benzene 196, 196, 207 + water + water + water 196, 196, 207 + dodecane 200 + 1,2-dichloroethane 207 + didecane 210 + dodecane 210 + dodecane 210 + dodecane 210 + dodecane 210 + nitric acid, uranyl salt, dithydrate E121-E126 + nitric acid, uranyl salt</pre>			
<pre>+ 2-octanol E127, E128, 139 + 2-octanone E127, E128, 143 + oxalic acid, butyl ester E127, E128, 143 + oxalic acid, uranyl salt 96, 110, 111 + 2,2'-oxybis(2-chloropropane) E127, E128, 170 + 1,1'-oxybisbutane E127, E128, 170, 187, 188 + 1,1'-oxybisbutane E127, E128, 170, 187, 186 + 1,1'-oxybisbutane E127, E128, 171, 179 + 1,1'-oxybispotane E127, E128, 171 + 1,1'-oxybispotane E127, E128, 171 + 1,1'-oxybispotane E127, E128, 171 + 2,2'-oxybispotane E127, E128, 171 + 2,2'-oxybispotane E127, E128, 171 + 2,2'-oxybispotane E127, E128, 133, 139 + 3-pentanol E127, E128, 133, 139 + 3-pentanone E127, E128, 143 + 1-pentanol E127, E128, 143 + 1-popanoic acid, tributyl ester E127, E128, 143 + propanoic acid, tributyl ester E127, E128, 143 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 2-propanol E127, E128, 171 + 1-undecanol E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + hitric acid, resium salt E22, E23, 76 + nitric acid, resium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monotherate + 1,1'-oxybisethane 204 + 1,1'-oxybisethane 204 + 1,1'-oxybisethane 204 + 1,1'-sybisethane 204 + 1,1'-s</pre>			
<pre>+ 2-octanone E127, E128, 150 + oxalic acid, butyl ester E127, E128, 143 + oxalic acid, uranyl salt 96, 110, 111 + 2.2'-oxybis(2-chloropropane) E127, E128, 170 + 1,1'-oxybisbutane E127, E128, 170, 187, 188 + 1,1'-oxybisbutane E127, E128, 170, 187, 180 E121-E126, E129, E130, 161-164, 189 + 1,1'-oxybispetane E127, E128, 171 + 1,1'-oxybispetane E127, E128, 171 + 1,1'-oxybispetane E127, E128, 171 + 1,1'-oxybispetane E127, E128, 143 + 1-pentanol E127, E128, 143 + 1-pentanol E127, E128, 143 + 1-pentanone E127, E128, 143 + 2-pentanone E127, E128, 143 + phosphoric acid, pentyl ester E127, E128, 143 + popanoic acid, tributyl ester E127, E128, 143 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + 1-pentanon E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + tricthylene glycol dibutyl ether E127, E128, 157 + 2-propanon E127, E128, 157 + 2-propanone E127, E128, 158 + 2-propanone E127, E128, 159 + 2-propanone E127, E128, 154, 155, 158 + 2-propanone E127, E128, 154, 155, 158 + 2-propanone E127, E128, 154, 151, 151, 154, 152, 154, 152, 154 + tricthylene glycol dibutyl ether E127, E128, 171 + tricthylene glycol dichloride E127, E128, 171 + thereate E121, E126 + nitric acid,</pre>			
<pre>+ oxalic acid, uranyl salt + oxalic acid, uranyl salt + oxalic acid, uranyl salt + 2.2'-oxybis(2chloropropane) + 1,1'-oxybisbutane + 1,2'-oxybisbutane + 1,2'-oxybisbutane + 1,2'-oxybisbutane + 1,2'-oxybisbutane + 1,2'-oxybisbutane + 1,2'-oxybisbutane + 1,1'-oxybisbutane + 1,1'-oxy</pre>			
<pre>+ oxalic acid, uranyl salt 96, 110, 111 + 2,2'-oxybis/2-chloropropane) E127, E128, 170 H 1,1'-oxybisbutane E127, E128, 170 E127, E128, 170, E127, E128, 170 E130, 161-164, 167, 172, 174, 175, 160-166, 189 H 1,1'-oxybispetane E127, E128, 171 H 2,2'-oxybispetane E127, E128, 143 H 1-pentanol acid, pentyl ester E127, E128, 133, 139 H 3-pentanone E127, E128, 133, 139 H 3-pentanone E127, E128, 143 H 1-pentanone E127, E128, 143 H 1-pentanone E127, E128, 143 H 2-pentanone E127, E128, 143 H 2-penpanoic acid, 2-methylpropyl ester E127, E128, 143 H 2-propanoic acid, 2-methylpropyl ester E127, E128, 143 H 2-propanoic acid, pentyl ester E127, E128, 143 H 2-propanoic acid, pentyl ester E127, E128, 143 H 2-propanoic acid, pentyl ester E127, E128, 143 H 2-propanone E127, E128, 139 H 2-propanone E127, E128, 139 H 2-propanone E127, E128, 139 H 2-propanone E127, E128, 139 H 2-propanone E127, E128, 130 H 2-propanone E127, E128, 131 H 4 that the full of 191-193 H 4 succinic acid, pentyl ester E127, E128, 171 H triethylene glycol dibulyl ether E127, E128, 170 H 1-undecanol E127, E128, 171 H triethylene glycol dichloride E127, E128, 171 H triethylene glycol dichloride E127, E128, 171 H triethylene glycol dichloride E127, E128, 171 H triethylene flycol dibulyl ether E127, E128, 171 H triethylene glycol dichloride E127,</pre>			-
<pre>+ 2,2'-oxybis(2-chloropropane) E127, E128, 170 + 1,1'-oxybisbutane E127, E128, 170, 187, 188 + 1,1'-oxybisethane E121-E126, E129, E130, 161-164, 167-170, 172, 174, 167-170, 172, 174, 167-170, 172, 174, 175, 160-166, 189 + 1,1'-oxybispetane E127, E128, 171 + 1,1'-oxybispetane E127, E128, 171 + 2,2'-oxybispetane E127, E128, 171 + 2,2'-oxybispetane E127, E128, 171 + 2,2'-oxybispetane E127, E128, 173 + 3-pentanol E127, E128, 133, 139 + 3-pentanon E127, E128, 157 + 3-pentanone E127, E128, 143 + 1-pentanoi E127, E128, 143 + 2-pentanone E127, E128, 143 + phosphoric acid, tributyl ester E128, 213, 214-216 + plutonium, bis(nitrato-0)dioxo-, (T-4) - 119, 120 + propanoic acid, Dutyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 2-propanoi acid, 2-methylpropyl ester E127, E128, 143 + 2-propanoi acid, pentyl ester E127, E128, 143 + 2-propanoi E127, E128, 157 + 2-propanone E127, E128, 143 + 2-propanoi acid, pentyl ester E127, E128, 143 + 2-propanoi acid, pentyl ester E127, E128, 143 + 2-propanoi E127, E128, 130 + 2-propanone E127, E128, 131 + 2-propanoi acid, pentyl ester E127, E128, 170 + tricthylene glycol dichloride E127, E128, 171 + benzene 196, 196, 207 + sacbutylbenzene 200 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 200 + 1,2-dichloroethane 201 + heptane 194, 197 + kerosine 219 + nitric acid, uranyl salt, dicherate E121-E126 + nitric acid, uranyl salt, dicherate E121-E126 + nitric acid, uranyl salt, dicherate E121-E126 + nitric acid, uranyl salt, trihydrate dietherate + nitric acid, uranyl salt, trihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate dietherate E121-E126</pre>			
<pre>+ 1,1'-oxybisbutane</pre>		+ oxalic acid, uranyl salt	
<pre>167, 168 + 1,1'-oxybisethane</pre>		+ 2,2'-oxybis(2-chloropropane)	E127, E128, 170
<pre>+ 1,1'-oxybisethane E121-E126, E129, E130, 161-164, 167-170, 172, 174, 175, 180-166, 189 + 1,1'-oxybispethane E127, E128, 171 + 1,1'-oxybispethane E127, E128, 171 + 2,2'-oxybispethane E127, E128, 133, 139 + 3-pentanol E127, E128, 143 + 1-pentanol E127, E128, 143 + 2-pentanone E127, E128, 143 + 3-pentanone E127, E128, 143 + 2-pentanone E127, E128, 143 + propanoic acid, tributyl ester E128, 213, 214-216 + phosphoric acid, urnyl ester E127, E128, 143 + propanoic acid, urnyl ester E127, E128, 143 + propanoic acid, urnyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 2-propanol E127, E128, 143 + 2-propoxy-2-propane E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 170 + triethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 170 + 1-undecanol E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + herene 196, 198, 207 + secbutylbenzene 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate</pre>		+ 1,1'-oxybisbutane	E127, E128, 170,
<pre>E130, 161-164, 167-170, 172, 174, 175, 180-166, 189 E127, E128, 171, 179 + 1,1'-oxybispotane E127, E128, 171 + 2,2'-oxybispopane E128, 170 + pentancic acid, pentyl ester E127, E128, 133, 139 + 3-pentanol E127, E128, 133, 139 + 3-pentanone E127, E128, 143 + phosphoric acid, tributyl ester E127, E128, 143 + phosphoric acid, tributyl ester E127, E128, 143 + phosphoric acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 2-propanon E127, E128, 143 + 1-propanoic acid, pentyl ester E127, E128, 143 + 1-propanoic acid, pentyl ester E127, E128, 143 + 1-propanoic acid, pentyl ester E127, E128, 143 + 2-propanon E127, E128, 143 + 2-propanon E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent) + benzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate Monoetherate E12</pre>			187, 188
<pre>E130, 161-164, 167-170, 172, 174, 175, 180-166, 189 E127, E128, 171, 179 + 1,1'-oxybispotane E127, E128, 171 + 2,2'-oxybispopane E128, 170 + pentancic acid, pentyl ester E127, E128, 133, 139 + 3-pentanol E127, E128, 133, 139 + 3-pentanone E127, E128, 143 + phosphoric acid, tributyl ester E127, E128, 143 + phosphoric acid, tributyl ester E127, E128, 143 + phosphoric acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 2-propanon E127, E128, 143 + 1-propanoic acid, pentyl ester E127, E128, 143 + 1-propanoic acid, pentyl ester E127, E128, 143 + 1-propanoic acid, pentyl ester E127, E128, 143 + 2-propanon E127, E128, 143 + 2-propanon E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent) + benzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate Monoetherate E12</pre>		+ 1,1'-oxybisethane	E121-E126, E129,
167-170, 172, 174, 175, 180-186, 189         + 1,1'-oxybiscotane       E127, E128, 171         + 1,1'-oxybispentane       E127, E128, 171         + 2,2'-oxybispropane       E127, E128, 113         + 2,2'-oxybispropane       E127, E128, 133         + 1-pentanol       E127, E128, 133         + 1-pentanol       E127, E128, 133         + 2-pentanone       E127, E128, 143         + phosphoric acid, tributyl ester       E127, E128, 143         + propanoic acid, tributyl ester       E127, E128, 143         + propanoic acid, butyl ester       E127, E128, 143         + propanoic acid, butyl ester       E127, E128, 143         + propanoic acid, pentyl ester       E127, E128, 143         + 1-propanoi       E127, E128, 143         + 2-propanon       E127, E128, 143         + 1-undecanol       E127, E128, 143         + tetraethylene glycol dibutyl ether       E127, E128, 153         + uranium oxide       97-99         + water       E127, E128, 133         + uranium oxide       97-99         + water       E127, E128, 133		,	
175. 160-166, 169         + 1,1'-oxybispotane       E127, E128, 171         + 1,1'-oxybispotane       E127, E128, 171         + 2,2'-oxybispopane       E128, 170         + pentanoic acid, pentyl ester       E127, E128, 133         + 1-pentanoi       E127, E128, 133         + 3-pantanoi       E127, E128, 133         + 3-pentanone       E127, E128, 133         + phosphoric acid, tributyl ester       E127, E128, 143         + propanoic acid, butyl ester       E127, E128, 143         + propanoic acid, pentyl ester       E127, E128, 143         + 1-propanol       E127, E128, 143         + 1-propanol       E127, E128, 143         + 1-propanol       E127, E128, 139         + 2-propoxy-2-propane       E127, E128, 131         + tetraethylene glycol dichloride       E127, E128, 131         + tetraethylene glycol dichloride       E127, E128, 131         + uranium oxide       97-99         + water       E1-226, Z7-120         + xanthyl ether       E127, E128, 133<	1		
<pre>+ 1,1'-oxybishexane E127, E128, 171, 179 + 1,1'-oxybispentane E127, E128, 171 + 2,2'-oxybispentane E128, 170 + pentanoic acid, pentyl ester E127, E128, 133 + 1-pentanol E127, E128, 133 + 2-pentanone E127, E128, 133 + 2-pentanone E127, E128, 143 + propanoic acid, tributyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 139 + 2-propanol E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 139 + 2-propanol E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 143 + turanium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 131 + uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 131 + uranium oxide 97-99 + water E1-E26, 27-120 + kardhylene phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, diehydrate dietherate E127-E126 + nitric acid, uranyl salt, dihydrate dietherate E127-E126 + nitric acid, uranyl salt, trihydrate monoetherate E127-E126 + nitric acid, uranyl salt, dihydrate dietherate E127-E126 + nitric acid, uranyl salt, dihydrate diethera</pre>			
<pre>+ 1,1'-oxybisoctane E127, E128, 171 + 1,1'-oxybispentane E127, E128, 171 + 2,2'-oxybispentane E127, E128, 133 + 1-pentanol E127, E128, 133, 139 + 3-pentanol E127, E128, 133 + 2-pentanone E127, E128, 143 + phosphoric acid, tributyl ester E127, E128, 143 + phosphoric acid, butyl ester E127, E128, 143 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 1-propanol E127, E128, 139 + 2-propanon E127, E128, 131 + tetraethylene glycol dichloride E127, E128, 171 + triethylene glycol dichloride E127, E128, 171</pre>	1	+ 1.11-ovubishevano	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			
<pre>+ 2,2'-oxybispropane E128, 170 + pentanoic acid, pentyl ester E127, E128, 143 + 1-pentanol E127, E128, 133, 139 + 3-pentanone E127, E128, 133, 139 + 3-pentanone E127, E128, 133 + 2-pentanone E127, E128, 148 + phosphoric acid, tributyl ester E127, E128, 143 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 1-propanol E127, E128, 139 + 2-propanon E127, E128, 139 + 2-propoxy-2-propane 153, 154, 156, 158 + 2-propoxy-2-propane 153, 176, 191-193 + succinic acid, pentyl ester E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnonent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 210 + heptane 194, 197 + kerosine 210 + heptane 194, 197 + kerosine 210 + nitric acid, runyl salt, dichlorate E121-E126 + nitric acid, uranyl salt, dichlorate E121-E126 + nitric acid, uranyl salt, dichlorate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, dichlorate 165, 166, 194-196,</pre>			
<pre>+ pentanoic acid, pentyl ester E127, E128, 143 + 1-pentanol E127, E128, 133 + 3-pentanone E127, E128, 133 + 2-pentanone E127, E128, 148 + phosphoric acid, tributyl ester E128, 213, 214-216 + plutonium, bis(nitrato-O)dioxo-, (T-4)- 119, 120 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 2-propanol E127, E128, 139 + 2-propanon E127, 146, 147, 151, + 2-propanon E127, 146, 147, 151, + 2-propanon E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 143 + turanium oxide 97-99 + water E122, E128, 133 + uranium oxide 97-99 + water E122, E128, 171 Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + socbutylbenzene 200 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 210 + heptane 194, 197 + kerosine 219 + nitric acid, uranyl salt, dietherate E127, E128, 76 + nitric acid, uranyl salt, dihydrate dietherate E127, E128, 76 + nitric acid, uranyl salt, dihydrate dietherate E127, E128, 76 + nitric acid, uranyl salt, trihydrate monoetherate E127, E128 + nitric acid, uranyl salt, dihydrate dietherate E127, E128 + nitric acid, uranyl salt, trihydrate monoetherate E127, E128 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt</pre>			
<pre>+ 1-pentanol</pre>	ļ		
<pre>+ 3-pentanol E127, E128, 133 + 2-pentanone E127, E128, 148 + phosphoric acid, tributyl ester E128, 213, 214-216 + plutonium, bis(nitrato-0)dioxo-, (T-4)- propanoic acid, butyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 139 + 2-propanon E127, 146, 147, 151, + 2-propanon E127, 146, 147, 151, + trietnylene glycol dibutyl ether E127, E128, 171 + trietnylene glycol dichloride E127, E128, 171 + trietnylene glycol dichloride E127, E128, 171 + trietnylene glycol dichloride E127, E128, 171 + uranium oxide 97-99 + water E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + 1,2-dichloroethane 219 + nitric acid, rubidium salt 227, E123, 76 + nitric acid, rubidium salt 227, 223, 76 + nitric acid, uranyl salt, dichderate E121-E126 + nitric acid, uranyl salt, dichderate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate + nitric acid, uranyl salt, trihydrate monoetherate + 1,1'-oxybisethane 105, 166, 194-196,</pre>			
<pre>+ 2-pentanone E127, E128, 157 + 3-pentanone E127, E128, 148 = phosphoric acid, tributyl ester E128, 213, 214-216 + plutonium, bis(nitrato-0)dioxo-, (T-4) - 119, 120 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 1-propanol E127, E128, 139 + 2-propanone E127, 128, 139 + 2-propanone E127, 128, 139 + 2-propoxy-2-propane E127, E128, 137 + succinic acid, pentyl ester E127, E128, 138 + tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + di-2-phenylbutane phosphonate 220 + 1,2-dichloroethane 200 + 1,2-dichloroethane 201 + did-2-phenylbutane phosphonate 220 + 1,2-dichloroethane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dichdrate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate + nitric acid, uranyl salt, dihydrate dietherate + nitric acid, uranyl salt, dihydrate monoetherate + nitric acid, uranyl salt, dihydrate monoetherate + nitric acid, uranyl salt, trihydrate monoetherate</pre>			
<pre>+ 3-pentanone E127, E128, 148 + phosphoric acid, tributyl ester E128, 213, 214-216 + plutonium, bis(nitrato-0)dioxo-, (T-4)- 119, 120 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + l-propanol E127, E128, 139 + 2-propanon E127, E128, 137 + succinic acid, pentyl ester E127, E128, 137 + triethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + uranium oxide 97-99 + water E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 200 + 1,2-dichloreethane 207 + did-2-phenylbutane phosphonate 210 + heptane 194, 197 + kerosine 219 + nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126</pre>		+ 3-pentanol	E127, E128, 133
<pre>+ phosphoric acid, tributyl ester E128, 213, 214-216 + plutonium, bis(nitrato-0)dioxo-, (T-4)- 119, 120 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + l-propanol E127, E128, 139 + 2-propanol E127, E128, 139 + 2-propony-2-propane E127, E128, 139 + succinic acid, pentyl ester E127, E128, 139 + succinic acid, pentyl ester E127, E128, 139 + tetraethylene glycol dibutyl ether E127, E128, 170 + triethylene glycol dichloride E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + uranium oxide 97-99 + water E127, E128, 171 + benzene 196, 198, 207 + sacchtylenezhe en 200 + water E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 200 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uran</pre>		+ 2-pentanone	E127, E128, 157
<pre>+ phosphoric acid, tributyl ester E128, 213, 214-216 + plutonium, bis(nitrato-0)dioxo-, (T-4)- 119, 120 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + l-propanol E127, E128, 139 + 2-propanol E127, E128, 139 + 2-propony-2-propane E127, E128, 139 + succinic acid, pentyl ester E127, E128, 139 + succinic acid, pentyl ester E127, E128, 139 + tetraethylene glycol dibutyl ether E127, E128, 170 + triethylene glycol dichloride E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + uranium oxide 97-99 + water E127, E128, 171 + benzene 196, 198, 207 + sacchtylenezhe en 200 + water E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 200 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uranyl salt, dieherate E121-E126 + nitric acid, uran</pre>			E127, E128, 148
<pre>+ plutonium, bis(nitrato-0)dioxo-, (T-4)- 119, 120 + propanoic acid, butyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 1-propanol E127, E128, 139 + 2-propanon E127, E128, 139 + 2-propanon E127, 146, 147, 151, 52, 154, 156, 158 + 2-propay-2-propane 173, 176, 191-193 + succinic acid, pentyl ester E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + uranium oxide 97-99 + water E1E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 200 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate F121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate F121-E126 + nitric acid, uranyl salt, trihydrate monoetherate F121-E126 + nitric acid, uranyl salt, trihydrate f121-E126 + nitric acid, uranyl salt, f14, f15, f16, f194-196,</pre>			
<pre>+ propanoic acid, butyl ester E127, E128, 143 + propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 1-propanol E127, E128, 139 + 2-propanol E127, E128, 139 + 2-propanone E127, 146, 147, 151, + 2-propoxy-2-propane E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 143 + tetraethylene glycol dichloride E127, E128, 143 + triethylene glycol dichloride E127, E128, 133 + uranium oxide 97-99 + water E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 207 + di-2-phenylbutane phosphonate 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate F121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>			
<pre>+ propanoic acid, 2-methylpropyl ester E127, E128, 143 + propanoic acid, pentyl ester E127, E128, 143 + 1-propanol E127, E128, 139 + 2-propanone E127, E128, 139 + 2-propoxy-2-propane E127, E128, 143 + 2-propoxy-2-propane 173, 176, 191-193 + succinic acid, pentyl ester E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + triethylene glycol dichloride E127, E128, 171 + triethylene glycol dichloride E127, E128, 173 + uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + 1,2-dichloroethane 207 + dicacane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate fielerate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate fielerate E121-E126 + nitric acid, uranyl salt, trihydrate fielerate E121-E126 + nitric acid, uranyl salt, trihydrate fielerate E121-E126 + nitric acid, uranyl salt, fielerate E121-E126 + nitric acid, uranyl salt, fi</pre>			
<pre>+ propanoic acid, pentyl ester E127, E128, 143 + 1-propanol E127, E128, 139 + 2-propanol E127, E128, 139 + 2-propanon E127, 146, 147, 151,</pre>			
+       1-propanol       E127, E128, 139         +       2-propanone       E127, E128, 139         +       2-propanone       E127, E128, 139         +       2-proponone       152, 154, 156, 158         +       2-propoxy-2-propane       173, 176, 191-193         +       succinic acid, pentyl ester       E127, E128, 139         +       tetraethylene glycol dibutyl ether       E127, E128, 143         +       tetraethylene glycol dichloride       E127, E128, 170         +       triethylene glycol dichloride       E127, E128, 171         +       twater       E127, E128, 171         +       water       E127, E128, 171         +       water       E127, E128, 171         +       benzene       196, 198, 207         +       secbutylbenzene       207 <td></td> <td></td> <td></td>			
+ 2-propanol       E127, E128, 139         + 2-proponone       E127, 146, 147, 151, 152, 154, 156, 158         + 2-propoxy-2-propane       173, 176, 191-193         + succinic acid, pentyl ester       E127, E128, 143         + tetraethylene glycol dibutyl ether       E127, E128, 171         + triethylene glycol dichloride       E127, E128, 171         + triethylene glycol dichloride       E127, E128, 133         + uranium oxide       97-99         + water       E127, E128, 171         Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent)       + benzene         + benzene       196, 198, 207         + secbutylbenzene       220         + dodecane       210         + heptane       194, 197         + kerosine       219         + nitric acid, cesium salt       E22, E23, 76         + nitric acid, uranyl salt, dietherate       E121-E126         + nitric acid, uranyl salt, dihydrate dietherate       E121-E126         + nitric acid, uranyl salt, trihydrate monoetherate       E121-E126         + nitric acid, u		+ propanoic acid, pentyl ester	
+ 2-propanone       E127, 146, 147, 151, 152, 154, 156, 158         + 2-propoxy-2-propane       173, 176, 191-193         + succinic acid, pentyl ester       E127, E128, 143         + tetraethylene glycol dibutyl ether       E127, E128, 171         + triethylene glycol dichloride       E127, E128, 171         + triethylene glycol dichloride       E127, E128, 170         + uranidecanol       E127, E128, 133         + uranium oxide       97-99         + water       E127, E128, 171         Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent)       + benzene         + benzene       196, 198, 207         + secbutylbenzene       200         + 1.2-dichloroethane       200         + dodecane       210         + heptane       194, 197         + kerosine       219         + nitric acid, cesium salt       E22, E23, 76         + nitric acid, uranyl salt, dietherate       E121-E126         + nitric acid, uranyl salt, dihydrate dietherate       E121-E126         + nitric acid, uranyl salt, trihydrate monoetherate			
152, 154, 156, 158         + 2-propoxy-2-propane       173, 176, 191-193         + succinic acid, pentyl ester       E127, E128, 143         + tetraethylene glycol dibutyl ether       E127, E128, 171         + triethylene glycol dichloride       E127, E128, 170         + uranium oxide       97-99         + water       E1-E26, 27-120         + xanthyl ether       E127, E128, 171         Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent)       + benzene         + benzene       196, 198, 207         + secbutylbenzene       220         + 1,2-dichloroethane       200         + did-2-phenylbutane phosphonate       210         + heptane       194, 197         + kerosine       219         + nitric acid, cesium salt       E22, E23, 76         + nitric acid, uranyl salt, dihydrate       E121-E126         + nitric acid, uranyl salt, dihydrate       E121-E126         + nitric acid, uranyl salt, trihydrate monoetherate       E121-E126         + nitric acid, uranyl salt, trihydrate monoetherate       E121-E126         + nitric acid, uranyl salt, trihydrate       E121-E126         + nitric acid, uranyl salt, trihydrate       E121-E126         + nitric acid, uranyl salt, trihydrate       E121-E126         + nit			
<pre>+ 2-propoxy-2-propane 173, 176, 191-193 + succinic acid, pentyl ester E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 170 + 1-undecanol E127, E128, 133 + uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate</pre>	3	+ 2-propanone	
<pre>+ succinic acid, pentyl ester E127, E128, 143 + tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 170 + t-undecanol E127, E128, 133 + uranium oxide 97-99 + water E1-E26, 27-120 + water E127, E128, 171 Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent) + benzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate</pre>			152, 154, 156, 158
<pre>+ tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 170 + 1-undecanol E127, E128, 133 + uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>		+ 2-propoxy-2-propane	173, 176, 191-193
<pre>+ tetraethylene glycol dibutyl ether E127, E128, 171 + triethylene glycol dichloride E127, E128, 170 + 1-undecanol E127, E128, 133 + uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>		+ succinic acid, pentyl ester	E127, E128, 143
<pre>+ triethylene glycol dichloride E127, E128, 170 + 1-undecanol E127, E128, 133 + uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-O)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid Cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>			E127, E128, 171
<pre>+ 1-undecanol E127, E128, 133 + uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate</pre>		+ triethvlene glycol dichloride	
<pre>+ uranium oxide 97-99 + water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis (nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>		+ 1-undecanol	
<pre>+ water E1-E26, 27-120 + xanthyl ether E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric methane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>			
<pre>+ xanthyl ether E127, E128, 171 Uranium, bis(nitrato-0)dioxo-, (T-4) - (multicomnponent) + benzene 196, 198, 207 + benzene 220 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate</pre>			
Uranium, bis(nitrato-0)dioxo-, (T-4)- (multicomnponent) + benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric methane 204 + 1,1'-oxybisethane 165, 166, 194-196,			
<pre>+ benzene 196, 198, 207 + secbutylbenzene 220 + 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>	TT man and some		
+ secbutylbenzene       220         + 1,2-dichloroethane       207         + di-2-phenylbutane phosphonate       220         + dodecane       210         + heptane       194, 197         + kerosine       219         + nitric acid       100-120, 204, 212, 217, 219, 221, 222, 223, 256         + nitric acid, cesium salt       E22, E23, 76         + nitric acid, rubidium salt       E22, E23, 76         + nitric acid, uranyl salt, dietherate       E121-E126         + nitric acid, uranyl salt, dithydrate dietherate       E121-E126         + nitric acid, uranyl salt, trihydrate monoetherate       E121-E126         + nitric acid, uranyl salt, trihydrate monoetherate       E121-E126         + nitric acid, uranyl salt, trihydrate monoetherate       E121-E126         + nitromethane       204         + 1,1'-oxybisethane       165, 166, 194-196,	oranium,		
+ 1,2-dichloroethane 207 + di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate 204 + 1,1'-oxybisethane 204			
<pre>+ di-2-phenylbutane phosphonate 220 + dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>			
+ dodecane 210 + heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,			
<pre>+ heptane 194, 197 + kerosine 219 + nitric acid 100-120, 204, 212,</pre>		+ di-2-phenylbutane phosphonate	220
<pre>+ kerosine 219 + nitric acid 100-120, 204, 212,</pre>		+ dodecane	210
<pre>+ kerosine 219 + nitric acid 100-120, 204, 212,</pre>		+ heptane	194, 197
<pre>+ nitric acid 100-120, 204, 212, 217, 219, 221, 222, 223, 256 + nitric acid, cesium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, trihydrate dietherate = nitric acid, uranyl salt, trihydrate monoetherate = 121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>		-	-
217, 219, 221, 222, 223, 256 + nitric acid, cesium salt + nitric acid, rubidium salt + nitric acid, uranyl salt, dietherate + nitric acid, uranyl salt, dietherate + nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane + 1,1'-oxybisethane 217, 219, 221, 222, 223, 256 E122, E23, 76 E121-E126 E121-E126 + 165, 166, 194-196,			100-120, 204, 212,
223, 256 + nitric acid, cesium salt + nitric acid, rubidium salt + nitric acid, uranyl salt, dietherate + nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane + 1,1'-oxybisethane 223, 256 E22, E23, 76 E121-E126 E121-E126 204 165, 166, 194-196,			
<pre>+ nitric acid, cesium salt E22, E23, 76 + nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate</pre>			
<pre>+ nitric acid, rubidium salt E22, E23, 76 + nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate</pre>		+ nitric acid coeium calt	
<pre>+ nitric acid, uranyl salt, dietherate E121-E126 + nitric acid, uranyl salt, dihydrate dietherate</pre>			
<pre>+ nitric acid, uranyl salt, dihydrate dietherate E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane + 1,1'-oxybisethane</pre>			
E121-E126 + nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane + 1,1'-oxybisethane E121-E126 204 165, 166, 194-196,			
<pre>+ nitric acid, uranyl salt, trihydrate monoetherate E121-E126 + nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,</pre>		+ nitric acid, uranyl salt, dihydrate diethe	
+ nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,			
+ nitromethane 204 + 1,1'-oxybisethane 165, 166, 194-196,		+ nitric acid, uranyl salt, trihydrate monoe	therate
+ 1,1'-oxybisethane 165, 166, 194-196,			
+ 1,1'-oxybisethane 165, 166, 194-196,		+ nitromethane	204

Uranium,	bis(nitrato-O)dioxo-, (T-4)- (multicomnponen	it)
	+ 1,1'-oxybisbutane	197, 198
	+ phosphoric acid, tributyl ester	217-223
	+ 2-propanone	159, 160
	+ tetrachloromethane	159, 160, 195, 198,
		206, 212, 218, 222
	+ trichloromethane	195, 197, 206, 208,
		211
	+ trioctylamine nitrate	206, 207, 209-211
	+ uranium oxide	112
	+ water-d2	E128, 199, 200

ł

## **REGISTRY NUMBER INDEX**

Page numbers preceded by E refer to evaluation text whereas those not preceded by E refer to compiled tables. 56-23-5 159, 160, 195, 198, 206, 207, 212, 218.

56-23-5	159, 160, 195, 198, 206, 207, 212, 218, 222, E259-E261, 290, 305, 306, 308, 314
56-81-5	E259-E261, 286
60-29-7	E121-E126, 161-170, 173, 174, 180-186,
	189, 194-196, 199, 200, E259-E261, 283,
	284, 288, 291, 312, 313-315
62-53-3	E259-E261, 290
64-17-5	E128, 131, 139, E259-E261, 285, 312,
	E316-E319, 329
64-18-6	201
64-19-7	202
67-56-1	E128, 131, 132, 139, E251-E261, 285
67-63-0	139, E259-E261, 285
67-64-1	E127, 146, 147, 151, 152, 154, 156, 158,
	159, 160, E259-E261, 289, 312
67-66-3	195, 197, 206, 208, 211, E259-E261, 290,
07-00-5	309, 311, 314
71-23-8	139, E259-E261, 285
71-36-3	139, E259-E261, 285
71-41-0	E128, 133, 139, E259-E261, 293
71-43-2	196, 198, 207, 209, E259-E261, 290, 311,
	315
71-55-6	E259-E261, 290
74-96-4	E259-E261, 290
75-09-2	E259-E261, 290
75-52-5	203-205, E259-E261, 295
75-65-0	138
75-97-8	155, 156
78-46-6	224, E259-E261, 306, 308
78-83-1	E127, E128, 134, 136, 137
78-92-2	E128, 134, E259-E261, 285, 307
78-93-3	E128, 148, 149, 156, E259-E261, 289, 294
79-01-6	E259-E261, 290
79-20-9	E259-E261, 287
79-24-3	205
79-46-9	203
91-22-5	E316-E319, 340
00 15 0	
93-15-2 93-55-0	E259-E261, 292
93-89-0	E259-E261, 289
94-47-3	E259-E261, 287 E259-E281, 294
95-50-1	E259-E261, 254 E259-E261, 311
95-53-4	E259-E261, 290
96-13-6	E128, 133, E259-E261, 293
96-22-0	149
97-95-0	E128, 133, 142, E259-E261, 293
98-86-2	157, E259-E261, 289
98-95-3	203, 208, 211, E259-E261, 290, 310
100-51-6	E259-E261, 286
100-66-1	E259-E261, 292
100-84-5 101-41-7	E259-E261, 292
TAT_3T_1	143

101-97-3 E259-E261, 287 102-85-2 E259-E261, 306, 308 103-37-7 E259-E261, 294 103-45-7 143 103-50-4 181 104-76-7 139 105-30-6 E128, 133 105-37-3 E259-E261, 287 105-46-4 142 105-54-4 145, E259-E261, 287 105-58-8 E259-E261, 287 105-99-7 143 106-23-0 148 106-24-1 E128, 133 106-33-2 E259-E261, 294 106-42-3 E259-E261, 281 106-43-4 E259-E261, 290 107-06-2 207 107-07-3 E259-E261, 286, 290 107-18-6 E259-E261, 285 107-21-1 E259-E261, 286 107-66-4 E316-E319, 332, 341, 342, 349 107-87-9 157 108-03-2 203, 205 108-05-4 142, E259-E261, 295 148, 149, 153, 154, 157, E259-E261, 289, 108-10-1 294, 307 108-11-2 E128, 134 108-20-3 E128, 170, 173, 176, 191-193 108-21-4 142, 144, E259-E261, 294 108-38-3 282 108-39-4 E259-E261, 286 E259-E261, 292 108-60-1 108-86-1 E259-E261, 290 E259-E261, 290 E259-E261, 290, 315 108-88-3 108-90-7 108-93-0 139, E259-E261, 287 148, E259-E261, 289 108-94-1 143, E259-E261, 295 109-43-3 E259-E261, 290 109-68-2 109-69-3 E259-E261, 314 109-86-4 E259-E261, 288 109-94-4 E259-E261, 287 110-00-9 181 110-19-0 143, E259-E261, 294 110-20-5 E259-E261, 291 110-40-7 143 110-43-0 148, 157, E259-E261, 289, 294 110-45-2 E259-E261, 295 110-80-5 E128, 133, E259-E261, 288 110-82-7 E259-E261, 313 110-86-1 E316-E319, 339 110-89-4 E259-E261, 290 150, E259-E261, 289 111-13-7 111-15-9 143 139, E259-E261, 286 111-27-3

1

111-44-4	190, E259-E261, 292
111-46-6	
	E259-E261, 286, 288
111-70-6	E128, 133, 139
111-87-5	E128, 133, 139, E259-E261, 293, 310
112-07-2	143
112-25-4	<b>N100 100</b>
112-25-4	E128, 133
112-26-5	170, E259-E261, 293, 295
112-36-7	E259-E261, 305
112-40-3	210, E259-E261, 279, 310
112-42-5	E128, 133, E259-E261, 293
112-42-5	E120, 155, E259-E201, 295
112-58-3	171, 179, E259-E261, 292
112-72-1	E259-E261, 293
112-73-2	E259-E261, 291, 305, 323, 338
112-98-1	
	E259-E261, 293
115-95-7	E259-E261, 294
119-36-8	E259-E261, 287
119-64-2	E259-E261, 290
	E259-E261, 290
121-69-7	E259-E261, 290
123-11-5	148
123-51-3	E128, 133-135, E259-E261, 286, 293
123-66-0	E259-E261, 287
123-72-8	148, E259-E261, 295
123-86-4	142, 144, E259-E261, 294
123-91-1	181, E259-E261, 288
	,,,
123-92-2	143, E259-E261, 294
123-96-6	139
124-06-1	E259-E261, 294
126-73-8	E128, 213-223, E259-E265, 266-279, 282,
	306-308, E316-E319, 331, 333-337, 348
135 00 0	
135-98-8	220, E259-E261, 280
140-88-5	E259-E261, 287
141-78-6	140-142, 144, E259-E261, 287
142-82-5	
	194, 197
142-96-1	170, 187, 188, 197, 198, E259-E261, 288
151-10-0	E259-E261, 292
540-18-1	143, E259-E261, 295
540-42-1	
	143, E259-E261, 294
540-59-0	E259-E261, 290
544-01-4	E259-E261, 288, 292
565-80-0	148, E259-E261, 289, 294
594-02-1	E100 100 E0E0 E0C1 000
584-02-1	E128, 133, E259-E261, 293
588-63-6	E259-E261, 292
590-01-2	143
591-78-6	E127, E128, 156
592-55-2	
592-55-2	E259-E261, 292
624-54-4	143
628-63-7	143, 144, E259-E261, 295
629-11-8	E259-E261, 286
629-14-1	177, 178, E259-E261, 305
629-82-3	171
638-49-3	142, E259-E261, 294
645-69-2	143
693-65-2	171, E259-E261, 292
928-45-0	E259-E261, 294
934-48-0	E259-E261, 294
	2002, 00.

994-05-8 E259-E261, 292 1116-76-3 206, 207, 209-211, E259-E261, 309-311 1330-20-9 E259-E261, 294 1344-58-7 97-99, 112 2031-89-2 96, 110, 111 2050-60-4 143, E259-E261, 295 2051-00-5 E259-E261, 294 2173-56-0 143, E259-E261, 295 2198-61-0 143, E259-E261, 295 3251-23-8 E23, 109, E238, E239, 254 4559-86-8 E259-E261, 295 E22, E23, 55-57, 100-102, E316-E319, 322 6484-52-2 7631-99-4 E22, E23, 60, 61 E19-E22, 37-54, 100-120, 204, 212, 217, 7697-37-2 219, 221, 222, 223, E235, E236, E238, E239, 248-252, 254-258, E259-E261, 269-279, 282, E316-E319, 320, 321, 323-328, 332, 333, 335-349 7732-18-5 E2-E26, 27-120, E121-E130, 131-164, 167-198, 201-224, E225-E239, 240-258, E259-E265, 267-315, E316-E319, 320-349 7757-79-1 E22, E23, 62-75, E316-E319, 325 E23, 90, 91, 108 7779-88-6 E22, E23, 76-78, 103, E316-E319, 327 7789-18-6 7789-20-0 199, 200 7790-69-4 E22, E23, 58, 59 8008-20-6 219, 278, E316-E319, 330, 334 E259-E261, 290 8032-32-4 10022-31-8 88, 89, 107 10042-76-9 E23, 87, 106 10045-94-0 E23, 94, 95 10102-06-4 E1 E22, E23, 79, 80, E316-E319, 328 10102-45-1 E23, 85, 86, 105 E23, 92, 93 10124-37-5 10325-94-7 E23, 83, 84, 104 10377-60-3 E238, E239, 255 10421-48-4 E22, E23, 76 13126-12-0 13470-07-0 E225 113-118, E235, E238, E239, 253, 257, 258, 13473-90-0 E259-E261, 282 13520-83-7 E1, E3-E12 13597-99-4 E23, 81, 82 13823-27-3 119, 120, E316-E319, 324-344 13823-29-5 165, 166, E225-E239, 240-258, E259-E265, 266-315 14767-04-5 E225, 242-244 15905-86-9 E1-E26, 27-120, E121-E130, 131-224, E238, E239, 256 16071-05-9 E1 16409-44-2 143 17118-09-1 346 20651-50-7 E1 20741-00-8 E225 22853-00-5 119, 120, E316-E319, 320-323, 343 23739-44-8 E225, 242-244 E259-E261, 294 23783-76-8 25933-53-3 E316-E319, 349 25933-55-5 E316-E319, 347

35073-27-9	142
39638-32-9	170
61443-54-7	E225, 242-244
66320-31-8	E316-E319, 345, 348
87174-21-8	E225

## AUTHOR INDEX

Page numbers preceded by E refer to evaluation text whereas those not preceded by E refer to compiled tables. Aartsen, J.J.Y. 218 Adelman, M. E12, E19-E22, E26, 42-44, 113-116 E225, E226, E235, E236, E238, E239, Afanas'ev, Yu.A. 252, 256, E259, E262, E265, 269-274 Afanasiev, Iu.A. E23, E26 Anderson, H.H. E316-E319, 325-328, 339, 340 Apelblat, A. E225, E230, E231, E236, E239, 247 Azoulay, D. E225, E230, E231, E236, E239, 247 Bachelet, M. E121, E126, E129, 169 Bastien, I.J. E12, E19-E22, E26, 42-44 E316, E319, 341, 342, 349 Belyaeva, T.B. Benrath, A. E1, E6, E10, E12-E16, E25, 30 Berezkina, V.V. 282 Berzelius, J. E225, E239 E316, E317, E319, 332, 341, 342, 349 Bogdanov, F.A. Bojan, N. E127, E130, 158-160 Bol'shakov, K.A. E1, E2, E6, E21, E25, 96, 110, 111 Bruce, F.R. E19, E25 Bryant, J.M. 213, E259-E261, E265, 268 Charpin, P. E238, E239 Chevrier, G. E238, E239 Cheylan, E. E121, E126, E129, 169 Chizhov, A.A. E259, E262, E265, 275-277, E316, E319, 335-337 Christensen, H.Th. E7, E12, E20, E21, E23, E26, 50, 51, 103, 106, 107 Chubukov, V.V. 223 Colani. A. E1, E2, E6, E19-E23, E25, 37, 55, 56, 60, 61, 63, 64 Cooper, V.R. E19, E22, E23, E25, 100, 101 Cordfunke, E.H.P. E19, E26, 97, 98 Cunningham, B.B. E316, E319, 322 Cypres, R. E1, E6, E25, 33, E121, E122, E124, E127-E129, 134, 144, 149, 172, 173 Davis, W. E21, E26, 49 Dawson, J.K. E316, E317, E319, 323, 329-331, 334, 338 De Bruin, H.J. E21, E26, 49 De Conninck Oe. E1, E4, E25, 27, E121, E127, E129, 131, 132, 140, 146, 161, 201, 202 De Keyser, W.L. E1, E16, E25, 33, E121, E122, E124, E127-E129, 134, 144, 149, 172, 173 Degtyarev, A.Ya. E1, E2, E6, E22, E26, 77-80 Deigele, E. E19-E21, E26, 52-54 Dyadin, Yu.A. E127, E128, E130, 216-224 E19, E26, 99 Efimova, V.S. E127, E130, 158-160 Eger, I. Elliott, R.M. E316, E317, E319, 329-331, 334 E7, E19-E22, E26, 112 Ensley, K. Fedorov, Yu.S. 212, 221, 222, E316, E319, 333, 348 Feldman, B.C. E316, E319, 320, 324 Ferraro, J.R. E225-E231, E234, E235, E236, E239, 248-251, E259-E263, E265, 303-308 Fletcher, J.M. E19, E25 Gaunt, J. E12, E19-E22, E26, 42-44 GEC Hanford Works E1, E2, E4, E12, E19, E25 Gerbanevskaya, M.M. E121, E126, E129, 184

Germann, F.E.E. E9, E25 Gibson, G. 250, 251, E262, E265 Gill, J.S. E1, E6, E10, E12-E16, E23, E25, 32, 34, E225-E232, E234, E236, E237, E239, 243-246 E259, E262, E265, 275-277, E316, E319, 335-337 E316, E317, E319, 332 220, E259, E265, 280 Gol'dfarb, Yu.Ya. Goncharuk, L.V. Gresky, A.T. Grishin, V.A. E1, E2, E6, E7, E23, E25, 85-89 Gromov, B.V. E19, E26, 99 E19, E26, 119, 120, E316, E319, 343, 344 Grosvenor, D.E. Grubbs, F.E. E3, E4, E25 Guempel, O. E1, E2, E5-E10, E13-E15, E18, E25, 29, E121, E122, E125, E126, E129, 164 Hall, N.F. E127, E129, 135, 145, 150, E259, E260, E265, 285-290, 298, 299, 301 E1-E3, E5-E8, E18, E19, E22, E23, E25, Harmon, M.K. 38, 100, 101 Hart, R.G. E19, E25, 40, 41 Healy, T.V. E127-E129, 214, E259-E263, E265, 266 E1, E6, E25, 33, E121, E122, E124, Herrmann, M. E127-E129, 134, 144, 149, 172, 173 E316, E319, 345-347 Hindman, J.C. Holmberg, K.E. E7, E12, E20, E21, E23, E26, 50, 51, 103, 106, 107 Huber, H.D. E225, E238, E239, 257, 258 Hurwic, J. E127, E128, E130, 215 Hyman, H.H. E19, E25 Kanevskii, E.A. E17, E26 E316, E319, 322 Katz, J. Katzin, L.I. E1, E2, E25, E121, E122, E125, E127, E129, 136-138, 151-154, 174, 175, 177-179, E225-E231, E234, E235, E236, E239, 248-251, E259-E263, E265, 303-308 E121, E124, E127, E130, E259, E265, 312 E121, E126, E130 Kertes, A.S. Khod'ko, N.N. Kolevich, T.A. E121, E126, E130 Korovin, S.S. E1, E2, E6, E21, E25, 96, 110, 111 Korvezee, A.E. 218 Kovaleva, T.V. E121, E124, E126, E129, 182, 183, 185, 186 Kovalskaya, M.P. E121, E126, E129, 182-184 Kraus, C.A. E127, E129, 141 Krevinskaia, M.Ye. E316, E319, 321 Kulikov, I.A. E259, E262, E265, 275-277, E316, E319, 335-337 Kurnakova, A.G. E23, E26, 102, 104, 105, 108, 109, E225, E227, E230, E231, E235, E236, E238, E239, 253-255 206, 207 Kuzina, M.G. LaChapelle, T.J. E316, E319, 345-347 Lacher, J.R. E7, E19-E22, E26, 112 Lance, M. E238, E239 Lane, J.A. E1, E12, E13, E25, 31 Lang, G.P. 36 Lawson, P.S. E21, E26, 49 Lebeau, P. E121, E122, E126, E129, 162, 163 E1, E4, E19, E26, E128, E130, 199, 200 Legin, E.K. Lerner, M.W. 219 Lewitz, N.M. E19, E26, 119, 120, E316, E319, 343, 344 Lipovskij, A.A. 206, 207 Magnusson, L.B. E316, E319, 345-347 Mansfield, R.G. E259, E265, 220, 280 E121, E124, E127, E130, E259, E265, 312 Marcus, Y. Marshall, W.L. E1, E6, E10, E12-E16, E23, E25, 32, 34, E225-E232, E234, E236, E237, E239, 244-246

McBeth, R.L. E259-E263, E265, 303-308 McKay, H.A. E127-E129, 214, E259-E263, 265, 266, 278 Medkov, B.K. E23, E26, 117, 118 Merz, E. E226, E239, E259, E262, E265, 279 Mezei, M. E127, E128, E130, 191-193 E127, E128, E130, 215 Michalczyk, J. Mikhailichenko, A.I. 282 Mikhlin, E.B. 282 Misciattelli, P. E1, E4, E6, E10, E25, E121, E122, E125, E126, E129, 165-167, E225, E226, E229, E231, E232, E236, E239, 240, E259, E265, 283 Mishin, V.Ya. E1, E2, E7, E19-E22, E26, 45-48 Moore, R.B. E127, E129, 147 Morris, G.O. E19, E25, 40, 41 Morss, L.R. E316, E319 Moskalkova, A.E. E121, E124, E129, 185 Mrochek, J. E21, E26 Nakashima, T. E226, E239, E259, E262, E265, 279 E1, E2, E5, E10, E15, E16, E25, 36 E259, E262, E265, 275-277, E316, E319, Nethaway, M.O. Neumoev, N.V. 335-337 Nierlich. M. E238, E239 Nikol'skii, V.D. E316, E319, 321 Nikolaev, A.V. E23, E26, 102, 104, 105, 108, 109, E127, E128, E130, 216, E225-E227, E230, E231, E235, E236, E238, E239, 217, 224, 252-256, E259, E262, E265, 269-274 Norstrom, A. E121, E129 Nosova, N.F. E1, E2, E6, E7, E22, E23, E25, E26, 58, 59, 77-95 Obruchnikov, A.V. 223 Ochkin, A.V. 223 Park, J.D. E7, E19-E22, E26, 112 Pavlovskaya, G.R. E17, E26 Perova, A.P. E1-E3, E6-E10, E13-E15, E18, E23, E25, 65-75 Petretic, G. 219 Petrov, M.R. E23, E26, 117, 118 Phillips, J.F. E225, E238, E239, 257, 258 Pozharskii, B.G. E316, E319, 321 E259, E262, E265, 275-277, E316, E319, Pyatibratotov, Yu.P. 335-337 Renard, E.V. E259, E262, E265, 275-277, E316, E319, 335-337 Rengevich, V.B. E17, E26 Rimbach, E. E22, E23, E25, 57, 62, 76 Ripan, R. E127, E130, 156-160 E23, E26, 117, 118 Roslyakova, O.N. Rovnyi, S.I. E316, E317, E319, 332 Ryabinin, A.I. E23, E26, E225, E226, E235, E236, E238, E239, 252, 256, E259, E262, E265, 269-274 Sahar, A. E225, E230, E231, E236, E239, 247 Schlundt, H. 147 E259, E265, 267 Schulz, W.W. Seaborg, G.T. E316, E319, 322 Secoy, C.H. E1, E6, E10, E12-E16, E25, 34, E225-E232, E234, E236, E237, E239, 243-246 Semenova, T.I. E259, E262, E265, 275-277, E316, E319, 335-337 Sillen, L.G. E121, E129 Sirotkina, I.G. E259, E262, E265, 275-277, E316, E319, 335-337 Smelov, V.S. 223

Sokhina, L.P. E316, E317, E319, 332, 341, 342, 349 Solovkin, A.S. E316, E319, 341, 342, 349 Staritzky, E. E228, E239 Statsevich, V.P. E259, E265, 313-315 Suglobov, D.N. E121, E125-E127, E129, 189, 190, 194-198, E259, E265, 313-315 Suglobova, I.G. E121, E125-E130, 187-198 Sullivan, J.C. E1, E2, E25, E121, E122, E125, E127, E129, 136-138, 151-154, 174, 175, 177-179 Templeton, C.C. E127, E129, 135, 145, 150, E225-E228, E230, E231, E234, E236, E237, E239, 241, 242, E259, E260, E265, 285-290, 298-301 Thibodaeu, R.D. E19, E26, 113-116 Tsyan-Tsi, Yui E1, E2, E6, E22, E26, 77-80 Ukraintsev, E.V. E259, E265, 281 Umreiko, D.S. E121, E126, E130 Van Name, R.G. E121, E124, E129, 168 Vasil'ev, A.M. E1, E2, E5-E10, E14, E15, E18, E25, 28 Vdovenko, V.M. E1, E4, E19, E26, E121, E124-E130, 182-200, 206, 207, E259, E265, 313-315 Verstegen, J.M.P. E127, E130, 208-211, E259, E265, 309-311 Vigner, D. E238, E239 Vogler, S. E19, E26, 119, 120, E316, E319, 343, 344 Voiland, E.E. E259, E265, 267 Walker, D.J. E228, E239 Wang, I. Wui 194-198 Warner, R.K. E1, E6, E25, 35, E121, E122, E127-E129, 139, 155-157, 176, 180, 181, 204, 205, E259, E265, 302 Wells, R.C. E259, E265, 284 Wendlandt, W.W. E127-E129, 213, E259-E263, E265, 268, 303-308 Yaffe, L. E121, E124, E127-E129, 133, 142, 143, 148, 170, 171, 203, E259, E260, E265, 291-297 Yakimov, M.A. E1, E2, E6, E7, E19-E23, E25, E26, 45-48, 58, 59, 77-95 Yakovlev, I.I. E127, E128, E130, 216, 217, 224 Zarubin, A.I. E17, E26 Zastenker, Ye.Ye. E316, E319, 321 Zil'berman, B.Ya. 212, 221, 222, E316, E319, 333, 348 Zimmer, E. E226, E239, E259, E262, E265, 279

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