INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

ANALYTICAL CHEMISTRY DIVISION
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SOLUBILITY DATA SERIES

Volume 10

NITROGEN AND AIR

SOLUBILITY DATA SERIES

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SOLUBILITY DATA SERIES

Volume 10

NITROGEN AND AIR

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SOLUBILITY DATA SERIES

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

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FOREWORD

If the knowledge is
undigested or simply wrong,
more is not better.

How to communicate and disseminate numerical data effectively in chemical science and technology has been a problem of serious and growing concern to IUPAC, the International Union of Pure and Applied Chemistry, for the last two decades. The steadily expanding volume of numerical information, the formulation of new interdisciplinary areas in which chemistry is a partner, and the links between these and existing traditional subdisciplines in chemistry, along with an increasing number of users, have been considered as urgent aspects of the information problem in general, and of the numerical data problem in particular.

Among the several numerical data projects initiated and operated by various IUPAC commissions, the *Solubility Data Project* is probably one of the most ambitious ones. It is concerned with preparing a comprehensive critical compilation of data on solubilities in all physical systems, of gases, liquids and solids. Both the basic and applied branches of almost all scientific disciplines require a knowledge of solubilities as a function of solvent, temperature and pressure. Solubility data are basic to the fundamental understanding of processes relevant to agronomy, biology, chemistry, geology and oceanography, medicine and pharmacology, and metallurgy and materials science. Knowledge of solubility is very frequently of great importance to such diverse practical applications as drug dosage and drug solubility in biological fluids, anesthesiology, corrosion by dissolution of metals, properties of glasses, ceramics, concretes and coatings, phase relations in the formation of minerals and alloys, the deposits of minerals and radioactive fission products from ocean waters, the composition of ground waters, and the requirements of oxygen and other gases in life support systems.

The widespread relevance of solubility data to many branches and disciplines of science, medicine, technology and engineering, and the difficulty of recovering solubility data from the literature, lead to the proliferation of published data in an ever increasing number of scientific and technical primary sources. The sheer volume of data has overcome the capacity of the classical secondary and tertiary services to respond effectively.

While the proportion of secondary services of the review article type is generally increasing due to the rapid growth of all forms of primary literature, the review articles become more limited in scope, more specialized. The disturbing phenomenon is that in some disciplines, certainly in chemistry, authors are reluctant to treat even those limited-in-scope reviews exhaustively. There is a trend to preselect the literature, sometimes under the pretext of reducing it to manageable size. The crucial problem with such preselection - as far as numerical data are concerned - is that there is no indication as to whether the material was excluded by design or by a less than thorough literature search. We are equally concerned that most current secondary sources, critical in character as they may be, give scant attention to numerical data.

On the other hand, tertiary sources - handbooks, reference books, and other tabulated and graphical compilations - as they exist today, are comprehensive but, as a rule, uncritical. They usually attempt to cover whole disciplines, thus obviously are superficial in treatment. Since they command a wide market, we believe that their service to advancement of science is at least questionable. Additionally, the change which is taking place in the generation of new and diversified numerical data, and the rate at which this is done, is not reflected in an increased third-level service. The emergence of new tertiary literature sources does not parallel the shift that has occurred in the primary literature.

With the status of current secondary and tertiary services being as briefly stated above, the innovative approach of the *Solubility Data Project* is that its compilation and critical evaluation work involve consolidation and reprocessing services when both activities are based on intellectual and scholarly reworking of information from primary sources. It comprises compact compilation, rationalization and simplification, and the fitting of isolated numerical data into a critically evaluated general framework.

The *Solubility Data Project* has developed a mechanism which involves a number of innovations in exploiting the literature fully, and which contains new elements of a more imaginative approach for transfer of reliable information from primary to secondary/tertiary sources. *The fundamental trend of the Solubility Data Project is toward integration of secondary and tertiary services with the objective of producing in-depth critical analysis and evaluation which are characteristic to secondary services, in a scope as broad as conventional tertiary services.*

Fundamental to the philosophy of the project is the recognition that the basic element of strength is the active participation of career scientists in it. Consolidating primary data, producing a truly critically-evaluated set of numerical data, and synthesizing data in a meaningful relationship are demands considered worthy of the efforts of top scientists. Career scientists, who themselves contribute to science by their involvement in active scientific research, are the backbone of the project. The scholarly work is commissioned to recognized authorities, involving a process of careful selection in the best tradition of IUPAC. This selection in turn is the key to the quality of the output. These top experts are expected to view their specific topics dispassionately, paying equal attention to their own contributions and to those of their peers. They digest literature data into a coherent story by weeding out what is wrong from what is believed to be right. To fulfill this task, the evaluator must cover *all* relevant open literature. No reference is excluded by design and every effort is made to detect every bit of relevant primary source. Poor quality or wrong data are mentioned and explicitly disqualified as such. In fact, it is only when the reliable data are presented alongside the unreliable data that proper justice can be done. The user is bound to have incomparably more confidence in a succinct evaluative commentary and a comprehensive review with a complete bibliography to both good and poor data.

It is the standard practice that any given solute-solvent system consists of two essential parts: I. Critical Evaluation and Recommended Values, and II. Compiled Data Sheets.

The Critical Evaluation part gives the following information:

(i) a verbal text of evaluation which discusses the numerical solubility information appearing in the primary sources located in the literature. The evaluation text concerns primarily the quality of data after consideration of the purity of the materials and their characterization, the experimental method employed and the uncertainties in control of physical parameters, the reproducibility of the data, the agreement of the worker's results on accepted test systems with standard values, and finally, the fitting of data, with suitable statistical tests, to mathematical functions;

(ii) a set of recommended numerical data. Whenever possible, the set of recommended data includes weighted average and standard deviations, and a set of smoothing equations derived from the experimental data endorsed by the evaluator;

(iii) a graphical plot of recommended data.

The compilation part consists of data sheets of the best experimental data in the primary literature. Generally speaking, such independent data sheets are given only to the best and endorsed data covering the known range of experimental parameters. Data sheets based on primary sources where the data are of a lower precision are given only when no better data are available. Experimental data with a precision poorer than considered acceptable are reproduced in the form of data sheets when they are the only known data for a particular system. Such data are considered to be still suitable for some applications, and their presence in the compilation should alert researchers to areas that need more work.

The typical data sheet carries the following information:

(i) components - definition of the system - their names, formulas and Chemical Abstracts registry numbers;

(ii) reference to the primary source where the numerical information is reported. In cases when the primary source is a less common periodical or a report document, published though of limited availability, abstract references are also given;

(iii) experimental variables;

(iv) identification of the compiler;

(v) experimental values as they appear in the primary source. Whenever available, the data may be given both in tabular and graphical form. If auxiliary information is available, the experimental data are converted also to SI units by the compiler.

Under the general heading of Auxiliary Information, the essential experimental details are summarized:

(vi) experimental method used for the generation of data;
(vii) type of apparatus and procedure employed;
(viii) source and purity of materials;
(ix) estimated error;
(x) references relevant to the generation of experimental data as cited in the primary source.

This new approach to numerical data presentation, developed during our four years of existence, has been strongly influenced by the diversity of background of those whom we are supposed to serve. We thus deemed it right to preface the evaluation/compilation sheets in each volume with a detailed discussion of the principles of the accurate determination of relevant solubility data and related thermodynamic information.

Finally, the role of education is more than corollary to the efforts we are seeking. The scientific standards advocated here are necessary to strengthen science and technology, and should be regarded as a major effort in the training and formation of the next generation of scientists and engineers. Specifically, we believe that there is going to be an impact of our project on scientific-communication practices. The quality of consolidation adopted by this program offers down-to-earth guidelines, concrete examples which are bound to make primary publication services more responsive than ever before to the needs of users. The self-regulatory message to scientists of 15 years ago to refrain from unnecessary publication has not achieved much. The literature is still, in 1982, cluttered with poor-quality articles. The Weinberg report (in "Reader in Science Information", Eds. J. Sherrod and A. Hodina, Microcard Editions Books, Indian Head, Inc., 1973, p.292) states that "admonition to authors to restrain themselves from premature, unnecessary publication can have little effect unless the climate of the entire technical and scholarly community encourages restraint..." We think that projects of this kind translate the climate into operational terms by exerting pressure on authors to avoid submitting low-grade material. The type of our output, we hope, will encourage attention to quality as authors will increasingly realize that their work will not be suited for permanent retrievability unless it meets the standards adopted in this project. It should help to dispel confusion in the minds of many authors of what represents a permanently useful bit of information of an archival value, and what does not.

If we succeed in that aim, even partially, we have then done our share in protecting the scientific community from unwanted and irrelevant, wrong numerical information.

A. S. Kertes

PREFACE

The discovery of nitrogen is usually attributed to Daniel Rutherford in 1772. Priestly, Scheele, and Cavendish also did important experiments on this "phlogisticated" air (in contrast to "dephlogisticated" air or oxygen). Lavoisier named the gas azote from the Greek, meaning without life since it did not support life. Because of its presence in niter or nitre (KNO_3) the English name is nitrogen. Nitrogen forms 78.09 per cent of the atmosphere by volume and 75.51 per cent by weight. Despite this great abundance in the atmosphere nitrogen is only present to the extent of 0.0046 weight per cent in the igneous rocks of the crust of the earth. It is not even listed in a table I have on the amounts of elements in the ocean. The great importance of nitrogen is due to its prevalence in air and its "fixed" form as various nitrates.

This particular volume is concerned with the solubility of nitrogen and air in pure liquids, liquid mixtures, aqueous and organic solutions, biological fluids, and miscellaneous fluids and fluid mixtures. High and low pressures are covered in separate sections, the dividing line being a gas partial pressure of about 200 kPa (2 bar). With the higher pressure data there is always a problem of attempting to distinguish between gas solubilities and vapor-liquid equilibria. We have striven to be reasonable in making this distinction. Certain fluids such as molten salts, slags, glasses, metals, and alloys have been excluded from this volume, as well as polymeric materials. The literature, including specialty tabulations and compilations, has been searched through the middle of 1981, although a few more recent papers are included. (The editor would appreciate hearing about articles which were missed.)

The individual data sheets in this volume were prepared using the solubility units presented in the original papers. In general, where a given system was studied by several groups a critical evaluation was prepared. These critical evaluations are meant to be comprehensive, i.e., citing all papers with measurements on that system even though data sheets are not prepared from papers containing data of poor or questionable quality. In these critical evaluations, recommended or tentative smoothed data are usually presented. All cited papers are discussed, albeit briefly in many instances. Related systems are also discussed.

To our knowledge the solubilities of nitrogen and air have been determined only by physical means (if we leave out difference methods in which oxygen and carbon dioxide are analyzed for via chemical methods). The data sheets contain concise descriptions of the methods used. Information is also provided on the source and purity of the components, although we are surprised at how many papers omit this information.

Gas solubilities are presented in the original papers in an almost bewildering number of units. In the data sheets we present the units given in the original papers with explanatory material where necessary. Where it is feasible the compilers have converted these solubilities into the Ostwald coefficient and/or the mole fraction solubility at 101.325 kPa (1 atm) partial pressure of gas. These conversions were carried out for the convenience of the user, and such compiler-generated conversions are noted on the data sheets. Unless otherwise specified the units for the Bunsen coefficients reported herein are cm^3 (STP) cm^{-3} atm^{-1}.

We are indebted to Dr. William Gerrard for two instances illuminating the necessity of caution in the choice of units to represent gas solubilities. At 295 K if we take the ratio of the solubility of nitrogen in olive oil in units of the Bunsen coefficient to that in water it is 3.5. However, in terms of the mole ratio (number of moles of gas/number of moles of solvent at a specified temperature and pressure) this ratio is 188. Similar ratios at 293 K for nitrogen in several solvents are (solvent, ratio of Bunsen coefficients, ratio of mole ratios): benzene, 7.10, 35.0; methanol, 8.66, 19.4; ethanol, 8.77, 28.4; 1-pentanol, 7.50, 41.7; acetone, 8.94, 36.4; and $CH_3CO_2C_5H_{11}$, 9.44, 83.6. One last example involves the solubility of nitrogen in some biological fluids at 298.5 K. The solvent is given first, the the Bunsen coefficient, then the mole ratio solubility: olive oil, 0.0686, 0.00273; tetralin, 0.0638, 0.000357; oleic acid, 0.085, 0.00111; and ethyl palmitate 0.109, 0.00144. The question of which solvent is "best" for a given gas thus depends on the solubility unit you are using. Caution is obviously required in talking about "solvent power." Solubility units need to be matched to a given model for rational use.

On the data sheets data are reported in the units presented in the original paper. The data are also converted to SI in the tables where this is conveniently feasible, and always in SI in the "VARIABLES" box. With respect to naming components, we have attempted to use IUPAC nomenclature throughout. The Hill system is used for the formulas and the unique Chemical Abstracts Service Registry Numbers are used for all identifiable substances. The Standard Order of Arrangement is used for the sequencing of systems in a given section. Sorting of systems using the table of contents worked unambiguously for most systems. However, some systems had to be assigned arbitrarily by the editor. Common names of substances are used in addition to the systematic names as an aid to the reader.

Error estimates are given where the author(s) give this information. They are also estimated by the compilers in many cases.

Real gas corrections are not necessary for the data on nitrogen solubilities reported in this volume since we found no data of a precision to require the corrections. At STP the molar volume of nitrogen is 22,403.8 cm^3 which corresponds to a correction of 0.05 per cent. Recommended second virial coefficients taken from the second edition of Dymond and Smith are shown below along with the per cent error for not applying the correction. Around room temperature the corrections are negligible.

T/K	$B_{22}/cm^3\ mol^{-1}$	Per cent Error	T/K	$B_{22}/cm^3\ mol^{-1}$	Per cent Error
100	-160	1.9	300	-4.2	0.02
150	- 71.5	0.58	400	9.0	0.03
200	- 35.2	0.21	500	16.9	0.04
250	- 16.2	0.08			

One of the surprising results of the literature search for this work was the discovery of the relatively small number of measurements for the solubility of air in liquids. Of course, reasonably good values of air solubilities may be calculated from nitrogen and oxygen solubilities since these are additive within at least one per cent. Our literature search unearthed only one paper on nitrogen in heavy water, D_2O. This system should be studied further.

In the interest of helping the reader we have included two special papers written specifically for this volume by Drs. H. L. Clever and E. Wilhelm. The paper by Dr. Clever expands on the salt-effect parameters pioneered by Sechenov. Useful equations and interconversions are developed along with a recommended systematic notation. An appendix to this paper includes practical tables for some common salts. The paper by Dr. Wilhelm presents a rigorous thermodynamic treatment for the solubility of gases in liquids. The formalism developed is particularly important for measurements of high precision. We are pleased to include these two papers and express a special thanks to both authors.

The Editor acknowledges the advice and helpful suggestions of his colleagues in IUPAC Commission V.8, the Commission on Solubility Data. He also gratefully acknowledges the work of his research assistant, Mr. Chai-Jing Chou, and the secretaries who worked on this volume - Marty Tucker, Carolyn Dowie, and Lesley Flanagan.

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Rubin Battino

Dayton, Ohio
April, 1982

THE SOLUBILITY OF GASES AND LIQUIDS

Introductory Information

C. L. Young, R. Battino, and H. L. Clever

INTRODUCTION

The Solubility Data Project aims to make a comprehensive search of the literature for data on the solubility of gases, liquids and solids in liquids. Data of suitable accuracy are compiled into data sheets set out in a uniform format. The data for each system are evaluated and where data of sufficient accuracy are available values are recommended and in some cases a smoothing equation is given to represent the variation of solubility with pressure and/or temperature. A text giving an evaluation and recommended values and the compiled data sheets are published on consecutive pages. The following paper by E. Wilhelm gives a rigorous thermodynamic treatment on the solubility of gases in liquids.

DEFINITION OF GAS SOLUBILITY

The distinction between vapor-liquid equilibria and the solubility of gases in liquids is arbitrary. It is generally accepted that the equilibrium set up at 300K between a typical gas such as argon and a liquid such as water is gas-liquid solubility whereas the equilibrium set up between hexane and cyclohexane at 350K is an example of vapor-liquid equilibrium. However, the distinction between gas-liquid solubility and vapor-liquid equilibrium is often not so clear. The equilibria set up between methane and propane above the critical temperature of methane and below the critical temperature of propane may be classed as vapor-liquid equilibrium or as gas-liquid solubility depending on the particular range of pressure considered and the particular worker concerned.

The difficulty partly stems from our inability to rigorously distinguish between a gas, a vapor, and a liquid; a subject which has been discussed in numerous textbooks. We have taken a fairly liberal view in these volumes and have included systems which may be regarded, by some workers, as vapor-liquid equilibria.

UNITS AND QUANTITIES

The solubility of gases in liquids is of interest to a wide range of scientific and technological disciplines and not solely to chemistry. Therefore a variety of ways for reporting gas solubility have been used in the primary literature. Sometimes, because of insufficient available information, it has been necessary to use several quantities in the compiled tables. Where possible, the gas solubility has been quoted as a mole fraction of the gaseous component in the liquid phase. The units of pressure used are bar, pascal, millimeters of mercury, and atmosphere. Temperatures are reported in Kelvins.

EVALUATION AND COMPILATION

The solubility of comparatively few systems is known with sufficient accuracy to enable a set of recommended values to be presented. This is true both of the measurements near atmospheric pressure and at high pressures. Although a considerable number of systems have been studied by at least two workers, the range of pressures and/or temperatures is often sufficiently different to make meaningful comparison impossible.

Occasionally, it is not clear why two groups of workers obtained very different sets of results at the same temperature and pressure, although both sets of results were obtained by reliable methods and are internally consistent. In such cases, sometimes an incorrect assessment has been given. There are several examples where two or more sets of data have been classified as tentative although the sets are mutually inconsistent.

Many high pressure solubility data have been published in a smoothed form. Such data are particularly difficult to evaluate, and unless specifically discussed by the authors, the estimated error on such values can only be regarded as an "informed guess".

Many of the high pressure solubility data have been obtained in a more general study of high pressure vapor-liquid equilibrium. In such cases a note is included to indicate that additional vapor-liquid equilibrium data are given in the source. Since the evaluation is for the compiled data, it is possible that the solubility data are given a classification which is better than that which would be given for the complete vapor-liquid data (or vice versa). For example, it is difficult to determine coexisting liquid and vapor compositions near the critical point of a mixture using some widely used experimental techniques which yield accurate high pressure solubility data. As another example, conventional methods of analysis may give results with an expected error which would be regarded as sufficiently small for vapor-liquid equilibrium data but an order of magnitude too large for acceptable high pressure gas-liquid solubility.

It is occasionally possible to evaluate data on mixtures of a given substance with a member of a homologous series by considering all the available data for the given substance with other members of the homologous series. In this study the use of such a technique has been limited.

The estimated error is often omitted in the original article and sometimes the errors quoted do not cover all the variables. In order to increase the usefulness of the compiled tables *estimated* errors have been included even when absent from the original article. If the error on *any* variable has been inserted by the compiler, this has been noted.

PURITY OF MATERIALS

The purity of materials has been quoted in the compiled tables where given in the original publication. The solubility is usually more sensitive to impurities in the gaseous component than to liquid impurities in the liquid component. However, the most important impurities are traces of a gas dissolved in the liquid. Inadequate degassing of the absorbing liquid is probably the most often overlooked serious source of error in gas solubility measurements.

APPARATUS AND PROCEDURES

In the compiled tables brief mention is made of the apparatus and procedure. There are several reviews on experimental methods of determining gas solubilities and these are given in References 1-7.

METHODS OF EXPRESSING GAS SOLUBILITIES

Because gas solubilities are important for many different scientific and engineering problems, they have been expressed in a great many ways:

The Mole Fraction, x(g)

The mole fraction solubility for a binary system is given by:

$$x(g) = \frac{n(g)}{n(g) + n(l)}$$

$$= \frac{W(g)/M(g)}{\{W(g)/M(g)\} + \{W(l)/M(l)\}}$$

here n is the number of moles of a substance (an *amount* of substance), W is the mass of a substance, and M is the molecular mass. To be unambiguous, the partial pressure of the gas (or the total pressure) and the temperature of measurement must be specified.

The Weight Per Cent Solubility, wt%

For a binary system this is given by

$$\text{wt\%} = 100\, W(g)/\{W(g) + W(l)\}$$

where W is the weight of substance. As in the case of mole fraction, the pressure (partial or total) and the temperature must be specified. The weight per cent solubility is related to the mole fraction solubility by

$$x(g) = \frac{\{wt\%/M(g)\}}{\{wt\%/M(g)\} + \{(100 - wt\%)/M(1)\}}$$

The Weight Solubility, C_w

The weight solubility is the number of moles of dissolved gas per gram of solvent when the partial pressure of gas is 1 atmosphere. The weight solubility is related to the mole fraction solubility at one atmosphere partial pressure by

$$x(g) \text{ (partial pressure 1 atm)} = \frac{C_w M(1)}{1 + C_w M(1)}$$

where M(1) is the molecular weight of the solvent.

The Moles Per Unit Volume Solubility, n

Often for multicomponent systems the density of the liquid mixture is not known and the solubility is quoted as moles of gas per unit volume of liquid mixture. This is related to the mole fraction solubility by

$$x(g) = \frac{n\ v^o(1)}{1 + n\ v^o(1)}$$

where $v^o(1)$ is the molar volume of the liquid component.

The Bunsen Coefficient, α

The Bunsen coefficient is defined as the volume of gas reduced to 273.15K and 1 atmosphere pressure which is absorbed by unit volume of solvent (at the temperature of measurement) under a partial pressure of 1 atmosphere. If ideal gas behavior and Henry's law are assumed to be obeyed, then

$$\alpha = \frac{V(g)}{V(1)}\ \frac{273.15}{T}$$

where V(g) is the volume of gas absorbed and V(1) is the original (starting) volume of absorbing solvent. The mole fraction solubility x is related to the Bunsen coefficient by

$$x(g, 1\text{ atm}) = \frac{\alpha}{\alpha + \frac{273.15}{T}\ \frac{v^o(g)}{v^o(1)}}$$

where $v^o(g)$ and $v^o(1)$ are the molar volumes of gas and solvent at a pressure of one atmosphere. If the gas is ideal,

$$x(g) = \frac{\alpha}{\alpha + \frac{273.15R}{v^o(1)}}$$

Real gases do not follow the ideal gas law and it is important to establish the real gas law used for calculating α in the original publication and to make the necessary adjustments when calculating the mole fraction solubility.

The Kuenen Coefficient, S

This is the volume of gas, reduced to 273.15K and 1 atmosphere pressure, dissolved at a partial pressure of gas of 1 atmosphere by 1 gram of solvent.

TABLE 1 Interconversion of parameters used for reporting solubility

$$L = \alpha(T/273.15)$$

$$C_W = \alpha/v_o\rho$$

$$K_H = \frac{17.033 \times 10^6 \rho(\mathrm{soln})}{\alpha\ M(1)} + 760$$

$$L = C_W\ v_{t,\mathrm{gas}}\ \rho$$

where v_o is the molal volume of the gas in cm^3mol^{-1} at 0°C, ρ the density of the solvent at the temperature of the measurement, ρ_{soln} the density of the solution at the temperature of the measurement, and $v_{t,\mathrm{gas}}$ the molal volume of the gas (cm^3mol^{-1}) at the temperature of the measurement.

SALT EFFECTS

Salt effect studies have been carried out for many years. The results are often reported as Sechenov (Setchenow) salt effect parameters. There appears to be no common agreement on the units of either the gas solubility, or the electrolyte concentration.

Many of the older papers report the salt effect parameter in a form equivalent to

$$k_{\mathrm{scc}}/\mathrm{mol\ dm^{-3}} = (1/(c_2/\mathrm{mol\ dm^{-3}}))\ \log\ ((c_1^\circ/\mathrm{mol\ dm^{-3}})/(c_1/\mathrm{mol\ dm^{-3}}))$$

where the molar gas solubility ratio, c_1°/c_1, is identical to the Bunsen coefficient ratio, α°/α, or the Ostwald coefficient ratio, L°/L. One can designate the salt effect parameters calculated from the three gas solubility ratios as k_{scc}, $k_{\mathrm{sc}\alpha}$, k_{scL}, respectively, but they are identical, and $k_{\mathrm{scc}}/\mathrm{dm^3\ mol^{-1}}$ describes all of them. The superzero refers to the solubility in the pure solvent.

Recent statistical mechanical theories favor a molal measure of the electrolyte and gas solubility. Some of the more recent salt effects are reported in the form

$$k_{\mathrm{smm}}/\mathrm{kg\ mol^{-1}} = (1/(m_2/\mathrm{mol\ kg^{-1}})\ \log\ ((m_1^\circ/\mathrm{mol\ kg^{-1}})/(m_1/\mathrm{mol\ kg^{-1}})$$

In this equation the m_1°/m_1 ratio is identical to the Kuenen coefficient ratio, s_1°/s_1, or the solvomolality ratio referenced to water, A_{sm}°/A_{sm}. Thus the salt effect parameters k_{smm}, k_{sms}, and $k_{\mathrm{sm}A_{sm}}$ are well represented by the $k_{\mathrm{smm}}/\mathrm{kg\ mol^{-1}}$.

Some experimentalists and theoreticians prefer the gas solubility ratio as a mole fraction ratio, x_1°/x_1. It appears that most calculate the mole fraction on the basis of the total number of ions. The salt effect parameters

$$k_{\mathrm{scx}}/\mathrm{dm^3\ mol^{-1}} = (1/(c_2/\mathrm{mol\ dm^{-3}}))\ \log\ (x_1^\circ/x_1)$$

and

$$k_{\mathrm{smx}}/\mathrm{kg\ mol^{-1}} = (1/(m_2/\mathrm{mol\ kg^{-1}}))\ \log\ (x_1^\circ/x_1)$$

are both in the literature, but k_{scx} appears to be the more common.

The following conversions were worked out among the various forms of the salt effect parameter from standard definitions of molarity, molality, and mole fraction assuming the gas solubilities are small.

$$k_{smc} = (c_2/m_2)\ k_{scc} = (c_2/m_2)\ k_{scm} + F_{1m}$$

$$k_{scm} = k_{scc} - F_{1c} = (m_2/c_2)\ k_{smc} - F_{1c} = (m_2/c_2)\ \kappa_{smm}$$

$$k_{scx} = (m_2/c_2)\ k_{smx} = (m_2/c_2)\ ksmm + F_{2c}$$

$$k_{smm} = k_{smx} - F_{2m} = (c_2/m_2)\ k_{scx} - F_{2m}$$

$$k_{smx} = (c_2/m_2)\ k_{scx} = (c_2/m_2)\ k_{scc} + F_{3m}$$

$$k_{scc} = k_{scx} - F_{3c} = (m_2/c_2)\ k_{smx} - F_{3c}$$

where

$$F_{1m} = (1/m_2)\ \log\ [(\rho°/\rho)\ (1000 + m_2M_2)/1000]$$

$$F_{1c} = (m_2/c_2)\ F_{1m}$$

$$F_2m = (1/m_2)\ \log\ [(1000 + \nu m_3\ M_3)/1000]$$

$$F_{2c} = (m_2/c_2)\ F_{2m}$$

$$F_{3m} = (1/m_2)\ \log\ [(1000\rho + (\nu M_3-M_2)\ c_2)/1000\rho°)$$

$$F_{3c} = (m_2/c_2)\ F_{3m}$$

The factors F_{1m}, F_{1c}, F_{2m}, F_{2c}, F_{3m}, and F_{3c} can easily be calculated from aqueous electrolyte data such as weight per cent and density as found in Volume III of the International Critical Tables. The values are small and change nearly linearly with both temperature and molality. The factors normally amount to no more than 10 to 20 per cent of the value of the salt effect parameter.

The symbols in the equations above are defined below:

Component	Molar Concentration $c/\text{mol dm}^{-3}$	Molal Concentration $m/\text{mol kg}^{-1}$	Mole Fraction x	Molecular Weight $M/\text{g mol}^{-1}$
Nonelectrolyte	c_1°, c_1	m_1°, m_1	x_1°, x_1	M_1
Electrolyte	c_2	m_2	x_2	M_2
Solvent	c_3	m_3	x_3	M_3

The superscript "°" refers to the nonelectrolyte solubility in the pure solvent. The pure solvent and solution densities are $\rho°/\text{g cm}^{-3}$ and $\rho/\text{g cm}^{-3}$, respectively. They should be the densities of gas saturated solvent (water) and salt solution, but the gas free densities will differ negligibly in the $\rho°/\rho$ ratio. The number of ions per formula of electrolyte is symbolized by ν.

The following table gives estimated errors in k_{scc} for various salt concentrations and a range of random errors in the gas solubility measurement

Error in $k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a]

$c_2/$ mol dm^{-3}	Random Error in gas solubility Measurement				
	±2%	±1%	±0.5%	±0.1%	±0.05%
1	±18%	±9%	±5%	±1.5%	±1%
0.1	±175%	±87%	±43%	±9%	±4%
0.05	±350%	±174%	±87%	±17%	±9%
0.01	±1750%	±870%	±435%	±87%	±43%

[a] Based on a k_{scc} value of 0.100.

AQUAMOLAL OR SOLVOMOLAL, A_{sm} or $m_i^{(s)}$

The term aquamolal was suggested by R. E. Kerwin (9). The unit was first used in connection with D_2O and $H_2O + D_2O$ mixtures. It has since been extended in use to other solvents. The unit represents the numbers of moles of solute per 55.51 moles of solvent. It is represented by

$m_i^{(s)}/\text{mol kg}^{-1} = (n_1 M_2/w_2)(w_2/M_0) = m_i(M_2/M_0)$ where an amount of n_i of solute i is dissolved in a mass w_2 of solvent of molar mass M_2; M_0 is the molar mass of a reference solvent and $m_i/\text{mol kg}^{-1}$ is the conventional molality in the reference solvent. The reference solvent is normally water.

TEMPERATURE DEPENDENCE OF GAS SOLUBILITY

In a few cases it has been found possible to fit the mole fraction solubility at various temperatures using an equation of the form

$$\ln x = A + B / (T/100K) + C \ln (T/100K) + DT/100K$$

It is then possible to write the thermodynamic functions $\Delta\overline{G}_1^\circ$, $\Delta\overline{H}_1^\circ$, $\Delta\overline{S}_1^\circ$ and $\Delta\overline{C}_{p_1}$ for the transfer of the gas from the vapor phase at 101,325 Pa partial pressure to the (hypothetical) solution phase of unit mole fraction as:

$$\Delta\overline{G}_1^\circ = -RAT - 100\,RB - RCT \ln (T/100) - RDT^2/100$$

$$\Delta\overline{S}_1^\circ = RA + RC \ln (T/100) + RC + 2\,RDT/100$$

$$\Delta\overline{H}_1^\circ = -100\,RB + RCT + RDT^2/100$$

$$\Delta\overline{C}_{p_1}^\circ = RC + 2\,RDT/100$$

In cases where there are solubilities at only a few temperatures it is convenient to use the simpler equations

$$\Delta\overline{G}_1^\circ = - RT \ln x = A + BT$$

in which case $A = \Delta\overline{H}_1^\circ$ and $-B = \Delta\overline{S}_1^\circ$

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The Ostwald Coefficient, L

The Ostwald coefficient, L, is defined as the ratio of the volume of gas absorbed to the volume of the absorbing liquid, all measured at the same temperature:

$$L = \frac{V(g)}{V(l)}$$

If the gas is ideal and Henry's Law is applicable, the Ostwald coefficient is independent of the partial pressure of the gas. It is necessary, in practice, to state the temperature and total pressure for which the Ostwald coefficient is measured. The mole fraction solubility, x(g), is related to the Ostwald coefficient by

$$x(g) = \left[\frac{RT}{P(g)\ L\ v^{o}(l)} + 1\right]^{-1}$$

where P is the partial pressure of gas. The mole fraction solubility will be at a partial pressure of P(g). (See the following paper by E. Wilhelm for a more igorous definition of the Ostwald coefficient.)

The Absorption Coefficient, β

There are several "absorption coefficients", the most commonly used one being defined as the volume of gas, reduced to 273.15K and 1 atmosphere, absorbed per unit volume of liquid when the total pressure is 1 atmosphere. β is related to the Bunsen coefficient by

$$\beta = \alpha(1 - P(l))$$

where P(l) is the partial pressure of the liquid in atmospheres.

The Henry's Law Constant

A generally used formulation of Henry's Law may be expressed as

$$P(g) = K_H x(g)$$

where K_H is the Henry's Law constant and x(g) the mole fraction solubility. Other formulations are

$$P(g) = K_2 C(l) \qquad \text{or} \qquad C(g) = K_c C(l)$$

where K_2 and K_c are constants, C the concentration, and (l) and (g) refer to the liquid and gas phases. Unfortunately, K_H, K_2 and K_c are all sometimes referred to as Henry's Law constants. Henry's Law is a *limiting law* but can sometimes be used for converting solubility data from the experimental pressure to a partial gas pressure of 1 atmosphere, provided the mole fraction of the gas in the liquid is small, and that the difference in pressures is small. Great caution must be exercised in using Henry's Law.

The Mole Ratio, N

The mole ratio, N, is defined by

$$N = n(g)/n(l)$$

Table 1 contains a presentation of the most commonly used inter-conversions not already discussed.

For gas solubilities greater than about 0.01 mole fraciton at a partial pressure of 1 atmosphere there are several additional factors which must be taken into account to unambiguously report gas solubilities. Solution densities or the partial molar volume of gases must be known. Corrections should be made for the possible non-ideality of the gas or the non-applicability of Henry's Law.

THE SOLUBILITY OF GASES IN LIQUIDS

Thermodynamic Considerations

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1. INTRODUCTION

Progress on the scope and accuracy of experimental methods for measuring the solubility of gases in liquids as well as advances in the development of estimation procedures have been quite impressive during the last decade or so. Hence, reasonably frequent updating of the introductory material of a data series concerned with this topic, perhaps reflecting shifting emphasis, is indicated. Various aspects of "gas solubility in liquids", including statistical thermodynamical theory, have been treated at different levels of sophistication in several recent review articles, monographs, introductory sections to critical data compilations, and primary publications (1-19), thus documenting unabated interest. Rather than attempting to present a comprehensive state-of-the-art report, we will focus in this article on essentially *classical* thermodynamics associated with the evaluation of Henry coefficients from high-precision measurements of the solubility of pure gases in pure liquids (20-22), that is to say on problems encountered when experimental imprecision is reduced to about 0.05% (or less). Gas solubilities in mixed solvent systems, though of considerable theoretical and practical interest, will not be considered. For the moment, a few representative recent publications, such as refs. (23-28), should suffice to indicate some problems and trends in this area of research.

2. THERMODYNAMICS

The thermodynamic analysis is based on the rigorous criterion for vapor(V)-liquid(L) phase equilibrium in PVT-systems of uniform temperature T and pressure P

$$f_i^V(T,P,y_i) = f_i^L(T,P,x_i) \tag{1}$$

that is, on the equality of the fugacities f_i for each component i in all phases. Here, x_i denotes the liquid phase mole fraction and y_i is the vapor phase mole fraction. Let component 2 be the liquid solvent, and component 1 the so-called dissolved gas (not necessarily a supercritical fluid). Introducing the auxiliary functions liquid-phase activity coefficient γ_i for which the asymmetric convention is adopted

$$\begin{aligned} &\gamma_2 \rightarrow 1 \text{ for } x_2 \rightarrow 1 \\ &\gamma_1 \rightarrow 1 \text{ for } x_1 \rightarrow 0 \end{aligned} \tag{2}$$

and vapor-phase fugacity coefficient ϕ_i, the equilibrium condition may be written as

$$y_i P \phi_i(T,P,y_i) = x_i \gamma_i(T,P,x_i) f_i^\circ(T,P) \tag{3}$$

$f_i^\circ(T,P)$ is an appropriate liquid-phase standard-state fugacity at the experimental system temperature and pressure. For the solvent, this is the Poynting-corrected *fugacity of pure solvent* at the same temperature and at orthobaric conditions (indicated by the subscript s), i.e., at saturation pressure $P_{s,2}$ of the solvent:

$$f_2^\circ(T,P) = P_{s,2}\phi_2^\circ(T,P_{s,2})\exp\{\int_{P_{s,2}}^{P}[V_2^{\circ L}(T,P)/RT]dP\} \tag{4}$$

$\phi_2^\circ(T,P_{s,2})$ is the fugacity coefficient of pure saturated solvent vapor, and $V_2^{\circ L}(T,P)$ denotes the molar volume of pure liquid solvent. Provided the pressure range $[P_{s,2},P]$ is not too large and the temperature well below the critical temperature $T_{c,2}$ of the solvent, a common useful approximation is the assumption that V_2^{oL} is independent of pressure and equal to the orthobaric molar liquid volume $V_{s,2}^{oL} = V_2^{oL}(T,P_{s,2})$. However, for large $[P_{s,2},P]$ and in the critical region, where V_2^{oL} changes rapidly with pressure, this simplification will, in general, *not* be satisfactory.

If needed, the pressure dependence of the molar volume of the pure liquid may be accounted for by any suitable equation of state, such as the modified Tait equation (29-31)

$$V^{oL}(T,P) = V^{oL}(T,P_{ref})\{1 + n(P-P_{ref})\beta_T^{oL}(T,P_{ref})\}^{-1/n}, \qquad (5)$$

where P_{ref} is a conveniently chosen reference pressure (for instance $P_{ref} = P_s$), $\beta_T^{oL} = -(V^{oL})^{-1}(\partial V^{oL}/\partial P)_T$ is the corresponding isothermal compressibility and n is a *pressure-independent* parameter. Note, that from eq. (5) it follows that

$$1/\beta_T^{oL}(T,P) = 1/\beta_T^{oL}(T,P_{ref}) + n(P - P_{ref}) \qquad (6)$$

which relation is identical with the linear tangent-modulus equation (30).

The standard-state fugacity for the gaseous component is the *Henry coefficient* $H_{1,2}$ for solute 1 dissolved in solvent 2,

$$f_1^o(T,P) = H_{1,2}(T,P) = H_{1,2}(T,P_{s,2})\exp\{\int_{P_{s,2}}^{P}[V_1^{\infty L}(T,P)/RT]dP\} \qquad (7)$$

where $V_1^{\infty L}(T,P)$ denotes the partial molar volume of dissolved gas at infinite dilution. As compared to the amount of experimental data available on the dependence of V_2^{oL} upon T and P, considerably less is known for $V_1^{\infty L}(T,P)$. Thus for want of a better assumption, it is common practice to assume $V_1^{\infty L}$ to be independent of pressure and equal to its value at $P = P_{s,2}$. We emphasize, however, that for similar reasons as above this simplification will not be satisfactory for large pressure ranges $[P_{s,2},P]$ and in the critical region. The preferred experimental method for determining $V_1^{\infty L}$ is either densimetry or dilatometry (32,33) at very small x_1 in conjunction with a suitable extrapolation procedure (see also section 5).

At the saturation pressure of the solvent, $H_{1,2}(T,P_{s,2})$ is rigorously accessible through experimentally determined ratios of fugacity over liquid phase mole fraction according to (2) (at T = const)

$$H_{1,2}(T,P_{s,2}) = \lim_{\substack{x_1\to 0\\ P\to P_{s,2}}} (f_1^L/x_1) = \lim_{\substack{x_1\to 0\\ P\to P_{s,2}}}[y_1P\phi_1(T,P,y_1)/x_1] \qquad (8)$$

since by definition the limiting values of both the activity coefficient γ_1 and the Poynting correction term are 1 as $x_1 \to 0$ (or $P\to P_{s,2}$). Thus, evaluation of Henry coefficients from measured isothermal sets $\{x_1, y_1, P\}$ according to the extrapolation procedure eq. (8) requires a vapor-phase equation of state for calculating $\phi_1(T,P,y_1)$.

The majority of gas solubility measurements are in the low-pressure domain, say with P not exceeding 1 MPa. Hence for many systems (excluding, for instance, strongly associating fluids) the *virial equation of state*

$$Z = PV/RT = 1 + B/V + C/V^2 + \ldots. \qquad (9)$$

is convenient*), and often yields entirely satisfactory results even when truncated after the term with V^{-1}. Here, Z is the compressibility factor, B and C are respectively termed the second and third virial coefficients, and V is the molar volume of the vapor phase. For conciseness, the superscript V denoting vapor phase was omitted. The virial equation has the important advantage over other equations of state of providing theoretically rigorous expressions for the dependence of the mixture virial coefficients on composition. For an n-component mixture

$$B(T,y_1,\ldots,y_n) = \sum_{i=1}^{n}\sum_{j=1}^{n} y_i y_j B_{ij}(T) \qquad (10a)$$

$$C(T,y_1,\ldots,y_n) = \sum_{i=1}^{n}\sum_{j=1}^{n}\sum_{k=1}^{n} y_i y_j y_k C_{ijk}(T) \qquad \text{etc.} \qquad (10b)$$

B_{ii}, C_{iii}, etc. refer to pure substance i, and $B_{ij} = B_{ji}$, $C_{ijk} = C_{ikj} = C_{jik} = \ldots$ etc., are the cross virial coefficients. As indicated, they are functions of temperature only.

To the order of approximation implied by using virial coefficients up to the third, we obtain for the *fugacity coefficient* of component i in the vapor phase

$$\ln\phi_i = \left(\frac{2}{V}\right)\sum_{j=1}^{n} y_j B_{ij} + \left(\frac{3}{2}\right)\left(\frac{1}{V^2}\right)\sum_{j=1}^{n}\sum_{k=1}^{n} y_j y_k C_{ijk} - \ln Z \qquad (11)$$

where, for the sake of clarity, the superscript V has again been omitted. For the vast majority of practical applications, eq. (11) provides satisfactory results up to the critical region. Unfortunately, experimental information on third virial coefficients is rather limited (36) and one has to rely heavily on correlation methods (2). This, and the computational convenience in using {T,P} rather than {T,V} as primary variables, leads to a widely used approximation for *low* pressures:

$$Z = 1 + BP/RT, \qquad (12)$$

where the second virial coefficient of the mixture is again given by eq. (10a). The corresponding expression for the fugacity coefficient is then

$$\ln\phi_i = \frac{P}{RT}\left(2\sum_{j=i}^{n} y_j B_{ij} - B\right) \qquad (13)$$

For binary mixtures, eqs. (12) and (13) yield the familiar relations.

$$Z = 1 + \frac{P}{RT}(y_1 B_{11} + y_2 B_{22} + y_1 y_2 \delta_{12}) \qquad (14)$$

$$\ln\phi_i = \frac{P}{RT}(B_{ii} + y_j^2 \delta_{12}) \qquad (15)$$

where the quantity δ_{12} is defined by $\delta_{12} = 2B_{12} - B_{11} - B_{22}$.

A comprehensive critical compilation of virial coefficients of pure gases as well as of cross virial coefficients (including data up to early 1979) has been prepared by Dymond and Smith (36). For recent advances in correlation methods see refs. (34,35,37-40), and the reviews, refs. (2, 12,13,18,41).

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* Large negative deviations from vapor phase ideality, even at rather low pressures, may occur in mixtures of strongly, that is "chemically", interacting components, such as in mixtures containing carboxylic acids (association equilibria). The virial equation of state is not useful for highly associating fluids, and appropriate chemical theories have been developed (34,35) which will, however, not be considered here.

3. VARIATION OF $H_{1,2}$ WITH TEMPERATURE

To date, the most useful approaches to a rational representation of the temperature dependence of Henry coefficients are those introduced by *Clarke* and *Glew* (42), and by *Benson* and *Krause* (20,21). These authors assume that $\ln(H_{1,2}/\text{Pa})$ and the associated standard thermodynamic function changes are well-behaved, continuous and derivable functions of either the thermodynamic temperature T, or the inverse temperature T^{-1}. Subsequently, the enthalpy of solution is expanded in a Taylor series about either (a) a suitably chosen reference temperature or (b) an inverse reference temperature. When adopting the former procedure, the experimental results are fitted by (unweighted) least-squares analysis to a Clarke-Glew-type equation (abbreviated as CG)

$$\begin{aligned}&\ell n[H_{1,2}(T,P_{s,2})/\text{Pa}]\\&\quad= A_0 + A_1(T/K)^{-1} + A_2\,\ell n(T/K) + A_3(T/K) + A_4(T/K)^2 + \ldots \qquad (16)\end{aligned}$$

Frequently, for computational convenience $\tau = 10^{-2}T/K$ is used instead of T/K. When the method of Benson and Krause (BK) is used, the results are fitted by a power series in T^{-1}

$$\ell n[H_{1,2}(T,P_{s,2})/\text{Pa}] = \sum_{i=0}^{n} a_i(T/K)^{-i} \qquad (17)$$

CG-type equations have been used extensively by Wilhelm et al. (13) in their recent critical review on low-pressure gas solubilities in water. We note that the 3-term version of eq. (16) is the well known Valentiner-equation (43).

The number of terms in either series eq. (16) or (17) should be based upon appropriate statistical criteria, such as the F_χ-*test* (44), in conjunction with experience as to the precision attainable with any particular experimental method. While numerical differences between values generated from either the CG or BK equation are in general exceedingly small within the temperature range covered by experiment, care must be exercised when extrapolation to higher temperatures is desired because of increasing divergence of the smoothing functions. Closely related to this problem is Beutier and Renon's recent study (45) on the limiting behavior of $H_{1,2}(T,P_{s,2})$ for $T \to T_{c,2}$ (see also section 5 below).

Both correlating equations (CG and BK) present the temperature variation of the Henry coefficient at saturation pressure $P_{s,2}=P_{s,2}(T)$ of the solvent, that is to say, temperature and pressure variation are coupled through the Clausius-Clapeyron equation:

$$dP_{s,2}/dT = P_{s,2}\Delta H_2^{\text{vap}}/RT^2\Delta Z_2 \qquad (18)$$

where ΔH_2^{vap} is the enthalpy of vaporization of pure solvent 2, and $\Delta Z_2 = Z_2^V - Z_2^L$ is the difference of the compressibility factors of pure coexisting gaseous and liquid solvent. For instance, the partial molar enthalpy of solution at $\{T,P_{s,2}\}$, that is the difference between the partial molar enthalpy $H_1^{\infty L}$ of solute 1 at infinite dilution in the liquid phase and the molar enthalpy H_1^{oV} of pure 1 in the perfect-gas reference state, is given by

$$\begin{aligned}H_1^{\infty L} - H_1^{oV} &= -RT^2\left(\frac{\partial\,\ell n[H_{1,2}(T,P)/\text{Pa}]}{\partial T}\right)_{P\,=\,P_{s,2}}\\&= -RT^2\left(\frac{d\,\ell n[H_{1,2}(T,P_{s,2})/\text{Pa}]}{dT}\right) + TV_1^{\infty L}\left(\frac{dP_{s,2}}{dT}\right) \qquad (19)\end{aligned}$$

The first term on the right-hand side is obtained from either one of the smoothing equations, and the temperature dependence of $P_{s,2}$ may be calculated from any suitable vapor pressure correlation, for example the Antoine equation. For temperatures well below $T_{c,2}$, the correction term $TV_1^{\infty L}(dP_{s,2}/dT)$ will generally be rather small [see, for instance, ref. (22)];

its magnitude will usually be within the uncertainty limits resulting from experimental imprecision and thus it may be neglected. However, at elevated temperatures it will contribute substantially, predominantly because $dP_{s,2}/dT$ increases rapidly with increasing T, though $V_1^{\infty L}$ may also increase significantly. The evaluation of $TV_1^{\infty L}(dP_{s,2}/dT)$ in the temperature region where it is significant requires $V_1^{\infty L}$ data which are often not available and one has to rely upon correlation methods, such as the one advanced by Brelvi and O'Connell (46).

4. RELATION OF $H_{1,2}$ TO THE OSTWALD COEFFICIENT

By way of example we will now apply results of preceding sections to establish a rigorous relation between the Henry coefficient $H_{1,2}(T,P_{s,2})$ and the *Ostwald coefficient* L, another widely used practical measure of gas solutility (22). This quantity is of importance in the theory of hydrophobic interaction [see, for example, ref. (47), and in particular ref. (48)].

Let the Ostwald coefficient be defined by

$$L(T,P) = (c_1^L/c_1^V)_{\text{equil}} \qquad (20)$$

where $c_1 = n_1/v$ with the appropriate superscript is the amount-of-substance concentration (or simply, concentration) of solute 1 in the coexisting liquid phase solution or vapor phase solution, respectively, and $v/(n_1+n_2) = V$ is the corresponding molar volume. Its *limiting value* for vanishingly small concentration is

$$L^\infty = \lim_{c_1^L \to 0} (c_1^L/c_1^V)_{\text{equil}} \qquad (21)$$

Note, that for $c_1^L \to 0$, $x_1 \to 0$, $y_1 \to 0$, $P \to P_{s,2}$ and $V \to V_2^\circ\,(T,P_{s,2})$. Eq. (20) in conjunction with eqs. (3) and (7) yields, after some algebraic manipulation,

$$L = \frac{RTZ^V\phi_1}{\gamma_1 H_{1,2}(T,P)V_2^L}\,[1 - c_1^L(V_1^L - V_2^L)] \qquad (22)$$

where V_2^L and V_1^L denotes, respectively, the partial molar volume of solvent and gas at $\{T,P,x_1\}$ in the liquid phase. Hence, in the limit (22) of vanishingly small concentration c_1^L

$$L^\infty = \frac{RTZ_2^V(T,P_{s,2})\,\phi_1^\infty(T,P_{s,2})}{H_{1,2}(T,P_{s,2})\,V_2^{\circ L}(T,P_{s,2})} \qquad (23)$$

Here, $Z_2^V(T,P_{s,2})$ is the compressibility factor of pure solvent vapor, and $\phi_1^\infty(T,P_{s,2})$ is the fugacity coefficient of gas at infinite dilution in the vapor phase. For this limiting condition "infinitely diluted solution of solute 1 in solvent 2" we obtain through use of eq. (11)

$$L^\infty = \left(\frac{RT}{H_{1,2}(T,P_{s,2})\,V_{s,2}^{\circ L}}\right) \exp\,[2B_{12}/V_{s,2}^{\circ V} + \tfrac{3}{2}C_{122}/(V_{s,2}^{\circ V})^2] \qquad (24)$$

At low pressures, the exponential may of course be expanded in a series and truncated after the term with B_{12}. Note, that the orthobaric molar volume $V_{s,2}^{\circ V}$ of pure solvent vapor has to be determined by an iterative procedure through use of the virial equation of state eq. (9).

Alternatively, for the low-pressure region, we may use the virial equation in its volume-explicit form eq. (12), which approach leads to (22) (after series expansion of ϕ_1^∞)

$$L^\infty = \left(\frac{RT}{H_{1,2}(T,P_{s,2})V_{s,2}^{\circ L}}\right)\left[1 + 2\left(\frac{P_{s,2}}{RT}\right)B_{12} + \left(\frac{P_{s,2}}{RT}\right)^2 B_{22}(2B_{12} - B_{22})\right] \qquad (25)$$

For $P_{s,2} < 0.1$ MPa, differences between results obtained by either eq. (24) (truncated after the B_{12}-term) or eq. (25) will usually be negligibly small. The above conversion formulae are exact to the order of approximation implied by the use of the virial equation, and supersede those given earlier (1,13,17). For correlating purposes, the variation of L^∞ (or L) with temperature over limited temperature ranges well below $T_{c,2}$ may either be accounted for by a CG-type or a BK-type equation.

5. CONCLUDING REMARKS

Frequently, the available experimental data do not warrant a thermodynamic treatment *in extenso* as discussed in sections 1-3. This may be due to a variety of reasons: limited experimental data, lack of auxiliary data for determining reliably the various correction terms, appreciable experimental uncertainties, or any combination thereof. Several reasonable simplifications are possible and will be presented below.

More often than not, Henry coefficients are *not* obtained through application of the thermodynamically rigorous prescription eq. (9), but through measurement (at constant temperature) of x_1 and y_1 at only *one* rather low pressure (and hence very small x_1). Evaluation according to $H_{1,2} = y_1\phi_1 P/x_1$ then assumes a Poynting correction equal 1, and further that under these specific experimental conditions, deviations of the activity coefficient from its limiting value $\gamma_1 = 1$ are indistinguishable from experimental scatter. For many typical gas solubility measurements the latter approximation will be entirely reasonable, but it may lead to serious errors for systems with strong (specific) ij-interactions, for elevated pressures and/or for conditions approaching those of the critical region.

As already indicated in section 2, one may often assume that $V_1^{\infty L}$ is independent of pressure and equal to $V_1^{\infty L}(T,P_{s,2})$, whence

$$\int_{P_{s,2}}^{P} \frac{V_1^{\infty L}}{RT}\,dP \approx V_1^{\infty L}(T,P_{s,2})(P-P_{s,2})/RT \qquad (26)$$

Preferably, $V_1^{\infty L}$ should be obtained by either dilatometry or densimetry (see section 2). Some pitfalls associated with its evaluation via the Krichevsky-Kasarnovsky equation have been discussed in detail by Gibbs and Van Ness (49) for ($H_2O + CO_2$). The Poynting-correction corresponding to eq. (26), as a function of pressure, is tabulated below for a specific example ($V_1^{\infty L} = 5 \cdot 10^{-5} m^3\ mol^{-1}$, T = 298.15 K):

$(P-P_{s,2})$/kPa	$\exp[V_1^{\infty L}(P-P_{s,2})/RT]$
10	1.0002
100	1.0020
1000	1.0204
10000	1.2235

It gives an indication of the possible error associated with the approximation $\exp\,[V_1^{\infty L}\,(P-P_{s,2})/RT] = 1$.

A particularly simple approximation for calculating vapor-phase fugacity coefficients at low pressures is the *Lewis rule*. It is based on the vapor phase behaving as an ideal mixture:

$$\phi_i(T,P,y_i) = \phi_i^\circ(T,P) \qquad (27)$$

that is to say at constant temperature and pressure, ϕ_i is assumed to be independent of the mixture composition and equal to the fugacity coefficient of pure i. From eq. (15) it follows that this can only be achieved if $B_{12} = (B_{11} + B_{22})/2$, a condition which will be rarely fulfilled. Nevertheless, the Lewis fugacity rule usually yields reasonable results when component i is present in large excess and/or when the physical properties of the components are not too different (δ_{12} fairly small compared to B_{ii}).

The approximation $\phi_i = 1$ (the vapor phase behaves as a mixture of ideal gases), together with γ_1=1 and ignoring the Poynting correction, leads to the most familiar and *simplest* form of Henry's law.

$$P_1 = x_1 H_{1,2} \qquad (28)$$

which may be used to obtain a first, relatively rough approximation for the true Henry coefficient $H_{1,2}(T,P_{s,2})$. No general statements as to the magnitude of associated errors are possible.

Prediction of Henry coefficients at elevated temperatures is often required in industrial applications, and when involving aqueous solutions, in the study of geochemical processes (50). Unfortunately, the majority of experimental investigations has been confined to temperatures below the normal boiling point of the solvent [see, for instance, refs. (13, 17)].

However, thermodynamics provides a rigorous expression for the *limiting value* of $H_{1,2}(T,P_{s,2})$ for $T \to T_{c,2}$ (and $P_{s,2} \to P_{c,2}$, the critical pressure of solvent 2), which should be incorporated in any rational wide-temperature range correlation extending up to the critical region. Evidently,

$$\lim_{T \to T_{c,2}} L^\infty = 1 \qquad (29)$$

whence from eq. (23).

$$\lim_{T \to T_{c,2}} H_{1,2}(T,P_{s,2}) = P_{c,2}\phi_1^\infty(T_{c,2},P_{c,2}) \qquad (30)$$

is obtained, which limiting relation is identical with that given by Beutier and Renon (45).

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The Sechenov Salt Effect Parameter.

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THE SECHENOV SALT EFFECT PARAMETER

Forms of Expression and Interconversion

In the following discussion the components are indexed so that:

the nonelectrolyte (gas) is component 1,

the electrolyte is component 2, and

the solvent (water) is component 3.

The symbols and units are:

Component	Molar Concentration c/mol dm^{-3}	Molal Concentration m/mol kg^{-1}	Mole Fraction x	Molecular Mass M/g mol^{-1}
Nonelectrolyte	c_1^0, c_1	m_1^0, m_1	x_1^0, x_1	M_1
Electrolyte	c_2	m_2	x_2	M_2
Solvent	c_3	m_3	x_3	M_3

The superscript "^{0}" refers to the nonelectrolyte solubility in the pure solvent. The pure solvent and solution densities are ρ^0/g cm^{-3} and ρ/g cm^{-3}, respectively. They should be the densities of gas saturated solvent (water) and salt solution, but the gas free densities will differ negligibly in the ρ^0/ρ ratio. The number of ions per formula of electrolyte is symbolized by ν, and the electrolyte apparent molar volume is symbolized by ϕ_{v2}.

The salt effect parameter is defined in any one of several forms,

$$k_{\mathrm{scc}} \;/\; \mathrm{dm^3 mol^{-1}} = (1/c_2)\log(c_1^0/c_1)$$

which numerically is the same as

$$k_{\mathrm{sc\alpha}} \;/\; \mathrm{dm^3 mol^{-1}} = (1/c_2)\log(\alpha_1^0/\alpha_1)$$

and

$$k_{\mathrm{scL}} \;/\; \mathrm{dm^3 mol^{-1}} = (1/c_2)\log(L_1^0/L_1)$$

where $\alpha/\text{cm}^3\text{(STP) cm}^{-3}\text{ atm}^{-1}$ is the Bunsen coefficient, and $L/\text{cm}^3\text{ cm}^{-3}$ is the Ostwald coefficient. The Sechenov parameter subscripts have the following significance: the first letter, s, refers to the Sechenov salt effect, the second letter the electrolyte measure of concentration, and the third letter the gas solubility unit of measure.

The ratios $c_1^0/c_1 = \alpha_1^0/\alpha_1 = L_1^0/L_1$ since $c_1 = 10^3\alpha_1/RT$ with T/K = 273.15, and $c_1 = L_{c,\text{ gas phase}} = 10^3\ L\ p/RT$ with T/K the temperature of the gas solubility measurement.

Another frequently used form is

$$k_{\text{smm}}\ /\ \text{kg mol}^{-1} = (1/m_2)\ \log\ (m_1^0/m_1)$$

which is equivalent to

$$k_{\text{sms}}\ /\ \text{kg mol}^{-1} = (1/m_2)\ \log\ (s_1^0/s_1)$$

where $s/\text{cm}^3\text{(STP) g}^{-1}\text{ atm}^{-1}$ is the Kuenen coefficient and $m_1 = 10^3\ s_1/RT$ with T/K = 273.15.

A mole fraction nonelectrolyte solubility ratio is also used. It may be combined with either a molar or a molal electrolyte concentration.

$$k_{\text{scx}}\ /\ \text{dm}^3\text{ mol}^{-1} = (1/c_2)\ \log\ (x_1^0/x_1)$$

and

$$k_{\text{smx}}\ /\ \text{kg mol}^{-1} = (1/m_2)\ \log\ (x_1^0/x_1)$$

Care should be taken to define how the mole fraction is calculated. Some calculate the electrolyte contribution to the total number of moles on the basis of the electrolyte formula and others on the basis of the total number of moles of ions. Our definition shall use the ions from the electrolyte assuming 100 per cent dissociation.

Masterton and co-workers (1) have applied scaled particle theory and used the salt effect parameter in the form $k_{\text{scx}}\ /\ \text{dm}^3\text{ mol}^{-1}$. Others (2) favor the $k_{\text{smm}}\ /\ \text{kg mol}^{-1}$ form for statistical mechanical approaches aimed at understanding salt effects.

Friedman (3) gives convincing arguments for using a form consistent with definitions of thermodynamics. The form he uses is

$$k_{1,2} = -(\delta\ln\ m_1/\delta m_2)_{\mu_1}$$

However, if $k_{1,2}$ is independent of m_2, then $k_{smm} = k_{1,2}/2.303$ since

$$k_{1,2} \int_0^{m_2} \delta m_2 = -\int_{m_1^0}^{m_1} \delta \ln m_1$$

$$k_{1,2}\, m_2 = -(\ln m_1 - \ln m_1^0) = \ln (m_1^0/m_1)$$

Ben-Naim (4) calculates Gibbs energy of transfer between pure water and electrolyte solution. His work implies the form k_{smc} of the salt effect parameter.

Most of the current workers in the area seem to favor either mole fraction or molality for the unit to express the nonelectrolyte solubility. However, there are arguments that suggest a volume concentration is better, especially when large pressures and/or solubilities are involved.

Some workers have reported the nonelectrolyte solubility as moles per kg of solution. We do not believe this is a satisfactory unit and it is not discussed further.

Krestov and co-workers (5) have started to use solvomolality as a unit. This is the number of moles per 55.51 mole of solvent. For water (H_2O) this is the same as molality, and for other solvents (D_2O, methanol, etc.) it is proportional to the molality. Thus its use will result in a k_{smm}/kg mol^{-1} value. (Solvomolality, $m_i^{(s)} = m_i(M_3/M_{H_2O})$).

I. Molarity and Molality

$$k_{scc} = \frac{1}{c_2} \log \frac{c_1^0}{c_1} = \frac{1}{c_2} \log \frac{\left[\dfrac{m_1^0}{(1000 + m_1^0 M_1) / 1000\rho^0}\right]}{\left[\dfrac{m_1}{(1000 + m_1 M_1 + m_2 M_2) / 1000\rho}\right]}$$

$$= \frac{1}{c_2} \log \left(\frac{m_1^0}{m_1}\right)\left(\frac{\rho^0}{\rho}\right)\left(\frac{1000 + m_1 M_1 + m_2 M_2}{1000 + m_1^0 M_1}\right)$$

$$= \frac{1}{c_2} \log \left(\frac{m_1^0}{m_1}\right) + \frac{1}{c_2} \log \left(\frac{\rho^0}{\rho}\right)\left(\frac{1000 + m_1 M_1 + m_2 M_2}{1000 + m_1^0 M_1}\right)$$

$$k_{scc} = k_{scm} + \frac{1}{c_2} \log \left(\frac{\rho^0}{\rho} \right) \left(\frac{1000 + m_1 M_1 + m_2 M_2}{1000 + m_1^0 M_1} \right)$$

and in addition

$$k_{smc} = \frac{1}{m_2} \log \frac{c_1^0}{c_1}$$

$$= \frac{c_2}{m_2} k_{scc} = \frac{c_2}{m_2} k_{scm} + \frac{c_2}{m_2} \left(\frac{1}{c_2} \log \left(\frac{\rho^0}{\rho} \right) \left(\frac{1000 + m_1 M_1 + m_2 M_2}{1000 + m_1^0 M_1} \right) \right)$$

$$= k_{smm} + \frac{c_2}{m_2} \left(\frac{1}{c_2} \log \left(\frac{\rho^0}{\rho} \right) \left(\frac{1000 + m_1 M_1 + m_2 M_2}{1000 + m_1^0 M_1} \right) \right)$$

The terms $m_1 M_1$ and $m_1^0 M_1$ are negligibly small except for the very soluble gases. Thus for most cases

$$k_{smc} = \frac{c_2}{m_2} k_{scc} \simeq k_{smm} + \frac{c_2}{m_2} \left(\frac{1}{c_2} \log \left(\frac{\rho^0}{\rho} \right) \left(\frac{1000 + m_2 M_2}{1000} \right) \right)$$

$$\simeq \frac{c_2}{m_2} k_{scm} + \frac{c_2}{m_2} \left(\frac{1}{c_2} \log \left(\frac{\rho^0}{\rho} \right) \left(\frac{1000 + m_2 M_2}{1000} \right) \right)$$

II. Mole Fraction and Molality

$$x_1^0 = \frac{m_1^0}{\frac{1000}{M_3} + m_1^0} = \frac{m_1^0 M_3}{1000 + m_1^0 M_3}$$

$$x_1 = \frac{m_1}{\frac{1000}{M_3} + m_1 + \nu m_2} = \frac{m_1 M_3}{1000 + m_1 M_3 + \nu m_2 M_3}$$

$$\frac{x_1^0}{x_1} = \frac{m_1^0}{m_1} \cdot \frac{(1000 + m_1 M_3 + \nu m_2 M_3)}{(1000 + m_1^0 M_3)}$$

$$\frac{1}{m_2} \log \frac{x_1^0}{x_1} = \frac{1}{m_2} \log \frac{m_1^0}{m_1} + \frac{1}{m_2} \log \left(\frac{(1000 + m_1 M_3 + \nu m_2 M_3)}{(1000 + m_1^0 M_3)} \right)$$

or

$$k_{smx} = k_{smm} + \frac{1}{m_2} \log \left(\frac{(1000 + m_1 M_3 + \nu m_2 M_3)}{(1000 + m_1^0 M_3)} \right)$$

and

$$k_{scx} = \frac{1}{c_2} \log \frac{x_1^0}{x_1} = \frac{m_2}{c_2} k_{smx}$$

$$= \frac{m_2}{c_2} k_{smm} + \frac{m_2}{c_2} \left[\frac{1}{m_2} \log \left(\frac{(1000 + m_1 M_3 + \nu m_2 M_3)}{(1000 + m_1^0 M_3)} \right) \right]$$

where c_2 is the electrolyte molar concentration of solution molality m_2.

For systems in which m_1^0 and m_1 are small, as is the usual case for gas solubilities, the terms $m_1^0 M_3$ and $m_1 M_3$ may be omitted from the sums in the log term.

For a 1-1 electrolyte at 1 mol kg^{-1} in which m_1^0 and m_1 are sufficiently small to ignore in the sums in the log term the equations simplify to

$$k_{scx} = \frac{1}{c_2} k_{smx} = \frac{1}{c_2} k_{smm} + \frac{1}{c_2} \log \left[\frac{(1000 + (2)\ (18.0152))}{1000} \right]$$

$$= \frac{1}{c_2} k_{smm} + \frac{1}{c_2} \frac{\ln (1 + 0.0360)}{2.303}$$

and using the first term of the expansion $\ln (1+x) = x - (1/2)\,x^2 + (1/3)\,x^3 - (1/4)\,x^4 + \cdots \quad (-1 < x < 1)$

$$= \frac{1}{c_2} k_{smm} + \frac{1}{c_2} \cdot \frac{0.0360}{2.303}$$

which is a form given by Masterton, Bolocofsky, and Lee (1). In this equation c_2 is the electrolyte molar concentration of the 1 mol kg^{-1} 1-1 electrolyte.

For any electrolyte molality, m_2.

$$k_{scx} = \frac{1}{c_2} \log \frac{x_1^0}{x_1} = \frac{m_2}{c_2} k_{smx} = \frac{m_2}{c_2} k_{smm} + \frac{m_2}{c_2} \left(\frac{1}{m_2} \log \left[\frac{(1000 + 2m_2\ 18.015)}{1000} \right] \right)$$

$$= \frac{m_2}{c_2} k_{smm} + \frac{m_2}{c_2} \frac{1}{m_2} \frac{\ln (1 + 0.0360 m_2)}{2.303}$$

$$= \frac{m_2}{c_2} k_{smm} + \frac{m_2}{c_2} \cdot \frac{0.0360}{2.303}$$

III. Mole Fraction and Molarity

$$x_1^0 = \frac{c_1^0}{\left\{\dfrac{1000\ \rho^0 - c_1^0\ M_1}{M_3}\right\} + c_1^0} = \frac{c_1^0\ M_3}{1000\ \rho^0 + (M_3 - M_1)\ c_1^0}$$

$$x_1 = \frac{c_1}{\left\{\dfrac{1000\ \rho - c_1\ M_1 - c_2\ M_2}{M_3}\right\} + c_1 + \nu c_2}$$

$$= \frac{c_1\ M_3}{1000\ \rho + (M_3 - M_1)\ c_1 + (\nu M_3 - M_2)\ c_2}$$

The densities ρ^0 and ρ should be the densities of gas saturated water and salt solution. However, use of gas-free water and gas-free salt solution densities makes a negligible difference (0.3 % in ρ for a gas mole fraction of 10^{-3}).

$$\frac{x_1^0}{x_1} = \frac{c_1^0}{c_1} \cdot \frac{(1000\rho + (M_3 - M_1)\ c_1 + (\nu M_3 - M_2)\ c_2)}{(1000\rho^0 + (M_3 - M_1)\ c_1^0)}$$

and

$$k_{scx} = \frac{1}{c_2} \log \frac{x_1^0}{x_1}$$

$$= \frac{1}{c_2} \log \frac{c_1^0}{c_1} + \frac{1}{c_2} \log\left\{\frac{(1000\rho + (M_3 - M_1)\ c_1 + (\nu M_3 - M_2)\ c_2)}{(1000\rho^0 + (M_3 - M_1)\ c_1^0)}\right\}$$

or

$$k_{scx} = k_{scc} + \frac{1}{c_2} \log\left\{\frac{(1000\rho + (M_3 - M_1)\ c_1 + (\nu M_3 - M_2)\ c_2)}{1000\rho^0 + (M_3 - M_1)\ c_1^0}\right\}$$

and

$$k_{smx} = \frac{1}{m_2} \log \frac{x_1^0}{x_1} = \frac{c_2}{m_2}\left\{\frac{1}{c_2} \log \frac{x_1^0}{x_1}\right\}$$

$$= \frac{c_2}{m_2}\left\{\frac{1}{c_2} \log \frac{c_1^0}{c_1} + \frac{1}{c_2} \log\left[\frac{(1000\rho + (M_3 - M_1)\ c_1 + (\nu M_3 - M_2)\ c_2)}{(1000\rho^0 + (M_3 - M_1)\ c_1^0)}\right]\right\}$$

or

$$k_{smx} = \frac{c_2}{m_2} k_{scx}$$

$$= \frac{c_2}{m_2} k_{scc} + \frac{c_2}{m_2}\left\{\frac{1}{c_2} \log\left[\frac{(1000\rho + (M_3 - M_1)\ c_1 + (\nu M_3 - M_2)\ c_2)}{(1000\rho^0 + (M_3 - M_1)\ c_1^0)}\right]\right\}$$

For systems in which c_1^0 and c_1 are small enough to ignore in the sums

$$k_{smx} = \frac{c_2}{m_2} k_{scx} = \frac{c_2}{m_2} k_{scc} + \frac{c_2}{m_2} \left[\frac{1}{c_2} \log\left(\frac{(1000\rho + (\nu M_3 - M_2)\ c_2)}{(1000\rho^0)} \right) \right]$$

and for a 1-1 electrolyte at a concentration of one mol dm^{-3}

$$k_{smx} = \frac{1}{m_2} k_{scx} = \frac{1}{m_2} k_{scc} + \frac{1}{m_2} \log\left(\frac{(1000\rho + (2M_3 - M_2)\ c_2}{(1000\rho^0)} \right)$$

where m_2 is the molality of the one molar solution.

An alternate approach is to use the apparent molar volume, ϕ_{v2}, of the electrolyte. Thus

$$x_1^0 = \frac{c_1^0}{\frac{1000}{M_3} + c_1^0} = \frac{c_1^0\ M_3}{1000 + c_1^0\ M_3}$$

$$x_1 = \frac{c_1}{\frac{1000 - \phi_{v2}}{M_3} + c_1 + \nu c_2} = \frac{c_1\ M_3}{1000 - \phi_{v2} + c_1\ M_3 + \nu c_2\ M_3}$$

$$\frac{x_1^0}{x_1} = \frac{c_1^0}{c_1} \cdot \frac{(1000 - \phi_{v2} + c_1\ M_3 + \nu c_2\ M_3)}{(1000 + c_1^0\ M_3)}$$

$$\frac{1}{c_2} \log \frac{x_1^0}{x_1} = \frac{1}{c_2} \log \frac{c_1^0}{c_1} + \frac{1}{c_2} \log\left(\frac{(1000 - \phi_{v2} + c_1\ M_3 + \nu c_2\ M_3)}{(1000 + c_1^0\ M_3)} \right)$$

The equation can be simplified for a one mol dm^{-3} 1-1 electrolyte solution in which the nonelectrolyte solubilities, c_1^0 and c_1 are small enough to be negligible in the sums to

$$k_{scx} = k_{scc} + \log\left(\frac{(1000 - \phi_{v2} + 2M_3)}{1000} \right)$$

$$k_{scx} = k_{scc} + \log\left[1 + \frac{(2)\ (18.0152)}{1000} - \frac{\phi_{v2}}{1000} \right]$$

$$= k_{scc} + \frac{\ln\left(1 + (0.0360 - \phi_{v2} / 1000)\right)}{2.303}$$

expanding the ln term as ln $(1+x) \equiv x$ where $x = (0.0360 - \phi_{v2} / 1000)$ gives

$$k_{scx} \simeq k_{scc} + \frac{(0.0360 - \phi_{v2} / 1000)}{2.303}$$

This is a form given by Masterton *et al.* (1).

Summary

The equations can be put in the following form for use.

From Part I

$$k_{smc} = \frac{c_2}{m_2} k_{scc} = \frac{c_2}{m_2} k_{scm} + F_{1m} = k_{smm} + F_{1m}$$

or

$$k_{scm} = k_{scc} - F_{1c} = \frac{m_2}{c_2} k_{smc} - F_{1c} = \frac{m_2}{c_2} k_{smm}$$

where

$$F_{1m} = \frac{1}{m_2} \log\left(\frac{\rho^{\circ}}{\rho}\right)\left(\frac{(1000 + m_1 M_1 + m_2 M_2)}{(1000 + m_1^{0} M_1)}\right)$$

$$F_{1c} = \frac{1}{c_2} \log\left(\frac{\rho^{\circ}}{\rho}\right)\left(\frac{(1000 + m_1 M_1 + m_2 M_2)}{(1000 + m_1^{0} M_1)}\right)$$

For all but very soluble gases the $m_1 M_1$ and $m_1^0 M_1$ terms may be neglected in the F_{1m} and F_{1c} terms.

From Part II

$$k_{scx} = \frac{m_2}{c_2} k_{smx} = \frac{m_2}{c_2} k_{smm} + F_{2c}$$

or

$$k_{smm} = k_{smx} - F_{2m} = \frac{c_2}{m_2} k_{scx} - F_{2m}$$

where

$$F_{2m} = \frac{1}{m_2} \log \left(\frac{(1000 + m_1 M_3 + \nu m_2 M_3)}{(1000 + m_1^{0} M_3)}\right)$$

$$F_{2c} = \frac{1}{c_2} \log \left(\frac{(1000 + m_1 M_3 + \nu m_2 M_3)}{(1000 + m_1^{0} M_3)}\right)$$

Again for all but the very soluble gases the $m_1 M_3$ and $m_1^0 M_3$ terms can be neglected in F_{2m} and F_{2c}.

From Part III

$$k_{smx} = \frac{c_2}{m_2} k_{scx} = \frac{c_2}{m_2} k_{scc} + F_{3m}$$

or

$$k_{scc} = k_{scx} - F_{3c} = \frac{m_2}{c_2} k_{smx} - F_{3c}$$

where

$$F_{3m} = \frac{1}{m_2} \log \left[\frac{(1000\rho + (M_3 - M_1)\ c_1 + (\nu M_3 - M_2)\ c_2)}{(1000\rho^0 + (M_3 - M_1)\ c_1^0)} \right]$$

and

$$F_{3c} = \frac{1}{c_2} \log \left[\frac{(1000\rho + (M_3 - M_1)\ c_1 + (\nu M_3 - M_2)\ c_2)}{(1000\rho^0 + (M_3 - M_1)\ c_1^0)} \right]$$

and again the terms in c_1 and c_1^0 in the F_{3m} and F_{3c} factors can normally be neglected.

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Represenative values of factors needed to convert Sechenov salt effect parameter forms.

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CONVERSION AMONG THE VARIOUS FORMS OF THE SECHENOV SALT EFFECT PARAMETER

Factors for Selected Electrolytes

93[1]Magnesium Sulfate; $MgSO_4$; [7487-88-9]

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	283.15 K	(10 °C)						
8	0.7205	0.7224	0.0014	0.0014	0.0155	0.0154	0.0141	0.0140
10	0.9189	0.9231	0.0020	0.0020	0.0155	0.0154	0.0135	0.0134
12	1.1251	1.1329	0.0025	0.0025	0.0154	0.0153	0.0129	0.0128
14	1.3394	1.3524	0.0031	0.0030	0.0154	0.0153	0.0124	0.0123
	303.15 K	(30 °C)						
2	0.1688	0.1695	0.0004	0.0004	0.0157	0.0156	0.0152	0.0152
4	0.3443	0.3462	0.0011	0.0011	0.0156	0.0155	0.0145	0.0144
6	0.5269	0.5303	0.0017	0.0017	0.0156	0.0155	0.0139	0.0138
8	0.7166	0.7224	0.0023	0.0022	0.0156	0.0154	0.0133	0.0132
10	0.9138	0.9231	0.0027	0.0027	0.0155	0.0154	0.0128	0.0127
12	1.1186	1.1329	0.0032	0.0032	0.0155	0.0153	0.0123	0.0121
14	1.3314	1.3524	0.0037	0.0036	0.0155	0.0153	0.0118	0.0116
16	1.5524	1.5824	0.0041	0.0041	0.0155	0.0152	0.0114	0.0112
18	1.7819	1.8236	0.0046	0.0045	0.0155	0.0152	0.0109	0.0107
20	2.0203	2.0769	0.0050	0.0049	0.0155	0.0151	0.0105	0.0102
22	2.2678	2.3432	0.0054	0.0053	0.0155	0.0150	0.0101	0.0098
24	2.5246	2.6235	0.0059	0.0056	0.0155	0.0150	0.0097	0.0093
26	2.7912	2.9189	0.0063	0.0060	0.0155	0.0149	0.0093	0.0089
	323.15 K	(50 °C)						
8	0.7111	0.7224	0.0027	0.0027	0.0157	0.0154	0.0130	0.0128
10	0.9068	0.9231	0.0031	0.0031	0.0157	0.0154	0.0125	0.0123
12	1.1101	1.1329	0.0035	0.0035	0.0157	0.0153	0.0121	0.0119
14	1.3214	1.3524	0.0039	0.0038	0.0156	0.0153	0.0117	0.0114

96[1]Barium Chloride; $BaCl_2$; [10361-37-2]

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	283.15 K	(10 °C)						
14	0.7647	0.7817	0.0124	0.0121	0.0235	0.0230	0.0111	0.0109
16	0.8911	0.9147	0.0125	0.0122	0.0235	0.0229	0.0110	0.0107
18	1.0226	1.0541	0.0127	0.0124	0.0235	0.0228	0.0108	0.0105
20	1.1593	1.2005	0.0130	0.0125	0.0235	0.0227	0.0106	0.0102

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[1] Number preceding electrolyte is the standard order of arrangement number.

96 Barium Chloride; $BaCl_2$; [10361-37-2] (Continued)

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	298.15 K	(25 °C)						
2	0.0975	0.0980	0.0118	0.0118	0.0235	0.0234	0.0117	0.0116
4	0.1984	0.2001	0.0122	0.0121	0.0235	0.0233	0.0113	0.0112
6	0.3029	0.3065	0.0126	0.0125	0.0235	0.0233	0.0109	0.0108
8	0.4113	0.4176	0.0129	0.0127	0.0236	0.0232	0.0107	0.0105
10	0.5237	0.5336	0.0131	0.0128	0.0236	0.0231	0.0105	0.0103
12	0.6403	0.6548	0.0132	0.0129	0.0236	0.0231	0.0103	0.0101
14	0.7614	0.7817	0.0134	0.0130	0.0236	0.0230	0.0102	0.0100
16	0.8871	0.9147	0.0135	0.0131	0.0236	0.0229	0.0101	0.0098
18	1.0177	1.0541	0.0137	0.0132	0.0236	0.0228	0.0099	0.0096
20	1.1534	1.2005	0.0139	0.0134	0.0237	0.0227	0.0097	0.0093
22	1.2947	1.3544	0.0141	0.0135	0.0237	0.0227	0.0096	0.0091
24	1.4415	1.5164	0.0144	0.0137	0.0237	0.0226	0.0094	0.0089
26	1.5942	1.6872	0.0146	0.0138	0.0238	0.0225	0.0091	0.0086
	313.15 K	(40 °C)						
14	0.7569	0.7817	0.0140	0.0136	0.0237	0.0230	0.0097	0.0094
16	0.8819	0.9147	0.0141	0.0136	0.0238	0.0229	0.0096	0.0093
18	1.0117	1.0541	0.0143	0.0137	0.0238	0.0228	0.0095	0.0091
20	1.1465	1.2005	0.0145	0.0138	0.0238	0.0227	0.0093	0.0089

98 Lithium Chloride; LiCl; [7447-41-8]

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	283.15 K	(10 °C)						
2	0.4773	0.4814	0.0075	0.0075	0.0156	0.0155	0.0081	0.0080
4	0.9656	0.9828	0.0078	0.0077	0.0157	0.0154	0.0078	0.0077
6	1.4650	1.5056	0.0080	0.0078	0.0157	0.0152	0.0076	0.0074
8	1.9752	2.0512	0.0082	0.0079	0.0157	0.0151	0.0074	0.0072
	303.15 K	(30 °C)						
1	0.2362	0.2383	0.0077	0.0076	0.0157	0.0156	0.0080	0.0079
2	0.4752	0.4814	0.0079	0.0078	0.0157	0.0155	0.0078	0.0077
4	0.9612	0.9828	0.0081	0.0079	0.0157	0.0154	0.0076	0.0076
6	1.4579	1.5056	0.0083	0.0080	0.0157	0.0152	0.0074	0.0072
8	1.9654	2.0512	0.0085	0.0081	0.0158	0.0151	0.0073	0.0070
10	2.4838	2.6209	0.0086	0.0082	0.0158	0.0150	0.0071	0.0068
12	3.0131	3.2166	0.0088	0.0082	0.0158	0.0148	0.0070	0.0066
14	3.5536	3.8400	0.0089	0.0083	0.0158	0.0147	0.0069	0.0064
16	4.1056	4.4930	0.0091	0.0083	0.0159	0.0145	0.0068	0.0062
18	4.6693	5.1779	0.0092	0.0083	0.0159	0.0143	0.0067	0.0060
20	5.2451	5.8971	0.0093	0.0083	0.0159	0.0142	0.0066	0.0059
	323.15 K	(50 °C)						
2	0.4716	0.4814	0.0085	0.0083	0.0158	0.0155	0.0073	0.0072
4	0.9541	0.9828	0.0084	0.0081	0.0158	0.0154	0.0075	0.0072
6	1.4474	1.5056	0.0086	0.0081	0.0158	0.0152	0.0074	0.0071
8	1.9516	2.0512	0.0086	0.0082	0.0159	0.0151	0.0073	0.0069

99 (1) Sodium Chloride; NaCl; [7447-41-8]

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	283.15 K	(10 °C)						
2	0.3472	0.3492	0.0070	0.0069	0.0156	0.0155	0.0087	0.0086
4	0.7044	0.7130	0.0072	0.0072	0.0156	0.0154	0.0084	0.0083
6	1.0720	1.0922	0.0075	0.0073	0.0156	0.0153	0.0082	0.0080
8	1.4498	1.4880	0.0077	0.0075	0.0156	0.0152	0.0079	0.0077
	298.15 K	(25 °C)						
1	0.1718	0.1728	0.0076	0.0076	0.0157	0.0156	0.0081	0.0080
2	0.3460	0.3492	0.0078	0.0077	0.0157	0.0155	0.0079	0.0079
4	0.7018	0.7130	0.0080	0.0078	0.0157	0.0154	0.0077	0.0076
6	1.0674	1.0922	0.0082	0.0080	0.0157	0.0153	0.0075	0.0074
8	1.4430	1.4880	0.0083	0.0081	0.0157	0.0152	0.0074	0.0072
10	1.8289	1.9013	0.0085	0.0082	0.0157	0.0151	0.0072	0.0069
12	2.2252	2.3334	0.0087	0.0083	0.0158	0.0150	0.0071	0.0067
14	2.6321	2.7856	0.0089	0.0084	0.0158	0.0149	0.0069	0.0065
16	3.0500	3.2594	0.0090	0.0085	0.0158	0.0148	0.0068	0.0063
18	3.4791	3.7562	0.0092	0.0085	0.0158	0.0147	0.0066	0.0062
20	3.9197	4.2779	0.0094	0.0086	0.0159	0.0146	0.0065	0.0060
	313.15 K	(40 °C)						
2	0.3443	0.3492	0.0082	0.0081	0.0158	0.0155	0.0076	0.0075
4	0.6980	0.7130	0.0084	0.0082	0.0158	0.0154	0.0074	0.0073
6	1.0614	1.0922	0.0085	0.0083	0.0158	0.0153	0.0073	0.0071
8	1.4347	1.4880	0.0087	0.0084	0.0158	0.0152	0.0071	0.0069

99 (2) Sodium Sulfate; Na_2SO_4; [7757-82-6]

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	283.15 K	(10 °C)						
10	0.7708	0.7823	0.0082	0.0080	0.0233	0.0230	0.0152	0.0149
12	0.9416	0.9600	0.0088	0.0087	0.0233	0.0229	0.0145	0.0142
14	1.1182	1.1461	0.0095	0.0092	0.0233	0.0228	0.0139	0.0136
16	1.3008	1.3410	0.0101	0.0098	0.0234	0.0227	0.0133	0.0129
	303.15 K	(30 °C)						
1	0.0707	0.0711	0.0068	0.0067	0.0235	0.0234	0.0168	0.0167
2	0.1427	0.1437	0.0074	0.0074	0.0235	0.0234	0.0161	0.0160
4	0.2905	0.2933	0.0081	0.0081	0.0235	0.0233	0.0154	0.0152
6	0.4434	0.4494	0.0088	0.0087	0.0235	0.0232	0.0147	0.0145
8	0.6016	0.6122	0.0094	0.0093	0.0235	0.0231	0.0141	0.0138
10	0.7653	0.7822	0.0100	0.0098	0.0235	0.0230	0.0135	0.0132
12	0.9346	0.9600	0.0105	0.0102	0.0235	0.0229	0.0130	0.0127
14	1.1095	1.1461	0.0110	0.0106	0.0235	0.0228	0.0125	0.0121
16	1.2904	1.3410	0.0115	0.0110	0.0235	0.0227	0.0121	0.0116
18	1.4775	1.5454	0.0119	0.0114	0.0236	0.0225	0.0116	0.0111
20	1.6706	1.7601	0.0124	0.0118	0.0236	0.0224	0.0112	0.0106
22	1.8704	1.9857	0.0129	0.0121	0.0237	0.0223	0.0108	0.0102
24	2.0769	2.2232	0.0133	0.0124	0.0237	0.0222	0.0104	0.0097

99 (2) Sodium Sulfate; Na_2SO_4; [7757-82-6] (Continued)

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	323.15 K	(50 °C)						
10	0.7591	0.7823	0.0107	0.0104	0.0237	0.0230	0.0130	0.0126
12	0.9269	0.9600	0.0112	0.0108	0.0237	0.0229	0.0125	0.0121
14	1.1001	1.1461	0.0117	0.0112	0.0237	0.0228	0.0120	0.0115
16	1.2792	1.3410	0.0122	0.0116	0.0238	0.0227	0.0116	0.0110

100 (1) Potassium Hydroxide; KOH; [1310-58-3]

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	288.15 K	(15 °C)						
1	0.1797	0.1800	0.0021	0.0021	0.0156	0.0156	0.0135	0.0135
2	0.3627	0.3637	0.0023	0.0023	0.0156	0.0155	0.0132	0.0132
3	0.5489	0.5512	0.0025	0.0025	0.0156	0.0155	0.0130	0.0130
4	0.7385	0.7426	0.0027	0.0027	0.0155	0.0154	0.0128	0.0127
5	0.9314	0.9380	0.0029	0.0029	0.0155	0.0154	0.0126	0.0125
6	1.1275	1.1376	0.0031	0.0031	0.0155	0.0153	0.0124	0.0123
8	1.5299	1.5498	0.0034	0.0034	0.0154	0.0152	0.0120	0.0119
10	1.9458	1.9803	0.0037	0.0036	0.0154	0.0151	0.0117	0.0115
12	2.3756	2.4303	0.0040	0.0039	0.0153	0.0150	0.0114	0.0111
14	2.8192	2.9013	0.0043	0.0042	0.0153	0.0149	0.0110	0.0107
16	3.2773	3.3947	0.0045	0.0044	0.0153	0.0148	0.0107	0.0104
20	4.2360	4.4556	0.0051	0.0048	0.0153	0.0145	0.0102	0.0097
24	5.2547	5.6281	0.0056	0.0052	0.0153	0.0142	0.0097	0.0090
28	6.3351	6.9309	0.0061	0.0056	0.0153	0.0140	0.0092	0.0084
32	7.4808	8.3870	0.0066	0.0059	0.0153	0.0137	0.0087	0.0078
36	8.6931	10.0251	0.0071	0.0061	0.0154	0.0134	0.0083	0.0072
40	9.9741	11.8815	0.0076	0.0064	0.0155	0.0130	0.0079	0.0067
44	11.3259	14.0033	0.0081	0.0066	0.0157	0.0127	0.0076	0.0061
48	12.7525	16.4514	0.0086	0.0067	0.0159	0.0123	0.0072	0.0056

100 (2) Potassium Chloride; KCl; [7447-40-7]

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	283.15 K	(10 °C)						
4	0.5504	0.5589	0.0118	0.0116	0.0157	0.0155	0.0040	0.0039
6	0.8363	0.8561	0.0120	0.0117	0.0158	0.0154	0.0038	0.0037
8	1.1294	1.1663	0.0122	0.0119	0.0158	0.0153	0.0036	0.0035
10	1.4300	1.4903	0.0125	0.0120	0.0159	0.0152	0.0034	0.0033
	303.15 K	(30 °C)						
1	0.1344	0.1355	0.0120	0.0119	0.0157	0.0156	0.0037	0.0037
2	0.2705	0.2737	0.0122	0.0120	0.0158	0.0156	0.0036	0.0035
4	0.5477	0.5588	0.0124	0.0122	0.0158	0.0155	0.0034	0.0033
6	0.8319	0.8561	0.0127	0.0123	0.0159	0.0154	0.0032	0.0031
8	1.1231	1.1663	0.0129	0.0124	0.0159	0.0153	0.0030	0.0029
10	1.4215	1.4902	0.0131	0.0125	0.0160	0.0152	0.0029	0.0028
12	1.7272	1.8289	0.0133	0.0125	0.0160	0.0151	0.0028	0.0026

100 (2) Potassium Chloride; KCl; [7447-40-7] (Continued)

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	303.15 K	(30 °C)	(Continued)					
14	2.0405	2.1833	0.0135	0.0126	0.0161	0.0151	0.0026	0.0025
16	2.3614	2.5547	0.0137	0.0126	0.0162	0.0150	0.0025	0.0023
18	2.6902	2.9441	0.0139	0.0127	0.0163	0.0149	0.0024	0.0022
20	3.0271	3.3530	0.0140	0.0127	0.0164	0.0148	0.0023	0.0021
22	3.3724	3.7829	0.0142	0.0127	0.0165	0.0147	0.0022	0.0020
24	3.7262	4.2354	0.0144	0.0127	0.0166	0.0146	0.0021	0.0019
26	4.0888	4.7123	0.0146	0.0127	0.0167	0.0145	0.0020	0.0018
	323.15 K	(50 °C)						
4	0.5435	0.5589	0.0133	0.0130	0.0159	0.0155	0.0026	0.0025
6	0.8253	0.8561	0.0134	0.0129	0.0160	0.0154	0.0026	0.0025
8	1.1141	1.1663	0.0135	0.0129	0.0160	0.0153	0.0026	0.0025
10	1.4100	1.4903	0.0136	0.0129	0.0161	0.0152	0.0025	0.0024

100 (3) Potassium Iodide; KI; [7681-11-0]

Wt %	c_2/ mol dm^{-3}	m_2/ mol kg^{-1}	F_{1c}	F_{1m}	F_{2c}	F_{2m}	F_{3c}	F_{3m}
	283.15 K	(10 °C)						
12	0.7922	0.8214	0.0197	0.0190	0.0160	0.0154	-0.0037	-0.0036
14	0.9391	0.9806	0.0199	0.0190	0.0161	0.0154	-0.0038	-0.0037
16	1.0908	1.1474	0.0200	0.0190	0.0161	0.0153	-0.0039	-0.0037
18	1.2474	1.3223	0.0202	0.0190	0.0162	0.0153	-0.0040	-0.0038
	303.15 K	(30 °C)						
1	0.0604	0.0608	0.0201	0.0200	0.0157	0.0156	-0.0044	-0.0043
2	0.1217	0.1229	0.0202	0.0200	0.0158	0.0156	-0.0044	-0.0044
4	0.2470	0.2510	0.0203	0.0200	0.0158	0.0156	-0.0045	-0.0044
6	0.3761	0.3845	0.0205	0.0200	0.0159	0.0155	-0.0046	-0.0045
8	0.5091	0.5238	0.0206	0.0200	0.0159	0.0155	-0.0047	-0.0045
10	0.6461	0.6693	0.0207	0.0200	0.0160	0.0155	-0.0047	-0.0046
12	0.7875	0.8214	0.0209	0.0200	0.0161	0.0154	-0.0048	-0.0046
14	0.9332	0.9806	0.0210	0.0200	0.0162	0.0154	-0.0049	-0.0046
16	1.0837	1.1474	0.0211	0.0200	0.0162	0.0153	-0.0049	-0.0046
18	1.2390	1.3223	0.0213	0.0200	0.0163	0.0153	-0.0050	-0.0047
20	1.3994	1.5059	0.0214	0.0199	0.0164	0.0152	-0.0050	-0.0047
24	1.7366	1.9022	0.0217	0.0198	0.0166	0.0151	-0.0051	-0.0048
28	2.0974	2.3426	0.0220	0.0197	0.0168	0.0150	-0.0052	-0.0047
35	2.7933	3.2436	0.0226	0.0194	0.0172	0.0148	-0.0054	-0.0046
45	3.9582	4.9285	0.0236	0.0189	0.0179	0.0144	-0.0056	-0.0045
55	5.3825	7.3623	0.0249	0.0182	0.0190	0.0139	-0.0059	-0.0043
	323.15 K	(50 °C)						
12	0.7808	0.8214	0.0219	0.0208	0.0162	0.0154	-0.0057	-0.0054
14	0.9252	0.9806	0.0220	0.0207	0.0163	0.0154	-0.0057	-0.0054
16	1.0743	1.1474	0.0221	0.0207	0.0164	0.0153	-0.0057	-0.0053
18	1.2281	1.3223	0.0222	0.0206	0.0165	0.0153	-0.0057	-0.0053

The calculations above are based on weight per cent and aqueous electrolyte density data that appear in *International Critical Tables*, McGraw-Hill Book Co., New York, 1928, Volume III.

I. M. Sechenov [J. Setchenow]

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1982, March

Ivan Mikhaylovich Sechenov (J. Setchenow, J. Setchenoff)

born 1829, August 1, Teply Stan, Simbirsk guberniya [now Sechenovo, Arzamas Oblast], Russia

died 1905, November 2, Moscow, Russia

Research interests: physiology, physical chemistry, psychology.

Selected Works, A. A. Subkov, Editor, Moscow, 1935.

A selection of Sechenov's publications. Those written originally in German are republished in German, the originals in Russian are republished in English. Many of the papers are on psychology.

There are earlier collections of Sechenov's papers. An 1889 one in French, and one *ca.* 1907 in Russian.

Sechenov papers on the salt effect and on the solubility of carbon dioxide in various electrolyte and nonelectrolyte aqueous solutions.

1. *Pflug. Arch.* 1874, *8*, 1 - 39.
2. *Akad. Nauk SSSR, Mem. Acad. Imp. Sci., St. Petersbourg* 1877, *22*, 102-
3. *Ibid.* 1879, *26*,
4. *Ibid.* 1886, *34*,
5. *Ibid.* 1887, *35*, 1 - 59.
6. *Nouv. Mem. Soc. Imp. Nat. Moscow* 1889, *15*, 203 - 274.
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8. *Ibid.* 1891, *8*, 657 - 660.
9. *Ann. Chim. Phys.* [*6*] 1892, *25*, 226 - 270.

Paper 7. is a long abstract of paper 6.
Paper 9. and paper 5. contain some data in common.
I do not have copies of papers 3. and 4. Their citations are not certain. All of the other papers are in German except 9. which is in French.

The Sechenov Salt Effect Equation.

$y = \alpha\, f(x)$ — α is the Bunsen coefficient in pure water,
y is the Bunsen coefficient in the salt solution,
and x is the dilution of the salt solution.

Sechenov tried several $f(x)$ on his data. They included

$\sqrt[x]{m}$ where $m < 1$,

$p^{k/x}$ where $p < 1$, and

$e^{-k/x}$. He decided the last function was the best.

Thus, he gave the equation as $y = \alpha e^{-k/x}$ or $k = -x \ln \frac{y}{\alpha} = x \ln \frac{\alpha}{y}$.

Our present designation would be $k_{scc}/\mathrm{dm\ mol^{-1}} = (1/c) \log (\alpha^0/\alpha)$.

Sechenov often gave weight and volume data from which the electrolyte concentration can be calculated. Sometimes he did not give the information to calculate the concentration. He would prepare a saturated solution and dilute the solution. He usually checked his equation by taking the Bunsen coefficient in water and in the most concentrated electrolyte solution to predict the Bunsen coefficient in the electrolyte solutions at each dilution. The agreement bewteen the calculated and the experimental Bunsen coefficients was satisfactory. The gas solubility apparatus used by Sechenov used a large solvent volume (up to *ca.* 500 cm^3). His solubility values agree within a few per cent of modern values.

APPENDIX I. Conversion Factors k and k^{-1}

Non-SI Unit	k 1 (non-SI Unit) = k (SI Unit)	k^{-1} 1 (SI Unit) = k^{-1} (non-SI Unit)
LENGTH		SI Unit, m
Å (angstrom)	1×10^{-10} (*)	1×10^{10} (*)
cm (centimeter)	1×10^{-2} (*)	1×10^{2} (*)
in (inch)	254×10^{-4} (*)	$3\ 937\ 008 \times 10^{-5}$
ft (foot)	$3\ 048 \times 10^{-4}$ (*)	$3\ 280\ 840 \times 10^{-6}$
AREA		SI Unit, m^2
cm^2	1×10^{-4} (*)	1×10^{4} (*)
in^2	$64\ 516 \times 10^{-8}$ (*)	$1\ 550\ 003 \times 10^{-3}$
ft^2	$9\ 290\ 304 \times 10^{-8}$ (*)	$1\ 076\ 391 \times 10^{-5}$
VOLUME		SI Unit, m^3
cm^3	1×10^{-6} (*)	1×10^{6} (*)
in^3	$16\ 387\ 064 \times 10^{-12}$ (*)	$6\ 102\ 374 \times 10^{-2}$
ft^3	$2\ 831\ 685 \times 10^{-8}$	$3\ 531\ 467 \times 10^{-5}$
l (litre)	1×10^{-3} (*)	1×10^{3} (*)
UKgal (UK gallon)	$45\ 461 \times 10^{-7}$	$21\ 997 \times 10^{-2}$
USgal (US gallon)	$37\ 854 \times 10^{-7}$	$26\ 417 \times 10^{-2}$
MASS		SI Unit, kg
g (gram)	1×10^{-3} (*)	1×10^{3} (*)
t (tonne)	1×10^{3} (*)	1×10^{-3} (*)
lb (pound)	$45\ 359\ 237 \times 10^{-8}$ (*)	$2\ 204\ 623 \times 10^{-6}$
DENSITY		SI Unit, kg m^{-3}
g cm^{-3}	1×10^{3} (*)	1×10^{-3} (*)
g l^{-1}	1 (*)	1 (*)
lb in^{-3}	$2\ 767\ 991 \times 10^{-2}$	$3\ 612\ 728 \times 10^{-11}$
lb ft^{-3}	$1\ 601\ 847 \times 10^{-5}$	$6\ 242\ 795 \times 10^{-8}$
lb $UKgal^{-1}$	$99\ 776 \times 10^{-3}$	$100\ 224 \times 10^{-7}$
lb $USgal^{-1}$	$1\ 198\ 264 \times 10^{-4}$	$8\ 345\ 406 \times 10^{-9}$
PRESSURE		SI Unit, Pa (pascal, kg $m^{-1}s^{-2}$)
dyn cm^{-2}	1×10^{-1} (*)	1×10 (*)
at (kgf cm^{-2})	$980\ 665 \times 10^{-1}$ (*)	$1\ 019\ 716 \times 10^{-11}$
atm (atmosphere)	$101\ 325$ (*)	$9\ 869\ 233 \times 10^{-12}$
bar	1×10^{5} (*)	1×10^{-5} (*)
lbf in^{-2} (p.s.i.)	$6\ 894\ 757 \times 10^{-3}$	$1\ 450\ 377 \times 10^{-10}$
lbf ft^{-2}	$47\ 880 \times 10^{-3}$	$20\ 886 \times 10^{-6}$
inHg (inch of mercury)	$3\ 386\ 388 \times 10^{-3}$	$2\ 952\ 999 \times 10^{-10}$
mmHg (millimeter of mercury, torr)	$1\ 333\ 224 \times 10^{-4}$	$7\ 500\ 617 \times 10^{-9}$

APPENDIX I. Conversion Factors k and k^{-1}

Non-SI Unit	k 1 (non-SI Unit) = k (SI Unit)		k^{-1} 1 (SI Unit) = k^{-1} (non-SI Unit)	
ENERGY			Unit, J (joule, kg m^2s^{-2})	
erg	1×10^{-7}	(*)	1×10^{7}	(*)
cal_{IT} (I.T. calorie)	$41\ 868 \times 10^{-4}$	(*)	$2\ 388\ 459 \times 10^{-7}$	
cal_{th} (thermochemical calorie)	$4\ 184 \times 10^{-3}$	(*)	$2\ 390\ 057 \times 10^{-7}$	
kW h (kilowatt hour)	36×10^{5}	(*)	$2\ 777\ 778 \times 10^{-13}$	
l atm	$101\ 325 \times 10^{-3}$	(*)	$9\ 869\ 233 \times 10^{-9}$	
ft lbf	$1\ 355\ 818 \times 10^{-6}$		$7\ 375\ 622 \times 10^{-7}$	
hp h (horse power hour)	2 684 519		$3\ 725\ 062 \times 10^{-13}$	
Btu (British thermal unit)	$1\ 055\ 056 \times 10^{-3}$		$9\ 478\ 172 \times 10^{-10}$	

An asterisk (*) denotes an exact relationship

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Water; H_2O; [7732-18-5]	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

Nitrogen is one of the atmospheric gases that has been studied by many workers over a long period of time. We selected the work of nine groups to use for the smoothing equation. In the process of fitting the data to the smoothing equation any data points which differed from the smooth equation by about two standard deviations or more were rejected. The 74 points used for the final smoothing were obtained as follows: (reference number-number of data points from that reference): 1-6; 2-28; 3-10; 4-1; 5-18; 6-1; 7-1; 8-1; 9-8. The fitting equation used was

$$\ln x_1 = A + B/(T/100K) + C \ln (T/100K) + DT/100K \qquad (1)$$

Using T/100K as the variable rather than T/K gives coefficients of approximately equal magnitude. The best fit for the 74 points was

$$\ln x_1 = -67.38765 + 86.32129/(T/100K) + 24.79808 \ln (T/100K) \qquad (2)$$

where x_1 is the mole fraction solubility at 101,325 Pa partial pressure of gas. The fit in $\ln x_1$ gave a standard deviation of 0.72% taken at the middle of the temperature range. Table 1 gives smoothed values of the mole fraction solubility and the Ostwald coefficient at 5K intervals.

Table 1 also gives the thermodynamic functions $\Delta\bar{G}^\circ_1$, $\Delta\bar{H}^\circ_1$, $\Delta\bar{S}^\circ_1$, and $\Delta\bar{C}^\circ_{p_1}$ for the transfer of the gas from the vapor phase at 101,325 Pa partial gas pressure to the (hypothetical) solution of unit mole fraction. These thermodynamic properties were calculated from the smoothing equation according to the following equations:

$$\Delta\bar{G}^\circ_1 = -RAT - 100RB - RCT \ln (T/100) - RDT^2/100 \qquad (3)$$

$$\Delta\bar{S}^\circ_1 = RA + RC \ln (T/100) + RC + 2RDT/100 \qquad (4)$$

$$\Delta\bar{H}^\circ_1 = -100RB + RCT + RDT^2/100 \qquad (5)$$

$$\Delta\bar{C}^\circ_{p_1} = RC + 2RDT/100 \qquad (6)$$

The experimental results of twenty-one other groups were not used for the smoothing equation for a variety of reasons. Although Douglas' (10) work is in general of high quality, the nitrogen solubility data appeared to vary erratically around the smoothing equation. Winkler's values (11) were mostly low. Van Slyke's two values (12) were close and high so both were discarded. Müller's results (13) were about 3% low. Just's values (14) were 1-3% high. Ikels single measurement (15) was 3% low. Orcutt and Seevers' single value (16) was 3% high. Behnke and Yarbrough's single value was 2% high (17). Stoddard's single value (18) was 8% low. Grollman's single value was 6% high (19). Morrison and Billett's single value (20) was 4% low. Brasted and Hirayama's single value (21) was 12% high. Drucker and Moles' single value (22) was 2% low. Christoff's single value was 10% low (23). Bunsen's five experimental values (24) were about 15% low. Braun's five values (25) ranged from 8% high to 2% low. Adeney and Becker's results (26) ranged from 1% high to about 6% low. Power and Stegall's single value (27) was 1.1% low. Wilcock and Battino's value at 298.15 K (28) was 1.4% low. The Wilcock and Battino paper also showed that the solubility of one gas is not affected by the presence of another within their experimental precision, and at the solubilities concerned. Cassuto's values (29) were off by more than 6%. The early measurements by Petterson and Sonden (30) were very low.

Weiss (31) analyzed the data then current on nitrogen solubilities in water and seawater and provided smoothing equations and smoothed data. Klots and Benson (32) determined the ratio of the solubility of ${}^{28}N_2/{}^{29}N_2$ in water in the range 275 to 300 K and found the ratio of the Henry's law

continued on following page

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

EVALUATOR:

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U.S.A.

December 1981

CRITICAL EVALUATION:

continued

constants (mole fraction and atm units) to be 1.00085 ± 0.00010 in this temperature range. Note that the heavier isotope is more soluble.

Figure 1 shows the temperature dependence of the solubility of nitrogen in water as mole fraction versus T/K. The curve was obtained from the smoothing equation. The solubility expressed as the Ostwald coefficient shows a minimum at about 338K, but over the temperature range of the data used for the smoothing equation no minimum was evident, although the trend to a minimum was apparent.

Table 1. Smoothed values of the solubility of nitrogen in water and thermodynamic functions[a] at 5K intervals using equation 2 at 101,325 Pa partial pressure of gas.

T/K	$10^5 x_1$[b]	$10^2 L$[c]	$\Delta\bar{G}^\circ_1$/kJ mol^{-1}	$\Delta\bar{H}^\circ_1$/kJ mol^{-1}	$\Delta\bar{S}^\circ_1$/J $mol^{-1} K^{-1}$
273.15	1.908	2.373	24.68	-15.45	-147
278.15	1.695	2.147	25.41	-14.42	-143
283.15	1.524	1.965	26.11	-13.39	-140
288.15	1.386	1.818	26.80	-12.36	-136
293.15	1.274	1.698	27.47	-11.33	-132
298.15	1.183	1.601	28.12	-10.30	-129
303.15	1.108	1.523	28.76	-9.27	-125
308.15	1.047	1.461	29.38	-8.24	-122
313.15	0.9981	1.413	29.98	-7.21	-119
318.15	0.9585	1.376	30.57	-6.17	-115
323.15	0.9273	1.349	31.14	-5.14	-112
328.15	0.9033	1.331	31.69	-4.11	-109
333.15	0.8855	1.321	32.23	-3.08	-106
338.15	0.8735	1.319	32.75	-2.05	-103
343.15	0.8666	1.324	33.26	-1.02	-100
348.15	0.8644	1.336	33.75	0.01	- 97

[a] $\Delta\bar{C}^\circ_{p_1}$ was independent of temperature and had the value 206 J mol^{-1} K^{-1}.

[b] Mole fraction solubility at 101,325 Pa partial pressure of gas.

[c] Ostwald coefficient.

In a review D. M. Himmelblau (33) reported on the partial molal heats and entropies of solution for gases (O_2, N_2, H_2, He, Xe, and CH_4) dissolved in water from the freezing to near the critical point. He also gave constants for a general solubility equation for these gases. Recently Clever and Han (34) summarized work on the solubility of hydrogen nitrogen, oxygen, and the noble gases in water from 350-600K. They give smoothing equations and critically evaluate the literature for these systems at high temperatures.

Schulze and Prausnitz (35) have correlated gas solubility data for aqueous systems at high temperatures within the framework of scaled scaled particle theory.

continued on following page

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

EVALUATOR:

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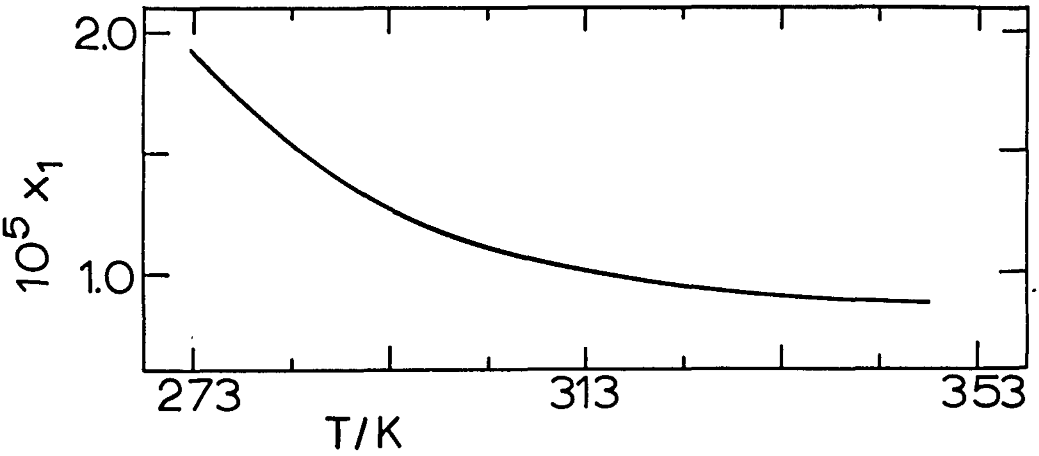
December 1981

CRITICAL EVALUATION:

continued

Note: The critical evaluation in the following section on nitrogen solubility in seawater which was prepared by Dr. C-T. A. Chen does not use the solubility data of Klots and Benson (2) for the pure water part of his smoothing equation. In that sense the pure water solubilities recommended in this part and the following one are not compatible. Differences are small and indicate different ways of judging data.



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COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Water; H_2O; [7732-18-5]	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

continued

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COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Winkler, L. W.

Ber. 1891, *24*, 3602-10.

VARIABLES:

T/K = 273-353

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	$10^5 x_1{}^{a,b}$	$10^2 L^{a,c}$	$10^2 \alpha^d$/cm^3(STP) cm^{-3} atm^{-1}
0.08	273.23	1.884	2.344	2.3435
10.01	283.16	1.492	1.924	1.8564
20.01	293.16	1.242	1.655	1.5420
29.97	303.12	1.082	1.487	1.3400
40.00	313.15	0.958	1.356	1.1825
50.00	323.15	0.884	1.286	1.087
60.02	333.17	0.836	1.247	1.022
69.99	343.14	0.802	1.226	0.976
79.99	353.14	0.791	1.237	0.957

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Ostwald coefficient.

[d] Bunsen coefficient. Values reported in this table are averages of three to eight measurements at each temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used Bunsen's absorptiometer and method.

SOURCE AND PURITY OF MATERIALS:

(1) From air by passing it through a heated to glowing copper tube.

(2) No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.03$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, 57, 611-24.

VARIABLES:

T/K = 293

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	P/mmHg	P/kPa	$10^5 x_1$ [a]	$10^2 \alpha$ [b]
293.38	695.5	92.73		1.590
293.28	689.2	91.89		1.552
293.30	648.6	86.47		1.552
293.35	665.3	88.70		1.565
293.33			1.260 [c]	1.565 [c]

[a] Mole fraction solubility (calculated by compiler) at 101.325 Pa partial pressure of gas.

[b] Bunsen coefficient.

[c] Average of four previous values.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparatus described in reference 1. An absorption type using gas burets and an absorption flask. Solubilities also determined in several other solvents and solutions.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) "Pure"

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$, compiler's estimate

REFERENCES:

1. Hüfner, G. *Archiv. G. Anatomie und Physiologie, Physiolog. Abtlg.* 1894, S., 191.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Water; H_2O; [7732-18-5]	Fox, C. J. J. *Trans. Faraday Soc.* 1909, *5*, 68-87.
VARIABLES:	PREPARED BY:
T/K = 274-325	R. Battino

EXPERIMENTAL VALUES:

T^a/K	Mole Fraction[b] $10^5 x_1$	Ostwald Coeff.[c] $10^2 L$	Bunsen Coeff.[d] $10^2 \alpha$
273.68	1.866	2.326	2.321
279.15	1.653	2.101	2.056
283.15	1.560	1.959	1.890
293.75	1.269	1.695	1.576
298.05	1.187	1.607	1.473
303.03	1.116	1.534	1.383
308.14	1.061	1.480	1.312
314.64	0.998	1.418	1.231
319.94	0.945	1.362	1.163
323.04	0.922	1.340	1.133
273.54[e]	1.874	2.334	2.331
277.55	1.710	2.162	2.128
280.55	1.601	2.046	1.992
284.05	1.494	1.932	1.858
285.95	1.444	1.880	1.796
287.40	1.404	1.836	1.745

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modified form of the Estreicher (1) apparatus was used. Diagram and procedure given in paper. The water is degassed by boiling using a double flask system. The quantity of water is determined by weighing. The dry gas is introduced from a gas buret, the flask shaken and a final reading of the volume of gas absorbed is made after there are no changes. A manometer is used to take readings at different pressures. Several readings at different temperatures are taken on one loading of the absorption flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - obtained by several time passing air to and fro over warm white phosphorus, soda lime, and P_2O_5.

(2) Water - "distilled water".

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.015$, estimated by compiler.

REFERENCES:

(1) Estreicher, T. *Z. Physik. Chem.* 1899, *31*, 176.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Fox, C. J. J.

Trans. Faraday Soc. 1909, 5, 68-87.

EXPERIMENTAL VALUES:

continued

T^a/K	Mole Fraction[b] 10^5x_1	Ostwald Coeff.[c] 10^2L	Bunsen Coeff.[d] $10^2\alpha$
292.15	1.266	1.682	1.573
296.45	1.216	1.638	1.509
303.05	1.117	1.535	1.384
308.91	1.047	1.465	1.295
313.43	1.008	1.427	1.244
318.88	0.957	1.376	1.179
321.85	0.930	1.348	1.144
325.16	0.900	1.315	1.105

[a] Original temperature reported as °C to 0.01°C.

[b] Mole fraction solubility at 101325 Pa (1atm) partial pressure of gas calculated by compiler.

[c] Ostwald coefficients calculated by compiler.

[d] Bunsen coefficients reported in original paper.

[e] Second series of measurements.

[f] Smoothing equation of author given as $1000\alpha = 22.998-0.5298t + 0.009196t^2 - 0.00006779t^3$ with t in °C.

[g] Author also determined the solubility of nitrogen in seawater from 0 to 28°C and 0 to 20 per mille Cl.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Water; H_2O; [7732-18-5]	Bohr, C. *Z. Physik. Chem.* 1910, *71*, 47-50.
VARIABLES: T/K = 294	PREPARED BY: R. Battino

EXPERIMENTAL VALUES:

T^a/K	$10^5 x_1{}^b$	$10^2 L^c$	$10^2 \alpha^d$
294.35	1.256	1.681	1.560

[a] Temperature reported to 0.1°C.

[b] Mole fraction solubility at 101.325 kPa (1 atm) partial pressure of gas calculated by compiler.

[c] Ostwald coefficient calculated by compiler.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption measuring apparatus is described in reference (1). This paper also reports solubilities in sulfuric acid solutions.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - no comment by author.

(2) Water - no comment by author.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.03$, estimate by author.

REFERENCES:

(1) Bohr, C. Sauerstoffaufnahme des Blutfarbstoffes. Kopenhagen 1895. Jolin, Archiv F. (Anat. u.) Physiologie 1889, 265.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Müller, C.

Z. Physik. Chem. 1912, *81*, 483-503.

VARIABLES:

T/K = 289-290

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T^a/K	Mole Fraction^b 10^5x_1	Ostwald Coeff.^{c} 10^2L	Bunsen Coeff.^{d} $10^2\alpha$
289.35	1.344	1.769	1.670
290.35	1.304	1.724	1.622

[a] Temperature reported to 0.1°C.

[b] Mole fraction solubility at 101.325 kPa (1 atm) partial pressure of gas calculated by compiler.

[c] Ostwald coefficient calculated by compiler.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water is degassed by pumping under vacuum. The absorption vessel is about 600 cm^3 and is separately thermostatted from the buret gas measuring system. Both are connected by a copper capillary tube. Gas uptake is read on the gas burets. The absorption flask volume and all liquid volumes were calibrated using mercury. The original paper contains details of operation and a drawing. Solubilities were also measured in aqueous solutions of sucrose, chloral hydrate, and glycerol.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - from heating potassium nitrite and ammonium nitrite. Washed with potassium hydroxide solution, ferrous sulfate solution, and sulfuric acid; and finally passed through a glowing copper tube.

(2) Water - no comment by author.

ESTIMATED ERROR

$\delta\alpha/\alpha = \pm 0.01$, estimate by compiler.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Adeney, W. E.; Becker, H. G.

Royal Dublin Soc. Scientific Pro. 1919, *15*, 609-28.

VARIABLES:

T/K = 277-308

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	$10^5 x_1{}^{a,b}$	$10^2 L^{a,c}$	$10^2 \alpha^d$/cm³(STP)cm⁻³atm⁻¹
3.5	276.7	1.771	2.232	2.203
11.2	284.4	1.463	1.895	1.820
15.0	288.2	1.369	1.795	1.701
20.1	293.3	1.247	1.663	1.549
24.8	296.0	1.173	1.588	1.456
30.4	303.6	1.067	1.469	1.322
35.1	308.3	0.986	1.377	1.220

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325kPa partial pressure of gas.

[c] Ostwald coefficient.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A manometric system using water-jacketed burets was used.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared from potassium bichromate, ammonium sulphate, and sodium nitrite.

(2) Distilled.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.01$, compiler's estimate
$\delta T/K = \pm 0.1$

REFERENCES:

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Frolich, P.K.; Tauch, E.J.; Hogan, J.J.; Peer, A.A. *Ind. Eng. Chem.* 1931, *23*, 548-50.
VARIABLES: T/K = 298.15 P/MPa (absolute) = 0.1-19	PREPARED BY: C-T. A. Chen.

EXPERIMENTAL VALUES:

P^a/atm	S^b
20 (2.03 MPa)	0.28
60 (6.08 MPa)	0.83
100 (10.13 MPa)	1.39
140 (14.18 MPa)	1.95
190 (19.25 MPa)	2.64

[a] Absolute pressure.

[b] Volume of nitrogen at 298.15 K and 1 atm per volume of water; estimated from figure 3 of the original paper.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water was introduced into a steel cylinder of 2 liters capacity. Nitrogen was then forced in under pressure and the cylinder agitated in a water bath maintained at 298.15 K. After the pressure had become constant, some water was withdrawn. The water and the nitrogen separating from it on release of pressure were collected over mercury in a buret and the two volumes were read directly. Corrections were made for the vapor pressure of the liquid and the atmospheric solubility of the gas. Pressures were measured with a Bourdon Gauge.

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

$\delta S/S = \pm 0.05$, compiler's estimate

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Goodman, J. B.; Krase, N. W.

Ind. Eng. Chem. 1931, *23*, 401-4

VARIABLES:

T/K = 273-443
P/MPa (hydrostatic) = 10.13 - 30.39

PREPARED BY:

C-T. A. Chen

EXPERIMENTAL VALUES:

p^a/atm	s^b						
	273.15K^c	298.15K	323.15K	353.15K	373.15K	417.15K	442.15K
100(10.13MPa)	1.46	1.07	1.003	0.934	0.954	1.025	1.08
125(12.66MPa)	1.76	1.44	1.24	1.15	1.17	1.30	1.52
200(20.26MPa)	3.19	2.76	2.49	2.27	2.25	2.68	3.29
300(30.39MPa)	3.60	3.25	2.99	2.86	2.91	3.46	3.83

[a] Hydrostatic pressure.

[b] cm^3 of nitrogen at STP per gram of water.

[c] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Nitrogen was forced into a 61 cm long, 6.3 cm inside-diameter steel cylinder, which contained water saturated with nitrogen at room temperature and the desired pressure. The water was then transferred to a thermostated steel pipet where it was stirred at the desired temperature and pressure. After equilibrium, a sample was withdrawn into a weighed glass trap. The nitrogen released was then measured over mercury in a buret. The pressure was measured by a Bourdon gauge.

SOURCE AND PURITY OF MATERIALS:

Compressed nitrogen from unspecified commercial source was drawn over heated copper wire at 450°C. Water and carbon dioxide were removed by passing nitrogen through soda lime.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V. L.; Heins, C.Jr.

J. Am. Chem. Soc. 1933, *55*, 947-53.

VARIABLES:

T/K = 298-373
P/MPa (hydrostatic) = 0-101

PREPARED BY:

C-T. A. Chen

EXPERIMENTAL VALUES:

cm^3 N_2 at STP per gram of water

P^a/atm	$T/K^{b,c}$ = 298.15	T/K^b = 323.15	T/K^b = 348.15	T/K^b = 373.15
25 (2.530 MPa)	0.348	0.273	0.254	0.266
50 (5.071 MPa)	0.674	0.533	0.494	0.516
100 (10.13 MPa)	1.264	1.011	0.946	0.986
200 (20.27 MPa)	2.257	1.830	1.732	1.822
300 (30.40 MPa)	3.061	2.534	2.413	2.546
500 (50.66 MPa)	4.441	3.720	3.583	3.799
800 (81.06 MPa)	6.134	5.221	5.062	5.365
1000 (101.3 MPa)	7.15	6.123	5.934	6.256

[a] Hydrostatic pressure.

[b] Calculated by compiler.

[c] Data include some values previously published (Wiebe, et al., 1932)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two cylinders of 1000 cc and 300 cc capacity, respectively were filled with water to three-fourth capacity. The nitrogen was bubbled through the larger and the smaller cylinder successively for several hours before water samples were taken from the smaller cylinder for analysis. The larger cylinder was used as a reservoir. The experiments were approached from both under and supersaturation.

SOURCE AND PURITY OF MATERIALS:

(1) 99.9% pure. Impurities are argon and traces of oxygen.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$\delta S/S = \pm 0.005$, authors' estimate

REFERENCES:

1. Wiebe, R.; Gaddy, V.L.; Heins, C. Jr. *Ind. Eng. Chem.* 1932, *24*, 927.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Dillon, R. T.; Margaria, R.

J. Biol. Chem. 1934, *105*, 571-96.

VARIABLES:

T/K = 298-311

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/°C	T^a/K	$P^b_{N_2}$/mmHg	$P^a_{N_2}$/kPa	$10^2\alpha^c$/cm^3(STP) cm^3 atm^{-1}	$10^2\alpha^{\circ d}$/cm^3(STP) g^{-1} H_2O
25	298.15	580	77.3	1.469	1.473
25	298.15	580	77.3	1.475	1.479
25	298.15	587	78.3	1.483	1.487
25	298.15	587	78.3	1.483	1.487
25	298.15	589	78.5	1.480	1.484
25	298.15	589	78.5	1.486	1.490
25	298.15	589	78.5	1.485	1.489
25	298.15	589	78.5	1.486	1.489
38	311.15	564.5	75.26	1.272	1.281

[a] Calculated by compiler.

[b] Partial pressure of nitrogen in air or gas mixture.

[c] Bunsen coefficient.

[d] Solubility in cm^3 (STP) of nitrogen per gram of water.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The water was saturated with gas using the rotating double tonometer method of Austin, et al. (1). 2-2.5 h was allowed for saturation. The amount of dissolved nitrogen was determined using the method of Van Slyke and Neill (2).

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) "Freshly distilled."

ESTIMATED ERROR:

$\delta T/K = \pm 0.04$
$\delta\alpha/\alpha = \pm 0.01$, compiler's estimate

REFERENCES:

1. Austin, J.H.; Cullen, G.E.; Hastings, A.B.; McLean, F.C.; Peters, J.D.; Van Slyke, D.D. *J. Biol. Chem.* 1922, *54*, 134.
2. Van Slyke, D.D.; Neil, J.M. *J. Biol. Chem.* 1924, *61*, 523.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Hawkins, J. A.; Shilling, C. W.

J. Biol. Chem. 1936, *113*, 273-8.

VARIABLES:

$T/K = 311$
$P/MPa = 0.1-0.6$

PREPARED BY:

R.Battino

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	$10^5 x_1{}^a$	$10^2 \alpha^b$
311.15	0.939	0.0951		1.281
311.15	0.945	0.0958		1.259
311.15	1.955	0.1981		1.299
311.15	3.921	0.3973		1.261
311.15	5.958	0.6037		1.246
311.15	6.042	0.6122		1.270
311.15			1.028^c	1.269^c

[a] Mole fraction solubility (calculated by compiler) at 101.325 Pa partial pressure of gas.

[b] Bunsen coefficient. Each value is average of duplicate runs.

[c] Average value.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Procedure followed is that of Austin, et al., (1). This is the Van Slyke approach. Also determined nitrogen solubility in ox and dog blood.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.015$, compiler's estimate.

REFERENCES:

1. Austin, J.H.; Cullin, C.E.; Hastings, A.B.; MacLean, F.C.; Peters, J.P.; Van Slyke, D.D. *J. Biol. Chem.* 1922, *54*, 134.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Morrison, T. J.; Billett, F.

J. Chem. Soc. <u>1952</u>, 3819-22.

VARIABLES:

T/K = 286-346

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K[a]	Mole Fraction[b] 10^5x_1	Ostwald Coeff.[c] 10^2L	S_o[d]
285.65	1.477	1.921	18.37
288.65	1.385	1.820	17.22
293.45	1.280	1.707	15.89
298.65	1.190	1.614	14.76
303.15	1.112	1.528	13.77
308.75	1.030	1.440	12.74
314.75	0.9702	1.379	11.97
319.55	0.9364	1.349	11.53
324.15	0.9156	1.335	11.25
328.65	0.9029	1.332	11.07
336.95	0.8781	1.322	10.72
345.65	0.8677	1.334	10.54

[a] Temperature reported to 0.1°C.

[b] Mole fraction solubility at 101.325 Pa (1 atm) partial pressure of gas calculated by compiler.

[c] Ostwald coefficient calculated by compiler.

[d] S_o is the solubility in cm^3 at standard temperature and pressure per 1000 g of water at a total gas pressure of 1 atm.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent is degassed by thorough boiling. It then flows in a thin film down a glass spiral and into a buret system containing the gas to be dissolved. Equilibrium is rapidly attained. Flow rates may be varied over a wide range without affecting the solubility. The solvent serves as its own indicator in the gas buret and volumes read on the burets are used to calculate the solubility The method is described in reference (1). The present paper describes an improved degassing section based on the vapor-pump principle.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - from a cylinder and from ammonium nitrite gave the same results.

(2) Water - no comment by authors.

ESTIMATED ERROR:

$\delta S_o/S_o$ = ±0.005, estimate of reproducibility by authors.

REFERENCES:

(1) Morrison, T. J.; Billett, F. *J. Chem. Soc.* <u>1948</u>, 2033-5.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Suciu, S. N.; Zoss, L. M.;
Sibbitt, W. L.

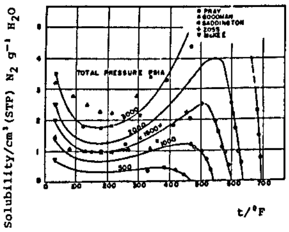
Am. Soc. Mech. Eng. Paper No. 53-A-64, Presented at the Annual Meeting, New York, 1953.

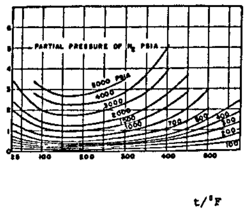
VARIABLES:

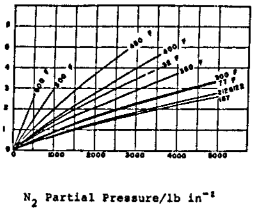
PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:







The authors prepared the figures above. They show the solubility of nitrogen in cm^3(STP) g^{-1} H_2O as a function of temperature at several total pressures (left); as a function of temperature at a dozen nitrogen partial pressures (middle), and as a function of nitrogen partial pressure at 11 different temperatures (right). They used data from:

Pray, H. A.; Schweickert, C. E.; Minnick, B. H. Battelle Memorial Institute Reprot BMI- T-25; *Ind. Eng. Chem.* 1952, *44*, 1146 - 1151.

Goodman, J. B.; Krase, N. W. *Ind. Eng. Chem.* 1931, *23*, 401.

Saddington, A. W.; Krase, N. W. *J. Am. Chem. Soc.* 1934, *56*, 353 - 361.

Zoss, L. M. Ph. D. thesis, Purdue University, 1952.

McKee, O. G. Ph. D. thesis, Purdue University, 1953.

Suciu, S. N. Ph. D. thesis, Purdue University, 1951.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Clever, H. L.; Battino, R.;
Saylor, J. H.; Gross, D.M.

J. Phys. Chem. 1957, *61*, 1078-82.

VARIABLES:

T/K = 298

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	$10^5 x_1$ [a]	$10^2 \beta$ [b]
298.15	1.185	1.47

[a] Mole fraction solubility at 101.325 Pa partial pressure of gas (calculated by compiler).

[b] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modification of the apparatus of Morrison and Billett (1) was used. The degassed liquid flows in a thin film through the gas down a 6 ft. absorption spiral. Gas uptake is measured on a gas buret where the solvent is the confining medium. See reference 1 for details.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.01$, compiler's estimate.

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033; *ibid.*, 1952, 3819.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Farhi, L. E.; Edwards, A. W. T.; Homma, T.

J. Appl. Physiol. 1963, *18*, 97-106.

VARIABLES:

T/K = 276-310

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	$10^5 x_1$ [a,b]	$10^2 L^{a,c}$	$10^2 \alpha^d$
3.1	276.25	1.783	2.243	2.218
26.8	299.95	1.153	1.570	1.430
27.15	300.30	1.150	1.567	1.425
32.0	305.15	1.080	1.494	1.337
32.05	305.20	1.079	1.493	1.336
37.05	310.20	1.027	1.442	1.270

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Ostwald coefficient.

[d] Bunsen coefficient in units of $cm^3 (STP)\ cm^{-3}\ atm^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Van Slyke method was used in conjunction with gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) Distilled.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.01$, compiler's estimate
$\delta T/K = \pm 0.05$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Klots, C. E.; Benson, B. B.

J. Marine Res. (Sears Found. Marine Res.) <u>1963</u>, *21*, 48-57.

VARIABLES:

T/K = 275-300

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T^a/K	Mole Fraction[b] 10^5x_1	Ostwald Coeff.[c] 10^2L	Bunsen Coeff.[d] $10^2\alpha$	Henry's Law[e] $10^{-4}K$
275.01	1.846	2.313	2.297	5.417
275.33	1.833	2.299	2.281	5.453
275.36	1.829	2.293	2.275	5.467
275.86	1.809	2.273	2.251	5.528
276.51	1.776	2.237	2.210	5.627
276.90	1.753	2.210	2.181	5.704
276.98	1.749	2.207	2.176	5.718
277.96	1.706	2.160	2.123	5.861
278.40	1.686	2.138	2.098	5.929
279.04	1.671	2.124	2.079	5.984
279.07	1.664	2.115	2.070	6.010
280.03	1.635	2.085	2.034	6.114
280.81	1.603	2.050	1.994	6.238
282.08	1.562	2.007	1.943	6.400
282.38	1.552	1.996	1.931	6.441
283.25	1.519	1.959	1.889	6.583
284.18	1.492	1.930	1.855	6.704
285.40	1.462	1.900	1.818	6.840
285.92	1.445	1.881	1.797	6.918
287.07	1.415	1.849	1.759	7.067
288.08	1.389	1.821	1.727	7.199
289.08	1.367	1.798	1.699	7.315
289.99	1.344	1.773	1.670	7.440
290.97	1.318	1.745	1.638	7.587
292.64	1.287	1.712	1.598	7.776

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two bulbs of ca. 300 cm^3 capacity are connected by two stopcocks. Degassed water is introduced into one bulb. The volumes of both are known to better than 0.05%. The stopcocks between the bulbs are opened, about one-half of the water is moved into the gas bulb and the apparatus agitated in a thermostat for up to 48 hours. The bulbs are placed upright and the saturated water and gas phases isolated. The undissolved gas is removed (via a Toepler pump) and its pressure, volume and temperature measured in the dry state to determine the number of moles of gas undissolved. The moles of dissolved gas are similarly determined. The constancy of the gas mass in a given experiment was about 0.05%. Solubilities are calculated from the known volumes and quantities with appropriate corrections for gas non-ideality.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - "Tank" grade with about 0.1% each oxygen and argon.

(2) Water - "distilled"

ESTIMATED ERROR:

Precision $\delta\alpha/\alpha = \pm 0.002$, Author's estimate.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Water; H_2O; [7732-18-5]	Klots, C. E.; Benson, B. B. *J. Marine Res. (Sears Found. Marine Res.)* 1963, *21*, 48-57.

EXPERIMENTAL VALUES:

continued

T^a/K	Mole Fraction[b] 10^5x_1	Ostwald Coeff.[c] 10^2L	Bunsen Coeff.[d] $10^2\alpha$	Henry's Law[e] $10^{-4}K$
293.33	1.271	1.696	1.579	7.864
294.41	1.246	1.667	1.547	8.028
295.27	1.232	1.653	1.530	8.113
296.29	1.207	1.625	1.498	8.288
297.20	1.197	1.616	1.485	8.354
298.22	1.183	1.603	1.468	8.453
299.25	1.164	1.582	1.444	8.584
300.16	1.149	1.565	1.424	8.711

T^a/K	$\alpha(Ar)/\alpha(N_2)$[f]
275.50	2.234
276.17	2.232
279.91	2.222
282.10	2.209
283.71	2.200
284.40	2.199
286.34	2.190
288.16	2.176
290.76	2.168
292.45	2.160
293.37	2.158
295.54	2.150
297.53	2.143
298.74	2.137
299.87	2.137

T^a/K	$\alpha(Ar)/\alpha(N_2)$[g]
276.34	2.238
285.71	2.207
294.97	2.147
300.43	2.132

[a] Calculated by compiler. Temperatures reported to 0.01°C.

[b] Mole fraction solubility at 101,325 Pa (1 atm) partial pressure of gas calculated by compiler.

[c] Ostwald coefficient calculated by compiler.

[d] Bunsen coefficient - data originally reported as.

[e] Henry's Law constant - data originally reported as.

Defined as $P_i = K_i x_i$ where P_i is the fugacity of nitrogen in atmospheres, and x_i is the mole fraction solubility.

[f] Ratio of argon solubility to nitrogen solubility expressed as Bunsen coefficients from original mixture of roughly 50:50 composition. Determined manometrically.

[g] Same as in (f), but determined mass spectrometrically. The precision in the solubility ratios is about 0.2%.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Douglas, E.

J. Phys. Chem. 1964, *68*, 169-74.

VARIABLES:

T/K = 276-303
P/kPa = 101.325

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T[a]/K	Mole Fraction[b] $10^5 x_1$	Ostwald Coeff.[c] $10^2 L$	Bunsen Coeff.[d] $10^2 \alpha$	No.Pts.[e]	Range in[f] $10^2 \alpha$
276.25	1.762	2.217	2.192	3	2.187-2.197
280.98	1.575	2.015	1.959	10	1.951-1.966
284.83	1.460	1.894	1.816	5	1.812-1.817
293.10	1.254	1.672	1.558	10	1.550-1.565
302.65	1.093	1.500	1.354	10	1.348-1.363

[a] Temperature reported to 0.01°C.

[b] Mole fraction solubility at 101.325kPa (1 atm) partial pressure of gas calculated by compiler.

[c] Ostwald coefficient calculated by compiler.

[d] Bunsen coefficient.

[e] Number of replicate measurements at that temperature. Value reported as Bunsen coefficient is an average of these measurements.

[f] The range in the replicate measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedures are based on the Scholander microgasometric apparatus (1). This version uses one arm with an expanded solvent reservoir. Degassed water is introduced into this reservoir and sealed over mercury. The water is then tipped into the absorption chamber. Gas is introduced and the entire apparatus is shaken in a water thermostat (controlled to 0.01°C). Gas and liquid volumes are read on a micrometer syringe by displacement of mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - no comment by author.

(2) Water - double distilled.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.003$, estimate by author.
$\delta T/K = \pm 0.02$, estimate by author.

REFERENCES:

(1) Scholander, P.F. J. Biol. Chem. 1947, 167, 235.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Enns, T.; Scholander, P. F.; Bradstreet, E. D.

J. Phys. Chem. 1965, *69*, 389-91.

VARIABLES:

T/K = 298
P/MPa (hydrostatic) = 0-10

PREPARED BY:

C-T.A. Chen.

EXPERIMENTAL VALUES:

P^a/atm	P^b/MPa	P^c/mm Hg	P^c/mm Hg	P^c/mm Hg
		T^b/K = 298.15		
0	0	733	705	732
34	3.45	773	744	769
68	6.89	803	777	806.5
102	10.34	843	811	844

[a] Hydrostatic pressure.

[b] Calculated by compiler.

[c] The values in the table are the nitrogen equilibrium pressures in units of mm Hg. The table shows the effect of the hydrostatic pressure on the nitrogen equilibrium pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water was gas-extracted before the experiment. Nitrogen at the desired initial pressure was dissolved in water at a constant temperature. The equilibrium vessel was shaken for 0.5 to 1 hr. After that, the water was transferred to a syringe which has a teflon tube attached to it. The pressure developed within the tube was then read on a mercury manometer.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Murray, C. N.; Riley, J. P.; Wilson, T. R. S.

Deep-See Research 1969, *16*, 297-310.

VARIABLES:

T/K = 274-304
P/kPa = 101.325

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T^a/K	Mole fraction[b] 10^5x_1	Ostwald Coeff.[c] 10^2L	Bunsen Coeff.[d] $10^2\alpha$
273.73	1.875	2.337	2.332
275.92	1.782	2.199	2.217
278.10	1.686	2.136	2.098
280.02	1.615	2.060	2.009
282.30	1.538	1.977	1.913
284.23	1.477	1.912	1.837
288.03	1.375	1.802	1.709
293.33	1.254	1.672	1.557
297.52	1.175	1.588	1.458
303.86	1.075	1.482	1.332

[a] Temperature reported to 0.01°C.

[b] Mole fraction solubility at 101.325 kPa (1 atm) partial pressure of gas calculated by compiler.

[c] Ostwald coefficient calculated by compiler.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was a modification of the design by Ben-Naim and Baer (1). Degassed water is forced by centrifugal action up two outside tubes of the absorption vessel and down a central tube contacting the gas along the way. Gas uptake is read on a gas buret system. The whole apparatus is thermostatted to 0.012°C. The degassing apparatus is a modification of the design of Battino and Evans (2) utilizing a magnetically driven pump.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - British Oxygen Company white spot grade (99.9%). Maximum levels of impurity were 0.001% O_2 and 0.005% Ar.

(2) Water - distilled

ESTIMATED ERROR:

$\delta T = \pm 0.02$K, estimate by compiler.
$\delta\alpha/\alpha = \pm 0.0019$, estimate of authors

REFERENCES:

(1) Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735-8.

(2) Battino, R.; Evans, F. D. *Anal. Chem.* 1966, *38*, 1627-9.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Power, G.G.; Stegall, H. *J. Appl.Physiology*, 1970, *29*, 145-9.
VARIABLES: T/K = 310	PREPARED BY: C.L. Young.

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α/cm^3 (STP) cm^{-3}atm^{-1}	S.D.*	No. of measurements
310.15	0.01257	0.00009	4

* Standard deviation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

5 to 12 cm^3 samples placed in a stirrer cell and gas, saturated with water vapor passed through water for 30-60 mins. Samples of saturated liquid withdrawn and transferred to Van Slyke apparatus. Dissolved gas removed under reduced pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson sample, purity better than 99.7 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Water; H_2O; [7732-18-5]	Spink, T. J. M.S. Thesis, Oregan State University, Corvallis, OR, 1971.

VARIABLES:	PREPARED BY:
T/K = 285-299 P/MPa (hydrostatic) = 0-0.20	C-T. A. Chen

EXPERIMENTAL VALUES:

t/°C	T^a/K	P^b=0 (0 MPa)		P=1 atm (0.1 MPa)		P=2 atm (0.2 MPa)	
		$10^6\ x_1$	$10^3\beta^c$	$10^6\ x_1$	$10^3\beta^c$	$10^6\ x_1$	$10^3\beta^c$
		Mixed System					
12.3	285.45	18.78	22.95	33.88	21.08	56.30	23.35
19.6	292.75	18.08	22.50	34.27	21.32	53.32	22.11
25.5	298.65	15.96	19.95	33.01	20.54	48.60	20.16
		Unmixed System					
25.5	298.65		15.73				

[a] Calculated by compiler.

[b] Hydrostatic pressure, in atm.

[c] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The saturation chamber was a six inch piece of Pyrex glass pipe, four inches in diameter. The nitrogen entered tangentially at the bottom and exitted from the top where a manometer was connected for pressure measurement. Water samples were drawn after five days and the dissolved nitrogen concentration measured by a Varian Aerograph 2100 chromatograph. A different experiment was also performed where the gas entered the chamber from the top of the chamber and no mixing was allowed.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson pre-purified grade, >99.997% purity.

(2) Doubly distilled.

ESTIMATED ERROR:

$\delta x_1/x_1$ = ±0.2, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; Battino, R.

Nature 1974, *252*, 614-5.

VARIABLES:

T/K = 298

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	$10^5x_1(N_2)^a$	$10^5x_1(O_2/N_2)^b$
298.15	1.166	1.775
298.15	1.166	1.779
298.15		1.757

[a] Mole fraction solubility at 101.325kPa partial pressure of gas.

[b] Mole fraction, but for a mixture of 49.5 mol per cent oxygen and 50.5 mol per cent nitrogen.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Degassed water is flowed slowly through an absorption spiral containing the gas. As the gas dissolves the uptake is determined on burets. Measurements are made at constant pressure. Details are given in reference (1).

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Distilled.

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm 0.01$, compiler's estimate

$\delta T/K = \pm 0.05$, compiler's estimate.

REFERENCES:

(1) Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Cosgrove, B. A.; Walkley, J.

J. Chromatogr. 1981, *216*, 161 - 7.

VARIABLES:

T/K = 278.15 - 313.15

p_1/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature T/K	Mol Fraction 10^4x_1
278.15	0.1692
283.15	0.1513
288.15	0.1372
293.15	0.1275
298.15	0.1175
303.15	0.1116
308.15	0.1062
313.15	0.09986

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A 20 ml volume of degassed solvent (sublimation technique) is transferred to a previously evacuated (10^{-4}mmHg) saturation cell immersed in an insulated controlled (± 0.01 K) water bath. The gas is dispersed through the constantly stirred solution at 1 atm by a course, fritted glass disc. Saturation is obtained within a few hours. Prior to analysis the solution is allowed to sit under 1 atm gas pressure for 1 hour.

A saturated sample is withdrawn from the saturation cell using a greaseless, gas tight (2.500 ± 0.001 ml) Gilmont syringe. A 0.250 ml sample is injected to "wet" the frit. It is stripped and then four 0.500 ml samples are injected sequentially in to the cell. The stripped gas is dried before entering the column. The gas is analyzed on a dual filamnet conductivity detector. Calibrations with pure gas are made before and after each series of runs.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No information.

(2) Water. No information.

ESTIMATED ERROR:

$\delta x_1/x_1$ = ± 0.015 (compiler)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Cosgrove, B. A.; Walkley, J.

J. Chromatogr. 1981, *216*, 161 - 7.

VARIABLES:

T/K = 278.15 - 313.15

p_1/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature T/K	Mol Fraction $10^4 x_1$
278.15	0.1862
283.15	0.1691
288.15	0.1561
293.15	0.1467
298.15	0.1335
303.15	0.1249
308.15	0.1170
313.15	0.1069

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A 20 ml volume of degassed solvent (sublimation technique) is transferred to a previously evacuated (10^{-4} mmHg) saturation cell immersed in an insulated controlled water bath (± 0.01 K) The gas is dispersed through the constantly stirred solution at 1 atm by a course, fritted glass disc. Saturation is obtained within a few hours. Prior to analysis the solution is allowed to sit under 1 atm gas pressure for 1 hour.

A saturated sample is withdrawn from the saturation cell using a greaseless, gas tight (2.500 ± 0.001 ml) Gilmont syringe.A 0.250 ml sample is injected to "wet" the frit. It is stripped and then four 0.500 ml samples are injected sequentially into the cell. The stripped gas is dried before entering the column. The gas is analyzed on a dual filament conductivity detector. Calibrations with pure gas are made before and after each series of runs.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No information

(2) Water-d_2. No information.

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm\ 0.015$ (compiler)

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Seawater	Chen-Tung A. Chen School of Oceanography Oregon State University Corvallis, OR 97331 U.S.A. February 1982

CRITICAL EVALUATION:

Nitrogen solubility measurements covering a wide range of salinity and temperature have been made by Törnoe (1), Dittmar (2), Hamberg (3), Fox (4), Rakestraw and Emmel (5), Benson and Parker (6), Douglas (7,8), and Murray, Riley and Wilson (9). The first three are only of historical interest because of the comparatively crude techniques used (9,10). The results of Fox (4) and Rakestraw and Emmel (5) are more precise but apparently suffer from systematic errors (9). Benson and Parker (6) did not measure the nitrogen solubility directly but only reported the ratio of solubility of nitrogen to argon or oxygen. Because of these limitations, these three are cited here but are excluded from further analysis.

The first accurate nitrogen solubility measurements on water and seawater were carried out by Douglas (7, 8) and later confirmed by Murray, Riley and Wilson (9). Since the data of these workers are similar in precision and have been shown to agree well (9,11) their results were combined to form the data base for this study. The following equation is used to represent the Bunsen solubility coefficient with a standard deviation of 5.4×10^{-5} units (approximately 0.4%):

$$\ln C = 59.7745 - 76.7685/(T/100\ K) - 88.327 \ln (T/100\ K) + 19.5287\ (T/100\ K) + S\left[(7.1485 \times 10^{-3} - 3.9793 \times 10^{-2}/(T/100\ K)\right] \qquad (1)$$

where T is the absolute temperature and S is the salinity in parts per thousand.

It should be pointed out that neither Douglas (7, 8) nor Murray, Riley and Wilson (9) corrected their data for the gas dissolution effect on the volume of the aqueous phase (11). Although their original experimental data have been compiled in this study, corrected values were used in the least squares fit. The corrections were made according to the following equation (Weiss, personal communication, 1979):

$$\Delta = \frac{273.15\Phi_V}{22404\ T} \qquad (2)$$

In the present study, the partial molal volume of nitrogen (Φ_V) in water is taken as 33.3 cm^3/mol (12), and the volume of 1 mole of nitrogen is taken as 22404 ml at STP.

For practical oceanographic purposes, it is convenient to use an equation for the nitrogen solubilities from water-saturated air at 1 atm total pressure in ml(STP)/l as a function of salinity and temperature (11, 13, 14). In order to take full advantage of the precision of the data, it is also desirable to express the solubility unit in terms of μmol/kg, since it is pressure and temperature independent (11, 13, 14). Consequently, the combined data sets have also been fit to the following equations (15, 16):

$$\ln C\ (ml/l) = -29.1410 + 53.3161/(T/100\ K) + 7.499 \ln (T/100\ K) + 1.8298\ (T/100\ K) + S\ (7.365 \times 10^{-3} - 4.038 \times 10^{-2}/(T/100\ K)) \pm 0.4\% \qquad (3)$$

continued on following page

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Seawater	Chen-Tung A. Chen School of Oceanography Oregon State University Corvallis, OR 97331 U.S.A. February 1982

CRITICAL EVALUATION:

continued

$$\ln C\ (\mu\text{mol/kg}) = -29.2710 + 58.6753/(T/100\ \text{K}) + 10.3401 \ln (T/100\ \text{K}) + 1.5045\ (T/100\ \text{K}) + S\ (7.116 \times 10^{-3} - 4.186 \times 10^{-2}/(T/100\ \text{K})) \pm 0.4\% \qquad (4)$$

The vapor pressures for pure water and seawater have been calculated using the formulas given by Besley and Bottomley (17, for pure water) and by Robinson (18, for seawater). The densities have been calculated using the equation of Millero, Gonzalez and Ward (19).

Limited information is available on the pressure effect of nitrogen solubility in pure water (12, 20-24), but nothing is available for seawater. It is the evaluator's opinion that, within the precision of these measurements, the pure water data can be applied to seawater. Since no seawater data are available, the more recent pure water data are compiled for reference but should be used for seawater only with caution.

References

1. Törnoe, H. *The Norwegian North Atlantic Expedition* 1876-78, *V.24*, Grondahl Christiania, 1880.
2. Dittmar, W. "Report on the Scientific Results of the Exploring Voyage of H.M.S. Challenger. Physics and Chemistry", *V.1* H. M. Stationery Office. London, 1884.
3. Hamberg, A. *J. Prakt. Chem.* 1886, *33* , 433-41.
4. Fox, C. J. J. *Trans. Faraday Soc.* , 1909, *5*, 68-87.
5. Rakestraw, N. W.; Emmel, V. M. *J. Phys. Chem.* 1938, *42*, 1211-5.
6. Benson, B. B.; Parker, P. D. M. *J. Phys. Chem.* 1961, *65*, 1489-96.
7. Douglas, E. *J. Phys. Chem.* 1964, *68*, 169-74.
8. Douglas, E. *J. Phys. Chem.* 1965, *69*, 2608-10.
9. Murray, C. N.; Riley, J. P.; Wilson, T. R. S. *Deep-Sea Res.* 1969, *16*, 297-310.
10. Coste, J. H. *J. Phys. Chem.* 1927, *31*, 81-7.
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continued on following page

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Seawater	Chen-Tung A. Chen School of Oceanography Oregon State University Corvallis, OR 97331 U.S.A. February 1982

CRITICAL EVALUATION:

continued

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COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Seawater

ORIGINAL MEASUREMENTS:

Fox, C.J.J

Trans. Faraday Soc. 1909, 5, 68-87.

VARIABLES:

T/K = 273-301
Chlorinity/‰ = 0-20

PREPARED BY:

C-T.A. Chen

EXPERIMENTAL VALUES:

T^a/K	Chlorinity (‰)	S^b (cc/1000cc)	T^a/K	Chlorinity (‰)	S (cc/1000cc)
273.15	0	18.64	289.15	0	13.45
	4	17.77		4	12.94
	8	16.90		8	12.44
	12	16.03		12	11.93
	16	15.18		16	11.73
	20	14.31		20	10.92
277.15	0	17.02	293.15	0	12.59
	4	16.27		4	12.15
	8	15.51		8	11.70
	12	14.75		12	11.25
	16	14.00		16	10.81
	20	13.24		20	10.36
281.15	0	15.63	297.15	0	11.86
	4	14.98		4	11.46
	8	14.32		8	11.07
	12	13.66		12	10.67
	16	13.00		16	10.27
	20	12.34		20	9.87

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modified form of Estreicher's (1) method. The seawater was acidified before boiling and weighing. The dry air was introduced from a burette to a glass bulb containing the gas-free seawater. The bulb was subsequently shaken and the resulting decrease of air in the burette measured until there were no changes.

SOURCE AND PURITY OF MATERIALS:

Unspecified air and seawater

ESTIMATED ERROR:

$\delta S/S = \pm 0.004$, compiler's estimate

REFERENCES:

1. Estreicher, T.Z. *Physik. Chem.* 1899, *31*, 176

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Seawater	Fox, C. J. J. *Trans. Faraday Soc.* 1909, 5, 68-87.

EXPERIMENTAL VALUES:

continued

T^a/K	Chlorinity (‰)	S^b (cc/1000cc)	T^a/K	Chlorinity (‰)	S (cc/1000cc)
285.15	0	14.45	301.15	0	11.25
	4	13.88		4	10.89
	8	13.30		8	10.52
	12	12.72		12	10.16
	16	12.15		16	9.80
	20	11.57		20	9.44

---

[a] Original temperature reported in °C to 0.01°C.

[b] Number of cc of nitrogen (containing Argon) absorbed by 1000cc of seawater from a free dry atmosphere at 760 mmHg total pressure.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Seawater

ORIGINAL MEASUREMENTS:

Rakestraw, N. W.; Emmel, V. M.

J. Phys. Chem. 1938, *42*, 1211-5.

VARIABLES:

T/K = 275-298
Chlorinity/‰ = 16-20

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	$10^2\alpha^b$/cm^3(STP)cm^{-3} atm^{-1}		
Chlorinity/‰		16.03	18.00	19.99
2.11	275.26	1.422	1.381	1.350
7.08	280.23	1.268	1.240	1.208
12.15	285.30	1.153	1.127	1.095
18.03	291.18	1.033	1.005	0.989
25.05	298.20	0.919	0.900	0.881

[a] Calculated by compiler.

[b] Bunsen coefficient.

[c] Chlorinity in grams of chlorine per kg of seawater.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Duplicate samples were saturated with air and then "analyzed for nitrogen" by a method unspecified.

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) "Natura" seawater, diluted as needed.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm0.01$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Seawater
Nitrogen/Argon and
Nitrogen/Oxygen ratios.

ORIGINAL MEASUREMENTS:

Benson, B.B.; Parker, P.D.M.

J. Phys. Chem. 1961, *65*, 1489-96.

VARIABLES:

T/K = 273 - 303

Concentration

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Salinity/‰	t/°C	T^a/K	N_2/Ar^b	$N_2/O_2{}^b$
0.066	0.0	273.2	37.92	1.836
0.066	5.0	278.2	38.29	1.825
0.48	10.0	283.2	38.42	1.826
0.066	15.0	288.2	38.66	1.859
0.084	20.0	293.2	39.03	1.887
0.11	25.0	298.2	39.43	1.941
0.102	30.0	303.2	39.71	1.987
32.59	0.0	273.2	37.78	1.833
32.565	5.0	278.2	37.78	1.803
32.60	10.0	283.2	38.00	1.830
32.65	15.0	288.2	37.51^c	1.821^c
32.58	20.0	293.2	38.47	1.907
32.65	25.0	298.2	38.78	1.934
32.97	30.0	303.2	39.25	1.954
34.70	0.0	273.2	37.52	1.845
34.70	5.0	278.2	37.64	1.816
34.71	10.0	283.2	38.05	1.828
34.67	15.0	288.2	37.96	1.833
34.695	20.0	293.2	38.28	1.858
34.65	25.0	298.2	38.89	1.947
35.11	30.0	303.2	39.23	1.926
36.12	0.0	273.2	37.74	1.860

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Four flasks containing distilled water and water of salinities ca. 32, 34, and 36‰ were thermostatted in contact with the atmosphere for over sixty hours. Samples were removed for salinity determinations. The dissolved gas was extracted from other samples and the Na/Ar and Na/O_2 ratios were determined on a mass spectrometer tuned to be sensitive to the ratios. Details of the procedure are given in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) From air of compositions: 78.08% N_2; 20.94% O_2, 0.93% Ar, 0.032% CO_2, traces of rare gases.

(2) Distilled, sea water, or sea water diluted with distilled water.

ESTIMATED ERROR:

$\delta(N_2/Ar)/(N_2/Ar) = \pm 0.015$, authors' estimate.

$\delta T/K = \pm 0.15$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Seawater Nitrogen/Argon and Nitrogen/Oxygen ratios.	Benson, B.B.; Parker. P.D.M. *J. Phys. Chem.* 1961, *65*, 1489-96.

CRITICAL EVALUATION: continued

Salinity/‰	t/°C	T^a/K	N_2/Ar^b	$N_2/O_2{}^b$
36.14	5.0	278.2	37.72	1.821
36.17	10.0	283.2	37.80	1.803
36.16	15.0	288.2	37.96	1.830
36.17	20.0	293.2	38.45	1.870
36.23	25.0	298.2	38.73	1.914
36.61	30.0	303.2	39.24	1.918

[a] Calculated by compiler.

[b] N_2/Ar and N_2/O_2 are the ratios of the concentrations of each species found in sea water saturated with air. To obtain the ratio of the Bunsen coefficients, α, use

$\alpha_{N_2}/\alpha_{O_2} = (20.94/78.08)(N_2/O_2)$ and

$\alpha_{N_2}/\alpha_{Ar} = (0.93/78.08)(N_2/Ar)$.

[c] This point rejected by the authors.

[d] The authors give the following least squares smoothed equations:

(1) $N_2/O_2 = 1.800 + 0.00533\ (t/°C) \pm 1.3\%$ for pure water.

(2) $N_2/O_2 = 1.807 + 0.00396\ (t/°C) \pm 1.5\%$ for salinities of 34.5‰.

(3) $N_2/Ar = 37.90 + 0.0590\ (t/°C) \pm 0.2$ to 1.5% for pure water.

(4) $N_2/Ar = 37.48 + 0.0522\ (t/°C) \pm 0.46\%$ for salinities of 34.5‰.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Seawater

ORIGINAL MEASUREMENTS:

Douglas, E.

J. Phys. Chem. 1965, *69*, 2608-10.

EXPERIMENTAL VALUES:

continued

t/°C	T^a/K	$10^2\alpha^c/cm^3$(STP) cm^{-3} atm^{-1}		
Cl‰ = 20.985				
2.10	275.25	1.689	1.692	1.698
5.92	279.07	1.566	1.563	1.567
10.15	283.30	1.442	1.436	1.442
15.05	288.20	1.319	1.320	1.320
19.41	292.56	1.227	1.222	1.231
24.88	298.03	1.140	1.139	1.139
29.99	303.14	1.076	1.078	1.071

[a] Calculated by compiler.

[b] Chlorinity is in grams of chlorine per kilogram of seawater.

[c] Bunsen coefficient.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Seawater

ORIGINAL MEASUREMENTS:

Douglas, E.

J. Phys. Chem. 1965, *69*, 2608-10.

VARIABLES:

T/K = 275-303
Chlorinity/‰ = 15-21

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	$10^2\alpha^c$/cm^3(STP) cm^{-3} atm^{-1}		
		Cl ‰ = 15.376		
1.50	274.65	1.857	1.858	1.852
6.46	279.61	1.661	1.667	1.670
10.00	283.15	1.544	1.550	1.551
14.81	287.96	1.416	1.422	1.417
19.99	293.14	1.299	1.303	1.304
25.08	298.23	1.209	1.210	1.203
29.83	302.98	1.137	1.144	1.139
		Cl ‰ = 18.604		
2.17	275.32	1.746	1.748	1.746
6.80	279.95	1.588	1.589	1.592
10.25	283.40	1.485	1.476	1.485
14.51	287.66	1.373	1.367	1.370
19.41	292.56	1.264	1.269	1.268
25.27	298.42	1.161	1.168	1.165
29.72	302.87	1.109	1.111	1.107

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used a modification of the Scholander microgasometric apparatus described in an earlier paper (1) of the author's. Gas-free seawater is equilibrated with the gas. All volumes are determined on a micrometer buret. The apparatus takes about 8 cm^3 of seawater.

SOURCE AND PURITY OF MATERIALS:

(1) Mass spectrometer analysis showed 0.04% O_2 and less than 0.03% Ar.

(2) Gas-free, millipore filtered, stored at 4°C.

ESTIMATED ERROR:

$\delta\alpha/\alpha$ = ±0.005, author's estimate
δCl % to ±0.05‰, author's estimate
δT/K = ±0.01, compiler's estimate

REFERENCES:

(1) Douglas, E. *J. Phys. Chem.* 1964, *68*, 169-74.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Seawater

ORIGINAL MEASUREMENTS:

Murray, C.N.; Riley, J.P.; Wilson, T.R.S.

Deep-Sea Research 1969, *16*, 297-310.

VARIABLES:

T/K = 274-304
Salinity/‰= 0-40

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Salinity /‰	Chlorinity /‰	$10^2\alpha^a$	Salinity /‰	Chlorinity /‰	$10^2\alpha^a$
0.58°C	(273.73 K)		6.87°C	(280.02 K)	
0.00	0.00	2.332	0.00	0.00	2.009
3.45	1.91	2.277	6.10	3.38	1.927
5.80	3.21	2.230	15.45	8.55	1.801
16.26	9.00	2.083	23.90	13.23	1.700
37.70	20.87	1.766	34.00	18.82	1.587
2.77°C	(275.92 K)		9.15°C	(282.30 K)	
0.00	0.00	2.217	0.00	0.00	1.913
8.65	4.79	2.078	10.01	5.45	1.784
18.80	10.41	1.938	13.55	7.50	1.739
26.42	14.62	1.837	20.73	11.48	1.663
33.20	18.38	1.731	31.15	17.24	1.546
4.95°C	(278.10 K)		11.08°C	(284.23 K)	
0.00	0.00	2.098	0.00	0.00	1.837
11.36	6.29	1.934	7.65	4.24	1.746
16.25	9.00	1.873	9.60	5.31	1.722
26.58	14.71	1.740	21.50	11.90	1.598
32.55	18.02	1.662	26.60	14.72	1.540
			34.25	18.96	1.456

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Ben-Naim and Baer (1) apparatus was used. In this a vortex caused by high-speed stirring forces liquid up two side-arms to return via a central arm. Equilibrium is rapid. Gas uptake (in the wet state) is measured on a gas buret system. The paper contains drawings and a detailed description of the apparatus and procedure.

SOURCE AND PURITY OF MATERIALS:

(1) British Oxygen Company, "white spot" grade, 99.9%

(2) Surface seawater

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$
$\delta S‰ = \pm 0.02$
$\delta\alpha/\alpha = \pm 0.002$

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735-8.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Seawater	Murray, C.N.; Riley, J.P.; Wilson, T.R.S. *Deep-Sea Research* 1969, *16*, 297-310.

EXPERIMENTAL VALUES:

continued

Salinity /‰	Chlorinity /‰	$10^2\alpha^a$	Salinity /‰	Chlorinity ‰	$10^2\alpha^a$
14.88°C (288.03 K)			24.37°C (297.52 K)		
0.00	0.00	1.709	0.00	0.00	1.458
8.35	4.62	1.604	14.15	7.83	1.329
23.90	13.23	1.455	21.50	11.90	1.266
26.75	14.81	1.424	31.85	17.63	1.189
34.05	18.83	1.365	35.81	19.82	1.158
20.18°C (293.33 K)			30.71°C (303.86 K)		
0.00	0.00	1.557	0.00	0.00	1.332
9.94	5.50	1.451	11.65	6.45	1.242
21.89	12.12	1.351	23.95	13.26	1.147
23.52	13.02	1.335	35.20	19.49	1.074
36.28	20.08	1.232	40.05	22.17	1.050

[a] Bunsen coefficient, cm^3 (STP) cm^{-3} atm^{-1}.

The table below gives the authors' smoothed values of the Bunsen coefficient as a function of temperature and chlorinity.

		Chlorinity(°/∘∘)										
T/K	t/°C	0	2	4	6	8	10	12	14	16	18	20
271.15	-1	---	---	---	---	---	---	---	---	---	---	19.00
272.15	-2	---	---	---	---	---	---	20.75	20.20	19.64	19.09	18.54
273.15	0	23.69	23.05	22.48	21.92	21.36	20.82	20.27	19.73	19.18	18.64	18.10
274.15	1	23.10	22.47	21.91	21.37	20.83	20.31	19.78	19.25	18.73	18.21	17.68
275.15	2	22.54	21.91	21.37	20.85	20.33	19.82	19.31	18.80	18.29	17.79	17.29
276.15	3	22.00	21.38	20.86	20.35	19.85	19.35	18.86	18.37	17.88	17.39	16.91
277.15	4	21.48	20.88	20.37	19.87	19.38	18.91	18.43	17.95	17.48	17.01	16.54
278.15	5	20.99	20.39	19.90	19.42	18.94	18.48	18.02	17.56	17.10	16.65	16.19
279.15	6	20.52	19.93	19.45	18.98	18.52	18.07	17.62	17.18	16.73	16.30	15.86
280.15	7	20.06	19.49	19.02	18.56	18.12	17.68	17.25	16.82	16.39	15.96	15.53
281.15	8	19.63	19.06	18.60	18.16	17.73	17.31	16.89	16.47	16.05	15.64	15.22
282.15	9	19.22	18.66	18.21	17.78	17.36	16.95	16.54	16.13	15.73	15.33	14.93
283.15	10	18.82	18.27	17.83	17.42	17.01	16.61	16.21	15.81	15.42	15.03	14.64
284.15	11	18.44	17.90	17.47	17.07	16.67	16.28	15.89	15.51	15.13	14.75	14.37
285.15	12	18.07	17.54	17.13	16.73	16.34	15.96	15.59	15.21	14.84	14.48	14.11
286.15	13	17.72	17.20	16.79	16.41	16.03	15.66	15.30	14.93	14.57	14.22	13.86
287.15	14	17.38	16.87	16.48	16.10	15.73	15.37	15.02	14.66	14.31	13.96	13.62
288.15	15	17.06	16.56	16.17	15.80	15.44	15.09	14.75	14.40	14.06	13.72	13.38
289.15	16	16.75	16.26	15.88	15.52	15.17	14.83	14.49	14.15	13.82	13.49	13.16
290.15	17	16.45	15.97	15.60	15.25	14.91	14.57	14.24	13.91	13.59	13.27	12.94
291.15	18	16.17	15.69	15.33	14.99	14.65	14.33	14.00	13.68	13.37	13.05	12.74
292.15	19	15.89	15.43	15.07	14.74	14.41	14.09	13.78	13.46	13.15	12.85	12.54
293.15	20	15.63	15.17	14.82	14.50	14.18	13.87	13.56	13.25	12.95	12.65	12.35
294.15	21	15.37	14.93	14.59	14.27	13.95	13.65	13.35	13.05	12.75	12.46	12.16
295.15	22	15.13	14.69	14.36	14.05	13.74	13.44	13.14	12.85	12.56	12.27	11.99

continued on following page

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Seawater	Murray, C.N.; Riley, J.P.; Wilson, T.R.S. *Deep-Sea Research* 1969, *16*, 297-310.

EXPERIMENTAL VALUES: continued

		Chlorinity (°/₀₀)										
T/K	t/°C	0	2	4	6	8	10	12	14	16	18	20
296.15	23	14.90	14.47	14.14	13.83	13.53	13.24	12.95	12.66	12.38	12.10	11.82
297.15	24	14.67	14.25	13.93	13.63	13.33	13.05	12.76	12.48	12.20	11.93	11.65
298.15	25	14.46	14.04	13.73	13.43	13.14	12.86	12.58	12.31	12.04	11.77	11.50
299.15	26	14.25	13.84	13.54	13.25	12.96	12.69	12.41	12.14	11.87	11.61	11.34
300.15	27	14.05	13.65	13.35	13.06	12.79	12.52	12.25	11.98	11.72	11.46	11.20
301.15	28	13.85	13.47	13.17	12.89	12.62	12.35	12.09	11.83	11.57	11.31	11.06
302.15	29	13.67	13.29	13.00	12.72	12.46	12.19	11.94	11.68	11.42	11.17	10.92
303.15	30	13.49	13.12	12.83	12.56	12.30	12.04	11.79	11.54	11.29	11.04	10.79
304.15	31	13.32	12.96	12.68	12.41	12.15	11.90	11.65	11.40	11.15	10.91	10.67
305.15	32	13.16	12.80	12.52	12.26	12.01	11.76	11.51	11.27	11.03	10.79	10.55
306.15	33	13.00	12.65	12.38	12.12	11.87	11.63	11.38	11.14	10.90	10.67	10.43
307.15	34	12.85	12.50	12.24	11.99	11.74	11.50	11.26	11.02	10.78	10.55	10.32

The following table gives the authors' smoothed values of nitrogen solubility in units of cm^3 (STP)/Lm^3 from an atmosphere of 78.08% N_2 and 100% relative humidity.

		Chlorinity (°/₀₀)										
T/K	t/°C	0	2	4	6	8	10	12	14	16	18	20
271.15	-2	---	---	---	---	---	---	---	---	---	---	14.74
272.15	-1	---	---	---	---	---	---	16.13	15.69	15.26	14.82	14.39
273.15	0	18.39	17.89	17.45	17.01	16.58	16.16	15.73	15.31	14.89	14.47	14.05
274.15	1	17.92	17.43	17.00	16.58	16.16	15.76	15.35	14.93	14.53	14.13	13.72
275.15	2	17.48	16.99	16.57	16.17	15.76	15.37	14.97	14.58	14.18	13.79	13.41
276.15	3	17.05	16.57	16.17	15.77	15.38	15.00	14.62	14.24	13.86	13.48	13.11
277.15	4	16.64	16.17	15.78	15.39	15.01	14.65	14.28	13.90	13.54	13.18	12.81
278.15	5	16.25	15.78	15.41	15.03	14.66	14.31	13.95	13.59	13.24	12.89	12.53
279.15	6	15.88	15.42	15.05	14.68	14.33	13.98	13.63	13.29	12.94	12.61	12.27
280.15	7	15.51	15.07	14.71	14.35	14.01	13.67	13.34	13.00	12.67	12.34	12.01
281.15	8	15.17	14.73	14.37	14.03	13.70	13.37	13.05	12.72	12.40	12.08	11.76
282.15	9	14.84	14.41	14.06	13.73	13.40	13.09	12.77	12.45	12.14	11.84	11.53
283.15	10	14.52	14.09	13.75	13.44	13.12	12.81	12.50	12.20	11.90	11.59	11.29
284.15	11	14.21	13.80	13.47	13.16	12.85	12.55	12.25	11.95	11.66	11.37	11.08
285.15	12	13.91	13.51	13.19	12.88	12.58	12.29	12.01	11.71	11.43	11.15	10.87
286.15	13	13.63	13.23	12.92	12.62	12.33	12.05	11.77	11.49	11.21	10.94	10.66
287.15	14	13.36	12.97	12.67	12.37	12.09	11.81	11.54	11.27	11.00	10.73	10.47
288.15	15	13.10	12.71	12.41	12.13	11.85	11.59	11.32	11.06	10.79	10.53	10.27
289.15	16	12.84	12.47	12.18	11.90	11.63	11.37	11.11	10.85	10.60	10.35	10.09
290.15	17	12.60	12.23	11.95	11.68	11.42	11.16	10.91	10.65	10.41	10.16	9.91
291.15	18	12.37	12.00	11.73	11.47	11.21	10.96	10.71	10.46	10.23	9.98	9.75
292.15	19	12.14	11.79	11.51	11.26	11.01	10.76	10.53	10.28	10.05	9.82	9.58
293.15	20	11.92	11.57	11.31	11.06	10.82	10.58	10.34	10.11	9.88	9.65	9.42
294.15	21	11.71	11.37	11.11	10.87	10.63	10.40	10.17	9.94	9.71	9.49	9.26
295.15	22	11.51	11.17	10.92	10.69	10.45	10.22	9.99	9.77	9.55	9.33	9.12
296.15	23	11.31	10.99	10.74	10.50	10.27	10.05	9.83	9.61	9.40	9.19	8.97
297.15	24	11.12	10.80	10.56	10.33	10.10	9.90	9.67	9.46	9.25	9.04	8.83
298.15	25	10.94	10.62	10.39	10.16	9.94	9.73	9.52	9.31	9.11	8.90	8.70
299.15	26	10.76	10.45	10.22	10.00	9.78	9.58	9.37	9.17	8.96	8.77	8.56
300.15	27	10.59	10.28	10.06	9.84	9.64	9.43	9.23	9.03	8.83	8.63	8.44

continued on following page

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Seawater	Murray, C.N.; Riley, J.P.; Wilson, T.R.S. *Deep-Sea Research* 1969, *16*, 297-310.

EXPERIMENTAL VALUES:

continued

		Chlorinity (‰)										
T/K	t/°C	0	2	4	6	8	10	12	14	16	18	20
301.15	28	10.41	10.13	9.90	9.69	9.49	9.28	9.09	8.89	8.70	8.50	8.31
302.15	29	10.25	9.97	9.75	9.54	9.35	9.14	8.96	8.76	8.57	8.38	8.19
303.15	30	10.09	9.82	9.60	9.40	9.20	9.01	8.82	8.63	8.45	8.26	8.07
304.15	31	9.94	9.67	9.46	9.26	9.07	8.88	8.69	8.51	8.32	8.14	7.96
305.15	32	9.79	9.53	9.32	9.12	8.94	8.75	8.57	8.39	8.21	8.03	7.85
306.15	33	9.65	9.39	9.19	8.99	8.81	8.63	8.45	8.27	8.09	7.92	7.74
307.15	34	9.51	9.25	9.06	8.87	8.69	8.51	8.33	8.15	7.98	7.81	7.64

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

An Evaluation of the Solubility of Nitrogen in Aqueous Electrolyte Solutions.

Not enough workers have measured the solubility of nitrogen in any one aqueous electrolyte system over common ranges of concentration and temperature to recommend solubility values. Most of the available data are classed as tentative.

In order to have a common basis for comparison, where possible the solubility data have been converted to Sechenov (Setschenow) salt effect parameters at a nitrogen partial pressure of 101.325 kPa in the form

$$k_{sc\alpha}/\mathrm{dm^3\ mol^{-1}} = (1/(c_2/\mathrm{mol\ dm^{-3}}))\log(\alpha°/\alpha)$$

where c_2 is the electrolyte concentration in mol dm^{-3}, and α° and α are the Bunsen coefficients in pure water and electrolyte solution, respectively. The Ostwald coefficient ratio, $L°/L$, will give the same value, but the salt effect parameter is symbolized, k_{scL}. Both ratios are equivalent to a molar gas solubility ratio, c_1°/c_1, thus

$$k_{scc} = k_{sc\alpha} = k_{scL} = (1/(c_2/\mathrm{mol\ dm^{-3}}))\ \log\ (c^\circ_{1,sat}/c_{1,sat})$$

Other forms of the salt effect parameter will be found on the data sheets that follow this discussion. They include

$$k_{sms}/\mathrm{kg\ mol^{-1}} = (1/(m_2/\mathrm{mol\ kg^{-1}}))\log(s°/s)$$

$$k_{scx}/\mathrm{dm^3\ mol^{-1}} = (1/(c_2/\mathrm{mol\ dm^{-3}}))\log(x°/x)$$

$$k_{smx}/\mathrm{kg\ mol^{-1}} = (1/(m_2/\mathrm{mol\ kg^{-1}}))\log(x°/x)$$

where m_2 is the electrolyte molality, $s°/s$ is the Kuenen coefficient ratio, and $x°/x$ is the mole fraction gas solubility ratio usually calculated with respect to all ions in the solution. The Kuenen coefficient, s, is referenced to 1 g of water whether it is for pure water or the electrolyte solution. Thus the $s°/s$ ratio is equal to a gas molality ratio m_1°/m_1, and $k_{smm} = k_{sms}$. The density data required to convert the salt effect parameter from one form to another were taken from the *International Critical Tables*, McGraw-Hill Co., Inc., 1928, Vol. III.

The various Sechenov constants can be interconverted by use of the relationships

$$k_{scc} = \frac{m_2}{c_2}\ k_{smm} + \frac{1}{c_2}\ \log\left[\left(\frac{\rho°}{\rho}\right)\left(\frac{(1000 + m_2M_2)}{1000}\right)\right] \qquad (1)$$

$$k_{scx} = \frac{m_2}{c_2}\ k_{smx} = \frac{m_2}{c_2}\ k_{smm} + \frac{m_2}{c_2}\left[\frac{1}{m_2}\left[\log\left(\frac{(1000 + \nu M_3m_2)}{1000}\right)\right]\right] \qquad (2)$$

and

$$k_{smx} = \frac{c_2}{m_2}\ k_{scx} = \frac{c_2}{m_2}\ k_{scc} + \frac{c_2}{m_2}\left[\frac{1}{c_2}\left[\log\left(\frac{(1000 + (\nu M_3 - M_2)c_2)}{1000\rho°}\right)\right]\right] \qquad (3)$$

where ρ and ρ° are the densities of gas saturated electrolyte solution and pure water respectively, and ν is the number of ions in the electrolyte formula. For very soluble gases the log terms above may need additional terms containing the gas concentrations in either molality or molarity.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

The activity coefficient of the dissolved nitrogen, y_1, is a function of the concentration of all solute species, which in the present systems are the electrolyte and the nonelectrolyte. At a given temperature log y_1 can be represented as a power series in c_1 and c_2

$$\log y_1 = \sum_{nm} k_{nm}\, c_1^n\, c_2^m \tag{4}$$

If it is assumed that for low concentrations of both nonelectrolyte, c_1, and electrolyte, c_2, the only important terms are the linear ones,

$$\log y_1 = k_1 c_1 + k_2 c_2 \tag{5}$$

The expression has been experimentally verified for moderately dilute solutions in which there is no chemical interaction between the solute species.

The measurements of the nonelectrolyte solubility in pure water, $c^\circ_{1,\mathrm{sat}}$, and in a salt solution, $c_{1,\mathrm{sat}}$, give directly the activity coefficient of the nonelectrolyte. Long and McDevit (8) show that

$$\log(y_1/y_1^\circ) = \log(c^\circ_{1,\mathrm{sat}}/c_{1,\mathrm{sat}}) = k_1(c_{1,\mathrm{sat}} - c^\circ_{1,\mathrm{sat}}) + k_2 c_2 \tag{6}$$

If the nonelectrolyte solubility values are low, as they generally are for a gas, the term in k_1 can be neglected, even though k_1 is similar in magnitude to k_2. Thus for low nonelectrolyte concentration

$$\log(y_1/y_1^\circ) = \log(c^\circ_{1,\mathrm{sat}}/c_{1,\mathrm{sat}}) = k_2\, c_2 \tag{7}$$

The solubility data which are evaluated in this section do not always meet the requirements set forth above. Thus, the experimental Setschenow salt effect parameters, k_s, may not be equivalent to the theoretically important salt effect parameter, k_2.

Although for a given system the experimental values of k_{scc}, $k_{sc\alpha}$, and k_{scL} will have the same magnitude and units, there may be a unit problem when one tries to use equation (3). The constant k_2 will have inverse c_2 units, $dm^3\ mol^{-1}$, and k_1 will have inverse c_1 units. If the gas solubility is expressed as $c_1/mol\ dm^{-3}$, k_1 units will be $dm^3\ mol^{-1}$, but if the Bunsen or Ostwald coefficients are used for c_{1sat} and c°_{1sat} in equation 3, then k_1 will have units which are the inverse of the Bunsen or Ostwald coefficients, cm^3 atm $(cm^3(STP))^{-1}$ and $cm^3 cm^{-3}$ respectively.

A plot of log (α°/α) *vs.* c_2 is usually linear over moderate concentrations of the electrolyte. However, curvature of the plot is often seen at above moderate concentrations, and in extreme cases one observes regions of both salting-out and salting-in over different concentration regions of the same isotherm.

The salt effect parameters, $k_{sc\alpha}/dm^3\ mol^{-1}$, are presented by several methods in the evaluation.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

In the first method $k_{sc\alpha}$ values are calculated for each experimental determination, and a graph is prepared of $k_{sc\alpha}$ *vs.* c_2. If the plot is linear and of zero slope, $k_{sc\alpha}$ is taken to be independent of concentration. In such cases an average value of $k_{sc\alpha}$ is given. If the plot is linear, but of non-zero slope, $k_{sc\alpha}$ is fitted to a linear equation in c_2.

In the second method a graph is prepared of $\log(\alpha°/\alpha)$ *vs.* c_2. A linear plot shows no concentration dependence of the salt effect parameter and the slope is $k_{sc\alpha}$. Recently some workers have fitted such plots that show curvature to a function

$$\log(\alpha°/\alpha) = k°_{sc\alpha}\, c_2/(1 + k'_{sc\alpha}\, c_2) \qquad (8)$$

In a sense the first method, in which the salt effect parameter is given by a linear function of concentration, $k_{sc\alpha} = a + bc_2$, is equivalent to

$$\log(\alpha°/\alpha) = (a + bc_2)c_2 = ac_2 + bc_2^2 \qquad (9)$$

however, the constants should be redetermined from the $\log(\alpha°/\alpha)$ and c_2. data.

Data on the solubility of nitrogen in aqueous electrolyte solutions are meager and, with a few exceptions, of poor quality. Solubility data are reported by more than one laboratory for only three systems. They are aqueous sulfuric acid, sodium chloride, and sodium sulfate. Overall there are data on about 25 systems.

The systems are given in the order of the standard arrangement for inorganic compounds used by the U. S. National Bureau of Standards publications. The number before each system is the standard order number for the electrolyte cation.

The general policy in evaluating salt effects on gas solubility has been to convert all salt effect data into sechenov salt effect parameters of the form $k_{scc}/\mathrm{dm}^3\,\mathrm{mol}^{-1}$ for purposes of comparison. The salt effect parameter is defined in terms of the ratio of the solubility in pure water to the solubility in the salt solution. When available, the author's solubility in pure water is used, rather than Battino's recommended values (this volume, pp. 1-3), in the belief that the author's systematic errors may partially cancel in the ratio. However, the choice of the nitrogen solubility in pure water is important and can change the value of k_{scc} especially when the electrolyte concentration is small. Further comments on this point will be made in several of the evaluations.

2 Nitrogen + Sulfuric acid [7664-93-9] + Water

Both Christoff (2) and Bohr (3) report Ostwald coefficients of nitrogen in aqueous sulfuric acid solutions at temperatures near 293.15 K. The salt effect parameter, k_{scc}, decreases as the sulfuric acid concentration increases.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

T/K	Sulfuric Acid c_2/mol dm^{-3}	Salt Effect Parameter, k_{scc}/dm^3 mol^{-1}	
		Bohr	Christoff
294.03	0.0	--	--
	2.45	0.096	--
	4.45	0.075	--
293.15	4.63	--	0.056
293.35	5.35	0.070	--
293.15	9.52	--	0.024
294.25	10.15	0.050	--
294.65	12.4	0.041	--
293.95	14.8	0.033	--
294.05	17.15	0.011	--
294.25	17.9	0.005	--
293.15	17.9	--	-0.002

At 17.9 mol dm^{-3} sulfuric acid Bohr's data indicates a small salting out, and Christoff's a small salting in. Both sets of data are classed as tentative with no reason to prefer one set over the other.

29 Nitrogen + Hydrated aluminum oxide [1333-84-2] + Water
41 Nitrogen + Hydrated ferric oxide [12259-21-1] + Water

The data of Shkol'nikova (11) are classed as tentative. She did not report a nitrogen in water solubility value. No salt effect parameters were calculated for the colloidal solutions.

93 Nitrogen + Magnesium sulfate [7487-88-9] + Water

Smith, Kelemen and Nagy (13) measured the solubility of nitrogen in 0, 1.25, and 2.49 mol dm^{-3} magnesium sulfate solutions at 303.15 K and a total pressure range of 1.5 to 7.0 MPa. The evaluator calculated values of k_{scc} assuming Henry's law was obeyed at each electrolyte concentration. The nitrogen solubility was reported as mole fraction which was calculated with respect to the number of moles of electrolyte (formula) rather than the number of moles of ions. The salt effect parameters change little with concentration. The data are classed as tentative.

T/K	Magnesium Sulfate c_2/mol dm^{-3}	Salt Effect Parameter k_{scc}/dm^{3}mol^{-1}	Standard Deviation σ/dm^3 mol^{-1}
303.15	1.25	0.222	0.012
	2.49	0.228	0.011

94 Nitrogen + Calcium chloride [10043-53-4] + Water

Smith, Kelemen, and Nagy (13) measured the solubility of nitrogen in 0, 0.50, 1.75, 3.50, and 5.60 mol dm^{-3} calcium chloride solutions at 303.15 K and a total pressure range of 12 to 73 bar. The evaluator calculated k_{scx} and k_{scc} values at four or five pressures at each concentration assuming Henry's law is obeyed. The nitrogen solubility was reported as mole fraction which was calculated with respect to moles of calcium chloride ($CaCl_2$) rather than respect to the moles of ions (Ca^{2+}, Cl^-). The salt effect parameter shows a definite decrease as the electrolyte concentration increases. The results are classed as tentative.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

T/K	Calcium Chloride c_2/mol dm^{-3}	Salt Effect Parameter k_{scc}/dm^3 mol^{-1}	Standard Deviation σ/dm^3 mol^{-1}
303.15	0.50	0.212	0.020
	1.75	0.177	0.008
	3.50	0.157	0.008
	5.60	0.149	0.026

96 Nitrogen + Barium chloride [10361-37-2] + Water

Braun (1) measured the solubility of nitrogen in water and in six solutions of barium chloride at molalities between 0.165 and 0.7707 mol kg^{-1} at five degree intervals from 278.2 to 298.2 K. The salt effect parameters calculated from the solubility data decreased with concentration and increased with temperature. The solubility parameters were greatest at the lower barium chloride concentrations and leveled off to values about 2/3 as large at the four higher concentrations. The variation of the salt effect parameter with concentration depends to some extent on the value of the solubility of nitrogen in water. The effect described above is not as pronounced when Battino's recommended nitrogen in water solubility is used instead of Barun's value. The increase of the parameter with temperature is contrary to normal behavior, thus the data are classed as doubtful. Average values of the parameter at barium chloride molalities from 0.35 to 0.77 mol kg^{-1} are below.

T/K	278.2	283.2	288.2	293.2	298.2
k_{scc}/dm^3 mol^{-1}	0.31	0.31	0.32	0.34	0.36

98 Nitrogen + Lithium chloride [7447-41-8] + Water

Morrison and Billett (9) measured the solubility of nitrogen in water and in one mol kg^{-1} lithium chloride solution at four temperatures. Only the salt effect parameter based on the two solubility measurements was reported by the authors. They are classed as tentative. Values of k_{smm}, k_{smx}, and k_{scc} are given below.

T/K	k_{smm}/kg mol^{-1}	k_{smx}/kg mol^{-1}	k_{scc}/dm^3 mol^{-1}
285.75	0.125	0.140	0.135
303.15	0.095	0.110	0.105
322.55	0.084	0.099	0.095
344.85	0.092	0.107	0.104

99(1)Nitrogen + Sodium Hydroxide [1310-73-3] + Water

Levina and Stisbarovskaya (7) measured the solubility of nitorgen in 0, 0.5, and 4 mol dm^{-3} sodium hydroxide at ten temperatures between 273 and 513 K at a total pressure of 9.81 MPa. The authors calculated the solubility of nitrogen at a nitrogen partial pressure at 9.81 MPa.

The salt effect parameters, k_{scm}, calculated from the data by the evaluator show considerable scatter. No effort was made to calculate k_{scc} values since it is believed the uncertainty in the data is larger than the conversion factor. The data are classed as tentative in the 275 to 323 K range and doubtful at the high temperatures.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Electrolyte

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

EVALUATOR:

H. Lawrence Clever
Department of Chemistry
Emory University
Atlanta, GA 30322 USA

1981, December

CRITICAL EVALUATION:

T/K	273	298	308	323
k_{scm}/dm^{3}mol^{-1}	0.20	0.22	0.19	0.22

T/K	348	373	398	423	473	513
k_{scm}/dm^{3}mol^{-1}	0.16	0.16	0.19	0.25	0.20	0.14

99(2)Nitrogen + Sodium chloride [7647-14-5] + Water

There are seven papers on the solubility of nitrogen in aqueous sodium chloride solution. Four of the papers (1, 4, 9, 12) report measurements of a nitrogen partial pressure near 101.325 kPa (1 atm), and three (13, 14, 15) report solubility measurements at nitrogen partial pressures up to 7 MPa. Although there is some scatter in the calculated salt effect parameters from the data in the seven papers, the values are of similar magnitude.

The salt effect parameter appears to decrease as the sodium chloride concentration increases. However, this trend depends to some extent on the value of the gas solubility in pure water chosen to calculate the solubility ratio. The choice of the value is more critical for dilute electrolyte solutions than concentrated solutions.

Braun (1) measured the solubility of nitrogen in 12 aqueous sodium chloride solutions over the 0.12 to 2.27 mol dm^{-3} concentration range at five degree intervals over the 278.2 to 298.2 K temperature range. The salt effect parameters calculated from the data decrease in magnitude as the sodium chloride concentration increases and increase in magnitude as the temperature increases. Both the concentration and temperature trends lead the evaluator to have doubts about the reliability of the data. At sodium chloride concentrations near 0.12 mol dm^{-3} the salt effect parameter is about 100 per cent greater than the values in the 1.0 to 2.2 mol dm^{-3} concentration range. The increase in k_{scc} magnitude with temperature is definitely contrary to the normal behavior in this temperature range. Braun's value for the solubility of nitrogen in pure water is greater than the recommended value at 298.2 K and less than the recommended value at the other temperatures. The data are classed as doubtful.

Van Slyke, Dillon, and Margaria (4) measured the solubility of nitrogen in water and in 0.155 mol dm^{-3} sodium chloride solution at 298.15 and 311.15 K. The salt effect parameters calculated from their data are sensitive to the nitrogen in water solubility values used. Values of k_{scc} are given for both the Van Slyke *et al.* and the Battino recommended value of the nitrogen + water solubility. The data are classed as tentative, but they were not used in the smoothed data fit.

Morrison and Billett (9) measured the solubility of nitrogen in water and in one mol kg^{-1} sodium chloride solution at four temperatures between 285.75 and 344.85 K at atmospheric pressure. Their data are classed as tentative.

Mishnina, Avdeeva, and Bozhovakaya (12) made some measurements of their own, but also used the measurements of Morrison and Billett (9) to prepare a table of smoothed values of the Bunsen coefficient and the salt effect parameter for sodium chloride solutions up to saturation at five degree intervals from 283.15 to 393.15 K. They apparently assume the salt effect parameter is independent of the sodium chloride concentration. Since their data are already smoothed the comparison of their data with the data of others should be used with caution. The data are classed as tentative.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Electrolyte

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

EVALUATOR:

H. Lawrence Clever
Department of Chemistry
Emory University
Atlanta, GA 30322 USA

1981, December

CRITICAL EVALUATION:

T/K	Salt Effect Parameter, k_{scc}/dm^3 mol^{-1}					
	Braun[1]	Van Slyke, Dillon, Margaria	Morrison, Billett	Mishnina, Avdeeva, Bozhovakaya	Smith, *et al.*	Smoothed Values[6]
278.15	0.158					--
283.15	0.166			0.160		0.161
285.75	--		0.164	--		--
288.15	0.168			0.148		0.150
293.15	0.185			0.137		0.141
298.15	0.295	0.114[2]/0.144[3]		0.129		0.134
303.15			0.132	0.121	0.124[4]	0.127
308.15				0.117		0.122
311.15		0.090[2]/0.117[3]		--		--
313.15				0.113		0.118
318.15				0.109		0.115
322.55			0.118	--		--
323.15				0.106	0.122[5]	0.113
324.65				--		--
328.15				0.106		0.111
333.15				0.106		0.110
338.15				0.106		0.109
343.15				0.106		0.109
353.15						0.110
344.85			0.119			--
363.15						0.113
373.15						0.118
375.65					0.116[5]	--
398.15					0.132[5]	--

[1] Average value of the salt effect parameter from Braun's data at sodium chloride concentrations between 1.17 and 2.27 mol dm^{-3}. The standard deviations ranged from 0.006 to 0.009. The salt effect parameters based on Braun's data over the 0.12 to 0.75 mol dm^{-3} range were up to 100 per cent larger. The larger values were rejected. The use of Battino's recommended nitrogen in water solubilities increased the 298.15 K k_{scc} value about 10 per cent and decreased the values at the other temperatures by 5 to 10 per cent.

[2] Values calculated using α° values of Van Slyke *et al.*

[3] Values calculated using α° values based on Battino's recommended values (*This volume*, pp. 1-3.).

[4] Smith, Kelemen, and Nagy (13).

[5] O'Sullivan and Smith (15).

[6] The smoothed values are based on a linear regression that weighted the Morrison and Billett (9) and the Smith *et al.* (13, 15) values two times and the Misnina *et al.* (12) values one time.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

Smith, Kelemen and Nagy (13), and O'Sullivan and Smith (14, 15) measured the solubility of nitrogen in water and in aqueous sodium chloride solution up to concentrations of 5.27 mol kg^{-1} and temperatures from 303.15 to 398.15 K under nitrogen pressures up to near 7 MPa. They reported the nitrogen solubility as mole fraction, but it should be noted that they calculated the mole fraction on the basis of the formula (NaCl) not the moles of the individual ions (Na^+, Cl^-). The evaluator calculated salt effect parameters from their data assuming Henry's law behavior. The results agree with those of Morrison and Billett (9), and Mishnina *et al.* (12) at one molar sodium chloride. At 303.15 K the salt effect parameters from the data of Smith *et al.* (13, 15) decrease with the salt concentration. At other temperatures the parameter does not show a consistent change with concentration. See table below.

Sodium Chloride c_2/mol dm^{-3}	k_{scc}/dm^3 mol^{-1}			
	303.15 K	324.65 K	375.65 K	398.15 K
1.00	0.124	0.122	0.116	0.132
2.7	0.113	--	--	--
4	--	0.120	0.124	0.126
5.47	0.098	--	--	--

The smoothed values of k_{scc} shown in the earlier comparison table were obtained by a linear regression that weighted the Morrison and Billett and the Smith *et al.* values two times, and the Mishnina *et al.* values one time. The equation is

$$\ln k_{scc} = -41.900 + 70.099/(T/100\ K) + 20.492 \ln (T/100\ K).$$

The Smith *et al.* value at 398.15 K was omitted.

99(3)Nitrogen + Sodium sulfite [10579-83-6] + Water
99(4)Nitrogen + Sodium sulfate [7757-82-6] + Water

Yasunishi (18) measured the solubility of nitrogen in water and in up to ten* concentrations of sodium sulfite and sodium sulfate between 0 and 1.0 mol dm^{-3} at 298.15 K. He made vapor pressure and solvent dilation corrections. The salt effect parameters calculated from his data show little variation with electrolyte concentration. The values were averaged. His results appear to be reliable and they are classed as tentative.

Smith, Kelemen, and Nagy (13) measured the solubility of nitrogen in 0, 0.50, 1.25, and 2.10 mol dm^{-3} sodium sulfate solution over the total pressure range of 1.5 to 7.0 MPa. The evaluator calculated the salt effect parameters assuming Henry's law is obeyed at each salt concentration. The nitrogen solubility was reported as mole fraction which was calculated with respect to the number of moles of electrolyte (Na_2SO_4), not the number of moles of ions (Na^+, SO_4^{2-}). The salt effect parameters, converted to k_{scc} values, decrease in magnitude as the sodium sulfate concentration increases. The value at 0.50 mol dm^{-3} is about 4 per cent less than Yasumishi's value at 298.15 K which is a reasonable decrease for the five degree increase in temperature. The other values are significantly lower in value.

Both sets of data are classed as tentative, but the Yasunishi data are preferred.

*different

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

T/K	Electrolyte	Number of Determinations[1]	Concentration Range c_2/mol dm^{-3}	Salt Effect Parameter k_{scc}/$dm^3 mol^{-1}$
298.15	Na_2SO_3	11	0 - 1.04	0.383 ± 0.012[2]
298.15	Na_2SO_4	8	0 - 1.08	0.353 ± 0.005[2]
303.15	Na_2SO_4	2	0 - 0.5	0.339
		2	0 - 1.25	0.30
		2	0 - 2.10	0.24

[1] Includes measurement in pure water.

[2] Average ± standard deviation.

99(5)Nitrogen + Sulfuric acid [7664-93-9]
+ Sodium sulfate [7757-82-6] + Water

The single solubility value of Kobe and Kenton (6) is classed as tentative. A data sheet on a gas mixture of nitrogen, oxygen, and carbon dioxide is also classed as tentative.

99(6)Nitrogen + Sodium sulfite [10579-83-6]
+ Sodium sulfate [7757-82-6] + Water

Yasunishi (18), see 99(3) and (4) above, measured the solubility of nitrogen in a mixed electrolyte solution of varying concentration and ratio of sulfite and sulfate ion. The salt effect parameters for the mixtures fall between the values reported above for the single salt solutions. They are classed as tentative.

99(7)Nitrogen + Sodium bicarbonate [144-55-8] + Water
99(8)Nitrogen + Sodium carbonate [497-19-8] + Water

Van Slyke, Dillon, and Margaria (4) measured the solubility of nitrogen in water and in solutions of sodium bicarbonate and sodium carbonate of one concentration. The salt effect parameter values were calculated using the author's value of the solubility of nitrogen in water. The use of Battino's recommended nitrogen + water solubility value would decrease the k_{scc} values by 18 and 16 per cent respectively. (Values are 0.139 and 0.312).

T/K	Electrolyte	Number of Determinations	Concentration c_2/mol dm^{-3}	Salt Effect Parameter[1] k_{scc}/dm^3 mol^{-1}
298.15	$NaHCO_3$	4	0.153	0.170 ± 0.007
	Na_2CO_3	2	0.077	0.373 ± 0.006

[1] Average ± standard deviation.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

99(9)Nitrogen + Acetic acid [64-19-7] + Sodium acetate [127-09-3] + Metal (2+) acetate + Water

Brasted and Hirayama (10) measured the solubility of nitrogen in water and in aqueous mixtures containing 1.0 mol dm^{-3} acetic acid, 0.50 mol dm^{-3} sodium acetate, and several concentrations of a transition metal (2+) acetate. There is some confusion in the paper over the Bunsen and Ostwald coefficient definitions, but the solubility data are clearly given as Ostwald coefficients.

It is unfortunate that the authors did not measure the nitrogen solubility in just the acetic acid and sodium acetate mixture. Such a solubility value would have been helpful in understanding the influence of the metal (2+) acetate on the nitrogen solubility. The salt effect parameter was calculated by the evaluator on the basis of both total electrolyte molarity and on ionic strength. The trends in the salt effect parameter values show no systematic pattern with either molarity or ionic strength.

T/K	Electrolyte[1] M(2+) Acetate	M(2+) Acetate Concentration[2] c_4/mol dm^{-3}	Salt Effect Parameter	
			$k_{scc}/dm^3\ mol^{-1}$	$k_{sIc}/dm^3\ mol^{-1}$
298.15	33. $Zn(C_2H_3O_2)_2$	0.15	0.169	0.116
	35. $Hg(C_2H_3O_2)_2$	0.05	0.083	0.070
		0.15	0.113	0.077
	36. $Cu(C_2H_3O_2)_2$	0.05	0.169	0.143
		0.157	0.123	0.084
	37. $Ni(C_2H_3O_2)_2$	0.051	0.148	0.126
		0.15	0.098	0.067
	40. $Co(C_2H_3O_2)_2$	0.033	0.187	0.166
		0.10	0.155	0.116
	48. $Mn(C_2H_3O_2)_2$	0.05	0.145	0.123
		0.15	0.123	0.084

[1] The number before the formula is the standard order number.

[2] The other concentrations are acetic acid, c_2/mol dm^{-3} = 1.00, and sodium acetate, c_3/mol dm^{-3} = 0.50. The acetic acid concentration was not used in the calculation of the k_{scc} and k_{sIc} values.

100(1)Nitrogen + Potassium chloride [7447-40-7] + Water

Bikov (5) measured the solubility of nitrogen in 0, 0.5, 1.0, and 2.0 mol dm^{-3} aqueous potassium chloride solution per gram of solvent at a total pressure of 9.81 MPa at eight temperatures between 273 and 513 K. The author calculated the solubility per g of solution at a nitrogen partial pressure of 9.81 MPa apparently by subtracting the water vapor pressure from the total pressure and assuming Henry's law is obeyed.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

The salt effect parameters, k_{scm}, calculated from the data by the evaluator showed scatter with respect to both the potassium chloride concentration and the temperature. The k_{scm} values are the average values for the three KCl solutions at each temperature. The data are classed as doubtful.

T/K	273	298	323	348	373	423	473	513
$k_{scm}/dm^3\ mol^{-1}$	0.13	0.16	0.10	0.09	0.09	0.13	0.17	0.12

100(2)Nitrogen + Potassium iodide [7681-11-0] + Water

Morrison and Billett (9) measured the solubility of nitrogen in water and in one mol kg^{-1} potassium iodide solution at four temperatures between 285.75 and 344.85 K. The authors reported the solubility in water and the solubility parameter, k_{smm}, but not the solubility in the solution. The data are classed as tentative.

T/K	Salt Effect Parameter		
	$k_{smm}/kg\ mol^{-1}$	$k_{smx}/kg\ mol^{-1}$	$k_{scc}/dm^3\ mol^{-1}$
285.75	0.134	0.149	0.160
303.15	0.100	0.115	0.126
322.55	0.086	0.101	0.113
344.85	0.084	0.099	0.112

100(3)Nitrogen + Potassium carbonate [584-08-7] + Water

Schröder (17) measured the solubility of nitrogen in 0, 0.5, 1, 2, 4, and 6 mol dm^{-3} aqueous potassium carbonate solutions at six temperatures between 323 and 403 K at nitrogen partial pressures between 1.01 and 4.05 MPa (10 and 40 atm). Most of the results are presented in graphs, but some results are tabulated. Results from the present work were combined with results from an earlier Schröder paper (16) to calculate several k_{scc} values at the nitrogen partial pressure of 4.05 MPa.

T/K	Potassium Carbonate $c_2/mol\ dm^{-3}$	Salt Effect Parameter $k_{scc}/dm^3\ mol^{-1}$
323.15	0.5	0.272
	1	0.263
	2	0.240
363.15	0.5	0.477
	1	0.456
	2	0.171, 0.329[1]
	4	0.209
	6	0.143

[1] Average 0.250.

The values at 363.15 for the 0.5 and 1 mol dm^{-3} potassium carbonate are classed as doubtful. The other values are classed as tentative.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

References:

1. Braun, L. *Z. Phys. Chem.* 1900, *33*, 721.
2. Christoff, A. *Z. Phys. Chem.* 1906, *55*, 622.
3. Bohr, C. *Z. Physik. Chem.* 1910, *71*, 47.
4. Van Slyke, D. D.; Dillon, R. T.; Margaria, R. *J. Biol. Chem.* 1934, *105*, 571.
5. Bikov, M. M. *Tr. Voronezhsk. Gos. Univ.* 1937, *9*, 29.
6. Kobe, K. A.; Kenton, F. H. *Ind. Eng. Chem., Anal. Ed.* 1938, *10*, 76.
7. Levina, M. I.; Stsibarovskaya, N. P. *Russ. J. Phys. Chem.* 1939, *12*, 653.
8. Long, F. A.; McDevit, W. F. *Chem. Rev.* 1952, *51*, 119.
9. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1952, 3819.
10. Brasted, R. C.; Harayama, C. *J. Phys. Chem.* 1958, *62*, 125.
11. Shkol'nikova, R. I. *Uch. Zap. Leningr. Gos. Univ., Ser. Khim. Nauk.* 1959, Nr. 18, 64. *Chem. Abstr.* 1961, *55*, 25443b.
12. Mishnina, T. A.; Avdeeva, O. I.; Bozhovakaya, T. K. *Materialy Vses. Nauchn. Issled. Geol. Inst.* 1961, *46*, 93.
13. Smith, N. O.; Kelemen, S.; Nagy, B. *Geochim. Cosmochim. Acta* 1962, *26*, 921.
14. O'Sullivan, T. D.; Smith, N. O. *Geochim. Cosmochim. Acta* 1966, *30*, 617.
15. O'Sullivan, T. D.; Smith, N. O. *J. Phys. Chem.* 1970, *74*, 1460. (*Corrn.-J. Phys. Chem.* 1970, *74*, 4612).
16. Schröder, W. *Z. Naturforsch.* 1969, 24b, 500.
17. Schröder, W. *Z. Phys. Chem. (Wiesbaden)* 1971, *75*, 248.
18. Yasunishi, A. *J. Chem. Eng. Jpn.* 1977, *10*, 89.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sulfuric acid; H_2SO_4; [7664-93-9]

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

ORIGINAL MEASUREMENTS:

Christoff, A.

Z. Phys. Chem. 1906, *55*, 622-34.

VARIABLES:

T/K = 293.15
P/kPa = Atmospheric
H_2SO_4/wt % = 0 - 95.6

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	H_2SO_4/wt %	$m_{H_2SO_4}$/mol kg^{-1}	Ostwald Coefficient $L \times 10^2$
293.15	0	0.0	1.537
	35.82	5.690	0.8447
	61.62	16.37	0.6144
	95.6	222.	1.672

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was an Ostwald type (1) with a lead capillary tube through which the gas flows to the absorption flask, the gas buret, and the gasometer.

The acid solution was degassed by boiling under reflux. The author estimates a one per cent change in the acid concentration due to the degassing procedure. The absorption vessel was filled with solvent, the gas was introduced, and the system shaken until equilibrium was reached.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Oxygen was removed from air by passage over copper in a combustion furnace.

(2) Sulfuric acid. Merck (Darmstadt). Specific gravity 1.271, 1.523, and 1.839 for 35.82, 61.61, and 95.6 wt per cent acid, respectively.

(3) Water. Distilled.

ESTIMATED ERROR:

$\delta T/K$ = 0.02 for acid
0.5 for gas
Barometric fluctuations are stated to be negligible.

REFERENCES:

1. Ostwald, W. *Lehrbuch der allgem. Chemie* (2 Aufl.), *1*, 615.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sulfuric Acid; H_2SO_4; [7664-93-9]

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

ORIGINAL MEASUREMENTS:

Bohr, C.

Z. Physik. Chem. 1910, *71*, 47-50.

VARIABLES:

T/K = 294
P/kPa = 101
C/N = 0-36

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T^a/K	Normality[b]	Ostwald Coeff.[c] 10^2L	Bunsen Coeff.[d] $10^2\alpha$
294.05	0.0	1.68	1.56
294.05	4.9	0.98	0.91
294.05	8.9	0.78	0.72
294.35	10.7	0.71	0.66
294.25	20.3	0.53	0.49
294.65	24.8	0.52	0.48
293.95	29.6	0.55	0.51
294.05	34.3	1.08	1.00
294.25	35.8	1.39	1.29

[a] Temperature reported to 0.1°C.

[b] Normality of sulfuric acid solution in g-equiv per liter.

[c] Ostwald coefficient calculated by compiler.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption measuring apperatus is described in reference (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha$ = ±0.03, estimate by author.

Normality to 0.1, estimate by author.

REFERENCES:

(1) Bohr, C. *Sauerstoffaufnahme des Blutfarbstoffes*, Kopenhagen 1895.
Jolin, *Archiv. F. (Anat. U.) Physiologie* 1889, 265.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

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

ORIGINAL MEASUREMENTS:

Shapka, A. V.; Yudina, L. V.; Zhuravleva, A.N.; Vorona, N.Ya; Drushlyak, O.G.

Vestn. Khar'kov Politekhn in-ta 1974, (98), 44-5.

Chem. Abstr. 1975, *83*, 137686m.

VARIABLES:

T/K = 290
P/MPa = 1.1-4.2

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

t/°C = 17 (290 K)

C_{HNO_3}/%	P/atm 11	P/atm 21	P/atm 31	P/atm 41
	S^a	S^a	S^a	S^a
0	0.161	0.290 0.280	0.45 0.465	0.5 0.439
18	0.155 0.165	0.300 0.320 0.323	0.404 0.425 0.440	0.643
42	0.139	0.292	0.40	0.45
50	0.115	0.230	0.326 0.342	0.43 0.45
67	0.154 0.16	0.225 0.300 0.25 0.31	0.365 0.41 0.37 0.45	0.44 0.46 0.495 0.53
	(1.11)[b]	(2.13)	(3.14)	(4.15)

[a] Solubility of nitrogen in ℓ N_2 (STP)/ℓ solution.
[b] Values in parentheses are the pressure in MPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Nitrogen at 60 atm was brought into contact with a known volume of nitric acid solution in a thermostated absorption vessel. The system was equilibrated for 30-40 minutes with stirring during which time the pressure was lowered to the desired value. A sample of the saturated solution was withdrawn and analyzed for the dissolved nitrogen content.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta S/S = \pm 0.03$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrated aluminum oxide; $Al_2O_3 \cdot xH_2O$; [1333-84-2]

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

ORIGINAL MEASUREMENTS:

Shkol'nikova, R. I.

Uch. Zap. Leningr. Gos. Univ., Ser. Khim. Nauk. 1959, Nr. 18, 64-86.

Chem. Abstr. 1961, *55*, 25443b.

VARIABLES:

$T/K = 293.15 - 313.15$
$P/kPa = 101.325$
$Al_2O_3/wt\ \% = 0.1, 0.35$

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Al_2O_3/Wt %	Bunsen Coefficient $\alpha \times 10^3$
293.15	0.1	15.8
	0.35	12.6
303.15	0.1	12.9
	0.35	10.3
313.15	0.1	10.0
	0.35	8.2

The enthalpy of solution of nitrogen was calculated from the temperature coefficient of the Bunsen coefficient. It is 3060, 4180, and 4460 cal mol^{-1} in water, and 0.1 and 0.35 wt % Al_2O_3 respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung were modified (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Stated to be near 100 per cent.

(2) Aluminium oxide. No information.

(3) Water. No information.

ESTIMATED ERROR:

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrated ferric oxide; $Fe_2O_3 \cdot xH_2O$; [12259-21-1]

(3) Water; H_2O· [7732-18-5]

ORIGINAL MEASUREMENTS:

Shkol'nikova, R. I.

Uch. Zap. Leningr. Gos. Univ., Ser. Khim. Nauk. 1959, Nr. 18, 64-86.

Chem. Abstr. 1961, *55*, 25443b.

VARIABLES:

$T/K = 293.15 - 313.15$
$P/kPa = 101.325$
$Fe_2O_3/wt\ \% = 0.1 - 0.8$

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Fe_2O_3/Wt %	Bunsen Coefficient $\alpha \times 10^3$
293.15	0.1	16.0
	0.5	13.4
	0.8	13.0
303.15	0.1	13.1
	0.5	11.1
	0.8	10.7
313.15	0.1	11.0
	0.5	9.9
	0.8	8.6

The enthalpy of solution of nitrogen was calculated from the temperature coefficient of the Bunsen coefficient. It is 3060, 3420, 3570, and 3760 cal mol^{-1} in water, and 0.1, 0.5, and 0.8 wt % Fe_2O_3 respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung were modified (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Stated to be near 100 per cent.

(2) Ferric oxide. No information.

(3) Water. No information.

ESTIMATED ERROR:

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68-80.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Barium chloride; $BaCl_2$; [10361-37-2] (3) Water; H_2O; [7732-18-5]	Braun, L. *Z. Phys. Chem.* 1900, *33*, 721-41.
VARIABLES:	PREPARED BY:
T/K = 278-298 Concentration	C.L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt per 100g soln./g	Bunsen coefficient, α
278.2	13.830	0.01270
	11.927	0.01368
	6.903	0.01598
	6.738	0.01628
	3.870	0.01802
	3.325	0.01826
	0.0	0.02173
283.2	13.830	0.01166
	11.927	0.01249
	6.903	0.01474
	6.738	0.01494
	3.870	0.01660
	3.325	0.01681
	0.0	0.02003
288.2	13.830	0.01036
	11.927	0.01139
	6.903	0.01317
	6.738	0.01340
	3.870	0.01480
	3.325	0.01502
	0.0	0.01789
293.2	13.830	0.00923
	11.927	0.00976
	6.903	0.01184
	6.738	0.01182
	3.870	0.01323
	3.325	0.01346

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Ostwald method, using gas buret and pipet. Measurement of volume of gas before and after absorption. Vapor pressure of water was allowed for assuming Raoult's law. Solution was degassed. Concentration of salt solution estimated by titration with silver nitrate solution.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.03$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Barium chloride; $BaCl_2$; [10361-37-2]

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

ORIGINAL MEASUREMENTS:

Braun, L.

Z. Phys. Chem. 1900, *33*, 721-41.

EXPERIMENTAL VALUES:

T/K	Wt. of salt per 100g soln. /g	Bunsen coefficient, α
293.2	0.0	0.01621
298.2	13.830	0.00783
	11.927	0.00855
	6.903	0.01044
	6.738	0.01036
	3.870	0.01137
	3.325	0.01190
	0.0	0.01432

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Lithium Chloride; LiCl; [7447-41-8]

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

ORIGINAL MEASUREMENTS:

Morrison, T. J.; Billett, F.

J. Chem. Soc. 1952, 3819-22.

VARIABLES:

T/K = 285.75 - 344.85

P/kPa = 101.325

PREPARED BY:

H. L. Clever, R. Battino

EXPERIMENTAL VALUES:

T/K	1/(T/K)	Salt Effect Parameters	
		(1/m)log(S°/S)[1]	(1/m)log(x°/x)
285.75	0.0035	0.125	0.140
303.15	0.0033	0.095	0.110
322.55	0.0031	0.084	0.099
344.85	0.0029	0.092	0.107

[1] The authors used (1/c)log(S°/S) with c defined as g eq salt per kg of water. For the 1-1 electrolyte the compiler changed the c to an m for $m_{LiCl}/mol\ kg^{-1}$. The nitrogen solubility S is cm^3(STP) kg^{-1}.

The salt effect parameters were calculated from two measurements. The solubility of nitrogen in water, S°, and in the one molal salt solution, S. Only the solubility of the nitrogen in water, and the value of the salt effect parameter are given in the paper. The solubility values in the salt solution are not given.

The compiler calculated the values of the salt effect parameter using the mole fraction gas solubility ratio.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The degassed solvent flows in a thin film down an absorption helix containing the nitrogen gas plus solvent vapor at a total pressure of one atmosphere. The volume of gas absorbed is measured in an attached buret system (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. From a cylinder and from ammonium nitrite gave the same results.

(2) Lithium Chloride. "AnalaR" material.

(3) Water. No information given.

ESTIMATED ERROR:

$\delta k = 0.010$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033-5.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium hydroxide; NaOH; [1310-73-2]

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

ORIGINAL MEASUREMENTS:

Levina, M. I.; Stsibarovskaya, N. P.

Russ. J. Phys. Chem. 1939, *12*, 653-9.

VARIABLES:

T/K = 273-533
P/MPa = 9.8
Concentration

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

t/°C	T^a/K	H_2O	Oxygen Solubility[b] NaOH Solution/N 0.5	2	4
Total pressure at 100 kg/cm^2 (9.81 MPa)					
0	273	1.24	1.03	0.41	0.18
25	298	1.01	0.76	0.37	0.16
35	308	0.88	0.65	0.35	0.14
50	323	0.78	0.58	0.26	0.15
75	348	0.64	0.55	0.25	0.17
100	373	0.71	0.59	0.31	0.20
125	398	0.77	0.62	0.33	--
150	423	0.99	0.80	0.44	0.24
200	473	1.46	1.07	0.62	0.37
240	513	1.66	1.44	0.84	0.51

[a] Calculated by compiler.

[b] Solubility in cm^3(STP) per 1 gram of solvent at total pressure of 100 kg/cm^2 (9.81 MPa).

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility determined by an apparatus described in the paper, by measuring the volume of liquid and air. Solubility of nitrogen was calculated from measured volume of air and oxygen (determined by pyrogallol).

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2,3) No details given.

ESTIMATED ERROR:

δ solubility/solubility = ±0.05, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium hydroxide; NaOH; [1310-73-2]

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

ORIGINAL MEASUREMENTS:

Levina, M. I.; Stsibarovskaya, N. P.

Russ. J. Phys. Chem. 1939, *12*, 653-9.

EXPERIMENTAL VALUES:

continued

t/°C	T^a/K	Solubility Coefficient[b]			
			NaOH Solution/N		
		H_2O	0.5	2	4
0	273	1.58	1.31	0.52	0.23
25	298	1.28	0.96	0.47	0.20
35	308	1.11	0.82	0.44	0.18
50	323	0.99	0.74	0.33	0.19
75	348	0.81	0.70	0.32	0.21
100	373	0.91	0.75	0.39	0.25
125	398	1.01	0.80	0.43	--
150	423	1.32	0.58	0.31	--
200	473	2.20	1.61	0.93	0.54
240	513	3.20	2.76	1.55	0.92

[a] Calculated by compiler.

[b] Solubility coefficient of cm^3(STP) per 1 gram of a solution at a partial nitrogen pressure of 100 kg/cm^2 (9.81 MPa).

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Braun, L. *Z. Phys. Chem.* 1900, *33*, 721- 41.
VARIABLES: T/K = 278-298 Concentration	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of salt per 100g soln./g	Bunsen coefficient, α
278.2	11.732	0.01016
	10.945	0.01052
	8.135	0.01266
	8.033	0.01248
	6.595	0.01380
	6.400	0.01375
	4.196	0.01579
	3.880	0.01615
	2.120	0.01795
	2.100	0.01805
	0.686	0.01994
	0.671	0.02000
	0.0	0.02173
283.2	11.732	0.00930
	10.945	0.00912
	8.135	0.01131
	8.033	0.01121
	6.595	0.01252
	6.400	0.01259
	4.196	0.01451
	3.880	0.01475
	2.120	0.01638
	2.100	0.01656
	0.686	0.01833
	0.671	0.01845
	0.0	0.02003

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Ostwald method, using gas buret and pipet. Measurement of volume of gas before and after absorption. Vapor pressure of water was allowed for assuming Raoult's law. Solution was degassed. Concentration of salt solution estimated by titration with silver nitrate solution.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.03$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium chloride; NaCl; [7647-14-5]

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

ORIGINAL MEASUREMENTS

Braun, L.

Z. Phys. Chem. 1900, *33*, 721-41.

EXPERIMENTAL VALUES:

T/K	Wt. of salt per 100g soln./g	Bunsen coefficient, α
288.2	11.732	0.00810
	10.945	0.00824
	8.135	0.01014
	8.033	0.00995
	6.595	0.01120
	6.400	0.01134
	4.196	0.01294
	3.880	0.01316
	2.120	0.01469
	2.100	0.01467
	0.686	0.01640
	0.671	0.01642
	0.0	0.01789
293.2	11.732	0.00657
	10.945	0.00703
	8.135	0.00872
	8.033	0.00871
	6.595	0.00972
	6.400	0.00975
	4.196	0.01151
	3.880	0.01168
	2.120	0.01311
	2.100	0.01314
	0.686	0.01477
	0.671	0.01484
	0.0	0.01621
298.2	11.732	0.00470
	10.945	0.00565
	8.135	0.00749
	8.033	0.00729
	6.595	0.00802
	6.400	0.00826
	4.196	0.00990
	3.880	0.01005
	2.120	0.01131
	2.100	0.01133
	0.686	0.01295
	0.671	0.01304
	0.0	0.01432

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium Chloride; NaCl; [7647-14-5]

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

ORIGINAL MEASUREMENTS:

Morrison, T. J.; Billett, F.

J. Chem. Soc. 1952, 3819-22.

VARIABLES:

T/K = 285.75 - 344.85

P/kPa = 101.325

PREPARED BY:

H. L. Clever, R. Battino

EXPERIMENTAL VALUES:

T/K	1/(T/K)	Salt Effect Parameters $(1/m)\log(S°/S)$ [1]	$(1/m)\log(x°/x)$
285.75	0.0035	0.154	0.169
303.15	0.0033	0.121	0.136
322.55	0.0031	0.106	0.121
344.85	0.0029	0.106	0.121

[1] The authors used (1/c)log(S°/S) with c defined as g eq salt per kg of water. For the 1-1 electrolyte the compiler changed the c to an m for m_{NaCl}/mol kg^{-1}. The nitrogen solubility S is cm^3(STP) kg^{-1}.

The salt effect parameters were calculated from two measurements. The solubility of nitrogen in water, S°, and in the one molal salt solution, S. Only the solubility of the nitrogen in water, and the value of the salt effect parameter are given in the paper. The solubility values in the salt solution are not given.

The compiler calculated the values of the salt effect parameter using the mole fraction gas solubility ratio.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The degassed solvent flows in a thin film down an absorption helix containing the nitrogen gas plus solvent vapor at a total pressure of one atmosphere. The volume of gas absorbed is measured in an attached buret system (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. From a cylinder and from ammonium nitrite gave the same results.

(2) Sodium Chloride. "AnalaR" material.

(3) Water. No information given.

ESTIMATED ERROR:

$\delta k = 0.010$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033-5.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium chloride; NaCl; [7647-14-5]

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

ORIGINAL MEASUREMENTS:

Mishnina, T. A.; Avdeeva, O. I. Bozhovakaya, T. K.

Materialy Vses. Nauchn. Issled. Geol. Inst. 1961, *46*, 93-110.

VARIABLES:

$T/K = 283.15 - 343.15$
$P/kPa = 101.325$
$c_2/mol\ dm^{-3} = 0 - 5.4$

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

NaCl/g eq dm^{-3} / T/K	Bunsen Coefficient, $\alpha \times 10^3$												Salt Effect Parameter k_s
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.4	
283.15	19.5	16.2	13.5	11.2	9.3	7.7	6.4	5.3	4.5	3.8	3.1	2.7	0.160
288.75	17.4	14.7	12.4	10.4	8.8	7.4	6.3	5.3	4.4	3.7	3.2	2.8	0.148
293.15	16.0	13.7	11.7	10.0	8.5	7.3	6.2	5.3	4.5	3.9	3.3	2.9	0.137
298.15	14.8	12.8	11.0	9.5	8.1	7.0	6.1	5.2	4.5	3.9	3.4	3.0	0.129
303.15	13.8	12.0	10.4	9.1	7.9	6.9	6.0	5.2	4.5	3.9	3.4	3.1	0.121
308.15	12.8	11.2	9.8	8.5	7.5	6.5	5.7	5.0	4.4	3.8	3.3	3.0	0.117
313.15	12.2	10.7	9.4	8.3	7.2	6.4	5.6	4.9	4.3	3.8	3.3	3.0	0.113
318.15	11.5	10.1	9.0	7.9	7.0	6.1	5.4	4.8	4.2	3.7	3.3	3.0	0.109
323.15	11.3	10.0	8.8	7.8	6.9	6.1	5.4	4.8	4.3	3.8	3.3	3.0	0.106
328.15	11.1	9.8	8.7	7.7	6.8	6.0	5.3	4.7	4.2	3.7	3.3	3.0	0.106
333.15	10.8	9.6	8.5	7.5	6.6	5.9	5.2	4.6	4.1	3.6	3.2	2.9	0.106
338.15	10.7	9.5	8.4	7.4	6.6	5.8	5.1	4.6	4.0	3.6	3.2	2.9	0.106
343.15	10.6	9.4	8.3	7.4	6.5	5.8	5.1	4.5	3.9	3.5	3.1	2.8	0.106

The table of smoothed Bunsen coefficients of nitrogen dissolved in aqueous sodium chloride solutions was prepared by the authors. The complete source of data for the table is not clear. A 1958 report of A. A. Cherepinnikov, mentioned in the paper, was not available to us.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium salts; see below.

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

ORIGINAL MEASUREMENTS:

Van Slyke, D.D.; Dillon, R.T.; Margaria, R.

J. Biol. Chem. 1934, *105*, 571-96.

VARIABLES:

T/K = 298-311
Concentration

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

At 25°C (298.15K) Except For Indicated Point

Liquid Phase	P_{N_2} [a]/mmHg	P_{N_2} [b]/kPa	$10^2\alpha$ [c]/ cm^3 (STP) cm^3 atm^{-1}	$10^2\alpha°$ [d]/ cm^3 (STP) g^{-1} H_2O
0.155 M NaCl[e]	582	77.6	1.408	1.416
0.155 M NaCl	582	77.6	1.410	1.418
0.155 M NaCl	590	78.7	1.406	1.414
0.155 M NaCl	590	78.7	1.410	1.418
0.155 M NaCl[f]	564.5	75.26	1.220	
0.077 M Na_2CO_3[g]	587	78.3	1.387	1.391
0.077 M Na_2CO_3	587	78.3	1.389	1.393
0.153 M $NaHCO_3$[h]	555	74.0	1.396[h]	1.404
0.153 M $NaHCO_3$	555	74.0	1.402[h]	1.410
0.153 M $NaHCO_3$	555	74.0	1.394[h]	1.402
0.153 M $NaHCO_3$	555	74.0	1.396[h]	1.404

[a] Nitrogen partial pressure. Solubilities calculated at 101 kPa P_{N_2}.

[b] Calculated by compiler.

[c] Bunsen coefficient.

[d] Solubility in cm^3 (STP) nitrogen per gram of water.

[e] Sodium chloride; NaCl; [7647-14-5].

[f] At 38°C (311.15 K).

[g] Sodium carbonate; Na_2CO_3; [497-19-8].

[h] Sodium bicarbonate; $NaHCO_3$; [144-55-8]. Solution also contained 0.003 M Na_2CO_3. Values have been corrected by adding 0.00004.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solutions were saturated with gas using the rotating double tonometer method of Austin, et al. (1). 2-2.5 h were allowed for saturation. The amount of dissolved nitrogen was determined using the method of Van Slyke and Neil (2).

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) Reagent grade.

(3) "Freshly Distilled".

ESTIMATED ERROR:

$\delta T/K = \pm 0.04$
$\delta\alpha/\alpha = \pm 0.01$, compiler's estimate.

REFERENCES:

1. Austin, J.H.; Cullen, G.E.; Hastings, A.B.; McLean, F.C.; Peters, J.D.; Van Slyke, D.D. *J. Biol. Chem.* 1922, *54*, 134.
2. Van Slyke, D.D.; Neil, J.M. *J. Biol. Chem.* 1924, *61*, 523.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Sulfurous acid, disodium salt, (Sodium sulfite); Na_2SO_3; [10579-83-6] (3) Water: H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Yasunishi, A. *J. Chem. Eng. Jpn.* 1977, *10*, 89-94
VARIABLES: T/K = 298 Concentration	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

Pressure = 1.01325×10^5 Pa

T/K	Conc of salt soln. /mol l^{-1}	Ostwald coefficient, *L*
298.15	0.0	0.01619
	0.102	0.01474
	0.106	0.01470
	0.209	0.01338
	0.318	0.01239
	0.472	0.01073
	0.636	0.00931
	0.778	0.00808
	0.785	0.00830
	0.938	0.00720
	1.043	0.00650

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent

(2) Guaranteed reagent

(3) Degassed

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1\%$

(estimated by compiler)

REFERENCES:

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Sulfuric acid, disodium salt, (Sodium sulfate); Na_2SO_4; [7757-82-6] (3) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Yasunishi, A. *J. Chem. Eng. Jpn.* 1977, *40*, 89-94.
VARIABLES: T/K = 298 Concentration	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

Pressure = 1.01325×10^5 Pa

T/K	Conc of salt soln. /mol l^{-1}	Ostwald coefficient, L
298.15	0.0	0.01619
	0.101	0.01491
	0.201	0.01377
	0.303	0.01262
	0.516	0.01075
	0.764	0.00871
	0.912	0.00761
	1.079	0.00670

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent

(2) Guaranteed reagent

(3) Degassed

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1\%$

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

(3) Sulfuric acid; H_2SO_4; [7664-93-9]

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

ORIGINAL MEASUREMENTS:

Kobe, K. A.; Kenton, F. H.

Ind. Eng. Chem., Anal. Ed. 1938, *10*, 76-7.

VARIABLES:

T/K = 298.15

N_2 P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Solvent Volume cm^3	Absorbed Oxygen Volume cm^3	Bunsen Coefficient $\alpha \times 10^2$	Ostwald Coefficient $L \times 10^2$
25	298.15	99.54	0.50		
		99.54	0.48	0.45 av.	0.49 av.

The solvent is a mixture of 800 g H_2O
200 g Na_2SO_4 (anhydrous)
40 cm^3 H_2SO_4 (36 N)

Thus the solution molality is:

$m_{Na_2SO_4}$/mol kg^{-1} 1.76

$m_{H_2SO_4}$/mol kg^{-1} 0.90

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was described in detail in an earlier paper (1). The apparatus consists of a gas buret, a pressure compensator, a 200 cm^3 absorption bulb, and a mercury leveling bulb. The absorption bulb is attached to a shaking machine.

The solvent and the gas are placed in an absorption bulb. The bulb is shaken until equilibrium is reached. The remaining gas is returned to the buret. The difference in the final and initial volumes is taken as the gas absorbed.

The authors also measured the solvent vapor pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Purity stated to be 99^+ per cent.

(2 & 3) Sodium sulfate and sulfuric acid. Sources not given. Analytical grades.

(4) Water. Distilled.

ESTIMATED ERROR:

$\delta\alpha/cm^3 = 0.001$ (authors)

REFERENCES:

1. Kobe, K. A.; Williams, J. S. *Ind. Eng. Chem., Anal. Ed.* 1935, *7*, 37.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sulfuric acid, disodium salt, (Sodium sulfate); Na_2SO_4; [7757-82-6]

(3) Sulfurous acid, disodium salt (Sodium sulfite); Na_2SO_4; [10579-83-6]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.

J. Chem. Eng. Jpn. 1977, *10*, 89-94

VARIABLES :

T/K = 298

Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

Pressure = 1.01325 x 10^5Pa

T/K	Total conc of salt/mol l^{-1}	Mole fraction of sodium sulfite in mixed salt.	Ostwald coefficient, L
298.15	0.305	0.253	0.01244
	0.300	0.502	0.01246
	0.303	0.713	0.01251
	0.598	0.504	0.00973
	0.864	0.258	0.00796
	0.883	0.508	0.00767

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent

(2) and (3) Guaranteed reagents

(4) Degassed

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1\%$

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Oxygen; O_2; [7782-44-7]

(3) Carbon dioxide; CO_2; [124-38-9]

(4) Sulfuric acid; H_2SO_4; [7664-93-9]

(5) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Kobe, K. A.; Kenton, F. H.

Ind. Eng. Chem., Anal. Ed. 1938, *10*, 76-7.

VARIABLES:

T/K = 298.15
p_1/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Gas Composition volume per cent	Solvent Volume V/cm³	N_2, O_2 and CO_2 Volume Absorbed v_1/cm³	Bunsen Coefficient α/cm³ (STP) cm⁻³ atm⁻¹	Ostwald Coefficient L/cm³ cm⁻³
t/°C	T/K					
25	298.15	6.1% O_2	49.54	1.53	0.0284	0.0310
		14.5% CO_2	49.54	1.54		
		79.4% N_2				

The solvent is a mixture of 800 g H_2O
200 g Na_2SO_4 (anhydrous)
40 ml H_2SO_4 (Conc., 36 normal)

Thus the molality of the solution is

$$m_4/\text{mol kg}^{-1} = 0.90\ (H_2SO_4)$$

$$m_5/\text{mol kg}^{-1} = 1.76\ (Na_2SO_4)$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in detail in an earlier paper (1). The apparatus consists of a gas buret, a pressure compensator, and a 200 cm³ absorption bulb and mercury leveling bulb. The absorption bulb is attached to a shaking mechanism.

The solvent and the gas are placed in the absorption bulb. The bulb is shaken until equilibrium is reached. The remaining gas is returned to the buret. The difference in the final and initial volumes is taken as the volume of gas absorbed.

SOURCE AND PURITY OF MATERIALS:

(1,2,3) Nitrogen, Oxygen, and Carbon dioxide. Source not given. Purity stated to be 99+ per cent.

(4,5) Sulfuric acid and sodium sulfate. Sources not given. Analytical grade.

(6) Water. Distilled.

ESTIMATED ERROR:

$\delta\alpha$/cm³ = ±0.005 (authors)

REFERENCES:

1. Kobe, K. A.; Williams, J. S. *Ind. Eng. Chem., Anal. Ed.* 1935, *7*, 37.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Acetic acid; $C_2H_4O_2$; [64-19-7]

(3) Sodium acetate; $C_2H_4O_2 \cdot Ha$; [127-09-3]

(4) Metal (2+) acetates

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

ORIGINAL MEASUREMENTS:

Brasted, R. C.; Hirayama, C.

J. Phys. Chem. 1958, *62*, 125-6.

VARIABLES:

T/K = 298.15
P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES: All metal acetate solutions are one mol dm^{-3} acetic acid.

Temperature t/°C	T/K	$c_{M(C_2H_4O_2)_2}$/mol dm^-	$c_{NaC_2H_4O_2}$/mol dm^{-3}	Ostwald Coefficient L x 10^2
25.00	298.15	0	0	1.61
		Cobalt (2+) acetate; $Co(C_2H_4O_2)_2$; [71-48-7]		
		0.033	0.50	1.28
		0.10	0.50	1.30
		Copper (2+) acetate; $Cu(C_2H_4O_2)_2$; [142-71-2]		
		0.050	0.50	1.30
		0.157	0.52	1.33
		Manganese (2+) acetate; $Mn(C_2H_4O_2)_2$; [638-38-0]		
		0.050	0.50	1.34
		0.15	0.50	1.34
		Mercury (2+) acetate; $Hg(C_2H_4O_2)_2$; [1600-27-7]		
		0.05	0.50	1.45
		0.15	0.50	1.36
		Nickel (2+) acetate; $Ni(C_2H_4O_2)_2$; [373-02-4]		
		0.051	0.51	1.33
		0.15	0.50	1.39
		Zinc (2+) acetate; $Zn(C_2H_4O_2)_2$; [557-34-6]		
		0.15	0.50	1.25

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

[1] The authors quote (with an error carried along) from Lannung (1), the definition of the Bunsen coefficient However, they call it an Ostwald coefficient. They compare their value of the solubility of N_2 in H_2O with a handbook Bunsen coefficient. They state they do not understand why their value, 1.61 x 10^{-2}, is high. Their value in water agrees well with the recommended Ostwald coefficient. The evaluator has labelled the result as Ostwald coefficient.

The apparatus was not described. The authors did measure the solution vapor pressure in a static vapor pressure apparatus.

All solutions were one molar in acetic acid. The first entry in the table is for pure water.

SOURCE AND PURITY OF MATERIALS:

The chemicals were of reagent grade. They were used without further purification. The source of the chemicals was not given.

ESTIMATED ERROR:

$\delta L/L = 0.01$ (authors)

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68-80.

COMPONENTS:

(1) Nitrogen: N_2; [7727-37-9]

(2) Potassium Chloride; KCl; [7447-40-7]

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

ORIGINAL MEASUREMENTS:

Bikov, M. M.

Tr. Voronezhsk. Gos. Univ. 1937, 9, 29-57.

VARIABLES:

T/K = 273-510
P/MPa = 9.81
Concentration

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

		Nitrogen Solubility[b]			
			KCl Solution/N		
t/°C	T^a/K	H_2O	0.5	1.0	2.0
Total Pressure of 100 kg/cm^2 (9.81 MPa)					
0	273	1.254	1.215	0.974	0.629
25	298	1.013	0.834	0.696	0.478
50	323	0.746	0.664	0.598	0.461
75	348	0.640	0.629	0.543	0.404
100	373	0.715	0.656	0.579	0.432
150	423	0.994	0.885	0.685	0.566
200	473	1.460	1.188	0.975	0.771
240	513	1.664	1.661	1.342	0.938

[a] Calculated by compiler.

[b] Solubility in cm^3(STP) per 1 gram of solvent.

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Details of the method and a drawing of the apparatus are given in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) No details given.

(3) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta S/s = \pm 0.01$ compiler's estimate for solubility.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Potassium Chloride; KCl; [7447-40-7]

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

ORIGINAL MEASUREMENTS:

Bikov, M. M.

Tr. Voronezhsk. Gos. Univ. 1937, *9*, 29-57.

EXPERIMENTAL VALUES:

continued

		Solubility Coefficient[b]			
			KCl Solution/N		
t/°C	T[a]/K	H_2O	0.5	1.0	2.0
0	273	1.587	1.538	1.233	0.796
25	298	1.282	1.056	0.881	0.605
50	323	0.944	0.841	0.758	0.587
75	348	0.814	0.799	0.690	0.514
100	373	0.914	0.839	0.741	0.552
150	423	1.323	0.176[c]	0.910	0.750
200	473	2.196	1.776	1.456	1.142
240	513	3.195	3.166	2.537	1.746

[a] Calculated by compiler.

[b] The solubility coefficient in cm^3(STP) of nitrogen dissolved per 1 gram of solution at a nitrogen partial pressure of 100 kg/cm^2 (9.81 MPa).

[c] Probably a typographical error.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Potassium Iodide; KI; [7681-11-0] (3) Water: H_2O; [7732-18-5]	Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1952, 3819-22.

VARIABLES:	PREPARED BY:
T/K = 285.75 - 344.85 P/kPa = 101.325	H. L. Clever, R. Battino

EXPERIMENTAL VALUES:

T/K	1/(T/K)	Salt Effect Parameters	
		(1/m) log(S°/S)[1]	(1/m) log(x°/x)
285.75	0.0035	0.134	0.149
303.15	0.0033	0.100	0.115
322.55	0.0031	0.086	0.101
344.85	0.0029	0.084	0.099

[1] The authors used (1/c)log(S°/S) with c defined as g eq salt per kg of water. For the 1-1 electrolyte the compiler changed the c to an m for m_{KI} /mol kg^{-1}. The nitrogen solubility S is cm^3(STP) kg^{-1}.

The salt effect parameters were calculated from two measurements. The solubility of nitrogen in water, S°, and in the one molal salt solution, S. Only the solubility of the nitrogen in water, and the value of the salt effect parameter are given in the paper. The solubility values in the salt solution are not given.

The compiler calculated the values of the salt effect parameter using the mole fraction gas solubility ratio.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The degassed solvent flows in a thin film down an absorption helix containing the nitrogen gas plus solvent vapor at a total pressure of one atmosphere. The volume of gas absorbed is measured in an attached buret system (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. From a cylinder and from ammonium nitrite gave the same results.

(2) Potassium Iodide, "AnalaR" material.

(3) Water. No information given.

ESTIMATED ERROR:

$\delta k = 0.010$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033-5.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Potassium carbonate; K_2CO_3; [584-08-7]

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

ORIGINAL MEASUREMENTS:

Schröder, W.

Z. Phys. Chem. (Wiesbaden) 1971, *75*, 248 - 64.

VARIABLES:

T/K = 323.15 - 403.15
p_1/MPa = 0.709 - 7.701
(7-76 atm)
K_2CO_3 c_2/mol dm^{-3} = 0.5 - 6

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/{}^\circ C$	Temperature T/K	Potassium Carbonate c_2/mol dm^{-3}	Nitrogen Pressure p_1/atm	Bunsen Coefficient α/m^3(STP) m^{-3} atm^{-1}
90	363.15	2	10	0.0099[2]
			14.5	0.0072[2]
			23	0.0056[2]
			40	0.0056[2], 0.0027[3]
		4	11.5	0.0076[2]
			16	0.0057[2]
			21.5	0.0042[2]
			29	0.0033[2]
			40	0.0018[3]
			49	0.0022[2]
		6	12	0.0060[2]
			14	0.0052[2]
			21	0.0036[2]
			33	0.0021[2]
			42	0.0017[2]
110	383.15	1	10	0.0145[1]
			13.5	0.0120[1]
			17	0.0105[1]
			25.5	0.0088[1]
			41	0.0075[1]
130	403.15	1	15	0.0109[1]

[1] [2] Author's "break points"from Tables 2 and 3, respectively.
[3] Values from Author's Table 4. [4] Author's earlier paper (1).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in an earlier paper (1). It is a bubbling-type autoclave based on the design of Wiebe *et al.* (2).In general the upper pressure limit was 70 - 80 atm.

The nitrogen partial pressure was obtained by subtraction of the solvent vapor pressure from the total pressure.

The values of the solubility of nitrogen in water, footnote [4], were read by the compiler from diagrams in the author's earlier paper (1). They were added to give a basis of comparison for the salt effect.

SOURCE AND PURITY OF MATERIALS:

No information.

ESTIMATED ERROR:

REFERENCES:

1. Schröder, W.
Z. Naturforsch. 1969, *24b*, 500.

2. Wiebe, R. ; Gaddy, V. L.; Heins, C. Jr.
J. Am. Chem. Soc. 1933, *55*, 947.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Potassium carbonate; K_2CO_3; [584-08-7]

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

ORIGINAL MEASUREMENTS:

Schröder, W.

Z. Phys. Chem. (Wiesbaden) 1971, *75*, 248 - 64.

EXPERIMENTAL VALUES:

The author measured the solubility of nitrogen in aqueous potassium carbonate as a function of temperature, pressure, and salt concentration.

The ranges covered by the experiments are summarized in the table below. Numerical data were not given. Isotherms of the Bunsen coefficient, α, *vs.* pressure, p_1/atm, were displayed for the three systems for which the pressure range and number of experimental points are given in the table.

Potassium Carbonate c_2/mol dm^{-3}	Isotherm T/K	Pressure Range p_1/atm	Number of Experimental Values
0.5	323.15		
1	323.15		
	343.15		
	363.15		
	383.15	7 - 52	60
	403.15	8 - 28	33
2	363.15		
4	363.15	7 - 76	61
6	363.15		

The author states that the isotherms can be broken in a maximum of 6 linear regions. He tabulated the Bunsen coefficient and pressure at the "break points" (knickpunkte) where linear regions met. The tabulated values plus some other values from this and from an earlier of the author's publications are given in the table below. The values are not experimental values, but the values read from the diagrams by the author and in some cases the compiler. The values reproduce the isotherms reasonably well.

Temperature t/°C	T/K	Potassium Carbonate c_2/mol dm^{-3}	Nitrogen Pressure p_1/atm	Bunsen Coefficient α/m^3(STP) m^{-3} atm^{-1}
50	323.15	0.0	10	0.0187[4]
			15	0.0161[4]
			20	0.0146[4]
			30	0.0136[4]
			40	0.0130[3] [4]
		0.5	40	0.0095[3]
		1	14.5	0.0102[1]
			30	0.0075[1]
			40	0.0071[3]
		2	40	0.0043[3]
70	343.15	1	13	0.0117[1]
			23	0.0086[1]
			38	0.0070[1]
90	363.15	0.0	10	0.0174[4]
			15	0.0158[4]
			20	0.0144[4]
			30	0.0130[4]
			40	0.0123[3] [4]
		0.5	40	0.0071[3]
		1	10	0.0142[1] [2]
			16	0.0108[1] [2]
			26	0.0085[1] [2]
			38	0.0072[1] [2]
			40	0.0043[3]

Continued on next page.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Polar Organic Compounds (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

The Solubility of Nitrogen in Mixtures of Polar Organic Compounds + Water

In this section ten nitrogen + polar organic compound + water systems are evaluated. The evaluation is difficult because all but two of the systems were studied at only one laboratory. The two systems studied at more than one laboratory were not studied at the same temperature or composition. Thus direct comparison of results from various laboratories is not possible.

Comparison of the nitrogen solubility in the pure components with the results of other workers can be made, especially for the nitrogen solubility in water, where we have Battino's recommended values to use (this volume, pp 1-3). Most of the papers report nitrogen in water Ostwald coefficients that are within 2 to 3 per cent of the recommended values. Tokunaga's (8) nitrogen in water solubility values are 4 to 5 per cent larger than the recommended values. Kretschmer, Nowakowska, and Wiebe (6) did not report a nitrogen + water solubility.

The solubility studies carried out before 1912 (1-5) used an Ostwald type apparatus. Just (2) gives a detailed description of the apparatus and the technique of the measurement. Both Kretschmer *et al.* (6) and Tokunaga (8) used modifications of the Horiuti apparatus. Kretschmer *et al.* either measured or used literature solvent vapor pressures and applied a correction for the dilation of the solvent due to the dissolved nitrogen. Tokunaga calculated the mixed solvent vapor pressure assuming Raoult's law and he did not correct for dilation, assuming the correction to be negligible.

Nitrogen + Methanol [67-56-1] + Water

Tokunaga (8) measured the solubility of nitrogen in the pure liquids and in thirteen methanol + water mixtures at 293.15 and 313.15 K. He made extra measurements in the 0 to 0.1 methanol mole fraction region where he showed there is a maximum in the solubility *vs.* mole fraction curve at 0.03-0.06 mole fraction methanol. The temperature coefficient of solubility changes from negative to positive as the composition changes from pure water to pure methanol. Similar behavior was reported earlier for argon in aqueous methanol (Solubility Series, Volume 4). Tokunaga's value of the solubility of nitrogen in water is 4 to 5 per cent greater than the recommended value and his nitrogen solubility in methanol is lower than the values reported by most others. The deviation towards high solubility values was also found in an evaluation of his work on oxygen as solute (Solubility Series, Volume 7). The data are classed as tentative.

Nitrogen + Ethanol [64-17-5] + Water

Just (2) measured the solubility of nitrogen in the two pure components and in two mixtures at 298.15 K. Kretschmer *et al.* (6) measured the solubility in ethanol and one mixture of 95 volume per cent ethanol at 298.15 K. The solubilities in the pure components agree well with accepted values and both sets of data are classed as tentative. Tokunaga (8) measured the solubility of nitrogen in the pure components and thirteen ethanol + water mixtures at 293.15 and 313.15 K. The features observed for the aqueous methanol system were also observed for aqueous ethanol. Tokunaga's nitrogen in water solubility values were discussed in the aqueous methanol system above. His solubilities in ethanol appear greater at 293.15 K and less at 313.15 K than the general run of the data of others. The data are classed as tentative.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Polar Organic Compounds (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

Nitrogen + 1-Propanol [71-32-8] + Water
Nitrogen + 2-Propanol [67-63-0] + Water

Tokunaga (8) measured the solubility of nitrogen in water, 1-propanol, 2-propanol and up to twelve alcohol + water mixtures at 293.15 and 313.15 K. The maximum at low alcohol concentrations and the sign change in the temperature coefficient of solubility observed in the aqueous methanol and ethanol solutions are also observed in these systems. The data are classed as tentative.

Nitrogen + 1,2,3-Propanetriol [56-81-5] + Water

Drucker and Moles (4) measured the solubility of nitrogen in water and in five 1,2,3-propanetriol + water mixtures at 298.15 K. Müller (5) measured the solubility of nitrogen in water and in seven mixtures near 288.15 K. The values of the nitrogen solubility in water are 2.5 and 1.6 per cent, respectively, lower than the recommended value. The two data sets differ in that Müller made more measurements at the large 1,2,3-propanetriol compositions where he observed a minimum in the solubility *vs.* solvent composition curve at about 80 weight per cent alcohol. Both sets of data are classed as tentative.

Nitrogen + Propanoic acid [79-09-4] + Water

Braun (1) measured the solubility of nitrogen in water and in eight acid + water mixtures at concentrations up to 1.7 mol kg^{-1} at five degree intervals between 278.2 and 298.2 K. Braun's values for the solubility of nitrogen in water range from 3.1 per cent greater at 278.2 to 2.4 per cent less at 298.2 K than the recommended values. The data are classed as tentative, but should be used with some caution. See the discussion of Braun's data in the aqueous electrolyte section under barium chloride and sodium chloride.

Nitrogen + 2-Methylpropanoic acid [79-31-2] + Water

Drucker and Moles (4) measured the solubility of nitrogen in water and up to six acid + water mixtures at 296.17 and 302.17 K. The data are classed as tentative.

Nitrogen + 2,2,2-Trichloro-1,1-ethanetriol [302-17-0] + Water

Müller (5) measured the solubility of nitrogen in water and in seven chloral hydrate + water mixtures at temperatures near 288.15 K. In addition to the original data he gives a table of solubility values corrected to 288.15 K. He observed a minimum in the solubility *vs.* solvent composition curve at about 56 weight per cent chloral hydrate. The data are classed as tentative.

Nitrogen + Acetamide [60-35-5] + Water

Hüfner (3) measured the solubility of nitrogen in water and in one mol dm^{-3} acetamide solution near 293 K. His value for the solubility of nitrogen in water agrees well with the recommended value. The data are classed as tentative.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Polar Organic Compounds

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

EVALUATOR:

H. Lawrence Clever
Department of Chemistry
Emory University
Atlanta, GA 30322 USA

1981, December

CRITICAL EVALUATION:

Nitrogen + Detergent + Water

Enns, Scholander, and Bradstreet (7) studied the effect of hydrostatic pressure up to about 10 MPa on the equilibrium pressure of nitrogen dissolved in water and in a solution of an unidentified detergent + water which had a surface tension equal to 30 per cent that of water. The effect of the detergent and the resulting reduced surface tension was negligible. The detergent concentration was not given, but it may be assumed that it was small. Thus, it appears that the bulk properties of water which influence solubility are not effected by the small amounts of detergent.

References:

1. Braun, L. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1900, *33*, 721.
2. Just, G. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1901, *37*, 342.
3. Hüfner, G. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1907, *57*, 611.
4. Drucker, K.; Moles, E. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1910, *75*, 405.
5. Müller, C., *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1912, *81*, 483.
6. Kretschmer, C. B.; Nowakowska, J.; Wiebe, R. *Ind. Eng. Chem.* 1946, *38*, 506.
7. Enns, T.; Scholander, P. F.; Bradstreet, E. D. *J. Phys. Chem.* 1965, *69*, 389.
8. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]
(2) Methanol; CH_4O; [67-56-1]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Tokunaga, J.

J. Chem. Eng. Data. 1975, *20*, 41-6.

VARIABLES:

$T/K = 293-313$
Composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Mole fraction of alcohol, x_{CH_4O}	Ostwald coefficient,* L	Henry's Constant /atm	Mole fraction of nitrogen in liquid, **x_{N_2}
293.15	0.0000	0.0179	74500	0.0000134
	0.0274	0.0188	68800	0.0000145
	0.0514	0.0197	64100	0.0000156
	0.0670	0.0198	62700	0.0000159
	0.0967	0.0183	66000	0.0000152
	0.1653	0.0202	56000	0.0000179
	0.2084	0.0217	50200	0.0000199
	0.2931	0.0261	38800	0.0000258
	0.4050	0.0318	28900	0.0000346
	0.5038	0.0448	19000	0.0000526
	0.6088	0.0598	13100	0.0000763
	0.6784	0.0723	10300	0.0000971
	0.7630	0.0910	7670	0.0000130
	0.8973	0.118	5390	0.0000186
	1.0000	0.138	4310	0.0000232
313.15	0.0000	0.0147	96600	0.0000104
	0.0225	0.0168	82700	0.0000121
	0.0478	0.0164	82300	0.0000122
	0.0664	0.0177	73500	0.0000136
	0.1009	0.0186	68800	0.0000145
	0.2036	0.0219	53300	0.0000188
	0.2971	0.0279	38400	0.0000260
	0.4278	0.0433	22200	0.0000450

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solvent solution. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.99 mole per cent.

(2/3) Guaranteed reagent, further purified by distillation.

Solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{N_2} = \pm 1-2\%$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Methanol; CH_4O; [67-56-1] (3) Water; H_2O [7732-18-5]	Tokunaga, J. *J. Chem. Eng. Data.* 1975, *20*, 41-6.

EXPERIMENTAL VALUES :

T/K	Mole fraction of alcohol, x_{CH_4O}	Ostwald coefficient,* L	Henry's Constant /atm	Mole fraction of nitrogen in liquid,** x_{N_2}
313.15	0.5200	0.0534	16700	0.0000599
	0.6712	0.0805	9850	0.000102
	0.7074	0.0867	8910	0.000112
	0.7897	0.101	7190	0.000139
	0.8957	0.117	5790	0.000173
	1.0000	0.146	4250	0.000235

* at 1.01325×10^5 Pa partial pressure

** at 1.01325×10^5 Pa partial pressure (calculated from the reciprocal of Henry's Constant).

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

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

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342-67.

VARIABLES:

T/K = 298.15
P/kPa = 101.325
Ethanol/vol % = 0 - 99.8

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Ethanol/ volume per cent	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0	0.01497	0.01634
	20	0.01407	0.01536
	33	0.01575	0.01719
	99.8	0.1312	0.1432

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared in aqueous solution by the reaction of sodium nitrite with ammonium nitrate in the presence of calcium dichromate.

(2) Ethanol. No information

(3) Water. Distilled.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141-52.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethyl Alcohol (Ethanol); C_2H_6O; [64-17-5]; (95% by volume)

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

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

T/K = 248.15 - 323.15
P/kPa = 101.325
Ethanol/vol % = 95

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
248.15	0.1039	0.0944
273.15	0.1053	0.1053
298.15	0.1063	0.1160
323.15	0.1090	0.1290

The Ostwald coefficients were measured at a total pressure of 101.325 kPa (1 atm). The compiler calculated the Bunsen coefficient value for an oxygen partial pressure of 101.325 kPa.(1 atm) assuming the Ostwald coefficient was independent of pressure.

The solvent is 95 volume percent ethanol, 5 volume per cent water.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that of Horiuti (1), it consisted of a gas buret, manometer, and absorption pipet equipped with a magnetic stirrer. All volumes were calibrated by mercury displacement.

The solvent was partly degassed by boiling under reflux. About 40 cm^3 of solvent was admitted into the absorption pipet, and pumped on to complete the degassing. Dry gas, measured in the buret, was admitted, final equilibrium was established after 1 to 3 hours stirring. During the solution process the total pressure was kept at one atm by additions of dry gas.

The solubility value was corrected for the increase of solvent volume with gas absorption

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial, but source not given. Passed through alkaline pyrogallol to remove O_2, passed through Drierite to dry.

(2) Ethanol. The alcohol was distilled made 95 per cent by volume by the addition of water. ρ_4^{25} /g cm^{-3} = 0.80724.

(3) Water.

ESTIMATED ERROR:

Gas buret $\delta V/cm^3 = 0.005$
Average deviation from the mean 0.3%, maximum deviation 0.9% (authors).

REFERENCES:

1. Horiuti, J. *J. Sci Papers Inst. Phys. Chem. Res. (Tokyo)* 1931, *17*, 125-256.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

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

ORIGINAL MEASUREMENTS:

Tokunaga, J.

J. Chem. Eng. Data. 1975, *20*, 41-6.

VARIABLES:

T/K = 293-313

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Mole fraction of alcohol, $x_{C_2H_6O}$	Ostwald coefficient*, L	Henry's Constant /atm	Mole fraction of nitrogen in liquid,** x_{N_2}
293.15	0.0000	0.0179	74500	0.0000134
	0.0070	0.0193	68100	0.0000147
	0.0199	0.0200	64100	0.0000156
	0.0558	0.0212	56700	0.0000176
	0.0815	0.0214	53800	0.0000186
	0.1015	0.0217	51300	0.0000195
	0.1558	0.0240	42600	0.0000235
	0.2757	0.0363	23600	0.0000424
	0.3206	0.0421	19100	0.0000524
	0.4628	0.0622	10900	0.0000917
	0.5952	0.0846	6930	0.000144
	0.7130	0.102	5150	0.000194
	0.8746	0.126	3620	0.000276
	0.9140	0.134	3320	0.000301
	1.0000	0.151	2730	0.000366
313.15	0.0000	0.0147	96600	0.0000104
	0.0195	0.0163	84100	0.0000119
	0.0385	0.0161	82000	0.0000122
	0.0509	0.0159	80200	0.0000125
	0.0574	0.0159	80200	0.0000125
	0.0734	0.0170	73100	0.0000137
	0.1087	0.0186	63100	0.0000158
	0.2237	0.0278	35200	0.0000284

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solvent solution. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.99 mole per cent.

(2/3) Guaranteed reagent, further purified by distillation. Solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{N_2} = \pm 1-2\%$.

REFERENCES:

COMPONENTS :	ORIGINAL MEASUREMENTS :
(1) Nitrogen; N_2; [7727-37-9] (2) Ethanol; C_2H_6O; [64-17-5] (3) Water; H_2O; [7732-18-5]	Tokunaga, J. *J. Chem. Eng. Data.* 1975, *20*, 41-6.

EXPERIMENTAL VALUES :

T/K	Mole fraction of alcohol, $x_{C_2H_6O}$	Ostwald coefficient,* L	Henry's Constant /atm	Mole fraction of nitrogen in liquid,** x_{N_2}
313.15	0.3120	0.0432	20000	0.0000500
	0.4162	0.0554	13700	0.0000730
	0.5061	0.0707	9680	0.000103
	0.6062	0.0852	7230	0.000138
	0.6946	0.100	5650	0.000177
	0.7751	0.115	4570	0.000219
	0.8814	0.136	3490	0.000287
	0.9702	0.151	2920	0.000343
	1.0000	0.156	2760	0.000362

* at 1.01325×10^5 Pa partial pressure.

** at 1.01325×10^5 Pa partial pressure (calculated from the reciprocal of Henry's Constant).

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2,2,2,-trichloro-1.1-ethanediol (chloral hydrate); $C_2H_3ClO_2$; [302-17-0]

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

ORIGINAL MEASUREMENTS:

Müller, C.

Z. Physik. Chem. 1912, *81*, 483-503.

VARIABLES:

T/K = 288-290
P/kPa = 101

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T^a/K	Weight Percentage[b] Chloral hydrate	Ostwald Coeff.[c] 10^2L	Bunsen Coeff.[d] $10^2\alpha$
288.75	15.8	1.664	1.574
288.55	28.2	1.498	1.418
289.55	37.25	1.365	1.288
290.05	47.	1.378	1.260
290.15	56.52	1.307	1.230
288.45	71.5	1.494	1.415
287.95	78.8	1.525	1.447

[a] Temperature reported to 0.1°C.

[b] 2,2,2 trichloro-1,1-ethanediol.

[c] Ostwald coefficient calculated by compiler.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water is degassed by pumping under vacuum. The absorption vessel is about 600 cm^3 and is separately thermostatted from the buret gas measuring system. Both are connected by a copper capillary tube. Gas uptake is read on the gas burets. The absorption flask volume and all liquid volumes were calibrated using mercury. The original paper contains details of operation and a drawing of the apparatus. Solubilities were also measured in pure water and sucrose.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - from heating potassium nitrite and ammonium nitrite. Washed with potassium hydroxide solution and sulfuric acid; and finally passed through a glowing copper tube.

(2) Chloral hydrate - from Merck or from Münster.

(3) Water - no comment by author.

ESTIMATED ERROR:

$\delta\alpha/\alpha$ = ±0.01 estimated by compiler.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Acetamide; C_2H_5NO or CH_3CONH_2; [60-35-5]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-24.

VARIABLES:

T/K = 293.35, 293.40

N_2 P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	$C_{C_2H_5NO}$/mol dm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunse Coefficient $\alpha \times 10^2$
20.18	293.33	0.0	---	--	1.565[2]
20.20	293.35	1.0	672.3	5.37	1.481
20.25	293.40	1.0	680.8	5.40	1.470

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at the stated pressure.

[2] Average of four runs, see Hüfner's N_2 + H_2O data sheet.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, described in reference (1), was the Bunsen absorption type. It consisted of an absorption flask, which holds 409.94 cm^3 of solvent, and gas burets.

The final partial pressure of the gas ranged between 648.6 and 720.7 mmHg. The author reported both the volume of gas absorbed at the final pressure in 409.94 cm^3 of solvent reduced to 273.15 K and 760 mmHg, and the Bunsen coefficient, which was calculated assuming Henry's law.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Stated to be argon free.

(2) Acetamide. Source not given.

(3) Water. Pure.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propanoic acid, (Propionic acid); $C_3H_6O_2$; [79-09-4]

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

ORIGINAL MEASUREMENTS:

Braun, L.

Z. Phys. Chem. 1900, *33*, 721-41.

VARIABLES:

T/K = 278-298
Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of acid per 100g soln./g	Bunsen coefficient, α
278.2	11.220	0.01951
	11.023	0.01977
	9.537	0.02040
	9.155	0.02026
	6.066	0.02077
	5.891	0.02089
	4.081	0.02095
	3.816	0.02087
	0.0	0.02173
283.2	11.220	0.01779
	11.023	0.01800
	9.537	0.01823
	9.155	0.01845
	6.066	0.01855
	5.891	0.01872
	4.081	0.01919
	3.816	0.01915
	0.0	0.02003
288.2	11.220	0.01593
	11.023	0.01585
	9.537	0.01634
	9.155	0.01630
	6.066	0.01637
	5.891	0.01648
	4.081	0.01688

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Ostwald method, using gas buret and pipet. Measurement of volume of gas before and after absorption. Vapor pressure of water was allowed for assuming Raoult's law. Solution was degassed. Concentration of salt solution estimated by titration with silver nitrate solution.

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.03$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propanoic acid, (Propionic acid); $C_3H_6O_2$; [79-09-4]

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

ORIGINAL MEASUREMENTS:

Braun, L.

Z. Phys. Chem. 1900, *33*, 721-41.

EXPERIMENTAL VALUES:

T/K	Wt. of acid per 100g soln./g	Bunsen coefficient, α
288.2	3.816	0.01674
	0.0	0.01789
293.2	11.220	0.01463
	11.023	0.01447
	9.537	0.01471
	9.155	0.01469
	6.066	0.01476
	5.891	0.01480
	4.081	0.01541
	3.816	0.01547
	0.0	0.01621
298.2	11.220	0.01301
	11.023	0.01295
	9.537	0.01336
	9.155	0.01329
	6.066	0.01335
	5.891	0.01338
	4.081	0.01365
	3.816	0.01371
	0.0	0.01432

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Propanol; C_3H_8O; [71-32-8]

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

ORIGINAL MEASUREMENTS:

Tokunaga, J.

J. Chem. Eng. Data. 1975, *20*, 41-6.

VARIABLES:

T/K =293-313

Composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Mole fraction of alcohol, $x_{C_3H_8O}$	Ostwald coefficient,* L	Henry's Constant /atm	Mole fraction of nitrogen in liquid,** x_{N_2}
293.15	0.0000	0.0179	74500	0.0000134
	0.0247	0.0210	59300	0.0000169
	0.0349	0.0180	67400	0.0000148
	0.0758	0.0202	54300	0.0000184
	0.0987	0.0234	44400	0.0000225
	0.1997	0.0371	22500	0.0000444
	0.3020	0.0541	12900	0.0000775
	0.4045	0.0636	9390	0.000106
	0.5014	0.0712	7380	0.000136
	0.6058	0.0846	5490	0.000182
	0.7775	0.101	3880	0.000258
	0.8640	0.109	3310	0.000302
	1.0000	0.123	2650	0.000377
313.15	0.0000	0.0147	96600	0.0000104
	0.0247	0.0170	77700	0.0000129
	0.0480	0.0163	76400	0.0000131
	0.0717	0.0205	57300	0.0000175
	0.1008	0.0283	38600	0.0000259
	0.1395	0.0365	27300	0.0000366
	0.2903	0.0616	12100	0.0000826
	0.4107	0.0798	7770	0.000129
	0.4955	0.0882	6280	0.000159
	0.6135	0.0989	4880	0.000205
	0.6993	0.108	4110	0.000243

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solvent solution. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.99 mole per cent.

(2/3) Guaranteed reagent, further purified by distillation. Solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{N_2} = \pm 1\text{-}2\%$.

REFERENCES:

COMPONENTS	ORIGINAL MEASUREMENTS
(1) Nitrogen; N_2; [7727-37-9] (2) 1-Propanol; C_3H_8O: [71-23-8] (3) Water; H_2O; [7732-18-5]	Tokunaga, J. *J. Chem. Eng. Data.* 1975, *20*, 41-6.

EXPERIMENTAL VALUES :

T/K	Mole fraction of alcohol, $x_{C_3H_8O}$	Ostwald coefficient,* L	Henry's Constant /atm	Mole fraction of nitrogen in liquid,** x_{N_2}
313.15	0.8251	0.118	3310	0.000302
	0.8761	0.122	3050	0.000328
	1.0000	0.132	2570	0.000389

* at 1.01325 x 10^5 Pa partial pressure

** at 1.01325 x 10^5 Pa partial pressure (calculated from the reciprocal of Henry's Constant).

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) 2-Propanol; C_3H_8O; [67-63-0] (3) Water; H_2O; [7732-18-5]	Tokunaga, J. *J. Chem. Eng. Data.* <u>1975</u>, *20*, 41-6.
VARIABLES:	PREPARED BY:
T/K = 293-313 Composition	C.L. Young

EXPERIMENTAL VALUES:

T/K	Mole fraction of alcohol, $x_{C_3H_8O}$	Ostwald coefficient,* L	Henry's Constant /atm	Mole fraction of nitrogen in liquid,** x_{N_2}
293.15	0.0000	0.0179	74500	0.0000134
	0.0709	0.0168	65900	0.0000152
	0.1585	0.0246	37100	0.0000270
	0.3288	0.0511	13000	0.0000769
	0.4000	0.0636	9350	0.000107
	0.5351	0.0773	6410	0.000156
	0.6396	0.0939	4680	0.000214
	0.7125	0.0986	4130	0.000242
	0.8147	0.117	3160	0.000316
	0.9031	0.119	2860	0.000350
	1.0000	0.133	2390	0.000418
313.15	0.0000	0.0147	96600	0.0000104
	0.0480	0.0136	91300	0.0000110
	0.1046	0.0205	52700	0.0000190
	0.1620	0.0299	31700	0.0000315
	0.2200	0.0395	21400	0.0000467
	0.3249	0.0586	12000	0.0000833
	0.4174	0.0732	8330	0.000120
	0.5300	0.0921	5700	0.000175
	0.6031	0.0990	4860	0.000206

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solvent solution. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.99 mole per cent.

(2/3) Guaranteed reagent, further purified by distillation. Solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{N_2} = \pm 1\text{-}2\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Propanol; C_3H_8O; [67-63-0]

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

ORIGINAL MEASUREMENTS:

Tokunaga, J.

J. Chem. Eng. Data. 1975, *20*, 41-6

EXPERIMENTAL VALUES :

T/K	Mole fraction of alcohol, $x_{C_3H_8O}$	Ostwald coefficient,* L	Henry's Constant /atm	Mole fraction of nitrogen in liquid,** x_{N_2}
313.15	0.7743	0.117	3420	0.000292
	0.8487	0.126	2970	0.000337
	0.9535	0.140	2450	0.000408
	1.0000	0.146	2210	0.000452

* at 1.01325×10^5 Pa partial pressure.

** at 1.01325×10^5 Pa partial pressure (calculated from the reciprocal of Henry's Constant).

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,2,3-Propanetriol (Glycerol); $C_3H_8O_3$; [56-81-5]

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

ORIGINAL MEASUREMENTS:

Drucker, K.; Moles, E.

Z. Physik. Chem. 1910, *75*, 405- 36.

VARIABLES:

T/K = 298

Wt. fraction of 1,2,3-Propanetriol

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Wt. fraction of 1,2,3-Propanetriol	*p*/mmHg	*p*/kPa	Ostwald coefficient, *L*	Ratio of density of soln./density of H_2O
298.2	0.0	760	101	0.0156	1.0
	0.16	598.4	79.8	0.0103	1.0392
		915.5	122.1	0.0103	
	0.297	556.5	74.2	0.0067	1.0744
		846.5	112.9	0.0068	
	0.489	617.7	82.4	0.0052	1.1263
		859.8	114.6	0.0051	
	0.745	588.5	78.5	0.0025	1.1931
	0.841	637.3	85.0	0.0024	1.2213
		757.0	100.9	0.0024	

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent degassed before being admitted to buret. Density of solution determined using a Sprengel pyknometer.

SOURCE AND PURITY OF MATERIALS:

(1) From cylinder, passed through concentrated alkali, alkaline pyrogallol and concentrated sulfuric acid then over hot copper.

(2) Pure sample, purity about 98 mole per cent.

(3) Distilled.

ESTIMATED ERROR:

$\delta L/L$ =±1-3% for dil. soln.;

±5-7% for conc. soln.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,2,3-propanetriol (glycerol); $C_3H_8O_3$; [56-81-5]

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

ORIGINAL MEASUREMENTS:

Müller, C.

Z. Physik. Chem. 1912, *81*, 483-503.

VARIABLES:

T/K = 287-291
P/kPa = 101.325

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T^a/K	Weight Percentage Glycerol[b]	Ostwald Coeff.[c] 10^2L	Bunsen Coeff.[d] $10^2\alpha$
289.25	25.	1.313	1.240
288.75	42.2	1.053	0.996
287.85	51.5	0.800	0.759
288.05	58.0	0.741	0.703
289.05	80.25	0.550	0.520
289.35	90.	0.604	0.570
291.15	95.	0.616	0.578

[a] Temperature reported to 0.1°C.

[b] 1,2,3-propanetriol.

[c] Ostwald coefficient calculated by compiler.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water is degassed by pumping under vacuum. The absorption vessel is about 600 cm^3 and is separately thermostatted from the buret gas measuring system. Both are connected by a copper capillary tube. Gas uptake is read on the gas burets. The absorption flask volume and all liquid volumes were calibrated using mercury. The original paper contains details of operation and a drawing of the apparatus. Solubilities were also measured in pure water, sucrose, and chloral hydrate.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - from heating potassium nitrite and ammonium nitrite. Washed with potassium hydroxide solution, ferrous sulfate solution and sulfuric acid; and finally passed through a glowing copper tube.

(2) Glycerol - from Merck.

(3) Water - no comment by author.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.01$, estimated by compiler.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,2,3-Propanetriol (glycerine); $C_3H_8O_3$; [56-81-5]

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

ORIGINAL MEASUREMENTS:

Hammel, A. von

Z. *Physik. Chem.* 1915, *90*, 121-5.

VARIABLES:

T/K = 288
Concentration

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

wt. % (2)	10^2L^a	wt. % (2)	10^2L^a
15°C (288 K)			
0	1.707	72.8	0.552
0	1.708	74.7	0.597
15.7	1.425	77.0	0.527
15.7	1.376	85.1	0.482
29.9	1.087	87.3	0.492
46.6	0.840	88.5	0.536
57.6	0.698	99.25	0.524
67.1	0.635		

[a] Ostwald coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Ostwald apparatus as modified by Geffcken (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta L/L = \pm 0.03$, Compiler's estimate

REFERENCES:

1. Geffcken, G. Z. *Physik. Chem.* 1904, *49*, 257-302.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Methylpropanoic acid; $C_4H_8O_2$; [79-31-2]

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

ORIGINAL MEASUREMENTS:

Drucker, K.; Moles, E.

Z. Physik. Chem. 1910, *75*, 405-36.

VARIABLES:

$T/K = 296-302$
$P/kPa = 31-116$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Solvent contained 37.5% component 2.

T/K	*p*/mmHg	*p*/kPa	Ostwald Coefficient, *L*	Ratio of density of soln./density of H_2O at 298.15 K
296.17	246.2	32.82	0.0393	0.9984
	492.2	65.62	0.0393	
	563.6	75.14	0.0393	
	836.3	111.5	0.0400	
	867.3	115.6	0.0401	
302.17	231	30.80	0.0373	
	468.4	62.45	0.0384	
	480.7	64.09	0.0383	
	536	71.46	0.0385	
	656	87.46	0.0384	
	720	95.99	0.0386	

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent degassed before being admitted to pipet. Density of solution determined using a Sprengel pyknometer.

SOURCE AND PURITY OF MATERIALS:

(1) From cylinder, passed through concentrated alkali, alkaline pyrogallol, concentrated sulfuric acid and over hot copper.

(2) From Kahlbaum, distilled four times.

(3) Distilled.

ESTIMATED ERROR:

$\delta L/L = \pm 1-3\%$ for dil. soln.;

$\pm 5-7\%$ for conc. soln.

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2, 3) Binary Component Organic Solvent	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

The Solubility of Nitrogen in Binary Organic Solvents

The solubility of nitrogen in binary organic solvents is reported in three papers (1, 2, 3). Seven systems were studied. No system was studied by more than one laboratory. Thus, no direct comparison of the data from different sources can be made and the data are all classed as tentative.

Kretschmer, Nowakowska, and Wiebe (1) measured the solubility of nitrogen at just one mole fraction and in the pure components at three temperatures. Thus, their data are of only limited value in giving information on the solubility of nitrogen in mixed solvents. Wiebe and co-workers are well known for reliable work. They used the technique and apparatus of the type first described by Horiuti. They either measured or used literature solvent vapor pressures and they corrected for dilation. Their results are classed as tentative.

Nitta, Katayama and co-workers (2, 3) also used a modified Horiuti apparatus and technique. They assumed Raoult's law valid to calculate the mixed solvent vapor pressures. They considered the solvent dilation correction too small to be significant. The binary solvents were stated to change composition less than 0.7 per cent on degassing and through the solubility procedure. The mole fraction solubilities are for a nitrogen partial pressure of 101.325 kPa (1 atm). Their work appears to have been carried out carefully and the data are classed as tentative.

The systems studied are listed below.

1. Nitrogen + Cyclohexane [110-82-7] + 2,2,4-Trimethylpentane [540-84-1]

   Nitta, Tatsuishi, and Katayama (2) measured the solubility of nitrogen in nine mixtures and the two pure components at 298.15 K.

2. Nitrogen + Ethanol [64-17-5] + 2,2,4-Trimethylpentane [540-84-1]

   Kretschmer, Nowakowska, and Wiebe (1) measured the solubility of nitrogen in the pure components and one mixture 0.739 mole fraction ethanol at 273.15, 298.15, and 323.15 K.

3. Nitrogen + 1-Propanol [71-23-8] + 2,2,4-Trimethylpentane [540-84-1]

   Nitta, Tatsuishi, and Katayama (2) measured the solubility of nitrogen in the pure components and nine mixtures at 298.15 K.

4. Nitrogen + Ethanol [64-17-5] + Benzene [71-43-2]

   Nitta, Fujio, and Katayama (3) measured the solubility of nitrogen in the pure components and nine mixtures at 298.15 K.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2, 3) Binary Component Organic Solvent	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

5. Nitrogen + Ethanol [64-17-5] + 1,1'-Oxybisethane [60-29-7]

Nitta, Fujio, and Katayama (3) measured the solubility of nitrogen in the pure components and nine mixtures at 273.15 K.

6. Nitrogen + Ethanol [64-17-5] + 2-Propanone [67-64-1]

Kretschmer, Nowakowska, and Wiebe (1) measured the solubility of nitrogen in the two pure components and one mixture of 0.558 mole fraction ethanol at temperatures of 273.15, 298.15 and 323.15 K.

7. Nitrogen + Ethanol [64-17-5] + Acetic acid, ethyl ester [141-78-6]

Nitta, Fujio, and Katayama (3) measured the solubility of nitrogen in the two pure components and nine mixtures at 298.15 K.

References:

1. Kretschmer, C. B.; Nowakowska, J.; Wiebe, R. *Ind. Eng. Chem.* 1946, *38*, 506.

2. Nitta, T.; Tatsuishi, A.; Katayama, T. *J. Chem. Eng. Japan* 1973, *6*, 475.

3. Nitta, T.; Fujio, J.; Katayama, T. *J. Chem. Eng. Data* 1978, *23*, 157.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol or Ethyl Alcohol; C_2H_6O; [64-17-5]

(3) 2-Propanone; C_3H_6O; [67-64-1]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

T/K = 273.15 - 323.15
p/kPa = 101.325
C_2H_6O/x_2 = 0.558

PREPARED BY:

D. G. T. Thornhill

EXPERIMENTAL VALUES:

T/K	Ethanol Mol Fraction x_2	Nitrogen Mol Fraction $10^4 x_1$	Nitrogen Ostwald Coefficient L_1/cm³ cm⁻³
273.15	0.558	4.05	0.1427
298.15	0.558	4.30	0.1609
323.15	0.558	4.65	0.1829

Smoothing equation:

$\Delta G_1^\circ/\mathrm{J\ mol^{-1}} = -RT\ \ln x_1/\mathrm{J\ mol^{-1}} = A + BT/\mathrm{K}.$

Coefficients in the smoothing equation, $A = \Delta H_1^\circ/\mathrm{J\ mol^{-1}}$ and $-B = S_1^\circ/\mathrm{J\ mol^{-1}\ K^{-1}}$, and standard deviation, σ_d, were determined by least-squares analysis.

$\sigma_d = \{\Sigma(\Delta G_1^\circ(\mathrm{calc}) - \Delta G_1^\circ)^2/(N - 1)\}^{\frac{1}{2}}$, N being the number of experimental values.

$\Delta H_1^\circ/\mathrm{J\ mol^{-1}} = 2042$ $\Delta S_1^\circ/\mathrm{J\ mol^{-1}\ K^{-1}} = -57.5$ $\sigma_d/\mathrm{J\ mol^{-1}} = 22$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturation of degassed solvent with dry gas. Solubilities were calculated from appropriate determinations of gas pressures and volumes, and of solvent volumes and vapour pressures.

The apparatus was similar to that of Horiuti (1). Solvent was initially degassed by boiling it under reflux. Then it was transferred to the evacuated absorption vessel, and degassing completed by pumping on it under vacuum. Mercury was now added to the vessel until it was completely filled. An accurately measured amount of gas was then added to the vessel from a buret until the mercury was displaced to a calibrated mark. The volume of displaced mercury equalled the gas phase volume. Subtraction of this latter value from the total volume of the absorption vessel yielded the volume of solvent. Gas and solvent were mixed by agitation with a stirrer, and intermittently fresh aliquots of gas were added to the vessel. During dissolution of gas care was taken to avoid diffusion of wet gas and solvent vapour from the absorption vessel to the buret. Final equilibrium was achieved after 1-3 hours. Corrections were made for increased solvent volume with gas absorption.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial nitrogen was freed of oxygen by passage through alkaline pyrogallol. Dried thoroughly by passage through $CaSO_4$.

(2) Ethanol. Fractionated and dried with Mg. ρ_2(298.15 K)/kg m⁻³ = 785.08.

(3) 2-Propanone. Treated with Ag_2O, dried with $CaSO_4$ ("Drierite"), and fractionated. ρ_3(298.15 K)/kg m⁻³ = 784.90. Boiling point (760 mmHg)/K = 329.25 - 329.29.

ESTIMATED ERROR: Average deviation of individual measurements from mean was 0.3%; maximum deviation was 0.9%. $\delta x_1/x_1 = \pm\ 0.005$ (evaluator).

REFERENCES:

1. Horiuti, J. *Sci. Papers Inst. Phys. Chem. Research* (Tokyo) 1931, *17*, 125.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

(3) Acetic acid, ethyl ester,
(Ethyl acetate); $C_4H_8O_2$;
[141-78-6]

ORIGINAL MEASUREMENTS:

Nitta, T.; Fujio, J.; Katayama, T.;

J. Chem. Eng. Data. 1978, *23*, 157-9.

VARIABLES:

T/K = 313

Composition

PREPARED BY:

C.L. Young, D. G. T. Thornhill

EXPERIMENTAL VALUES:

T/K	Mole fraction of of alcohol in mixture (before adsorption of nitrogen), x_2	Ostwald coefficient, *L*	Henry's Constant /atm	Mole fraction[a] of nitrogen x_{N_2}
313.15	0.0	0.2059	1242	0.0008052
	0.1000	0.2052	1297	0.0007710
	0.2000	0.2010	1382	0.0007236
	0.3000	0.1983	1465	0.0006826
	0.4000	0.1953	1559	0.0006414
	0.5000	0.1908	1677	0.0005963
	0.6000	0.1863	1810	0.0005525
	0.7000	0.1801	1979	0.0005053
	0.8000	0.1727	2190	0.0004566
	0.9000	0.1653	2437	0.0004103
	1.0	0.1584	2767	0.0003614

[a] Calculated by compiler. The equation $x_{N_2} = 8.15 \times 10^{-4} - 4.46 \times 10^{-4} x_2$ reproduces the nitrogen solubility with an average deviation of 0.7%.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturation of degassed solvent with dry gas. Solubilities were calculated from approximate determinations of gas pressures and volumes. The apparatus was similar to those described by Horiuti (1), Kretschmer et al., (2) and Tokunaga et al., (3). Initially mixed solvent of known composition was degassed by pumping on it while it boiled under reflux. Degassed solvent was then transferred to the absorption vessel and degassed mercury added until the vessel was completely filled. An accurately measured amount of gas was now added to the vessel from a buret, and the mercury displaced to a calibrated mark. The volume of displaced mercury equalled of this latter value from the total volume of the absorption vessel yielded

continued on following page

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen super-pure grade, purity 99.99 mole per cent.

(2) Spectral grade from Nakarai.

(3) Merck Uvasol grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2}/x_{N_2} = \pm 0.008$

REFERENCES:

(1) Horiuti, J. *Sci. Papers Phys. Chem. Research (Tokyo)* 1931, *17*, 125.

(2) Nitta, T.; Tatsuishi, A.; Katayama, T. *J. Chem. Eng. Jap.* 1973, *6*, 475.

continued on following page

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethanol; C_2H_6O; [64-17-5] (3) Acetic acid, ethyl ester, (Ethyl acetate); $C_4H_8O_2$; [141-78-6]	Nitta, T.; Fujio, J.; Katayama, T. *J. Chem. Eng. Data.* 1978, *23*, 157-9.

METHOD/APPARATUS/PROCEDURE:

continued

the volume of solvent. Gas and solvent were mixed by agitation with stirrer bar, and intermittently fresh aliquots of gas were added to the vessel. During dissolution of gas care was taken to avoid diffusion of wet gas and solvent vapour from the absorption vessel to the buret. Final equilibrium was achieved after 1-1½ hours. Corrections were made for increased solvent volume with gas absorption.

REFERENCES:

continued

3. Katayama, T.; Nitta, T.
J. Chem. Eng. Data 1976, *21*, 194.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

(3) 1,1'-oxybisethane
(diethyl ether); $C_4H_{10}O$;
[60-29-7]

ORIGINAL MEASUREMENTS:

Nitta, T.; Fujio, J.; Katayama, T.

J. Chem. Eng. Data 1978, *23*, 157-9 .

VARIABLES:

T/K = 273
Composition

PREPARED BY:

C.L. Young , D. G. T. Thornhill

EXPERIMENTAL VALUES:

T/K	Mole fraction of alcohol in mixture (before adsorption of nitrogen) , x_2	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction[a] of nitrogen x_{N_2}
273.15	0.0	0.2668	835.1	0.001197
	0.1000	0.2562	909.0	0.001100
	0.2000	0.2429	1004	0.0009960
	0.3000	0.2330	1099	0.0009099
	0.4000	0.2180	1236	0.0008091
	0.50000	0.2035	1397	0.0007185
	0.6000	0.1923	1563	0.0006398
	0.7000	0.1778	1797	0.0005565
	0.8000	0.1637	2081	0.0004805
	0.9000	0.1500	2431	0.0004114
	1.0	0.1378	2847	0.0003512

[a] Calculated by compiler. The equation $x_{N_2} = 1.170 \times 10^{-3} - 8.55 \times 10^{-4} x_2$ reproduces the nitrogen solubility with an average deviation of 2.7%.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE :

Saturation of degassed solvent with dry gas. Solubilities were calculated from approximate determinations of gas pressures and volumes. The apparatus was similar to those described by Horiuti (1), Kretschmer et al., (2) and Tokunaga et al., (3). Initially mixed solvent of known composition was degassed by pumping on it while it boiled under reflux. Degassed solvent was then transferred to the absorption vessel and degassed mercury added until the vessel was completely filled. An accurately measured amount of gas was not added to the vessel from a buret, and the mercury displaced to a calibrated mark. The volume of displaced mercury equalled of this latter value from the total volume of the absorption vessel yielded

continued on following page

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen super-pure grade, purity 99.99 mole per cent.

(2) Spectral grade from Nakarai.

(3) Nakarai sample, dried and fractionated.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2}/x_2 = \pm 0.008$

REFERENCES:

1. Horiuti, J. *Sci. Papers Phys. Chem. Research (Tokyo)* 1931, *17*, 125.
2. Nitta, T.; Tatsuishi, A.; Katayama, T. *J. Chem. Eng. Jap.* 1973, *6*, 475.

continued on following page

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethanol; C_2H_6O; [64-17-5] (3) 1,1'-oxybisethane (diethyl ether); $C_4H_{10}O$; [60-29-7]	Nitta, T.; Fujio, J.; Katayama, T. *J. Chem. Eng. Data* 1978, *23*, 157-9.

METHOD/APPARATUS/PROCEDURE:

continued

the volume of solvent. Gas and solvent were mixed by agitation with stirrer bar, and intermittently fresh aliquots of gas were added to the vessel. During dissolution of gas care was taken to avoid diffusion of wet gas and solvent vapour from the absorption vessel to the buret. Final equilibrium was achieved after 1-1½ hours. Corrections were made for increased solvent volume with gas absorption.

REFERENCES:

continued

3. Katayama, T.; Nitta, T.
J. Chem. Eng. Data 1976, *21*, 194.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

(3) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Nitta, T.; Fujio, J.; Katayama, T.

J. Chem. Eng. Data. 1978, *23*, 157-9.

VARIABLES:

$T/K = 298$

Composition

PREPARED BY:

C.L. Young, D. G. T. Thornhill

EXPERIMENTAL VALUES:

T/K	Mole fraction of alcohol in mixture (before adsorption of nitrogen), x_2	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction[a] of nitrogen x_{N_2}
298.15	0.0	0.1238	2211	0.0004523
	0.1000	0.1262	2245	0.0004454
	0.2000	0.1284	2287	0.0004373
	0.3000	0.1309	2330	0.0004292
	0.4000	0.1317	2408	0.0004153
	0.5000	0.1330	2488	0.0004019
	0.6000	0.1346	2562	0.0003903
	0.7000	0.1379	2615	0.0003824
	0.8000	0.1409	2683	0.0003727
	0.9000	0.1443	2750	0.0003636
	1.0	0.1494	2793	0.0003580

[a] Calculated by compiler. The equation $x_{N_2} = 4.54 \times 10^{-4} - 1.00 \times 10^{-4} x_2$ reproduces the nitrogen solubility with an average deviation of 0.6%.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE

Saturation of degassed solvent with dry gas. Solubilities were calculated from approximate determinations of gas pressures and volumes. The apparatus was similar to those described by Horiuti (1), Kretschmer et al., (2) and Tokunaga et al., (3). Initially mixed solvent of known composition was degassed by pumping on it while it boiled under reflux. Degassed solvent was then transferred to the absorption vessel and degassed mercury added until the vessel was completely filled. An accurately measured amount of gas was not added to the vessel from a buret, and the mercury displaced to a calibrated mark. The volume of displaced mercury equalled of this latter value from the total volume of the absorption vessel yielded

continued on following page

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen super-pure grade, purity 99.99 mole per cent.

(2) Spectral grade from Nakarai.

(3) Merck Uvasol grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2}/x_{N_2} = \pm 0.008$

REFERENCES:

(1) Horiuti, J. *Sci. Papers Phys. Chem. Research (Tokyo)* 1931, *17*, 125.

(2) Nitta, T.; Tatsuishi, A.; Katayama, T. *J. Chem. Eng. Jap.* 1973, *6*, 475.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethanol; C_2H_6O; [64-17-5] (3) Benzene; C_6H_6; [71-43-2]	Nitta, T.; Fujio, J.; Katayama, T. *J. Chem. Eng. Data.* 1978, *23*, 157-9.

METHOD/APPARATUS/PROCEDURE

continued

the volume of solvent. Gas and solvent were mixed by agitation with stirrer bar, and intermittently fresh aliquots of gas were added to the vessel. During dissolution of gas care was taken to avoid diffusion of wet gas and solvent vapour from the absorption vessel to the buret. Final equilibrium was achieved after 1-1½ hours. Corrections were made for increased solvent volume with gas absorption.

REFERENCES:

continued

3. Katayama, T.; Nitta, T.
J. Chem. Eng. Data 1976, *21*, 194.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol or Ethyl Alcohol; C_2H_6O; [64-17-5]

(3) 2,2,4-Trimethylpentane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

$T/K = 273.15 - 323.15$

$p/kPa = 101.325$

$C_2H_6O/x_2 = 0.739$

PREPARED BY:

D. G. T. Thornhill

EXPERIMENTAL VALUES:

T/K	Ethanol Mol Fraction x_2	Nitrogen Mol Fraction 10^4x_1	Nitrogen Ostwald Coefficient $L_1/cm^3 cm^{-3}$
273.15	0.739	6.71	0.1785
298.15	0.739	6.87	0.1939
323.15	0.739	7.06	0.2100

Smoothing equation:

$\Delta G_1^\circ/J\ mol^{-1} = -RT \ln x_1/J\ mol^{-1} = A + BT/K.$

Coefficients in the smoothing equation, $A = \Delta H_1^\circ/J\ mol^{-1}$ and $-B = \Delta S_1^\circ/J\ mol^{-1}\ K^{-1}$, and standard deviation, σ_d, were determined by least-squares analysis.

$\sigma_d = \left(\Sigma(\Delta G_1^\circ(calc) - \Delta G_1^\circ)^2/(N-1)\right)^{\frac{1}{2}}$, N being the number of experimental values.

$\Delta H_1^\circ/J\ mol^{-1} = 749$

$\Delta S_1^\circ/J\ mol^{-1}\ K^{-1} = -58.0$

$\sigma_d/J\ mol^{-1} = 9$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturation of degassed solvent with dry gas. Solubilities were calculated from appropriate determinations of gas pressures and volumes, and of solvent volumes and vapour pressures.

The apparatus was similar to that of Horiuti (1). Solvent was initially degassed by boiling it under reflux. Then it was transferred to the evacuated absorption vessel, and degassing completed by pumping on it under vacuum. Mercury was now added to the vessel until it was completely filled. An accurately measured amount of gas was then added to the vessel from a buret until the mercury was displaced to a calibrated mark. The volume of displaced mercury equalled the gas phase volume. Subtraction of this latter value from the total volume of the absorption vessel yielded the volume of solvent. Gas and solvent were mixed by agitation with a stirrer, and intermittently fresh aliquots of gas were added to the vessel. During dissolution of gas care was taken to avoid diffusion of wet gas and solvent vapour from the absorption vessel to the buret. Final equilibrium was achieved after 1-3 hours. Corrections were made for increased solvent volume with gas absorption.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial nitrogen was freed of oxygen by passage through alkaline pyrogallol. Dried thoroughly by passage through $CaSO_4$.

(2) Ethanol. Fractionated and dried with Mg. $\rho_2(298.15\ K)/kg\ m^{-3} = 785.08$.

(3) 2,2,4-Trimethypentane. Certified material dried with $CaSO_4$, and fractionated. $\rho_3(298.15\ K)/kg\ m^{-3} = 687.74$. Boiling point (760 mmHg)/K=372.39.

ESTIMATED ERROR: Average deviation of individual measurements from mean was 0.3%; maximum deviation was 0.9%. $\delta x_1/x_1 = \pm\ 0.005$ (evaluator).

REFERENCES:

1. Horiuti, J. *Sci. Papers Inst. Phys. Chem. Research* (Tokyo) 1931, *17*, 125.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Propanone or acetone; C_3H_6O; [67-64-1]

(3) Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

T/K = 273.15 - 323.15
P/kPa = 101.325
Ethanol/vol % = 50

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
273.15	0.1427	0.1427
298.15	0.1474	0.1609
323.15	0.1546	0.1829

The Ostwald coefficients were measured at a total pressure of 101.325 kPa (1 atm). The compiler calculated the Bunsen coefficient value for an oxygen partial pressure of 101.325 kPa (1 atm) assuming the Ostwald coefficient was independent of pressure.

The solvent is acetone in ethanol, 50 per cent by volume.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that of Horiuti (1), it consisted of a gas buret, manometer, and absorption pipet equipped with a magnetic stirrer. All volumes were calibrated by mercury displacement.

The solvent was partly degassed by boiling under reflux. About 40 cm^3 of solvent was admitted into the absorption pipet, and pumped on to complete the degassing. Dry gas, measured in the buret, was admitted, final equilibrium was established after 1 to 3 hours stirring. During the solution process the total pressure was kept at one atm by additions of dry gas.

The solubility value was corrected for the increase of solvent volume with gas absorption

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial, but source not given. Passed through alkaline pyrogallol to remove O_2, passed through Drierite to dry.

(2) 2-Propanone. Source not given. Treated with Ag_2O, dried over $CaSO_4$, distilled, b.p. (760 mmHg)/°C 56.10-56.14, density, ρ_4^{25}/g cm^{-3} 0.78490

(3) Ethanol. Source not given. Dried with Mg. Density, ρ/g cm^{-3} 0.78508.

ESTIMATED ERROR:

Gas buret $\delta V/cm^3 = 0.005$
Average deviation from the mean 0.3%, maximum deviation 0.9% (authors).

REFERENCES:

1. Horiuti, J.
J. Sci Papers Inst. Phys. Chem. Res. (Tokyo) 1931, *17*, 125-256.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Propanol; C_3H_8O; [71-23-8]

(3) Pentane, 2,2,4-trimethyl-, C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Nitta, T.; Tatsuishi. A.; Katayama, T.

J. Chem. Eng. Japan 1973, *6*, 475-80.

VARIABLES:

T/K = 298
Composition

PREPARED BY:

C.L. Young , D. G. T. Thornhill

EXPERIMENTAL VALUES:

T/K	Mole fraction of 1-propanol in soln. before saturation. x_2	Ostwald coefficient, L	Henry's Law Constant /atm	Mole fraction[a] of nitrogen x_{N_2}
298.15	0.0000	0.2255	653.8	0.001530
	0.1000	0.2207	706.2	0.001416
	0.2000	0.2157	766.7	0.001304
	0.3000	0.2110	834.6	0.001198
	0.4000	0.2052	918.7	0.001088
	0.5000	0.1973	1028	0.0009727
	0.6000	0.1874	1170	0.0008547
	0.7000	0.1753	1363	0.0007336
	0.8000	0.1622	1616	0.0006188
	0.9000	0.1474	1971	0.0005073
	1.0000	0.1312	2482	0.0004029

[a] Calculated by compiler. The equation $x_{N_2} = 1.534 \times 10^{-3} - 1.135 \times 10^{-3} x_2$ reproduces the nitrogen solubility with an average deviation of 0.6%.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE

Saturation of degassed solvent with dry gas. Solubilities were calculated from approximate determinations of gas pressures and volumes. The apparatus was similar to those described by Horiuti (1), Kretschmer et al., (2) and Tokunaga et al., (3). Initially mixed solvent of known composition was degassed by pumping on it while it boiled under reflux. Degassed solvent was then transferred to the absorption vessel and degassed mercury added until the vessel was completely filled. An accurately measured amount of gas was not added to the vessel from a buret, and the mercury displaced to a calibrated mark. The volume of displaces mercury equalled of this latter value from the total volume of the absorption vessel yielded the

continued on following page

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen super-pure grade of purity 99.9995 mole per cent.

(2) Nakarai Chemical sample dried and fractionated, purity about 99.9 mole per cent.

(3) Nakarai Chemical sample dried and fractionated, purity better than 99.98 mole per cent

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x/x = \pm 1\%$
(estimated by compiler.)

REFERENCES:

(1) Horiuti, J. *Sci. Papers Inst. Phys. Chem. Research (Tokyo)* 1931, *17*, 125.

(2) Kretschmer, C. B.; Nowakowska, J.; Wiebe, R. *Ind. Eng. Chem.* 1946, *38*, 506.

continued on following page

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) 1-Propanol; C_3H_8O; [71-23-8] (3) Pentane, 2,2,4-trimethyl-, C_8H_{18}; [540-84-1]	Nitta, T.; Tatsuishi, A.; Katayama, T. *J. Chem. Eng. Japan* 1973, *6*, 475-80.

METHOD/APPARATUS/PROCEDURE:

continued

volume of solvent. Gas and solvent were mixed by agitation with stirrer bar, and intermittently fresh aliquots of gas were added to the vessel. During dissolution of gas care was taken to avoid diffusion of wet gas and solvent vapour from the absorption vessel to the buret. Final equilibrium was achieved after 1-1½ hours. Corrections were made for increased solvent volume with gas absorption.

REFERENCES:

continued

3. Tokunaga, J.; Nitta, T.; Katayama, T.
Kagaku Kogaku 1969, *33*, 775.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

(3) Pentane, 2,2,4-trimethyl-;
C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Nitta, T.; Tatsuishi, A.;
Katayama, T.

J. Chem. Eng. Japan 1973, *6*, 475-80.

VARIABLES:

T/K = 298
Composition

PREPARED BY:

C.L. Young, D. G. T. Thornhill

EXPERIMENTAL VALUES:

T/K	Mole fraction of cyclohexane in soln. before saturation, x_2	Ostwald coefficient, L	Henry's Law Constant /atm	Mole fraction[a] of nitrogen, x_{N_2}
298.15	0.0000	0.2255	653.8	0.001530
	0.1000	0.2216	689.0	0.001451
	0.2000	0.2168	730.4	0.001369
	0.3000	0.2131	771.6	0.001296
	0.4000	0.2084	820.2	0.001219
	0.5000	0.2040	873.1	0.001145
	0.6000	0.1984	936.8	0.001067
	0.7000	0.1923	1010	0.000990
	0.8000	0.1857	1096	0.0009124
	0.9000	0.1780	1201	0.0008326
	1.0000	0.1705	1320	0.0007575

[a] Calculated by compiler. The equation $x_1 = 1.528 \times 10^{-3} - 7.70 \times 10^{-4} x_2$ reproduces the nitrogen solubility with an average deviation of 0.1%.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE

Saturation of degassed solvent with dry gas. Solubilities were calculated from approximate determinations of gas pressures and volumes. The apparatus was similar to those described by Horiuti (1), Kretschmer et al., (2) and Tokunaga et al., (3). Initially mixed solvent of known composition was degassed by pumping on it while it boiled under reflux. Degassed solvent was then transferred to the absorption vessel and degassed mercury added until the vessel was completely filled. An accurately measured amount of gas was now added to the vessel from a buret, and the mercury displaced to a calibrated mark. The volume of displaced mercury equalled of this latter value from the total volume of the absorption vessel yielded

continued on following page

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen super-pure grade of purity 99.9995 mole per cent.

(2) Wako Pure Chemical sample, purity better than 99.9 mole per cent.

(3) Nakarai Chemical sample dried and fractionated, purity better than 99.98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x/x = \pm 1\%$
(estimated by compiler).

REFERENCES:

1. Horiuti, J. *Sci. Papers Inst. Phys. Chem. Research (Tokyo)* 1931, *17*, 125.
2. Kretschmer, C.B.; Nowakowska, J. Wiebe, R. *Ind. Eng. Chem.* 1946, *38*, 506.

continued on following page

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Cyclohexane; C_6H_{12}; [110-82-7] (3) Pentane, 2,2,4-trimethyl-; C_8H_{18}; [540-84-1]	Nitta, T.; Tatsuishi, A.; Katayma, T. *J. Chem. Eng. Japan* 1973, *6*, 475-80.

METHOD/APPARATUS/PROCEDURE

continued

the volume of solvent. Gas and solvent were mixed by agitation with stirrer bar, and intermittently fresh aliquots of gas were added to the vessel. During dissolution of gas care was taken to avoid diffusion of wet gas and solvent vapour from the absorption vessel to the buret. Final equilibrium was achieved after 1-1½ hours. Corrections were made for increased solvent volume with gas absorption.

REFERENCES:

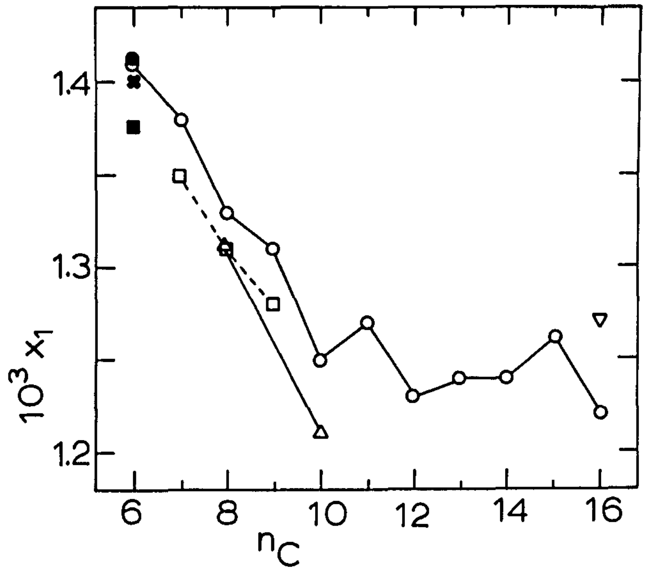
continued

3. Tokunaga, J.; Nitta, T.; Katayama, T.
Kagaku Kogaku 1969, *33*, 775.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) n-Alkanes and 2,2,4-Trimethylpentane	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

The solubility of nitrogen in saturated hydrocarbons has been studied by a number of workers at pressures below two bars. (For critical evaluations of these systems at higher pressures see the high pressure section.) The figure below shows the data of Makranczy, et al. (1)-○; Gjaldbaek and Hildebrand (2)-✕; Patyi, et al. (3)-●; Thomsen and Gjaldbaek (4)-□; Wilcock, et al. (5)-△; Katayama and Nitta (6)-■; and Tremper and Prausnitz (7)-▽ for the n-alkanes. For carbon numbers six through ten the Makranczy, et al., values are significantly higher than those of other workers. (The data of Guerry (8) and Ijams (9) were very low and/or erratic and were not graphed.) Obviously, these systems await a definitive study.



The data for the individual n-alkanes and 2,2,4-trimethylpentane (isooctane)will be discussed individually below.

Nitrogen in n-Hexane

The solubility of nitrogen in n-hexane was determined by five groups (1,2,3,6,8) but Guerry's datum (8) was much too low to be considered. We used the data of the other four groups, rejecting the 313.15 K value from reference 1 to end up with nine points in the temperature range 213.15 to 298.15 K. These data were smoothed to yield

$$\ln x_1 = -6.39422 - 0.553875/(T/100\text{K}) \qquad (1)$$

The standard deviation in $\ln x_1$ was 0.016. Smoothed recommended values at 10 K intervals are given below.

T/K	$10^3 x_1$	T/K	$10^3 x_1$
213.15	1.29	263.15	1.35
223.15	1.30	273.15	1.36
233.15	1.32	283.15	1.37
243.15	1.33	293.15	1.38
253.15	1.34	298.15	1.39

continued on following page

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) n-Alkanes and 2,2,4-Trimethylpentane	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

continued

The thermodynamic properties are $\Delta\bar{H}°=461$ J mol^{-1} and $\Delta\bar{S}°=-53$ J K^{-1} mol^{-1} and are independent of temperature.

Nitrogen in n-Heptane

The solubility of nitrogen in n-heptane was determined by four groups (1,4,8,9) but we selected the work of Thomsen and Gjaldbaek (4) as being the most reliable. The smoothed data from their paper in the range 298 to 308 K are given by:

$$\ln x_1 = -6.04777 - 1.66951/(T/100K) \qquad (2)$$

The standard deviation in $\ln x_1$ was 0.0049. The smoothed mole fraction at 298.15 K is 1.35×10^{-3}. The thermodynamic properties are $\Delta\bar{H}°=1388$ J mol^{-1} and $\Delta\bar{S}°=-50$ J K^{-1} mol^{-1}.

Nitrogen in n-Octane

This system was studied by four workers (1,4,5,9) and the results obtained by Thomsen and Gjaldbaek (4) and Wilcock et al., (5) were selected as the most reliable. Smoothing these results in the range 298 to 308K yielded:

$$\ln x_1 = -5.98284 - 1.94827/(T/100K) \qquad (3)$$

The standard deviation in $\ln x_1$ was 0.0053. $\Delta\bar{H}°=1620$ J mol^{-1} and $\Delta\bar{S}°=-49$ J K^{-1} mol^{-1}.

Nitrogen in n-Nonane

The Thomsen and Gjaldbaek (4) data were the only ones which we considered reliable, but they only determined the solubility at 298.15K. The average of the values is $x_1 = 1.28 \times 10^{-3}$. The Makranczy, et al., (1) values show too great a temperature dependence when compared with other workers and are to be treated as tentative until further checks are made.

Nitrogen in n-Decane

Wilcock, et al.'s values (5) are the most reliable for this system. The other two sets of results (1,9) were not used. Smoothing of Wilcock, et al's three points yields:

$$\ln x_1 = -6.82876 + 0.340428/(T/100K) \qquad (4)$$

This is for the range 283 to 313K. The standard deviation in $\ln x_1$ is 0.00052. Smoothed values at 5K intervals follow.
$\Delta\bar{H}°=-283$ J mol^{-1} and $\Delta\bar{S}°=-56.8$ J K^{-1} mol^{-1}.

continued on following page

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) n-Alkanes and 2,2,4-Trimethylpentane	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

continued

T/K	10^3x_1	T/K	10^3x_1
283.15	1.220	303.15	1.211
288.15	1.218	308.15	1.209
293.15	1.215	313.15	1.206
298.15	1.213		

Nitrogen in 2,2,4-Trimethylpentane

For this system we used the results of Kretschmer, et al., (10) and Baldwin and Daniel (11) rejecting Ijams single value (9). Over the temperature range 248 to 323 K the smoothing equation is:

$$\ln x_1 = -6.30691 - 0.503860/(T/100K) \qquad (5)$$

with a standard deviation of 0.014 in ln x_1. Smoothed values at 10K intervals follow.

T/K	10^3x_1	T/K	10^3x_1
248.15	1.49	298.15	1.54
258.15	1.50	308.15	1.55
268.15	1.51	318.15	1.56
278.15	1.52	328.15	1.56
288.15	1.53		

$\Delta\bar{H}°=-419$ J mol^{-1} and $\Delta\bar{S}°=-52$ J K^{-1} mol^{-1}.

Nitrogen in n-Hexadecane

The data reported by Tremper and Prausnitz (7) are considered the most reliable here; that of Makranczy, et. al., (1) not being used. The smoothing equation is:

$$\ln x_1 = -5.54557 - 3.45285/(T/100K) \qquad (6)$$

with a standard deviation of 0.019 in ln x_1. Smoothed values are at 25K intervals for the range 300 to 475 K. $\Delta\bar{H}°=2871$ J mol^{-1} and $\Delta\bar{S}°=-46$ J K^{-1} mol^{-1}:

T/K	10^3x_1	T/K	10^3x_1
300	1.24	400	1.65
325	1.35	425	1.73
350	1.46	450	1.81
375	1.55	475	1.89

References

1. Makranczy, J.; Megyery-Balog, Mrs. K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269-80.
2. Gjaldbaek, J. C.; Hildebrand, J. H. *J. Am. Chem. Soc.* 1949, *71*, 3147-50.
3. Patyi, L.; Furmer, I. E.; Makranczy, J.; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M. G. *Zh. Prikl. Khim.* 1978, *51*, 1296-1300.

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COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) n-Alkanes and 2,2,4-Trimethylpentane	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

continued

4. Thomsen, E. S.; Gjaldbaek, J. C. *Acta. Chem. Scand.* 1963, *17*, 127-33.
5. Wilcock, R. J.; Battino, R.; Danforth, W. F.; Wilhelm, E. *J. Chem. Thermodyn.* 1978, *10*, 817-22.
6. Katayama, T.; Nitta, T. *J. Chem. Eng. Data* 1976, *21*, 194-6.
7. Tremper, K. K.; Prausnitz, J. M. *J. Chem. Eng. Data* 1976, *21*, 295-9.
8. Guerry, D. Jr. Ph. D. Thesis 1944, Vanderbilt University, Nashville, TN.
9. Ijams, C. C. Ph. D. Thesis 1941, Vanderbilt University, Nashville, TN.
10. Kretschmer, C. B.; Nowakowska, J.; Wiebe, R. *Ind. Eng. Chem.* 1946, *38*, 506-9.
11. Baldwin, R. R.; Daniel, S. G. *J. Appl. Chem.* 1952, *2*, 161-5; *J. Inst. Petrol., London* 1953, *39*, 105-24.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Pentane; C_5H_{12}; [109-66-0]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs. K; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*(2), 269-280.

VARIABLES:

T/K = 298.15 -
Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.45	0.280	0.306
313.15	1.23	0.232	0.266

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -8{,}516 + 82.91T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hexane; C_6H_{14}; [110-34-3]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Hildebrand, J. H.

J. Am. Chem. Soc. 1949, *71*, 3147-50.

VARIABLES:

T/K = 298.10 - 298.45

Total P/kPa = 101.325

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.10	1.40	0.241	0.263
298.45	1.39	0.237	0.259

One value from the paper was rejected.

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Stuart Oxygen Co. 99.996 percent N_2.

(2) Hexane. Phillips Petroleum Co. Research grade.

ESTIMATED ERROR:

$\delta T/K = 0.05$

$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.

2. Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem. Eng. Data. 1976, *21*, 194-6.

VARIABLES:

T/K = 213-298

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction* of nitrogen in liquid, x_{N_2}
298.15	0.256	727	0.001376
273.15	0.235	749	0.001335
253.15	0.219	764	0.001309
233.15	0.206	766	0.001305
213.15	0.195	758	0.001319

* at a partial pressure of 1 atmosphere

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with equilibrium cell of approximately 0.08 litres. Magnetic stirrer. Solvent carefully degassed. Equilibrium established in 1-1.5 hours. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen Co. sample, purity 99.9995 mole per cent.

(2) Merck Uvasol spectral grade sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at $T = 213.15$K, ± 0.05 at other temperatures; $\delta x_{N_2} = \pm 1\%$

REFERENCES:

1. Nitta, T.; Tatsuishi. A.; Katayama, T. *J. Chem. Eng. Jpn.* 1973, *6*, 475.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs.K; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*(2), 269-280.

VARIABLES:

T/K = 298.15 - 313.15
Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.41	0.240	0.262
313.15	1.17	0.195	0.223

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -9,655 + 86.96T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS;

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Patyi, L; Furmer, I. E.; Makranczy, J.; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M. G.

Zh. Prikl. Khim. 1978, *51*, 1296-1300.

VARIABLES:

T/K = 298

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	α^*	Mole fraction of nitrogen at a partial pressure of 101.325 kPa
298.15	0.241	0.001411

* volume of gas (measured at 101.325 kPa and 273.15 K) dissolved by one volume of hexane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. Pressure measured when known amounts of gas were added, in increments, to a known amount of liquid in a vessel of known dimensions. Corrections were made for the partial pressure of solvent. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

Purity better than 99 mole per cent as determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta\alpha = \pm 4\%$ or less.

REFERENCES:

1. Bodor, E.; Bor, G. J.; Mohai, B.; Sipos, G. *Veszpremi. Vegyip. Egy. Kozl.* 1957, *1*, 55.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Alkanes; C_6H_{14} and C_7H_{16}

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

VARIABLES:

T/K = 293.15, 298.15
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
Hexane; C_6H_{14}; [110-54-3]			
293.15	12.6	0.217	0.233
298.15	12.5	0.213	0.232
Heptane; C_7H_{16}; [142-82-5]			
293.15	12.3	0.189	0.203
298.15	12.4	0.189	0.206

The Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified (2) so that small solvent samples (2 cm^3) could be used with almost complete recovery of the sample.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Ohio Chemical Co. Oil pumped, 99.8 per cent pure.

(2) Alkanes. Distilled from sodium in air. In addition to the solubility data the thesis contains data of the refractive index, density, vapor pressure, and b.p.

SOURCE AND PURITY OF MATERIALS:

Hexane. Eastman Kodak Co.
B.p. (760.3 mmHg) t/°C 68.85 - 68.90.

Heptane. B.p. (753.9 mmHg) t/°C 98.27 - 98.28 (corr.).

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D.
J. Biol. Chem. 1939, *130*, 545.

2. Ijams, C. C.
Ph.D. thesis, 1941
Vanderbilt University

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Thomsen, E. S.; Gjaldbaek, J. C.

Acta Chem. Scand. 1963, *17*, 127-33.

VARIABLES:

T/K = 298.15 - 308.35

Total P/kPa = 101.325

PREPARED BY:

E. S. Thomsen

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.35	0.205	0.224
298.15	1.36	0.207	0.226
298.25	1.34	0.204	0.223
298.25	1.35	0.205	0.224
308.15	1.38	0.207	0.223
308.35	1.37	0.206	0.232

The mole fraction and Ostwald solubility values were calculated by the compiler.

Smoothed Data: $\Delta G^\circ/J\ mol^{-1} = -RT\ ln\ X_1 = 1398.1 + 50.250\ T$

Std. dev. $G^\circ = 13.3$, Coef. Corr. = 0.9938

$\Delta H^\circ/J\ mol^{-1} = 1398.1$, $\Delta S^\circ/J\ K^{-1}\ mol^{-1} = -50.250$.

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^\circ/J\ mol^{-1}$
298.15	1.35	16,380
303.15	1.36	16,631
308.15	1.37	16,882

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorped volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Contained 0.2 percent Ar, but no O_2.

(2) Heptane. Merck Co. Distillation range 0.09 K.

ESTIMATED ERROR:

$\delta T/K = 0.05$

$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

2. Gjaldbaek, J. C.
Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Heptane; C_7H_{16}; [142-82-5]	ORIGINAL MEASUREMENTS: Makranczy, J.; Megyery-Balog, Mrs. K.; Rusz, L.: Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*(2), 269-80.
VARIABLES: T/K = 298.15 - 313.15 Total P/kPa = 101.325	PREPARED BY: S. A. Johnson H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.38	0.210	0.229
313.15	1.05	0.157	0.180

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -14,143 + 102.19T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Volumetric method, described in detail in reference (1).	SOURCE AND PURITY OF MATERIALS: Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.
	ESTIMATED ERROR: $\delta X_1/X_1 = 0.03$
	REFERENCES: 1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Alkanes; C_7H_{16}, C_8H_{18}, and $C_{10}H_{22}$

ORIGINAL MEASUREMENTS:

Ijams, C. C.

Ph.D. thesis, 1941
Vanderbilt University
Nashville, TN

VARIABLES:

T/K = 298.15
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
Heptane; C_7H_{16}; [142-82-5]			
298.15	1.22	0.186	0.203
Octane; C_8H_{18}; [111-65-9]			
298.15	1.14	0.157	0.171
2,2,4-Trimethylpentane or isooctane; C_8H_{18}; [540-84-1]			
298.15	1.48	0.200	0.218
Decane; $C_{10}H_{22}$; [124-18-5]			
298.15	1.23	0.141	0.154

The mole fraction and Ostwald coefficient values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified so that small solvent sample (2 cm^3) could be used with almost 100 per cent recovery of the solvent.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. Purity 99.5 per cent.

(2) Alkanes. Purified. Vapor pressure and boiling point also reported in the thesis.

ESTIMATED ERROR:

δT/K = 0.05

REFERENCES:

1. Van Slyke, D. D. *J. Biol. Chem.* 1939, *130*, 545.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Thomsen, E. S.; Gjaldbaek, J. C.

Acta Chem. Scand. 1963, *17*, 127-33.

VARIABLES:

$T/K = 298.15 - 308.05$

Total $P/kPa = 101.325$

PREPARED BY:

E. S. Thomsen

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.31	0.180	0.196
298.25	1.29	0.177	0.193
298.25	1.32	0.181	0.198
298.25	1.32	0.181	0.198
298.45	1.30	0.178	0.194
308.05	1.34	0.182	0.205

The mole fraction and Ostwald solubility values were calculated by the compiler.

Smoothed Data: $\Delta G^{o}/J\ mol^{-1} = -RT \ln X_1 = 1961.0 + 48.628\ T$

$\Delta H^{o}/J\ mol^{-1} = 1961.0$, $\Delta S^{o}/J\ K^{-1}\ mol^{-1} = -48.628$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^{o}/J$ mol
298.15	1.31	16,459
303.15	1.32	16,702
308.15	1.34	16,946

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Contained 0.2 percent Ar, but no O_2.

(2) Octane. British Drug House. Fractionated, distillation range 0.02 K. About 1 percent impurity.

ESTIMATED ERROR:

$\delta T/K = 0.05$

$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

2. Gjaldbaek, J. C.
Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Octane; C_8H_{18}; [111-65-9]	Makranczy, J.; Megyery-Balog, Mrs.K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*(2),269-80.
VARIABLES:	PREPARED BY:
T/K = 298.15 - 313.15 Total P/kPa = 101.325	S. A. Johnson H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.33	0.182	0.199
313.15	1.04	0.140	0.161

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -12{,}728 + 97.75T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; Battino, R.; Danforth, W. F.; Wilhelm, E.

J. Chem. Thermodyn. 1978, *10*, 817-22.

VARIABLES:

T/K = 298.25
P/kPa = 101.325

PREPARED BY:

A. L. Cramer

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.25	1.311	0.1800	0.1965

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. 99.999 per cent.

(2) Octane. Phillips Petroleum Co. 99 mol %, distilled, density $\rho_{298.15} = 0.6988$.

ESTIMATED ERROR:

$\delta T/K = 0.02$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.01$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2,2,4-Trimethylpentane or iso-octane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowaska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

T/K = 248.15 - 323.15
P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
248.15	1.496	0.2139	0.1943
273.15	1.503	0.2083	0.2088
298.15	1.533	0.2069	0.2258
323.15	1.583	0.2073	0.2452

The Ostwald coefficients were measured at a total pressure of 101.325 kPa (1 atm). The compiler calculated the Bunsen coefficient and mole fraction values for an oxygen partial pressure of 101.325 kPa (1 atm) assuming the Ostwald coefficient was independent of pressure.

Smoothed Data: $\ln x_1 = -6.2753 - 0.5891/(T/100\ K)$

Standard error about the regression line = 1.84×10^{-5}

T/K	Mol Fraction $x_1 \times 10^3$
253.15	1.491
263.15	1.505
273.15	1.517
283.15	1.529
293.15	1.540
298.15	1.545
303.15	1.550
313.15	1.559
323.15	1.569

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that of Horiuti (1), it consisted of a gas buret, manometer, and absorption pipet equipped with a magnetic stirrer. All volumes were calibrated by mercury displacement.

The solvent was partly degassed by boiling under reflux. About 40 cm^3 of solvent was admitted into the absorption pipet, and pumped on to complete the degassing. Dry gas, measured in the buret, was admitted, final equilibrium was established after 1 to 3 hours stirring. During the solution process the total pressure was kept at one atm by additions of dry gas.

The solubility value was corrected for the increase of solvent volume with gas absorption, and for the nitrogen impurity in the oxygen.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial, but source not given. Passed through alkaline pyrogallol to remove O_2, passed through Drierite to dry.

(2) 2,2,4-Trimethylpentane. "Certified material," source not given. Dried over $CaSO_4$, distilled, b.p. (760 mmHg)/°C 99.24, density, ρ_4^{25}/g cm^{-3} 0.68774.

ESTIMATED ERROR:

Gas buret $\delta V/cm^3 = 0.005$
Average deviation from the mean 0.3%, maximum deviation 0.9% (authors).

REFERENCES:

1. Horiuti, J.
J. Sci Papers Inst. Phys. Chem. Res. (Tokyo) 1931, *17*, 125.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2,2,4-Trimethylpentane (Isooctane); C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Baldwin, R. R.; Daniel, S. G.;

J. Appl. Chem. 1952, *2* (Apr.), 161-5.

J. Inst. Petrol. London 1953, *39*, 105-124.

VARIABLES:

$T/K = 293.15$

$P/kPa = 101.325$

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	1.55	0.211	0.226

The mole fraction solubility was calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method consists of two operations: Saturation of the liquid with the gas under consideration; and determination of the amount of dissolved gas in the liquid saturated with the gas. All gases were passed through a liquid air trap to remove water and CO_2 vapors before passage through the liquid. All gases were passed through a long coil, thermostated, before the saturation process.

Oil or similar liquid is deaerated by passing it through a continuously evacuated vessel. Gas is then passed through the liquid to saturation. Liquid is then degassed, and transfered to a storage burette, disconnected from the degassing apparatus, thermostated, and saturated with the desired gas. Burette is now connected to another degassing apparatus, portions of the oil degassed and gas collected.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. From commercial cylinders, and gas analysis on a Bone and Wheeler apparatus shows it to be at least 99.5% pure; no source given.

(2) 2,2,4-Trimethylpentane. No information given.

ESTIMATED ERROR:

$\delta P/P = 0.01$
$\delta\alpha/\alpha = 0.01$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Nonane; C_9H_{20}; [111-84-2]

ORIGINAL MEASUREMENTS:

Thomsen, E. S.; Gjaldbaek, J. C.

Acta Chem. Scand. 1963, *17*, 127-33.

VARIABLES:

T/K = 298.15 - 298.25
Total P/kPa = 101.325

PREPARED BY:

E. S. Thomsen

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.28	0.160	0.175
298.15	1.28	0.160	0.175
298.15	1.29	0.161	0.176
298.25	1.28	0.160	0.175

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Contained 0.2 percent Ar, but no O_2.

(2) Nonane. Fluka "purum". Fractionated, distillation range 0.08 K.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

2. Gjaldbaek, J. C.
Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Nonane; C_9H_{20}; [111-84-2]	ORIGINAL MEASUREMENTS: Makranczy, J.; Megyery-Balog, Mrs.K; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* <u>1976</u>, *4*(2), 269-80.
VARIABLES: T/K = 298.15 - 313.15 Total P/kPa = 101.325	PREPARED BY: S. A. Johnson H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.31	0.163	0.178
313.15	1.03	0.126	0.145

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -12,446 + 96.93T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* <u>1957</u>, *1*, 55. *Chem. Abstr.* <u>1961</u>, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs.K; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*(2), 269-80.

VARIABLES:

T/K = 298.15 - 313.15
Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.25	0.143	0.156
313.15	1.02	0.114	0.131

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -10,525 + 90.88T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; Battino, R.; Danforth, W. F.; Wilhelm, E.

J. Chem. Thermodyn. 1978, *10*, 817-22.

VARIABLES:

$T/K = 283.18 - 313.19$
$P/kPa = 101.325$

PREPARED BY:

H. L. Clever
A. L. Cramer

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
283.18	1.220	0.1419	0.1471
298.11	1.214	0.1391	0.1518
313.19	1.206	0.1360	0.1559

The Bunsen coefficients were calculated by the compiler.

The solubility values were adjusted to 101.325 kPa (1 atm) assuming Henry's law.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -284.6 + 56.782\ T$

Std. Dev. $\Delta G^o = 1.6$, Coef. Corr. = 0.9999

$\Delta H^o/J\ mol^{-1} = -284.6$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -56.782$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
278.15	1.22	15,509
288.15	1.22	16,077
298.15	1.21	16,665
308.15	1.21	17,213
318.15	1.20	17,780

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. 99.999 per cent.

(2) Decane. Phillips Petroleum Co. 99 mol % distilled, density, $\rho_{298.15} = 0.7264$.

ESTIMATED ERROR:

$\delta T/K = 0.02$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.01$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc*, 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Undecane; $C_{11}H_{24}$; [1120-21-4]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs. K; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*, 269-80.

VARIABLES:

T/K = 298.15 - 313.15
Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.27	0.134	0.146
313.15	1.02	0.106	0.122

Smoothed Data: $\Delta G^{o}/J\ mol^{-1} = -RT \ln X_1 = -11,346 + 93.50T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Oswald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases).
No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen, N_2; [7727-37-9]

(2) Dodecane; $C_{12}H_{26}$; [112-40-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs. K; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*(2), 269-80.

VARIABLES:

T/K = 298.15 - 313.15
Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.23	0.121	0.132
313.15	0.95	0.092	0.105

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT\ ln\ X_1 = -13,367 + 100.55T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Tridecane; $C_{13}H_{28}$; [629-50-5]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs. K; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*(2), 269-80.

VARIABLES:

T/K = 298.15 - 313.15
Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.24	0.114	0.124
313.15	0.97	0.087	0.100

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -12{,}708 + 98.27T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient is independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Tetradecane; $C_{14}H_{30}$; [629-59-4]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs. K;
Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4* (2),
269-80.

VARIABLES:

T/K = 298.15 - 313.15
Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.24	0.106	0.116
313.15	0.95	0.080	0.092

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -13,785 + 101.88T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler for a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient was independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases).
No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Pentadecane; $C_{15}H_{32}$; [629-62-9]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs. K; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*(2), 269-80.

VARIABLES:

T/K = 298.15 - 313.15

Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.26	0.102	0.111
313.15	0.93	0.074	0.085

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -15,717 + 108.23T$

Both the data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient was independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, Mrs. K; Rusz, L.; Patyi, L.

Hung. J. Ind. Chem. 1976, *4*(2), 269-80.

VARIABLES:

T/K = 298.15 - 313.15
Total P/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	1.22	0.093	0.102
313.15	0.94	0.071	0.081

Smoothed Data: $\Delta G^\circ/\text{J mol}^{-1} = -RT \ln X_1 = -13.492 + 101.03T$

The data and the equation are classed as tentative.

Mol Fractions and Bunsen Coefficients were calculated by the compiler at a nitrogen partial pressure of 101.325 kPa (1 atm) with the assumption that the Ostwald coefficient was independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method, described in detail in reference (1).

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.03$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Hexadecane; $C_{16}H_{34}$; [544-76-3]	Tremper, K.K.; Prausnitz, J.M. *J. Chem.Eng. Data* 1976, *21*, 295-9.
VARIABLES:	**PREPARED BY:**
T/K = 300-475	C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant[a] /atm	Mole fraction[b] of nitrogen at 1 atm partial pressure, x_{N_2}
300	790.0	0.00127
325	743.0	0.00135
350	701.0	0.00143
375	661.0	0.00151
400	618.0	0.00162
425	576.0	0.00174
450	546.0	0.00183
475	517.0	0.00193

a. Authors stated measurements were made at several pressures and values of solubility used were all within the Henry's-Law region.

b. Calculated by compiler assuming linear relationship between mole fraction and pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Volumetric apparatus similar to that described by Dymond and Hildebrand (1). Pressure measured with a null detector and precision gauge. Details in ref. (2).

SOURCE AND PURITY OF MATERIALS:

Solvent degassed, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2} = \pm 1\%$.

REFERENCES:

1. Dymond, J.; Hildebrand, J.H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.
2. Cukor, P.M.; Prausnitz, J.M. *Ind. Eng. Chem. Fundam.* 1971, *10*, 638.

COMPONENTS:	EVALUATOR:
(1) Nitrogen, N_2; [7727-37-9] (2) Cyclohexane; C_6H_{12}; [110-82-7]	Rubin Battino Department of Chemistry Wright State University Dayton, OH 45435 U.S.A. December 1981

CRITICAL EVALUATION:

There are seven groups that determined the solubility of nitrogen in cyclohexane (1-7). Guerry's two points (7) are much too low when compared with more reliable measurements. The single points obtained by Gjaldbaek and Hildebrand (1) and Patyi, et al. (5), are in good agreement but again are lower than the recommended values. The results obtained by Wild, et al. (6), are a special case inasmuch as their results were obtained via two methods (which show good internal agreement), at partial pressures of nitrogen up to 1.9 MPa, and over a wide temperature range - 300 to 443 K. However, the mole fraction solubilities calculated at 101 kPa partial pressure of nitrogen are almost double the results obtained by other workers and also show an opposite slope with respect to temperature dependence. We classify the Wild, et al. (6), values as tentative over the temperature range they covered.

For smoothing we used the data from three papers (2,3,4) covering a temperature range of 283 to 307 K at a nitrogen partial pressure of 101 kPa. The smoothing equation is:

$$\ln x_1 = -6.14235 - 3.06839/(T/100K) \qquad (1)$$

with a standard deviation of 0.0041 in $\ln x_1$. $\Delta\bar{H}° = 2552$ J mol^{-1} and $\Delta\bar{S}° = -51$ J K^{-1} mol^{-1}. The smoothed mole fractions which are recommended values at 5K intervals follow.

T/K	$10^4\ x_1$	T/K	$10^4\ x_1$
283.15	7.27	298.15	7.68
288.15	7.41	303.15	7.81
293.15	7.55	308.15	7.94

There is not sufficient comparative work reported on other cyclic hydrocarbons to warrant further comment.

References

1. Gjaldbaek, J. C.; Hildebrand, J. H. *J. Am. Chem. Soc.* 1949, *71*, 3147-50.
2. Dymond, J. H. *J. Phys. Chem.* 1967, *71*, 1829-31.
3. Dymond, J. H.; Hildebrand, J. H. *Ind. Eng. Chem., Fundam.* 1967, *6*, 130-1.
4. Wilhelm, E.; Battino, R. *J. Chem. Thermodyn.* 1973, *5*, 117-20.
5. Patyi, L.; Furmer, I. E.; Makranczy, J.; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M. G. *Zh. Prikl. Khim.* 1978, *51*, 1296-1300.
6. Wild, J. D.; Sridhar, J.; Potter, O. E. *Chem. Eng. J.* 1978, *15*, 209-14.
7. Guerry, D. Jr. Ph.D. Thesis 1944, Vanderbilt University, Nashville, TN.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Hildebrand, J. H.

J. Am. Chem. Soc. 1949, *71*, 3147-50.

VARIABLES:

T/K = 298.13
Total P/kPa = 101.325

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.13	0.755	0.156	0.170
298.13	0.752	0.155	0.169

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorped volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Stuart Oxygen Co. 99.996 percent N_2.

(2) Cyclohexane. Paragon Testing Laboratories. Boiling point 80.63 - 80.66°C at 755.7 mmHg.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.
2. Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Dymond, J. H.

J. Phys. Chem. 1967, *71*, 1829-31.

VARIABLES:

T/K = 291.00 - 306.52

P/kPa = 101.325

PREPARED BY:

M. E. Derrick

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	Temperature T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
17.85	291.00	7.52	0.156	0.166
25.45	298.60	7.70	0.159	0.174
30.70	303.85	7.87	0.161	0.179
33.37	306.52	7.89	0.161	0.181

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\ln x_1 = -6.196 - 2.8998/(T/100)$

T/K	Mol Fraction $x_1 \times 10^4$
293.15	7.57
298.15	7.70
303.15	7.82
308.15	7.95

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The liquid is saturated with the gas at a gas partial pressure of 1 atm.

The apparatus is that described by Dymond and Hildebrand (1). The apparatus uses an all-glass pumping system to spray slugs of degassed solvent into the gas. The amount of gas dissolved is calculated from the initial and final gas pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. General Dynamics Corp. Dried.

(2) Cyclohexane. Matheson, Coleman and Bell chromatoquality reagent. Dried and fractionally frozen. m.p. 6.45°C.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.01$

REFERENCES:

1. Dymond, J.; Hildebrand, J. H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Dymond, J.; Hildebrand, J. H.

Ind. Eng. Chem., Fundam. 1967, *6*, 130-1.

VARIABLES:

T/K = 298.15
Total P/kPa = 101.325

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	7.68	0.158	0.173

The Bunsen and Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of an all-glass buret system and a two bulb absorption vessel.

A magnetic pump forces solvent from the lower bulb over the wall of the upper bulb which contains the gas. The solvent flow back to the lower bulb. Pumping is continued until there is no further pressure change.

The amount of gas absorbed is calculated from the initial and final gas pressure.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$\delta x_1/x_1$ ±0.01 or less.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Wilhelm, E.; Battino, R.

J. Chem. Thermodyn. 1973, *5*, 117-20.

VARIABLES:

$T/K = 283.39 - 297.59$
$P/kPa = 101.325$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
283.39	0.726	0.152	0.158
283.53	0.730	0.153	0.159
297.59	0.760	0.157	0.171

The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT\ ln\ X_1 = 2135.2 + 52.541\ T$

Std. Dev. $\Delta G^o = 3.5$, Coef. Corr. = 0.9999

$\Delta H^o/J\ mol^{-1} = 2135.2$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -52.541$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
283.15	0.727	17,012
288.15	0.739	17,275
293.15	0.750	17,538
298.15	0.761	17,880

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass spiral tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. Minimum purity 99.99 mole per cent.

(2) Cyclohexane. Phillips Petroleum Co. Pure Grade. Distilled.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971 *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Patyi, L.; Furmer, I. E.; Makranczy, J.; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M. G.
Zh. Prikl. Khim. 1978, *51*, 1296-1300.

VARIABLES:

T/K = 298

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	α^*	Mole fraction of nitrogen at a partial pressure of 101.325 kPa
298.15	0.155	0.000755

* volume of gas (measured at 101.325 kPa and 273.15 K) dissolved by one volume of cyclohexane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. Pressure measured when known amounts of gas were added, in increments, to a known amount of liquid in a vessel of known dimensions. Corrections were made for the partial pressure of solvent. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

Purity better than 99 mole per cent as determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta\alpha = \pm 4\%$ or less.

REFERENCES:

1. Bodor, E.; Bor, G. J.; Mohai, B.; Sipos, G. *Veszpremi. Vegyip. Egy. Kozl.* 1957, *1*, 55.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclic hydrocarbons; C_6H_{10} and C_6H_{12}

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

VARIABLES:

T/K = 293.15, 298.15
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
Cyclohexene; C_6H_{10}; [110-83-8]			
293.15	6.10	0.135	0.145
298.15	6.22	0.137	0.150
Cyclohexane; C_6H_{12}; [110-82-7]			
293.15	7.22	0.150	0.161
298.15	7.22	0.149	0.163

The Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified (2) so that small solvent samples (2 cm^3) could be used with almost complete recovery of the sample.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Ohio Chemical Co. Oil pumped, 99.8 per cent pure.

(2) Hydrocarbons. Both were Eastman Kodak Co. products. They were purified by standard methods, and distilled from Na in a nitrogen atm.

SOURCE AND PURITY OF MATERIALS:

Cyclohexene. B.p. (756.6 mmHg) t/°C 82.35 - 82.50 (corr.).

Cyclohexane. B.p. (760.7 mmHg) t/°C 80.90 (corr.).

Data on density, refractive index and vapor pressure are in the thesis.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D.
   J. Biol. Chem. 1939, *130*, 545.

2. Ijams, C. C.
   Ph.D. thesis, 1941
   Vanderbilt University

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methylcyclohexane; C_7H_{14}; [108-87-2]

ORIGINAL MEASUREMENTS:

Field, L. R.; Wilhelm, E.; Battino, R.

J. Chem. Thermodyn. 1974, *6*, 237-43.

VARIABLES:

T/K = 284.29 - 313.27
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
284.29	0.849	0.1508	0.1569
298.18	0.946	0.1653	0.1804
313.27	0.988	0.1697	0.1946

The gas solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

The Bunsen coefficients were calculated by the compiler.

Smoothed Data: $\Delta G^\circ/\text{J mol}^{-1} = -RT \ln X_1 = 3824.9 + 45.244\ T$

Std. Dev. ΔG° = 45.6, Coef. Corr. = 0.9977

$\Delta H^\circ/\text{J mol}^{-1} = 3824.9$, $\Delta S^\circ/\text{J K}^{-1}\text{ mol}^{-1} = -45.244$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^\circ/\text{J mol}^{-1}$
283.15	0.853	16,636
293.15	0.902	17,088
303.15	0.950	17,541
313.15	0.997	17,993

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is applied intermittently through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass spiral tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. Minimum purity 99.99 mole per cent.

(2) Methylcyclohexane. Phillips Petroleum Co. Pure Grade. Distilled.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclooctane; C_8H_{16}; [292-64-8]

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; Battino, R.; Wilhelm, E.

J. Chem. Thermodyn. 1977, *9*, 111-5.

VARIABLES:

T/K = 289.04 - 313.52
P/kPa = 101.325

PREPARED BY:

H. L. Clever
A. L. Cramer

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
289.04	0.570	0.0955	0.1011
298.26	0.598	0.0994	0.1085
313.52	0.660	0.1081	0.1241

The Bunsen coefficients were calculated by the compiler.

The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: $\Delta G^o/\text{J mol}^{-1} = -RT \ln X_1 = 4564.0 + 46.351\ T$

Std. Dev. $\Delta G^o = 14.3$, Coef. Corr. = 0.9999

$\Delta H^o/\text{J mol}^{-1} = 4564.0$, $\Delta S^o/\text{J K}^{-1}\text{ mol}^{-1} = -46.351$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/\text{J mol}^{-1}$
288.15	0.564	17,920
293.15	0.583	18,152
298.15	0.602	18,384
303.15	0.620	18,615
308.15	0.639	18,847
313.15	0.657	19,079

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is applied intermittently through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass spiral tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. minimum purity 99.99 mol per cent.

(2) Cyclooctane. Chemical Samples Co. 99 mol percent, distilled, refractive index (NaD, 298.15 K) 1.4562.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/\text{mmHg} = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) *cis*-Dimethylcyclohexane; C_8H_{16}; [2207-01-4]

ORIGINAL MEASUREMENTS:

Geller, E. B.; Battino, R.; Wilhelm, E.

J. Chem. Thermodyn. 1976, *8*, 197-202.

VARIABLES:

T/K = 297.97 - 312.97
P/kPa = 101.325

PREPARED BY:

H. L. Clever
A. L. Cramer

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
297.97	0.884	0.1401	0.1528
312.97	0.923	0.1440	0.1650

The Bunsen coefficient was calculated by the compiler.

The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: The equation is based on two pair of experimental values and should be used with caution.

$$\Delta G^\circ/J\ mol^{-1} = -RT \ln X_1 = 2223.5 + 50.996\ T$$

$$\Delta H^\circ/J\ mol^{-1} = 2223.5,\ \Delta S^\circ/J\ K^{-1}\ mol^{-1} = -50.996$$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^\circ/J\ mol^{-1}$
298.15	0.885	17,428
303.15	0.898	17,683
308.15	0.911	17,938
313.15	0.923	18,193

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass spiral tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Either Air Products & Chemicals, Inc. or Matheson Co., Inc. 99 mol per cent or better.

(2) *cis*-1,2-Dimethylcyclohexane. Chemical Samples Co. Fractionally distilled and stored in dark. Refractive index (NaD, 298.15 K) 1.4337.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) *trans*-1,2-Dimethylcyclohexane; C_8H_{16}; [6876-23-9]

ORIGINAL MEASUREMENTS:

Geller, E. B.; Battino, R.; Wilhelm, E.

J. Chem. Thermodyn. 1976, *8*, 197-202.

VARIABLES:

$T/K = 298.25 - 313.01$
$P/kPa = 101.325$

PREPARED BY:

H. L. Clever
A. L. Cramer

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.25	1.001	0.1545	0.1687
313.01	1.016	0.1544	0.1770

The Bunsen coefficients were calculated by the compiler.

The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: The Gibbs energy equation is based on only two pair of points and should be used with caution.

$$\Delta G^\circ/J\ mol^{-1} = -RT \ln X_1 = 785.05 + 54.793\ T$$

$$\Delta H^\circ/J\ mol^{-1} = 785.05,\ \Delta S^\circ/J\ K^{-1}\ mol^{-1} = -54.793$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Either Air Products & Chemicals Inc., or Matheson Co., Inc. 99 mol per cent or better.

(2) *trans*-1,2-Dimethylcyclohexane. Chemical samples Co. Fractionally distilled and stored in dark. Refractive index (NaD, 298.15 K) 1.4248.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) *cis*-1,4-Dimethylcyclohexane, 70 mol %; C_8H_{16}; [624-29-3]

(3) *trans*-1,4-Dimethylcyclohexane, 30 mol %; C_8H_{16}; [2207-04-7]

ORIGINAL MEASUREMENTS:

Geller, E. B.; Battino, R.; Wilhelm, E.

J. Chem. Thermodyn. 1976, *8*, 197-202.

VARIABLES:

T/K = 298.17 - 313.15

P/kPa = 101.325

PREPARED BY:

H. L. Clever

A. L. Cramer

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.17	0.997	0.1539	0.1681
313.15	1.029	0.1565	0.1794

The Bunsen coefficients were calculated by the compiler.

The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: The Gibbs energy equation is based on only two pair of experimental values. It should be used with caution.

$$\Delta G^\circ/\text{J mol}^{-1} = -RT \ln X_1 = 1689.1 + 51.802\ T$$

$$\Delta H^\circ/\text{J mol}^{-1} = 1689.1,\ \Delta S^\circ/\text{J K}^{-1}\text{ mol}^{-1} = -51.802$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass spiral tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Either Air Products & Chemicals, Inc., or Matheson Co., Inc. 99 mol per cent or better.

(2) *cis*-1,4-Dimethylcyclohexane.

(3) *trans*-1,4-Dimethylcyclohexane. Chemical Samples Co. The binary mixture used as received. Composition determined by refractive index by authors.

ESTIMATED ERROR:

$\delta T/K = 0.03$

$\delta P/\text{mmHg} = 0.5$

$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) *cis*-1,3-Dimethylcyclohexane, 59 mol %; C_8H_{16}; [638-04-0]

(3) *trans*-1,3-Dimethylcyclohexane, 41 mol %; C_8H_{16}; [2207-03-6]

ORIGINAL MEASUREMENTS:

Geller, E. B.; Battino, R.; Wilhelm, E.

J. Chem. Thermodyn. 1976, *8*, 197-202.

VARIABLES:

T/K = 298.07 - 313.01
P/kPa = 101.325

PREPARED BY:

H. L. Clever
A. L. Cramer

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.07	1.005	0.1547	0.1688
313.01	1.043	0.1580	0.1811

The Bunsen coefficients were calculated by the compiler.

The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: The Gibbs energy equation is based on only two pair of experimental values and should be used with caution.

$$\Delta G^{o}/J\ mol^{-1} = -RT \ln X_1 = 1924.2 + 50.937\ T$$

$$\Delta H^{o}/J\ mol^{-1} = 1924.2,\ \Delta S^{o}/J\ K^{-1}\ mol^{-1} = -50.937$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is applied intermittently through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Either Air Products & Chemicals, Inc., or Matheson Co., Inc. 99 mol per cent or better.

(2) *cis*-1,4-Dimethylcyclohexane.

(3) *trans*-1,4-Dimethylcyclohexane. Chemical Samples Co. Binary mixture used as received. Authors analyzed mixture by refractive index.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) 1,1' - Bicyclohexyl; $C_{12}H_{22}$; [92-51-3]	ORIGINAL MEASUREMENTS: Tremper, K.K.; Prausnitz, J.M. *J. Chem. Eng. Data* 1976, *21*, 295-9.
VARIABLES: T/K = 300-475	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant[a] /atm	Mole fraction[b] of nitrogen at 1 atm partial pressure, x_{N_2}
300	1345.0	0.0007435
325	1274.0	0.0007849
350	1200.0	0.0008333
375	1123.0	0.0008905
400	1041.0	0.0009606
425	945.0	0.001058
450	829.0	0.001206
475	716.0	0.001397

a. Authors stated measurements were made at several pressures and values of solubility used were all within the Henry's-Law region.

b. Calculated by compiler assuming linear relationship between mole fraction and pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE. Volumetric apparatus similar to that described by Dymond and Hildebrand (1). Pressure measured with a null detector and precision gauge. Details in ref. (2).	SOURCE AND PURITY OF MATERIALS: Solvent degassed, no other details given.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta x_{N_2} = \pm 1\%$.
	REFERENCES: 1. Dymond, J.; Hildebrand, J.H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130. 2. Cukor, P.M.; Prausnitz, J.M. *Ind. Eng. Chem. Fundam.* 1971, *10*, 638.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Benzene; C_6H_6; [71-43-2] (2') Toluene; C_7H_8; [108-88-3]	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

Benzene

Five papers (1-5) report on the solubility of nitrogen in benzene. Just's two points (1) were significantly lower and Patyi, et al.'s, single point (5) significantly higher than the other three papers' values. Thus, the recommended values were obtained from smoothing the data in references 2,3, and 4. This yielded

$$\ln x_1 = -6.05445 - 4.95673/(T/100K) \qquad (1)$$

with a standard deviation in ln x_1 of 0.0090. $\Delta\bar{H}° = 4121$ J mol^{-1}, $\Delta\bar{S}° = -50$ J K^{-1} mol^{-1}. Smoothed values at 5K intervals follow.

T/K	$10^4\ x_1$	T/K	$10^4\ x_1$
278.15	3.95	308.15	4.70
283.15	4.08	313.15	4.82
288.15	4.20	318.15	4.94
293.15	4.33	323.15	5.06
298.15	4.45	328.15	5.18
303.15	4.58	333.15	5.30

Toluene

The nitrogen/toluene system was studied by Just (1) and Field, et al., (2). Both sets of data were combined for smoothing but due to the variation in the data the smoothed values may only considered to be tentative. The smoothing equation is

$$\ln x_1 = -6.27576 - 3.71675/(T/100K) \qquad (2)$$

with a standard deviation in ln x_1 of 0.030. $\Delta\bar{H}° = 3090$ J mol^{-1} and $\Delta\bar{S}° = -52$ J K^{-1} mol^{-1}. Smoothed values follow.

T/K	$10^4\ x_1$	T/K	$10^4\ x_1$
283.15	5.06	303.15	5.52
288.15	5.18	308.15	5.63
293.15	5.29	313.15	5.74
298.15	5.41		

References

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342-67.
2. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res.* (*Jpn*) 1931/32, *17*, 125-256.
3. Gjaldbaek, J.C.; Hildebrand, J.H. *J. Am. Chem. Soc.* 1949, *71*, 3147-50.
4. Byrne, J.E.; Battino, R.; Danforth, W.F. *J. Chem. Thermodyn.* 1974, *6*, 245-50.
5. Patyi, L.; Furmer, I. E.; Makranczy, J.; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M. G. *Zh. Prikl. Khim.* 1978, *51*, 1296-1300.
6. Field, L. R.; Wilhelm, E.; Battino, R. *J. Chem. Thermodyn.* 1974, *6*, 237-43.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Benzene; C_6H_6; [71-43-2]	ORIGINAL MEASUREMENTS: Just, G. *Z. Phys. Chem.* 1901, *37*, 342-67.
VARIABLES: T/K = 293-298 P/kPa = 101.325	PREPARED BY: M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	4.12	0.1038	0.1114
298.15	4.24	0.1062	0.1159

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Benzene. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Horiuti, J.

Sci. Pap. Inst. Phys. Chem. Res. *(Jpn)* 1931/32, *17*, 125-256.

VARIABLES:

T/K = 280.25 - 333.15

Total P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
280.25	0.4045	0.1036	0.1063
293.15	0.4292	0.1083	0.1162
313.15	0.4799	0.1182	0.1355
333.15	0.5374	0.1291	0.1575

Smoothed Data: $\ln X_1 = -17.9801 + 12.1852/(T/100) + 5.646 \ln (T/100)$

Standard error about the regression line = 1.55×10^{-6}

T/K	Mol Fraction $X_1 \times 10^3$
283.15	0.4096
293.15	0.4303
303.15	0.4534

T/K	Mol Fraction $X_1 \times 10^3$
313.15	0.4789
323.15	0.5071
333.15	0.5378

If the gas and solution are assumed to be ideal the fitted equation gives the following thermodynamic values.

T/K	ΔG^o/kJ mol^{-1}	ΔH^o/J mol^{-1}	ΔS^o/J K^{-1} mol^{-1}	ΔC_p^o/J K^{-1} mol^{-1}
283.15	18.363	3161	-53.69	46.95
298.15	19.150	3865	-51.27	46.95

The Ostwald coefficient was measured at a total pressure of one atm. The Bunsen coefficient and the mole fraction solubility values were calculated by the compiler for a gas pressure of one atm assuming the gas to behave ideally and the Ostwald coefficient to be independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet was determined at various miniscus heights by weighing a quantity of water. The miniscus height was read with a cathetometer.

The dry gas introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas was determined from a gas buret reading, the volume of the solvent was determined from the miniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared in the laboratory by heating sodium azide (Kahlbaum, recrystalized and dried). Gas dried over phosphorous pentoxide.

(2) Benzene. Merck. Extra pure, free from sulfur sample refluxed with sodium amalgam. Normal boiling point 80.18°C.

ESTIMATED ERROR:

$\delta T/K = 0.05$

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Hildebrand, J. H.

J. Am. Chem. Soc. 1949, *71*, 3147-50.

VARIABLES:

T/K = 298.15
Total P/kPa = 101.325

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.448	0.124	0.135

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Stuart Oxygen Co. 99.996 percent N_2.

(2) Benzene. Reagent grade.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.

2. Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Yen, L. C.; McKetta, J. J.

J. Chem. Eng. Data 1962, *7*, 288-9.

VARIABLES:

T/K = 301

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C (301 K)

Run	α^a/cm^3 (STP) cm^{-3} atm $^{-1}$
N-2	0.118
N-3	0.115
N-4	0.116
N-6	0.113
N-7	0.118
N-8	0.113

[a] Bunsen coefficient. Average value is 0.115.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used a modified version of the solubility apparatus of Markham and Kobe (1).

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) J. T. Baker Chemical Co.,
Baker analyzed grade, distilled.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.016$

REFERENCES:

1. Markham, A. E.; Kobe, K. A. *J. Am. Chem. Soc.* 1941, *63*, 449.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Byrne, J. E.; Battino, R.; Danforth, W. F.

J. Chem. Thermodyn. 1974, *6*, 245-50.

VARIABLES:

T/K = 310.64, 310.69
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
310.64	0.471	0.1163	0.1323
310.69	0.473	0.1168	0.1328

The Bunsen coefficients and mol fraction solubilities were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass spiral tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. Minimum purity 99.99 mole per cent.

(2) Benzene. Baker Analyzed Reagent Grade. Thiophene free, 99.9 mol per cent.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Patyi, L.; Furmer, I. E.; Makranczy, J; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M.G.

Zh. Prikl. Khim. 1978, *51*, 1296-1300.

VARIABLES:

T/K = 298

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	α^*	Mole fraction of nitrogen at a partial pressure of 101.325 kPa
298.15	0.124	0.000495

* volume of gas (measured at 101.325 kPa and 273.15 K) dissolved by one volume of benzene.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. Pressure measured when known amounts of gas were added, in increments, to a known amount of liquid in a vessel of known dimensions. Corrections were made for the partial pressure of solvent. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

Purity better than 99 mole per cent as determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta\alpha = \pm 4\%$ or less.

REFERENCES:

1. Bodor, E.; Bor, G. J.; Mohai, B.; Sipos, G. *Veszpremi. Vegyip. Egy. Kozl.* 1957, *1*, 55.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methyl benzene or toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342-67.

VARIABLES:

T/K = 293.15, 298.15
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	5.24	0.1105	0.1186
298.15	5.39	0.1131	0.1235

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Methyl benzene. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W. *Z. Physik. Chem.* 1890, *6*, 141.
2. Steiner, *Ann. Phys. (Leipzig)* 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methylbenzene or Toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Field, L. R.; Wilhelm, E.; Battino, R.

J. Chem. Thermodyn. 1974, *6*, 237-43.

VARIABLES:

$T/K = 283.39 - 313.28$
$P/kPa = 101.325$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
283.39	0.497	0.1061	0.1101
298.29	0.574	0.1204	0.1315
313.28	0.560	0.1158	0.1328

The gas solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

The Bunsen coefficients were calculated by the compiler.

Smoothed Data: $\Delta G^\circ/J\ mol^{-1} = -RT \ln X_1 = 2875.7 + 52.860\ T$

Std. Dev. $\Delta G^\circ = 116.8$, Coef. Corr. = 0.9894

$\Delta H^\circ/J\ mol^{-1} = 2875.7$, $\Delta S^\circ/J\ K^{-1}\ mol^{-1} = -52.860$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^\circ/J\ mol^{-1}$
283.15	0.511	17,843
293.15	0.533	18,372
303.15	0.554	18,900
313.15	0.574	19,429

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass spiral tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. Minimum purity 99.99 mole per cent.

(2) Toluene. Phillips Petroleum Pure Grade. Distilled.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Dimethylbenzene or xylene; C_8H_{10}; [1330-20-7]	ORIGINAL MEASUREMENTS: Just, G. *Z. Phys. Chem.* 1901, *37*, 342-67.
VARIABLES: T/K = 293.15, 298.15 P/kPa = 101.325	PREPARED BY: M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	6.03	0.1104	0.1185
298.15	6.12	0.1115	0.1217

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

The compiler assumed the dimethylbenzene was a mixture of 40 per cent 1,3-dimethylbenzene, and 20 per cent each of 1,2-dimethylbenzene, 1,4-dimethylbenzene, and ethylbenzene. See Riddick, J. A.; Bunger, W. B. Organic Solvents, 3rd Ed., Wiley-Interscience, New York, 1970, p. 614.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Dimethylbenzene. No information given.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Naphthalene, 1-methyl; $C_{11}H_{10}$; [90-12-0]

ORIGINAL MEASUREMENTS:

Tremper, K.K.; Prausnitz, J.M.

J. Chem. Eng. Data 1976, *21*, 295-9.

VARIABLES:

T/K = 300-475

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant[a] /atm	Mole fraction[b] of nitrogen at 1 atm partial pressure, x_{N_2}
300	2970.0	0.0003367
325	2729.0	0.0003664
350	2481.0	0.0004031
375	2222.0	0.0004500
400	1949.0	0.0005131
425	1655.0	0.0006042
450	1338.0	0.0007474
475	1108.0	0.0009025

a. Authors stated measurements were made at several pressures and values of solubility used were all within the Henry's-Law region.

b. Calculated by compiler assuming linear relationship between mole fraction and pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Volumetric apparatus similar to that described by Dymond and Hildebrand (1). Pressure measured with a null detector and precision gauge. Details in ref. (2).

SOURCE AND PURITY OF MATERIALS:

Solvent degassed, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2} = \pm 1\%$.

REFERENCES:

1. Dymond, J.; Hildebrand, J.H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.
2. Cukor, P.M.; Prausnitz, J.M. *Ind. Eng. Chem. Fundam.* 1971, *10*, 638.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Benzene, 1, 1'-methylenebis- (Diphenylmethane); $C_{13}H_{12}$; [101-81-5]	Tremper, K.K.; Prausnitz, J.M. *J. Chem. Eng. Data* 1976, *21*, 295-9.
VARIABLES:	PREPARED BY:
T/K = 300-475	C.L. Young

EXPERIMENTAL VALUES:

T/K	Henry's Constant[a] /atm	Mole fraction[b] of nitrogen at 1 atm partial pressure, x_{N_2}
300	2937.0	0.0003405
325	2570.0	0.0003891
350	2304.0	0.0004340
375	2081.0	0.0004805
400	1890.0	0.0005291
425	1717.0	0.0005824
450	1553.0	0.0006439
475	1421.0	0.0007037

a. Authors stated measurements were made at several pressures and values of solubility used were all within the Henry's-Law region.

b. Calculated by compiler assuming linear relationship between mole fraction and pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Volumetric apparatus similar to that described by Dymond and Hildebrand (1). Pressure measured with a null detector and precision gauge. Details in ref. (2).

SOURCE AND PURITY OF MATERIALS:

Solvent degassed, no details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2} = \pm 1\%$.

REFERENCES:

1. Dymond, J.; Hildebrand, J.H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.
2. Cukor, P.M.; Prausnitz, J.M. *Ind. Eng. Chem. Fundam.* 1971, *10*, 638.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Alcohols	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

In this section we will do a critical evaluation of the 1-alkanols from C_1 to C_{12}, 2-propanol, and 2-methyl-1-propanol (isobutanol) First we will discuss the data for the individual alcohols and then discuss the data at 298.15K for the 1-alkanols.

Methanol

The nitrogen/methanol system was studied by five groups (1-5). Just's data (1) were rejected for being too low and Makranczy, et al's, datum (5) for being too high. The remaining three sets of data were smoothed to yield.

$$\ln x_1 = -8.17081 - 6.97967 \times 10^{-2}/(T/100\text{K}) \qquad (1)$$

in the range 213 to 323 K with a standard deviation of 0.019 in $\ln x_1$. Smoothed recommended values at 10 K intervals follow. $\Delta\bar{H}° = 5803$ J mol^{-1} and $\Delta\bar{S}° = 68$ J K^{-1} mol^{-1}.

T/K	$10^4\ x_1$	T/K	$10^4\ x_1$	T/K	$10^4\ x_1$
213.15	2.74	253.15	2.75	293.15	2.76
223.15	2.74	263.15	2.75	298.15	2.76
233.15	2.74	273.15	2.76	303.15	2.76
243.15	2.75	283.15	2.76	313.15	2.77
				323.15	2.77

Ethanol

This system was studied by six groups (1-6) with Just's (1) and Metschl's (6) values being too low and Makranczy, et al.'s (5), value being too high. The smoothing equation obtained from references 2,3, and 4 gave

$$\ln x_1 = -7.95312 + 4.43802 \times 10^{-2}/(T/100\text{K}) \qquad (2)$$

in the range 213 to 323 K with a standard deviation in $\ln x_1$ of 0.016. Smoothed recommended values at 10 K intervals follow. $\Delta\bar{H}° = -37$ J mol^{-1} $\Delta\bar{S}° = -66$ J K^{-1} mol^{-1}.

T/K	$10^4\ x_1$	T/K	$10^4\ x_1$	T/K	$10^4\ x_1$
213.15	3.59	253.15	3.58	293.15	3.57
223.15	3.59	263.15	3.58	298.15	3.57
233.15	3.58	273.15	3.57	303.15	3.57
243.15	3.58	283.15	3.57	313.15	3.57
				323.15	3.56

1-Propanol

The nitrogen/1-propanol system was studied by four groups (3,4,5,7). Again, Makranczy, et al.'s (5), value was too high to use. Also the 308 K value of Boyer and Bircher (3) was anomalously high. The remaining data from references 3,4, and 7 gave

$$\ln x_1 = -7.90598 + 0.257433/(T/100\text{K}) \qquad (3)$$

in the range 213 to 298 K with a standard deviation of 0.015 in $\ln x_1$. Smoothed values at 10K intervals follow. $\Delta\bar{H}° = 214$ J mol^{-1} and $\Delta\bar{S}° = -62$ J K^{-1} mol^{-1}.

continued on following page

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Alcohols

EVALUATOR:

Rubin Battino
Department of Chemistry
Wright State University
Dayton, Ohio 45435
U.S.A.

December 1981

CRITICAL EVALUATION:

continued

T/K	10^4 x_1	T/K	10^4 x_1	T/K	10^4 x_1
213.15	4.16	243.15	4.10	273.15	4.05
223.15	4.14	253.15	4.08	283.15	4.04
233.15	4.12	263.15	4.06	293.15	4.02
				298.15	4.02

2-Propanol

This system was studied by Kretschmer, et al. (2), and Katayama and Nitta (4). Smoothing their values in the range 213 to 323 K gave

$$\ln x_1 = -7.63455 - 0.110188/(T/100K) \qquad (4)$$

with a standard deviation of 0.026 in $\ln x_1$. The table below gives smoothed recommended values for this system. $\Delta\bar{H}° = 92$ J mol^{-1} and $\Delta\bar{S}° = -63$ J K^{-1} mol^{-1}.

T/K	10^4 x_1	T/K	10^4 x_1	T/K	10^4 x_1
213.15	4.59	253.15	4.63	293.15	4.66
223.15	4.60	263.15	4.64	298.15	4.66
233.15	4.61	273.15	4.74	303.15	4.66
243.15	4.62	283.15	4.75	313.15	4.67
				323.15	4.67

1-Butanol

Four groups (2-5) studied this system and we used all of their data to obtain the following smoothing equation:

$$\ln x_1 = -7.64505 - 0.111660/(T/100K) \qquad (5)$$

The standard deviation in $\ln x_1$ is 0.026 and $\Delta\bar{H}° = 93$ J mol^{-1} and $\Delta\bar{S}° = -64$ J K^{-1} mol^{-1}. Smoothed values at 10 K intervals follow for the range 213 to 323 K.

T/K	10^4 x_1	T/K	10^4 x_1	T/K	10^4 x_1
213.15	4.54	253.15	4.58	293.15	4.61
223.15	4.55	263.15	4.59	298.15	4.61
233.15	4.56	273.15	4.59	303.15	4.61
243.15	4.57	283.15	4.60	313.15	4.62
				323.15	4.62

2-Methyl-1-Propanol (Isobutanol)

This system was only studied by Battino, et al. (8), in the range 274 to 328 K. The smoothing equation is:

$$\ln x_1 = -7.69430 + 0.179798/(T/100K) \qquad (6)$$

with a standard deviation of 0.014 in $\ln x_1$. Smoothed recommended values at 5 K intervals follow. $\Delta\bar{H}_1° = -149$ J mol^{-1} and $\Delta\bar{S}_1° = -64$ K^{-1} mol^{-1}.

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COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Alcohols	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

continued

T/K	$10^4\ x_1$	T/K	$10^4\ x_1$	T/K	$10^4\ x_1$
273.15	4.86	293.15	4.84	313.15	4.82
278.15	4.86	298.15	4.84	318.15	4.82
283.15	4.85	303.15	4.83	323.15	4.81
288.15	4.85	308.15	4.83	328.15	4.81

1-Pentanol

The nitrogen/1-pentanol system was studied by four groups (1,3,5, 7) but with widely varying results. Thus, the smoothed values based on a least squares fit of the data must be regarded as tentative pending a more definitive study. The smoothing equation in the range 293 to 308K is:

$$\ln x_1 = -6.0966 - 4.3302/(T/100K) \qquad (7)$$

with a standard deviation of 0.047 in $\ln x_1$. Smoothed values at 5K intervals follow.

T/K	$10^4\ x_1$	T/K	$10^4\ x_1$
293.15	5.14	303.15	5.39
298.15	5.27	308.15	5.52

1-Octanol

This system was investigated by four groups (3,5,9,10). Makranczy, et al.'s, value (5) was significantly high and was not used. Smoothing of the remaining values in the range 283 to 314 K gave

$$\ln x_1 = -6.18842 - 3.49654/(T/100K) \qquad (8)$$

with a standard deviation in $\ln x_1$ of 0.044. This is a rather large error and the smoothed results should be considered tentative.

T/K	$10^4\ x_1$	T/K	$10^4\ x_1$
283.15	5.97	298.15	6.35
288.15	6.10	303.15	6.48
293.15	6.23	308.15	6.60
		313.15	6.72

1-Decanol

Makranczy, et al. (5), and Wilcock, et al. (10), both studied this system, but the former's result was judged to be too high. A least squares fitting of Wilcock, et al.'s, three points in the range 283 to 313 K gave

$$\ln x_1 = -6.65033 - 1.98173/(T/100K) \qquad (9)$$

with a standard deviation of 0.0029 in $\ln x_1$. Smoothed recommended values follow. $\Delta\bar{H}° = 1648\ J\ mol^{-1}$ and $\Delta\bar{S}° = -55\ J\ K^{-1}\ mol^{-1}$ for this system.

continued on following page

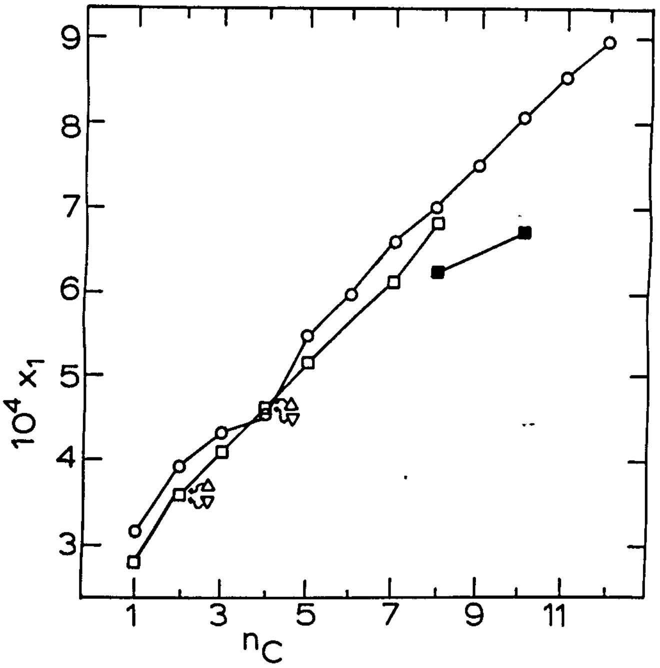
COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Alcohols	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION: continued

T/K	$10^4 x_1$	T/K	$10^4 x_1$
283.15	6.42	298.15	6.65
288.15	6.50	303.15	6.73
293.15	6.58	308.15	6.80
		313.15	6.87

1-Alkanols

The figure below shows the results for Boyer and Bircher (3) □ ,and Makranczy, et al. (5), ○. At a glance it is obvious that the Makranczy, et al. (5), values appear to be always significantly higher than the results for other workers. We do not know the reason for this. As an aid we list below the figure the recommended values at 298.15 K for the 1-alkanols up through 1-decanol. A least-squares



For the above figure the solid squares are for Wilcock et al. (10), the triangles for Katayama and Nitta (4), and the inverted triangles for Kretschmer at al. (2).

continued on following page

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Alcohols

EVALUATOR:

Rubin Battino
Department of Chemistry
Wright State University
Dayton, Ohio 45435
U.S.A. December 1981

CRITICAL EVALUATION:

continued

298.15 K

Solvent	$10^4 x_1$
methanol	2.76
ethanol	3.57
1-propanol	4.02
1-butanol	4.61
1-pentanol	5.27
1-hexanol	5.84
1-heptanol	6.10
1-octanol	6.35
1-decanol	6.65

fitting of the mole fraction solubility versus carbon number, n, yields:

$$x_1 = 2.2725 \times 10^{-4} + 4.4885 \times 10^{-5}\ n \qquad (10)$$

with a standard deviation in x_1 of 3.0×10^{-5}. (The smoothed values from equation (10) are obviously different from the recommended values listed in the table.)

References

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342-67.
2. Kretschmer, C. B.; Nowakowska, J.; Wiebe, R. *Ind. Eng. Chem.* 1946, *38*, 506-9.
3. Boyer, F. L.; Bircher, L. J. *J. Phys. Chem.* 1960, *64*, 1330-1.
4. Katayama, T.; Nitta, T. *J. Chem. Eng. Data* 1976, *21*, 194-6.
5. Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
6. Metschl, J. *J. Phys. Chem.* 1924, *28*, 417-37.
7. Gjaldbaek, J.C.; Niemann, H. *Acta Chem. Scand.* 1958, *12*, 1015-23.
8. Battino, R.; Evans, F. D.; Danforth, W. F.; Wilhelm, E. *J. Chem. Thermodyn.* 1971, *3*, 743-51.
9. Ijams, C. C. Ph.D. Thesis 1941, Vanderbilt University, Nashville, TN.
10. Wilcock, R. J.; Battino, R.; Danforth, W. F.; Wilhelm, E. *J. Chem. Thermodyn.* 1978, *10*, 817-22.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342-67.

VARIABLES:

T/K = 293-298
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	2.27	0.1256	0.1348
298.15	2.36	0.1296	0.1415

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Methanol. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

T/K = 248.15 - 323.15
P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
248.15	0.2708	0.1580	0.1435
273.15	0.2703	0.1532	0.1532
298.15	0.2739	0.1507	0.1645
323.15	0.2795	0.1492	0.1765

The Ostwald coefficients were measured at a total pressure of 101.325 kPa (1 atm). The compiler calculated the Bunsen coefficient and mole fraction values for an oxygen partial pressure of 101.325 kPa (1 atm) assuming the Ostwald coefficient was independent of pressure.

Smoothed Data: $\ln x_1 = -8.0863 - 0.3326/(T/100\ K)$

Standard error about the regression line = 2.52×10^{-6}

T/K	Mol Fraction $x_1 \times 10^3$
253.15	0.270
263.15	0.271
273.15	0.272
283.15	0.274
293.15	0.275
298.15	0.275
303.15	0.276
313.15	0.277
323.15	0.278

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that of Horiuti (1), it consisted of a gas buret, manometer, and absorption pipet equipped with a magnetic stirrer. All volumes were calibrated by mercury displacement.

The solvent was partly degassed by boiling under reflux. About 40 cm^3 of solvent was admitted into the absorption pipet, and pumped on to complete the degassing. Dry gas, measured in the buret, was admitted, final equilibrium was established after 1 to 3 hours stirring. During the solution process the total pressure was kept at one atm by additions of dry gas.

The solubility value was corrected for the increase of solvent volume with gas absorption, and for the nitrogen impurity in the oxygen.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial, but source not given. Passed through alkaline pyrogallol to remove O_2, passed through Drierite to dry.

(2) Methanol. Source not given. Distilled, dried with metallic Al, b.p. (760 mmHg)/°C 64.50, density, ρ_4^{25}/g cm^{-3} 0.78650.

ESTIMATED ERROR:

Gas buret $\delta V/cm^3 = 0.005$
Average deviation from the mean 0.3%, maximum deviation 0.9% (authors).

REFERENCES:

1. Horiuti, J. *J. Sci Papers Inst. Phys. Chem. Res. (Tokyo)* 1931, *17*, 125.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330-1.

VARIABLES:

T/K = 298.15

P/kPa = 101.325

PREPARED BY:

M. E. Derrick

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.279	0.153	0.167 ± 0.003

The Bunsen coefficient was calculated by the compiler.

The observed mole fraction solubility was taken from Boyer's dissertation (2).

The Dissertation gives the equations log X_1 = -3.594 + 0.449 log C at 298.15 K where C is the number of carbon atoms in the alcohol. The mole fraction solubility given in the original paper was calculated from the 298.15 K equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors for their use.

The total pressure of gas and solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (1) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.7 per cent nitrogen.

(2) Methanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = 0.01$

$\delta L/cm^3 = 0.003$

REFERENCES:

1. Peters, J. P.; Van Slyke, D. D. "Quantitative Clinical Chemistry" Williams and Wilkins Co., Baltimore, MD, 1932, Volume II.
2. Boyer, F. L. Ph.D. Dissertation Vanderbilt U., 1959, Nashville,TN

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem.Eng. Data 1976, *21*, 194-6.

VARIABLES:

T/K = 213-298

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction* of nitrogen in liquid, x_{N_2}
298.15	0.164	3660	0.000273
273.15	0.152	3720	0.000269
253.15	0.145	3700	0.000270
233.15	0.139	3640	0.000275
213.15	0.134	3520	0.000284

* at a partial pressure of 1 atmosphere

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with equilibrium cell of approximately 0.08 litres. Magnetic stirrer. Solvent carefully degassed. Equilibrium established in 1-1.5 hours. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen Co. sample, purity 99.9995 mole per cent.

(2) Nakarai Chemicals sample, purity, 99.9 mole per cent

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at T= 213.15K, ±0.05 at other temperatures; $\delta x_{N_2} = \pm 1\%$

REFERENCES:

1. Nitta, T.; Tatsuishi, A.; Katayama, T. *J. Chem.Eng.Jpn.* 1973 *6*, 475.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Methanol; CH_4O; [67-56-1]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES:	PREPARED BY:
T/K = 298	C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of nitrogen*, x_{N_2}
298.15	101.3	0.186	0.0003096

* calculated by compiler

\+ partial pressure of nitrogen.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{N_2} = \pm 3\%$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55, *Chem. Abstr.* 1961, *55*, 3175h

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) 1,2-Ethanediol or Ethylene glycol; $C_2H_5O_2$; [107-21-1]	Gjaldbaek, J. C.; Niemann, H. *Acta Chem. Scand.* 1958, *12*, 1015-23.
VARIABLES: T/K = 298.16 Total P/kPa = 101.325	PREPARED BY: J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.16	0.0342	0.01374	0.01500
298.17	0.0356	0.01428	0.01559

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Dansk Ilt-og Brint Fabrik. Contained less than 0.13 percent oxygen.

(2) 1,2-Ethanediol. Fractionated in a column at low pressure. Normal boiling point 197.30 - 197.42°C, refractive index at 20°C, $n_D = 1.4320$.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.

2. Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342 - 367.

VARIABLES:

T/K = 293.15, 298.15
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	3.40	0.1304	0.1400
298.15	3.44	0.1312	0.1432

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Ethanol. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W. *Z. Physik. Chem.* 1890, *6*, 141.
2. Steiner, *Ann. Phys. (Leipzig)* 1894, *52*, 275.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethanol; C_2H_6O; [64-17-5]	Metschl, J. *J. Phys. Chem.* 1924, *28*, 417-37.
VARIABLES:	**PREPARED BY:**
T/K = 298.15 P/kPa = 101.325	M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	3.40	0.130	0.142

The compiler calculated the mole fraction and Ostwald coefficient values.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The degassed solvent is saturated with nitrogen at 6 to 10 different pressures between 1.5 and 4.5 atm.

The pressure is reduced to one atm, and the "supersaturated gas" is shaken out of the solvent and measured.

The slope of a plot of the volume of gas reduced to standard conditions shaken out of 100 cm^3 of solvent *vs.* the pressure of saturation is nearly identical to the solubility-pressure graph (Henry's law). The slope of the curve is used to obtain the Bunsen coefficient. From the method of calculation the value represents the volume of gas shaken out of the solvent when the pressure is reduced from 2 to 1 atm.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in the presence of calcium dichromate in aqueous solution.

(2) Ethanol. Treated with metallic sodium and distilled. Specific gravity 0.7992 at 15°C. About 98 per cent pure.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

$T/K = 248.15 - 323.15$
$P/kPa = 101.325$

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
248.15	0.3498	0.1409	0.1280
273.15	0.3545	0.1391	0.1391
298.15	0.3572	0.1364	0.1489
323.15	0.3655	0.1358	0.1606

The Ostwald coefficients were measured at a total pressure of 101.325 kPa (1 atm). The compiler calculated the Bunsen coefficient and mole fraction values for an oxygen partial pressure of 101.325 kPa (1 atm) assuming the Ostwald coefficient was independent of pressure.

Smoothed Data: $\ln x_1 = -7.7832 - 0.4397/(T/100\ K)$

Standard error about the regression line = 2.18×10^{-6}

T/K	Mol Fraction $x_1 \times 10^3$
253.15	0.350
263.15	0.3525
273.15	0.355
283.15	0.357
293.15	0.359
298.15	0.3595
303.15	0.360
313.15	0.362
323.15	0.364

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that of Horiuti (1), it consisted of a gas buret, manometer, and absorption pipet equipped with a magnetic stirrer. All volumes were calibrated by mercury displacement.

The solvent was partly degassed by boiling under reflux. About 40 cm^3 of solvent was admitted into the absorption pipet, and pumped on to complete the degassing. Dry gas, measured in the buret, was admitted, final equilibrium was established after 1 to 3 hours stirring. During the solution process the total pressure was kept at one atm by additions of dry gas.

The solubility value was corrected for the increase of solvent volume with gas absorption, and for the nitrogen impurity in the oxygen.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial, but source not given. Passed through alkaline pyrogallol to remove O_2, passed through Drierite to dry.

(2) Ethanol. Source not given. Dried with Mg. Density, $\rho/g\ cm^{-3}$ 0.78508.

ESTIMATED ERROR:

Gas buret $\delta V/cm^3 = 0.005$
Average deviation from the mean 0.3%, maximum deviation 0.9% (authors).

REFERENCES:

1. Horiuti, J.
J. Sci Papers Inst. Phys. Chem. Res. (Tokyo) 1931, *17*, 125.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethanol; C_2H_6O; [64-17-5]	Boyer, F. L.; Bircher, L. J. *J. Phys. Chem.* 1960, *64*, 1330-1.

VARIABLES:	PREPARED BY:
T/K = 298.15 P/kPa = 101.325	M. E. Derrick

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.359	0.136	0.149 ± 0.002

The Bunsen coefficient was calculated by the compiler.

The observed mole fraction solubility was taken from Boyer's dissertation (2).

The Dissertation gives the equations log X_1 = -3.594 + 0.449 log C at 298.15 K where C is the number of carbon atoms in the alcohol. The mole fraction solubility given in the original paper was calculated from the 298.15 K equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors for their use.

The total pressure of gas and solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (1) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.7 per cent nitrogen.

(2) Ethanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = 0.01$

$\delta L/cm^3 = 0.002$

REFERENCES:

1. Peters, J. P.; Van Slyke, D. D. "Quantitative Clinical Chemistry" Williams and Wilkins Co., Baltimore, M.D., 1932, Volume II.
2. Boyer, F. L. Ph.D. Dissertation Vanderbilt U., 1959, Nashville,TN

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem.Eng. Data 1976, *21*,194-6.

VARIABLES:

T/K = 213-298

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,L	Henry's Constant /atm	Mole fraction* of nitrogen in liquid, x_{N_2}
298.15	0.149	2800	0.000357
273.15	0.138	2840	0.000352
253.15	0.131	2830	0.000353
233.15	0.125	2800	0.000357
213.15	0.121	2700	0.000370

* at partial pressure of 1 atmosphere

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with equilibrium cell of approximately 0.08 litres. Magnetic stirrer. Solvent carefully degassed. Equilibrium established in 1-1.5 hours. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen Co. sample, purity 99.9995 mole per cent.

(2) Nakarai Chemicals sample, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at $T = 213.15K$, ± 0.05 at other temperatures; $\delta x_{N_2} = \pm 1\%$

REFERENCES:

1. Nitta, T.; Tatsuishi, A.; Katayama, T. *J. Chem.Eng.Jpn.* 1973 *6*,475.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Rusz, L.; Balog-Megyery, K.

Hung. J. Ind. Chem. 1979, *7*, 41-6.

VARIABLES:

T/K = 298

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of nitrogen*, x_{N_2}
298.15	101.3	0.164	0.000393

* calculated by compiler

\+ partial pressure of nitrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{N_2} = \pm 3\%$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.

   Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
   Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Propanol; C_3H_8O; [71-23-8]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Niemann, H.

Acta Chem. Scand. 1958, *12*, 1015-23.

VARIABLES:

T/K = 298.06
Total P/kPa = 101.325

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.06	0.406	0.1209	0.1319
298.06	0.406	0.1208	0.1318

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Dansk Ilt-og Brint Fabrik. Contained less than 0.13 percent oxygen.

(2) 1-Propanol. Dried and fractionated, boiling point 97.1 - 97.4°C, refractive index at 20°C, $n_D = 1.3856$.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A.
   J. Am. Chem. Soc. 1930, *52*, 68.
2. Gjaldbaek, J. C.
   Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Propanol; C_3H_8O; [71-23-8]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330-1.

VARIABLES:

T/K = 298-308

P/kPa = 101.325

PREPARED BY:

M. E. Derrick

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.409	0.122	0.133 ± 0.001
308.15	0.437	0.129	0.146 ± 0.002

The Bunsen coefficients were calculated by the compiler.

The observed mole fraction solubilities were taken from Boyer's dissertation (2).

The Dissertation gives the equations log X_1 = -3.594 + 0.449 log C at 298.15 K and log X_1 = -3.576 + 0.452 log C at 308.15 K where C is the number of carbon atoms in the alcohol. The mole fraction solubility given in the original paper was calculated from the 298.15 K equation.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = 5016.1 + 48.040\ T$

The equation is tentative.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors for their use.

The total pressure of gas and solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (1) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.7 per cent nitrogen.

(2) 1-Propanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = 0.01$

$\delta L/cm^3 = 0.002$

REFERENCES:

1. Peters, J. P.; Van Slyke, D. D. "Quantitative Clinical Chemistry" Williams and Wilkins Co., Baltimore, MD, 1932, Volume II.
2. Boyer, F. L. Ph.D. Dissertation Vanderbilt U., 1959, Nashville, TN

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1- Propanol; C_3H_8O; [71-23-8]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem. Eng. Data. 1976, *21*, 194-6

VARIABLES:

$T/K = 213-298$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction* of nitrogen in liquid, x_{N_2}
298.15	0.131	2490	0.000402
273.15	0.121	2520	0.000397
253.15	0.115	2500	0.000400
233.15	0.111	2450	0.000408
213.15	0.107	2360	0.000424

* at partial pressure of 1 atmosphere

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with equilibrium cell of approximately 0.08 litres. Magnetic stirrer. Solvent carefully degassed. Equilibrium established in 1-1.5 hours. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen Co. sample, purity 99.9995 mole per cent.

(2) Nakarai Chemicals sample, distilled, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at $T = 213.15$ K, ± 0.05 at other temperatures; $\delta x_{N_2} = \pm 1\%$

REFERENCES:

1. Nitta, T.; Tatsuishi. A.; Katayama, T. *J.Chem.Eng. Jpn.* 1973, *6*, 475.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) 1-Propanol; C_3H_8O; [71-2-8]	ORIGINAL MEASUREMENTS: Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES: T/K = 298	PREPARED BY: C.L. Young.

EXPERIMENTAL VALUES:

T/K	P^{+}/kPa	Ostwald coefficient	Mole fraction of nitrogen*, x_{N_2}
298.15	101.3	0.141	0.000433

* calculated by compiler

\+ partial pressure of nitrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{N_2} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Propanol; C_3H_8O; [67-63-0]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

$T/K = 273.15 - 323.15$
$P/kPa = 101.325$

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
273.15	0.4523	0.1353	0.1353
298.15	0.4607	0.1342	0.1465
323.15	0.4821	0.1367	0.1617

The Ostwald coefficients were measured at a total pressure of 101.325 kPa (1 atm). The compiler calculated the Bunsen coefficient and mole fraction values for an oxygen partial pressure of 101.325 kPa (1 atm) assuming the Ostwald coefficient was independent of pressure.

Smoothed Data: $\ln x_1 = -7.2995 - 1.1105/(T/100K)$

Standard error about the regression line = 6.13×10^{-6}

T/K	Mol Fraction $x_1 \times 10^3$
273.15	0.450
283.15	0.457
293.15	0.463
298.15	0.466
303.15	0.469
313.15	0.474
323.15	0.479

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that of Horiuti (1), it consisted of a gas buret, manometer, and absorption pipet equipped with a magnetic stirrer. All volumes were calibrated by mercury displacement.

The solvent was partly degassed by boiling under reflux. About 40 cm^3 of solvent was admitted into the absorption pipet, and pumped on to complete the degassing. Dry gas, measured in the buret, was admitted, final equilibrium was established after 1 to 3 hours stirring. During the solution process the total pressure was kept at one atm by additions of dry gas.

The solubility value was corrected for the increase of solvent volume with gas absorption, and for the nitrogen impurity in the oxygen.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial, but source not given. Passed through alkaline pyrogallol to remove O_2, passed through Drierite to dry.

(2) 2-Propanol. Source not given. Distilled, dried with metallic Al, b.p.(760 mmHg)/°C 82.24, density, $\rho_4^{25}/g\ cm^{-3}$ 0.78081.

ESTIMATED ERROR:

Gas buret $\delta V/cm^3 = 0.005$
Average deviation from the mean 0.3%, maximum deviation 0.9% (authors).

REFERENCES:

1. Horiuti, J. *J. Sci. Papers Inst. Phys. Chem. Res. (Tokyo)* 1931, *17*, 125.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Propanol; C_3H_8O; [67-63-0]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem. Eng. Data. 1976, *21*, 194-6.

VARIABLES:

T/K = 213-298

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction* of nitrogen in liquid, x_{N_2}
298.15	0.147	2170	0.000461
273.15	0.135	2210	0.000452
253.15	0.128	2210	0.000452
233.15	0.121	2190	0.000457
213.15	0.118	2090	0.000478

* at a partial pressure of 1 atmosphere

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with equilibrium cell of approximately 0.08 litres. Magnetic stirrer. Solvent carefully degassed. Equilibrium established in 1-1.5 hours. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen Co. sample, purity 99.9995 mole per cent.

(2) Nakarai Chemicals sample, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at $T = 213.15$K, ± 0.05 at other temperatures; $\delta x_{N_2} = \pm 1\%$

REFERENCES:

1. Nitta, T.; Tatsuishi, A.; Katayama, T. *J. Chem.Eng.Jpn.* 1973, *6*, 475.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Butanol; $C_4H_{10}O$; [71-36-3]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-9.

VARIABLES:

T/K = 273.15 - 323.15
P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
273.15	0.4312	0.1075	0.1075
298.15	0.4605	0.1122	0.1225
323.15	0.4821	0.1148	0.1358

The Ostwald coefficients were measured at a total pressure of 101.325 kPa (1 atm). The compiler calculated the Bunsen coefficient and mole fraction values for an oxygen partial pressure of 101.325 kPa (1 atm) assuming the Ostwald coefficient was independent of pressure.

Smoothed Data: $\ln x_1 = -7.0243 - 1.9750/(T/100K)$

Standard error about the regression line = 1.98×10^{-6}

T/K	Mol Fraction $x_1 \times 10^3$
273.15	0.4319
283.15	0.4431
293.15	0.4537
298.15	0.4589
303.15	0.4639
313.15	0.4737
323.15	0.4830

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that of Horiuti (1), it consisted of a gas buret, manometer, and absorption pipet equipped with a magnetic stirrer. All volumes were calibrated by mercury displacement.

The solvent was partly degassed by boiling under reflux. About 40 cm^3 of solvent was admitted into the absorption pipet, and pumped on to complete the degassing. Dry gas, measured in the buret, was admitted, final equilibrium was established after 1 to 3 hours stirring. During the solution process the total pressure was kept at one atm by additions of dry gas.

The solubility value was corrected for the increase of solvent volume with gas absorption, and for the nitrogen impurity in the oxygen.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial, but source not given. Passed through alkaline pyrogallol to remove O_2, passed through Drierite to dry.

(2) 1-Butanol. Source not given. Distilled, dried with metallic Al, b.p. (760 mmHg)/°C 117.67, density, ρ_4^{25}/g cm^{-3} 0.80573.

ESTIMATED ERROR:

Gas buret $\delta V/cm^3 = 0.005$
Average deviation from the mean 0.3%, maximum deviation 0.9% (authors).

REFERENCES:

1. Horiuti, J. *J. Sci Papers Inst. Phys. Chem. Res. (Tokyo)* 1931, *17*, 125.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Butanol; $C_4H_{10}O$; [71-36-3]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330-1.

VARIABLES:

T/K = 298-308

P/kPa = 101.325

PREPARED BY:

M. E. Derrick

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.460	0.112	0.122 ± 0.001
308.15	0.473	0.114	0.129 ± 0.002

The Bunsen coefficients were calculated by the compiler.

The observed mole fraction solubilities were taken from Boyer's dissertation (2).

The Dissertation gives the equations log X_1 = -3.594 + 0.449 log C at 298.15 K and log X_1 = -3.576 + 0.452 log C at 308.15 K where C is the number of carbon atoms in the alcohol. The mole fraction solubility given in the original paper was calculated from the 298.15 K equation.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = 2085.8 + 56.891\ T$

The equation is tentative.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors for their use.

The total pressure of gas and solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (1) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.7 per cent nitrogen.

(2) 1-Butanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = 0.01$

$\delta L/cm^3 = 0.001$

REFERENCES:

1. Peters, J. P.; Van Slyke, D. D. "Quantitative Clinical Chemistry" Williams and Wilkins Co., Baltimore, MD, 1932, Volume II.
2. Boyer, F. L. Ph.D. Dissertation Vanderbilt U., 1959, Nashville,TN

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Butanol; $C_4H_{10}O$; [71-36-3]

ORIGINAL MEASUREMENTS:

Katayama, T.; Nitta, T.

J. Chem. Eng. Data. 1976, *21*, 194-6.

VARIABLES:

T/K = 213-298

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient, L	Henry's Constant /atm	Mole fraction* of nitrogen in liquid, x_{N_2}
298.15	0.123	2170	0.000461
273.15	0.114	2190	0.000457
253.15	0.107	2200	0.000455
233.15	0.101	2180	0.000459
213.15	0.0954	2150	0.000465

* at a partial pressure of 1 atmosphere

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Volumetric apparatus with equilibrium cell of approximately 0.08 litres. Magnetic stirrer. Solvent carefully degassed. Equilibrium established in 1-1.5 hours. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Osaka Oxygen Co. sample, purity 99.9995 mole per cent.

(2) Nakarai Chemicals sample, distilled purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.12$ at $T = 213.15K$, ± 0.05 at other temperatures; $\delta x_{N_2} = \pm 1\%$

REFERENCES:

1. Nitta, T.; Tatsuishi. A.; Katayama, T. *J. Chem. Eng. Jpn.* 1973, *6*, 475.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) 1-Butanol; $C_4H_{10}O$; [71-36-3]	ORIGINAL MEASUREMENTS: Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES: T/K = 298	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of nitrogen*, x_{N_2}
298.15	101.3	0.120	0.000451

* calculated by compiler

\+ partial pressure of nitrogen.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{N_2} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55, *Chem. Abstr.* 1961, *55*, 3175h

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Methyl-1-propanol or Isobutanol; $C_4H_{10}O$; [78-83-1]

ORIGINAL MEASUREMENTS:

Battino, R.; Evans, F. D.; Danforth, W. F.; Wilhelm, E.

J. Chem. Thermodyn. 1971, *3*, 743-51.

VARIABLES:

T/K = 274.02 - 327.96
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
274.02	0.477	0.118	0.118
282.78	0.490	0.119	0.124
295.83	0.495	0.120	0.130
298.41	0.482	0.116	0.127
312.77	0.484	0.115	0.132
327.96	0.475	0.112	0.134

The Bunsen coefficients were calculated by the compiler.
The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -216.5 + 64.195\ T$

Std. Dev. $\Delta G^o = 36.1$, Coef. Corr. = 0.9996

$\Delta H^o/J\ mol^{-1} = -216.5$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -64.195$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
278.15	0.487	17,639
288.15	0.485	18,281
298.15	0.484	18,923
308.15	0.483	19,565
318.15	0.481	20,207
328.15	0.480	20,849

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. 99.999 per cent.

(2) 2-methyl-1-propanol. Fisher Co. Certified grade (99 mole per cent).

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.5$
$\delta X_1/X_1 = 0.01$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Pentanol; $C_5H_{12}O$; [71-41-0]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342-67.

VARIABLES:

T/K = 293-298
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	5.43	0.1126	0.1208
298.15	5.44	0.1122	0.1225

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) 1-Pentanol. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W. *Z. Physik. Chem.* 1890, *6*, 141.

2. Steiner, *Ann. Phys. (Leipzig)* 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Pentanol; $C_5H_{12}O$; [71-41-0]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Niemann, H.

Acta Chem. Scand. 1958, *12*, 1015-23.

VARIABLES:

T/K = 298.06 - 298.15
Total P/kPa = 101.325

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.06	0.491	0.1021	0.1114
298.15	0.495	0.1013	0.1106

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Dansk Ilt-og Brint Fabrik. Contained less than 0.13 percent oxygen.

(2) 1-Pentanol. Fractionated at about 115 mmHg. Normal boiling point 137.83 - 137.90°C. Refractive index at 20°C, $n_D = 1.412$.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

2. Gjaldbaek, J. C.
Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Pentanol; $C_5H_{12}O$; [71-41-0]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330-1.

VARIABLES:

$T/K = 298\text{-}308$

$P/kPa = 101.325$

PREPARED BY:

M. E. Derrick

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.516	0.106	0.116 ± 0.002
308.15	0.568	0.115	0.130 ± 0.004

The Bunsen coefficients were calculated by the compiler.

The observed mole fraction solubilities were taken from Boyer's dissertation (2).

The Dissertation gives the equations $\log X_1 = -3.594 + 0.449 \log C$ at 298.15 K and $\log X_1 = -3.576 + 0.452 \log C$ at 308.15 K where C is the number of carbon atoms in the alcohol. The mole fraction solubility given in the original paper was calculated from the 298.15 K equation.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = 7312.1 + 38.408T$

The equation is tentative.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors for their use.

The total pressure of gas and solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (1) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.7 per cent nitrogen.

(2) 1-Pentanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K$: 0.01

$\delta L/cm^3$: 0.004

REFERENCES:

1. Peters, J. P.; Van Slyke, D. D. "Quantitative Clinical Chemistry" Williams and Wilkins Co., Baltimore, MD, 1932, Volume II.
2. Boyer, F. L. Ph.D. Dissertation Vanderbilt U., 1959, Nashville,TN

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) 1-Pentanol; $C_5H_{12}O$; [71-41-0] or 1-Hexanol; $C_6H_{14}O$; [111-27-3]	ORIGINAL MEASUREMENTS: Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES: T/K = 298	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of nitrogen*, x_{N_2}
		1-Pentanol	
298.15	101.3	0.123	0.000546
		1-Hexanol	
298.15	101.3	0.117	0.000599

* calculated by compiler

\+ partial pressure of nitrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{N_2} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B,; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Hexanol; $C_6H_{14}O$; [111-27-3]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330-1.

VARIABLES:

T/K = 298.15
P/kPa = 101.325

PREPARED BY:

M. E. Derrick

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.584	0.104	0.114 ± 0.003

The Bunsen coefficient was calculated by the compiler.

The observed mole fraction solubility was taken from Boyer's dissertation (2).

The Dissertation gives the equations $\log X_1 = -3.594 + 0.449 \log C$ at 298.15 K where C is the number of carbon atoms in the alcohol. The mole fraction solubility given in the original paper was calculated from the 298.15 K equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors for their use.

The total pressure of gas and solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (1) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.7 per cent nitrogen.

(2) 1-Hexanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = 0.01$

$\delta L/cm^3 = 0.003$

REFERENCES:

1. Peters, J. P.; Van Slyke, D. D. "Quantitative Clinical Chemistry" Williams and Wilkins Co., Baltimore, MD, 1932, Volume II.
2. Boyer, F. L. Ph.D. Dissertation Vanderbilt U., 1959, Nashville, TN

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexanol; $C_6H_{12}O$; [108-93-0]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Niemann, H.

Acta Chem. Scand. 1958, *12*, 1015-23.

VARIABLES:

T/K = 298.15
Total P/kPa = 101.325

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.266	0.0562	0.0613

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Dansk Ilt-og Brint Fabrik. Contained less than 0.13 percent oxygen.

(2) Cyclohexanol. Fractionated by distillation at low pressure and fractionated by freezing.

Completely solid at 24°C. Estimated water content was 0.05 percent.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.
2. Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Heptanol; $C_7H_{16}O$; [111-70-6]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330-1.

VARIABLES:

T/K = 298.15

P/kPa = 101.325

PREPARED BY:

M. E. Derrick

EXPERIMENTAL VALUES:

	$X_1 \times 10^3$	Coefficient α	Coefficient L
298.15	0.610	0.0962	0.105 ± 0.002

The Bunsen coefficient was calculated by the compiler.

The observed mole fraction solubility was taken from Boyer's dissertation (2).

The Dissertation gives the equations log X_1 = -3.594 + 0.449 log C at

298.15 K where C is the number of carbon atoms in the alcohol. The mole fraction solubility given in the original paper was calculated from the 298.15 K equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors for their use.

The total pressure of gas and solvent vapor in the solution chamber was adjusted to a pressure cf one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (1) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.7 per cent nitrogen.

(2) 1-Heptanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = 0.01$

$\delta L/cm^3 = 0.002$

REFERENCES:

1. Peters, J. P.; Van Slyke, D. D. "Quantitative Clinical Chemistry' Williams and Wilkins Co., Baltimore, MD, 1932, Volume II.
2. Boyer, F. L. Ph.D. Dissertation Vanderbilt U., 1959, Nashville,TN

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Aliphatic alcohols;
$C_7H_{16}O$ and $C_8H_{18}O$

ORIGINAL MEASUREMENTS:

Ijams, C. C.

Ph.D. thesis, 1941
Vanderbilt University
Nashville, TN

VARIABLES:

T/K = 298.15
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
1-Heptanol; $C_7H_{16}O$; [111-70-6]			
298.15	0.609	0.0963	0.1051
1-Octanol; $C_8H_{18}O$; [111-87-5]			
298.15	0.657	0.0930	0.1015

The mole fraction and Ostwald coefficient values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified so that small solvent sample (2 cm^3) could be used with almost 100 per cent recovery of the solvent.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. Purity 99.5 per cent.

(2) Aliphatic alcohols. Purified. Vapor pressure and boiling point also reported in the thesis.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D.
J. Biol. Chem. 1939, *130*, 545.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]
(2) 1-Heptanol; $C_7H_{16}O$; [111-70-6]

or

1-Octanol; $C_8H_{18}O$; [111-87-5]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Rusz, L.; Balog-Megyery, K.

Hung. J. Ind. Chem. 1979, *7*, 41-6.

VARIABLES:

T/K = 298

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	p^+/kPa	Ostwald coefficient	Mole fraction of nitrogen*, x_{N_2}
		1-Heptanol	
298.15	101.3	0.114	0.000660
		1-Octanol	
298.15	101.3	0.108	0.000700

* calculated by compiler

\+ partial pressure of nitrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{N_2} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55, *Chem. Abstr.* 1961, *55*, 3175h

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Octanol; $C_8H_{18}O$; [111-87-5]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330-1.

VARIABLES:

$T/K = 298-308$

$P/kPa = 101.325$

PREPARED BY:

M. E. Derrick

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.680	0.0934	0.102 ± 0.002
308.15	0.673	0.0940	0.106 ± 0.001

The Bunsen coefficients were calculated by the compiler.

The observed mole fraction solubilities were taken from Boyer's dissertation (2).

The Dissertation gives the equations $\log X_1 = -3.594 + 0.449 \log C$ at 298.15 K and $\log X_1 = -3.576 + 0.452 \log C$ at 308.15 K where C is the number of carbon atoms in the alcohol. The mole fraction solubility given in the original paper was calculated from the 298.15 K equation.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -823.32 + 63.400\ T$

The equation is tentative.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors for their use.

The total pressure of gas and solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (1) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.7 per cent nitrogen.

(2) 1-Octanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = 0.01$

$\delta L/cm^3 = 0.002$

REFERENCES:

1. Peters, J. P.; Van Slyke, D. D. "Quantitative Clinical Chemistry" Williams and Wilkins Co., Baltimore, MD, 1932, Volume II.

2. Boyer, F. L. Ph.D. Dissertation Vanderbilt U., 1959, Nashville, TN

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Octanol; $C_8H_{18}O$; [111-87-5]

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; Battino, R.; Danforth, W. F.; Wilhelm, E.

J. Chem. Thermodyn. 1978, *10*, 817-22.

VARIABLES:

T/K = 283.32 - 313.60

P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
283.32	0.5727	0.08208	0.08514
298.15	0.6230	0.08822	0.09629
313.60	0.6353	0.08876	0.1019

The Bunsen coefficients were calculated by the compiler.

The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = 2495.1 + 53.169\ T$

Std. Dev. $\Delta G^o = 44.0$, Coef. Corr. = 0.9985

$\Delta H^o/J\ mol^{-1} = 2495.1$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -53.169$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
278.15	0.568	17,284
288.15	0.589	17,816
298.15	0.610	18,348
308.15	0.631	18,879
318.15	0.650	19,411

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. The Matheson Co., Inc. 99.999 per cent.

(2) 1-octanol. Eastman Organic Chemicals. Distilled, density $\rho_{298.15} = 0.8247\ g\ cm^{-3}$

ESTIMATED ERROR:

$\delta T/K = 0.03$

$\delta P/mmHg = 0.5$

$\delta X_1/X_1 = 0.01$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Nonanol; $C_9H_{20}O$; [143-08-8]

or

1-Decanol; $C_{10}H_{22}O$; [112-08-8]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Rusz, L.;
Balog-Megyery, K.

Hung. J. Ind. Chem. 1979, *7*, 41-6.

VARIABLES:

T/K - 298

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of nitrogen*, x_{N_2}
		1-Nonanol	
298.15	101.3	0.105	0.000750
		1-Decanol	
298.15	101.3	0.103	0.000805

* Calculated by compiler

\+ Partial pressure of nitrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

δx_{N_2} = ±3%.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos. G.
Veszpremi Vegyip. Egy.Kozl 1957, *1*, 55,
Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Decanol; $C_{10}H_{22}O$; [112-30-1]

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; Battino, R.
Danforth, W. F.; Wilhelm, E.

J. Chem. Thermodyn. 1978, *10*, 817-22.

VARIABLES:

T/K = 282.57 - 313.42
P/kPa = 101.325

PREPARED BY:

A. L. Cramer

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
282.57	0.6403	0.07590	0.07852
298.08	0.6681	0.07822	0.08536
313.42	0.6859	0.07927	0.09096

The Bunsen coefficients were calculated by the compiler.

The solubility values were adjusted to a nitrogen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: $\Delta G^\circ/\text{J mol}^{-1} = -RT \ln X_1 = 1637.5 + 55.327\ T$

Std. Dev. $\Delta G^\circ = 8.8$, Coef. Corr. = 0.9999

$\Delta H^\circ/\text{J mol}^{-1} = 1637.5$, $\Delta S^\circ/\text{J K}^{-1}\text{ mol}^{-1} = -55.327$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^\circ/\text{J mol}^{-1}$
278.15	0.635	17,027
288.15	0.650	17,580
298.15	0.666	18,133
308.15	0.680	18,687
318.15	0.694	19,240

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. 99.999 per cent.

(2) 1-Decanol. Eastman Organic Chemicals. Distilled, density $\rho_{298.15} = 0.8206\ \text{g cm}^{-3}$.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/\text{mmHg} = 0.5$
$\delta X_1/X_1 = 0.01$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) 1-Undecanol; $C_{11}H_{24}O$; [112-42-5] or 1-Dodecanol; $C_{12}H_{26}O$; [112-53-8]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES:	PREPARED BY:
T/K = 298	C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of nitrogen*, x_{N_2}
		1-Undecanol	
298.15	101.3	0.100	0.000849
		1-Dodecanol	
298.15	101.3	0.098	0.000898

* calculated by compiler

\+ partial pressure of nitrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus of Bodor, Bor, Mohai, and Sipos (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

δx_{N_2} = ±3%.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55, Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) 2-Propanone(acetone); C_3H_6O; [67-64-1]	Rubin Battino Department of Chemistry Wright State University Dayton, Ohio 45435 U.S.A. December 1981

CRITICAL EVALUATION:

The nitrogen/acetone system has been studied by three groups (1,2,3). However, the two data points obtained by Just were so low that they are to be not considered. Smoothing the other points in the temperature range 195 to 314 K gave the following least squares equation:

$$\ln x_1 = -11.3529 + 3.77545/(T/100K) + 2.34933 \ln (T/100K)$$

The standard deviation of the fit in the mole fraction was 3.2×10^{-6} or about 0.4% at the mid-range of temperature. Smoothed values at 10K intervals are given below. The $\Delta\bar{C}p°$ value was constant at 20 J K^{-1} mol^{-1}. Entropy and enthalpy changes are also given in the table.

T/K	$10^4 x_1$	$\Delta\bar{H}°$/J mol^{-1}	$\Delta\bar{S}°$/ J K^{-1} mol^{-1}
193.15	3.891	634	-62.0
203.15	3.979	829	-61.0
213.15	4.083	1024	-60.1
223.15	4.200	1220	-59.2
233.15	4.330	1415	-58.3
243.15	4.471	1610	-57.5
253.15	4.623	1806	-56.7
263.15	4.784	2001	-56.0
273.15	4.955	2196	-55.2
283.15	5.135	2392	-54.5
293.15	5.324	2587	-53.9
298.15	5.421	2684	-53.5
303.15	5.520	2782	-53.2
313.15	5.726	2977	-52.6
323.15	5.939	3173	-51.9

References

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342-67.
2. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. (Jpn)* 1931/32, *17*, 125-256.
3. Kretschmer, C. B.; Nowakowska, J.; Wiebe, R. *Ind. Eng. Chem.* 1946, *38*, 506-9.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) 2-Propanone or acetone; C_3H_6O; [67-64-1]	Just, G. *Z. Phys. Chem.* 1901, *37*, 342-67.
VARIABLES: T/K = 293-298 P/kPa = 101.325	PREPARED BY: M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	4.22	0.1289	0.1383
298.15	4.41	0.1338	0.1460

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) 2-Propanone. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W. *Z. Physik. Chem.* 1890, *6*, 141.
2. Steiner, *Ann. Phys. (Leipzig)* 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Propanone or Acetone; C_3H_6O; [67-64-1]

ORIGINAL MEASUREMENTS:

Horiuti, J.

Sci. Pap. Inst. Phys. Chem. Res. (Jpn) 1931/32, *17*, 125-256.

VARIABLES:

T/K = 195.05 - 314.25

Total P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
195.05	0.3907	0.1354	0.0967
212.85	0.4090	0.1387	0.1081
232.40	0.4300	0.1423	0.1211
252.95	0.4610	0.1486	0.1376
273.15	0.4948	0.1553	0.1553
293.15	0.5328	0.1628	0.1747
314.25	0.5699	0.1691	0.1946

Smoothed Data: $\ln X_1 = -11.2433 + 3.6459/(T/100) + 2.2850 \ln (T/100)$

Standard error about the regression line = 1.90×10^{-6}

T/K	Mol Fraction $X_1 \times 10^3$	T/K	Mol Fraction $X_1 \times 10^3$
193.15	0.3892	263.15	0.4775
203.15	0.3980	273.15	0.4943
213.15	0.4083	283.15	0.5119
223.15	0.4200	293.15	0.5303
233.15	0.4327	303.15	0.5495
243.15	0.4467	313.15	0.5695
253.15	0.4616		

The Ostwald coefficient was measured at a total pressure of one atm. The Bunsen coefficient and the mole fraction solubility values were calculated by the compiler for a gas pressure of one atm assuming the gas to behave ideally and the Ostwald coefficient to be independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet was determined at various miniscus heights by weighing a quantity of water. The meniscus height was read with a cathetometer.

The dry gas introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care was taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas was determined from a gas buret reading, the volume of the solvent was determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared in the laboratory by heating sodium azide (Kahlbaum, recrystalized and dried). Gas dried over phosphorus pentoxide.

(2) 2-Propanone. Nippon Pure Chem. Co. or Merck. Extra pure grade, recrystallized with sodium sulfite. Stored over calcium chloride then fractionated. Normal boiling point 56.09°C.

ESTIMATED ERROR:

$\delta T/K = 0.05$

If the gas and solution are assumed to be ideal, the fitted equation gives the following thermodynamic values.

T/K	ΔG^o/kJ mol^{-1}	ΔH^o/J mol^{-1}	ΔS^o/J K^{-1} mol^{-1}	ΔC_p^o/J K^{-1} mol^{-1}
273.15	17.288	2158	-55.39	19.00
298.15	18.652	2633	-53.73	19.00

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Propanone or acetone; C_3H_6O; [67-64-1]

ORIGINAL MEASUREMENTS:

Kretschmer, C. B.; Nowakowska, J.; Wiebe, R.

Ind. Eng. Chem. 1946, *38*, 506-09.

VARIABLES:

T/K = 248.15 - 298.15
P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
248.15	0.4550	0.1475	0.1340
273.15	0.4954	0.1564	0.1554
298.15	0.5486	0.1664	0.1816

The Ostwald coefficients were measured at a total pressure of 101.325 kPa (1 atm). The compiler calculated the Bunsen coefficient and mole fraction values for an oxygen partial pressure of 101.325 kPa (1 atm) assuming the Ostwald coefficient was independent of pressure.

Smoothed Data: $\ln x_1 = -6.5910 - 2.7528/(T/100K)$

Standard error about the regression line = 6.98×10^{-6}

T/K	Mol Fraction $x_1 \times 10^3$
253.15	0.463
263.15	0.482
273.15	0.501
283.15	0.519
293.15	0.537
298.15	0.545

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that of Horiuti (1), it consisted of a gas buret, manometer, and absorption pipet equipped with a magnetic stirrer. All volumes were calibrated by mercury displacement.

The solvent was partly degassed by boiling under reflux. About 40 cm^3 of solvent was admitted into the absorption pipet, and pumped on to complete the degassing. Dry gas, measured in the buret, was admitted, final equilibrium was established after 1 to 3 hours stirring. During the solution process the total pressure was kept at one atm by additions of dry gas.

The solubility value was corrected for the increase of solvent volume with gas absorption, and for the nitrogen impurity in the oxygen.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial, but source not given. Passed through alkaline pyrogallol to remove O_2, passed through Drierite to dry.

(2) 2-Propanone. Source not given. Treated with Ag_2O, dried over $CaSO_4$, distilled, b.p. (760 mmHg)/°C 56.10 - 56.14, density, $\rho_4^{25}/g\ cm^{-3}$ 0.78490.

ESTIMATED ERROR:

Gas buret $\delta V/cm^3 = 0.005$
Average deviation from the mean 0.3%, maximum deviation 0.9% (authors).

REFERENCES:

1. Horiuti, J.
J. Sci Papers Inst. Phys. Chem. Res. (Tokyo) 1931, *17*, 125.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexanone; $C_6H_{10}O$; [108-94-1]

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

VARIABLES:

$T/K = 293-298$
$P/kPa = 101.325$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	3.72	0.0804	0.0863
298.15	3.77	0.0812	0.0886

The Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified (2) so that small solvent samples (2 cm^3) could be used with almost complete recovery of the sample.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Ohio Chemical Co. Oil pumped, 99.8 per cent pure.

(2) Cyclohexanone. Eastman Kodak Co. Purified, distilled, b.p. (754.5 mmHg) t/°C 155.19. Refractive index, density, and vapor pressure data are in the thesis.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D.
J. Biol. Chem. 1939, *130*, 545.
2. Ijams, C. C.
Ph.D. thesis, 1941
Vanderbilt University

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Acetic Acid; $C_2H_4O_2$; [64-19-7]	Just, G. *Z. Phys. Chem.* <u>1901</u>, *37*, 342-67.
VARIABLES:	**PREPARED BY:**
T/K = 293-298 P/kPa = 101.325	M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	2.79	0.1092	0.1172
298.15	2.80	0.1090	0.1190

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Acetic Acid. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W. *Z. Physik. Chem.* <u>1890</u>, *6*, 141.
2. Steiner, *Ann. Phys. (Leipzig)* <u>1894</u>, *52*, 275.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) 2-Methylpropanoic acid; $C_4H_8O_2$; [79-31-2]	ORIGINAL MEASUREMENTS: Drucker, K.; Moles, E. *Z. Physik. Chem.* 1910, *75*, 405-36.
VARIABLES: T/K = 298 P/kPa = 35-111	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	*p*/mmHg	*p*/kPa	Ostwald coefficient, *L*
298.20	262.6	35.01	0.1609*
	388.3	51.77	0.1640
	566.1	75.47	0.1647
	662.4	88.31	0.1656
	783.5	104.5	0.1656
	832.2	111.0	0.1666

* probably in error.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using an Ostwald type gas buret and pipet. Solvent degassed before being admitted to pipet.

SOURCE AND PURITY OF MATERIALS:

(1) From cylinder, passed through concentrated alkali, alkaline pyrogallol, concentrated sulfuric acid and over hot copper.

(2) From Kahlbaum, distilled four times.

ESTIMATED ERROR:

$\delta L/L = \pm 1\text{-}3\%$ for dil. soln.;

±5-7% for conc. soln.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Acetic acid, methyl ester or Methyl acetate; $C_3H_6O_2$; [79-20-9]

ORIGINAL MEASUREMENTS:

Horiuti, J.

Sci. Pap. Inst. Phys. Chem. Res. (Jpn) 1931/32, *17*, 125-256.

VARIABLES:

T/K = 194.45 - 313.25

Total P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
194.45	0.3948	0.1264	0.0900
213.05	0.4225	0.1323	0.1032
232.55	0.4573	0.1398	0.1190
252.85	0.4905	0.1462	0.1353
273.15	0.5342	0.1551	0.1551
293.15	0.5761	0.1629	0.1748
313.25	0.6201	0.1706	0.1957

Smoothed Data: $\ln X_1 = -10.3409 + 2.3823/(T/100) + 1.9228 \ln (T/100)$

Standard error about the regression line = 1.62×10^{-6}

T/K	Mol Fraction $X_1 \times 10^3$
193.15	0.3930
203.15	0.4075
213.15	0.4231
223.15	0.4395
233.15	0.4567
243.15	0.4748
253.15	0.4935

T/K	Mol Fraction $X_1 \times 10^3$
263.15	0.5130
273.15	0.5332
283.15	0.5540
293.15	0.5755
303.15	0.5976
313.15	0.6203

The Ostwald coefficient was measured at a total pressure of one atm. The Bunsen coefficient and the mole fraction solubility values were calculated by the compiler for a gas pressure of one atm assuming the gas to behave ideally and the Ostwald coefficient to be independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet was determined at various miniscus heights by weighing a quantity of water. The meniscus height was read with a cathetometer.

The dry gas introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas was determined from a gas buret reading, the volume of the solvent was determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared in the laboratory by heating sodium azide (Kahlbaum, recrystalized and dried). Gas dried over phosphorus pentoxide.

(2) Acetic acid, methyl ester. Merck. Extra pure grade treated with phosphorous pentoxide several times and distilled several times. Normal boiling point, 57.12°C.

ESTIMATED ERROR:

$\delta T/K = 0.05$

If the gas and solution are assumed to be ideal the fitted equation gives the following thermodynamic values.

T/K	ΔG^o/kJ mol^{-1}	ΔH^o/J mol^{-1}	ΔS^o/J K^{-1} mol^{-1}	ΔC_p^o/J K^{-1} mol^{-1}
273.15	17.116	2386	-53.93	15.99
298.15	18.446	2785	-52.53	15.99

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Acetic acid ethyl ester or ethyl acetate; $C_4H_8O_2$; [141-78-6]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342-67.

VARIABLES:

T/K = 293-298
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	6.83	0.1564	0.1678
298.15	6.95	0.1582	0.1727

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Acetic acid ethyl ester. No information given.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Acetic acid 2-methylpropyl ester or isobutyl acetate; $C_6H_{11}O_2$; [110-19-0]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342-67.

VARIABLES:

$T/K = 293\text{-}298$
$P/kPa = 101.325$

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	9.39	0.1585	0.1701
298.15	9.47	0.1589	0.1734

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Acetic acid 2-methylpropyl ester. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Acetic acid pentyl ester or amyl acetate; $C_7H_{14}O_2$; [628-63-7]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342-67.

VARIABLES:

T/K = 293-298
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	9.35	0.1409	0.1512
298.15	9.43	0.1413	0.1542

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Acetic acid pentyl ester. No information given.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) 1,1'-Oxybisethane or diethyl ether; $C_4H_{10}O$; [60-29-7]	**ORIGINAL MEASUREMENTS:** Christoff, A. *Z. Phys. Chem.* 1912, *79*, 456-60.
VARIABLES: T/K = 273.15 P/kPa = Atmospheric	**PREPARED BY:** M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
273.15	1.16	0.258	0.258

The author measured the Ostwald coefficient. The total pressure was corrected for the vapor pressure of the solvent at the temperature of the measurement. The compiler calculated the mole fraction and Bunsen coefficient values.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modified Ostwald apparatus described by Just (1), and modified by Skirrow (2). The apparatus consists of a thermostated gas buret and absorption flask.

The modification involves the use of vapor free gas in the gas buret. A correction is made for the vapor pressure of the liquid. A steel capillary tube with a stopcock, which prevents the gas and the liquid vapor mixing in the buret, is used to connect the absorption flask and the buret.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by decomposing sodium nitrite. Passed over glowing copper to remove nitric oxide.

(2) Diethyl ether. Merck (Darmstadt). Stated to be pure and anhydrous.

ESTIMATED ERROR:

$\delta L/L = 0.05$

REFERENCES:

1. Just, G.
Z. Phys. Chem. 1901, *37*, 342.

2. Skirrow, F. W.
Z. Phys. Chem. 1902, *41*, 139.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,1-Oxybisethane or Diethylether; $C_4H_{10}O$; [60-29-7]

ORIGINAL MEASUREMENTS:

Horiuti, J.

Sci. Pap. Inst. Phys. Chem. Res. (Jpn) 1931/32, *17* , 125-256.

VARIABLES:

T/K = 195.45 - 293.15

Total P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
195.45	1.157	0.2872	0.2055
212.55	1.136	0.2755	0.2144
232.05	1.139	0.2691	0.2286
252.65	1.155	0.2651	0.2452
273.15	1.199	0.2672	0.2672
293.15	0.9113	0.2674	0.2870

Smoothed Data: $\ln X_1 = 4.39833 - 13.8281/(T/100) - 6.14581 \ln (T/100)$

Standard error about the regression line = 9.53×10^{-5}

T/K	Mol Fraction $X_1 \times 10^3$
193.15	1.11
203.15	1.15
213.15	1.18
223.15	1.19
233.15	1.19
243.15	1.17

T/K	Mol Fraction $X_1 \times 10^3$
253.15	1.14
263.15	1.11
273.15	1.07
283.15	1.03
293.15	0.98

The Ostwald coefficient was measured at a total pressure of one atm. The Bunsen coefficient and the mole fraction solubility values were calculated by the compiler for a gas pressure of one atm assuming the gas to behave ideally and the Ostwald coefficient to be independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet was determined at various miniscus heights by weighing a quantity of water. The meniscus height was read with a cathetometer.

The dry gas introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas was determined from a gas buret reading, the volume of the solvent was determined from the meniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared in the laboratory by heating sodium azide (Kahlbaum, recrystalized and dried) Gas dried over phosphorous pentoxide.

(2) 1,1-Oxybisethane. Merck's "for analysis". Stored over sodium amalgam and distilled. Constant boiling within 0.01°C.

ESTIMATED ERROR:

$\delta T/K = 0.05$

If the gas and solution are assumed to be ideal the fitted equation gives the following thermodynamic values.

T/K	ΔG^o/kJ mol^{-1}	ΔH^o/J mol^{-1}	ΔS^o/J K^{-1} mol^{-1}	ΔC_p^o/J K^{-1} mol^{-1}
273.15	15.533	-2460	-65.88	-51.1
293.15	16.887	-3482	-69.49	-51.1

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Cyclic ethers: C_4H_8O, $C_4H_8O_2$, C_5H_8O, and $C_5H_{10}O$	Guerry, D. Jr. Ph.D. thesis, 1944 Vanderbilt University Nashville, TN

VARIABLES:	PREPARED BY:
T/K = 293-298 P/kPa = 101.325	H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
Tetrahydrofuran; C_4H_8O; [109-99-9]			
293.15	5.07	0.140	0.150
298.15	5.21	0.143	0.156
1,4-Dioxane; $C_4H_8O_2$; [123-91-1]			
293.15	2.29	0.0827	0.0888
298.15	2.37	0.0844	0.0921
2,3-Dihydropyran; C_5H_8O; [25512-65-6]			
293.15	4.90	0.121	0.130
298.15	4.93	0.121	0.132
Tetrahydro-2H-pyran; $C_5H_{10}O$; [142-68-7]			
293.15	5.77	0.133	0.143
298.15	5.93	0.136	0.148

The Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was a modified Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co.

The procedure of Van Slyke (1) for pure liquids was modified (2) so that small solvent samples (2 cm^3) could be used with almost 100 per cent recovery of the sample.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

Tetrahydrofuran. Eastman Kodak Co. B.p.(752.7 mmHg) t/°C 65.50 - 65.54.

1,4-Dioxane. Eastman Kodak Co. B.p.(743.7 mmHg) t/°C 100.81-100.82.

Dihydro-2H-pyran. Prepared from tetrahydrofurfuryl alcohol. B.p. (743.6 mmHg) t/°C 84.81 - 84.89.

Tetrahydro-2H-pyran. Prepared by catalytic reduction of dihydro-2H-pyran. B.p.(750.6 mmHg) t/°C 87.51-87.52. All b.p. are corrected.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Ohio Chemical Co. Oil pumped, 99.8 per cent pure.

(2) Cyclic ethers. The ethers were fractionally distilled from over Na in a nitrogen atmosphere. In addition to the solubility data the thesis contains measured values of refractive index, density, vapor pressure and b.p.

ESTIMATED ERROR:

δT/K = 0.05

REFERENCES:

1. Van Slyke, D. D. *J. Biol. Chem.* 1939, *130*, 545.
2. Ijams, C. C. Ph.D. thesis, 1941 Vanderbilt University

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) 1,1'-Oxybispropane or dipropyl ether; $C_6H_{14}O$; [111-43-3]	Guerry, D. Jr. Ph.D. thesis, 1944 Vanderbilt University Nashville, TN
VARIABLES: T/K = 293-298 P/kPa = 101.325	**PREPARED BY:** H. L. Clever

EXPERIMENTAL VALUES·

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	12.0	0.198	0.212
298.15	12.2	0.199	0.217

The Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified (2) so that small solvent samples (2 cm^3) could be used with almost complete recovery of the sample.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Ohio Chemical Co. Oil pumped, 99.8 per cent pure.

(2) Dipropyl ether. Eastman Kodak Co. Refluxed four hours over Na, then distilled from Na in a N_2 atm. B.p. (746.2 mmHg) t/°C 89.03 - 89.28 (corr.). Refractive index, density, and vapor pressure data are in the thesis.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D. *J. Biol. Chem.* 1939, *130*, 545.

2. Ijams, C. C. Ph.D. thesis, 1941 Vanderbilt University

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) 1,2-Epoxyethane (ethylene oxide); C_2H_4O; [75-21-8]	ORIGINAL MEASUREMENTS: Olson, J. D. *J. Chem. Eng. Data* 1977, *22*, 326-9.
VARIABLES: T/K = 273-323 P/MPa = 0.7-2.2	PREPARED BY: R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	H^b/(atm/mole fraction)	P/atm (Range)	No. of Points
0	273.2	2800	7-20	6
25	298.2	2180	9-22	11
50	323.2	1820	18-21	3

[a] Calculated by compiler.

[b] Henry's law constant calculated over pressure range and number of experimental data points indicated. H defined as

$$H = \lim_{x \to 0} (f_1/x_1)$$ where f is the fugacity and x the mole fraction.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The nitrogen and ethylene oxide were weighed into a bomb of known volume. Equilibrium pressures were determined at each temperature for several loadings.

SOURCE AND PURITY OF MATERIALS:

(1) Linde high purity - 99.99%.

(2) UCC commercial grade. No volatile impurities above 100 ppm level.

ESTIMATED ERROR:

δT/K = ±0.1
δH/H = ±0.01, compiler's estimate

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Trichloromethane or chloroform; $CHCl_3$; [67-66-3]	Just, G. *Z. Physik. Chem.* 1901, *37*, 342-67.
VARIABLES:	PREPARED BY:
T/K= 293-298 P/kPa= 101.325	M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	4.27	0.1195	0.1282
298.15	4.45	0.1235	0.1348

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Trichloromethane. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W. *Z. Physik. Chem.* 1890, *6*, 141.
2. Steiner, *Ann. Phys. (Leipzig)* 1894, *52*, 275.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Trichloromethane or chloroform; $CHCl_3$; [67-66-3]	ORIGINAL MEASUREMENTS: Körösy, F. *Trans. Faraday Soc.* 1937, *33*, 416-25.
VARIABLES: T/K = 295.15 P/kPa = 101.325	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
295.15	4.25	0.118	0.128

The mole fraction and Bunsen coefficient values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and method of Winkler (1) were used. However, the apparatus was usually not thermostated, and degassing was by evacuation and shaking the solvent, not by evacuating and boiling the solvent as was done by Winkler.

SOURCE AND PURITY OF MATERIALS:

No information

ESTIMATED ERROR:

$\delta L/L = 0.05$

REFERENCES:

1. Winkler, L. W. *Ber.* 1891, *24*, 89.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane, chlorotrifluoro; $CClF_3$; [75-72-9]

(2') Tetrafluoromethane; CF_4; [75-73-0]

ORIGINAL MEASUREMENTS:

Leites, I.L.; Adlivankina, M.A.

Khim. Prom. 1966, *42*, 848-50.

VARIABLES:

T/K = 93-123
P/kPa = 101.325

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

		α^a/m^3(STP) m^{-3} atm^{-1}	
t/°C	T^b/K	(Freon-13) $CClF_3$	(Freon - 14) CF_4
-150	123	0.293	0.066
-160	113	0.346	0.138
-170	103	0.415	0.231
-180	93	0.428[c]	0.346

[a] Bunsen coefficient.

[b] Calculated by compiler.

[c] Obtained by extrapolation.

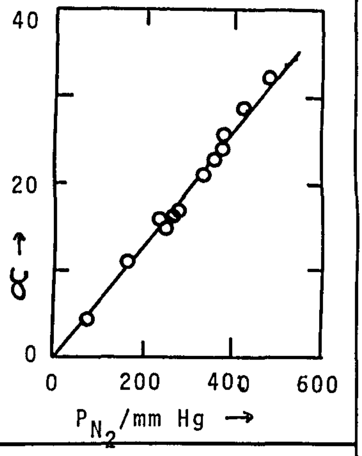


Figure: Solubility of nitrogen in CF_4 at -180°C

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility was determined by a static method. The system was thermostated in a specially constructed cryostat.

SOURCE AND PURITY OF MATERIALS:

(1) Purified by removing O_2 and H_2O

(2) 0.2% N_2

(2') 1.5% N_2

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta\alpha/\alpha = \mp 0.02$, compiler's estimate

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Dichlorodifluoromethane or Freon-12; CCl_2F_2; [75-71-8]	Steinberg, M.; Manowitz, B.; Pruzansky, J. *US AEC BNL*-542 (T-140). *Chem. Abstr.* 1959, *53*, 21242g
VARIABLES:	PREPARED BY:
T/K = 199.65 - 276.15	H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/^{\circ}C$	T/K	Solubility Coefficient[1]	Henry's Constant[2] H/atm	Mol Fraction[3] 10^3x_1
-73.5	199.65	0.65	-	2.05
-70	203.15	-	510	1.96
-30	243.15	0.44	-	1.51
-12.3	260.85	-	600	1.67
0.0	273.15	-	630	1.59
+ 3.0	276.15	0.47	-	1.73

[1] The solubility coefficient is defined $cm^3(288.15K)\ cm^{-3}atm^{-1}$. The gas volume is reduced to 288.15 K and 1 atm, the solvent volume is for the temperature of the measurement.

[2] Henry's constant, $H/\text{atm} = (p_1/\text{atm})/\ x_1$.

[3] The mole fraction values were calculated for a gas partial pressure of 101.325 kPa (1 atm) by the compiler. Density data were taken from Bichowsky, F. R.; Gilkey, W. K. *Ind. Eng. Chem.* 1931, *23*, 366 - 7.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Dynamic tracer technique (1).	(1) Nitrogen. (2) Dichlorodifluoromethane. No information.
	ESTIMATED ERROR:
	$\delta x_1/x_1 = \pm\ 0.05 - 0.10$ (compiler)
	REFERENCES:
	1. Steinberg, M.; Manowitz, B. *Ind. Eng. Chem.* 1959, *51*, 47.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Tetrachloromethane; CCl_4; [56-23-5]

ORIGINAL MEASUREMENTS:

Horiuti, J.

Sci. Pap. Inst. Phys. Chem. Res. (Jpn) 1931/32, *17*, 125-256.

VARIABLES:

T/K = 253.45 - 333.25

Total P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

	$X_1 \times 10^3$	Coefficient α	Coefficient L
253.45	0.5558	0.1354	0.1256
273.15	0.5894	0.1403	0.1403
293.15	0.6304	0.1465	0.1572
313.15	0.6744	0.1529	0.1754
333.25	0.7208	0.1601	0.1953

Smoothed Data: $\log X_1 = -11.30302 + 4.07891/(T/100) + 2.3634 \ln (T/100)$

Standard error about the regression line = 9.19×10^{-7}

T/K	Mol Fraction $X_1 \times 10^3$
253.15	0.5550
263.15	0.5721
273.15	0.5903
283.15	0.6096
293.15	0.6300

T/K	Mol Fraction $X_1 \times 10^3$
303.15	0.6514
313.15	0.6738
323.15	0.6971
333.15	0.7213

If the gas and solution are assumed to be ideal the fitted equation gives the following thermodynamic values.

T/K	$\Delta G^o/kJ\ mol^{-1}$	$\Delta H^o/J\ mol^{-1}$	$\Delta S^o/J\ K^{-1}\ mol^{-1}$	$\Delta C_p^o/J\ K^{-1}\ mol^{-1}$
273.15	16.885	1976	-54.58	19.65
298.15	18.228	2467	-52.86	19.65

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet was determined at various miniscus heights by weighing a quantity of water. The miniscus height was read with a cathetometer.

The dry was gas introduced into the degassed solvent. The gas and solvent were mixed with a magnetic stirrer until saturation. Care was taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas was determined from a gas buret reading, the volume of the solvent was determined from the miniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared in the laboratory by heating sodium azide (Kahlbaum, recrystalized and dried). Gas dried over phosphorus pentoxide.

(2) Tetrachloromethane. Kahlbaum. Dried, and distilled. Normal boiling point 76.74°C.

ESTIMATED ERROR:

$\delta T/K = 0.05$

The Ostwald coefficient was measured at a total pressure of one atm. The Bunsen coefficient and the mole fraction solubility values were calculated by the compiler for a gas pressure of one atm assuming the gas to behave ideally and the Ostwald coefficient to be independent of pressure.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2,2,2 - Trichloro,-1,1-ethanediol (chloral hydrate); $C_2H_3ClO_2$; [302-17-0]

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

ORIGINAL MEASUREMENTS:

Hammel, A. von

Z. Physik. Chem. 1915, *90*, 121-5.

VARIABLES:

T/K = 288

Concentration

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

wt. % (2)	$10^2 L^a$	$10^2 \alpha^b$	wt. % (2)	$10^2 L^a$	$10^2 \alpha^b$
		15°C (288 K)			
0	1.725		37.6	1.23	1.30
0	1.675	1.796^c	48.9	1.15	1.21
0	1.706		49.3	1.18	1.24
6.9	1.64	1.73	61.3	1.14	1.20
14.0	1.54	1.62	70.9	1.31	1.38
15.0	1.52	1.60	71.2	1.30	1.37
23.6	1.34	1.41	78.3	1.52	1.60
26.1	1.41	1.49	79.1	1.56	1.65

[a] Ostwald coefficient.

[b] Bunsen coefficient.

[c] Average value. About 6% lower than best modern values

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Ostwald apparatus as modified by Geffcken (1) was used.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta L/L = \pm 0.03$, compiler's estimate

REFERENCES:

1. Geffcken, G. *Z. Physik. Chem.* 1904, *49*, 257-302.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,2-Dichloro-1,1,2,2-tetrafluoroethane or Freon-114; $C_2Cl_2F_4$; [76-14-2]

ORIGINAL MEASUREMENTS:

Williams, V. D.

J. Chem. Eng. Data 1959, *4*, 92-3.

VARIABLES:

T/K = 293 - 333
N_2 P/kPa = 70 - 900

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Henry's Constant
t/°F	T/K	$k/(\text{psia})^{-1} = x_1/p_1/\text{psia}$
68	293	5.5×10^{-4}
104	313	3.7×10^{-4}
140	333	2.0×10^{-4}

The nine to ten solubility measurements made at each temperature are shown in a graph. Only the Henry's constants were tabulated.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and apparatus were similar to those of Parmlee (1).

A 450 g sample of Freon-114 was placed in a 1000 cm^3 bomb equiped with a three-way diaphram valve. The Freon-114 was frozen and pumped on to degas. Its vapor pressure was checked at 293 K as a measure of its purity. Nitrogen gas was added to the bomb. The bomb was rocked for ½ hour after pressure equilibrium was reached.

Both the gas phase and the liquid phase were sampled. They were analyzed by a mass spectroscope.

SOURCE AND PURITY OF MATERIALS:

No information

ESTIMATED ERROR:

$\delta k/k = 0.05$

REFERENCES:

1. Parmelee, H. M. *Refrig. Eng.* 1951, *59*, 573.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,1,2-trichloro-1,2,2-trifluoroethane; $C_2Cl_3F_3$ or $(CCl_2F \cdot CClF_2)$ [76-13-1]

ORIGINAL MEASUREMENTS:

Hiraoka, H.; Hildebrand, J. H.

J. Phys. Chem. 1964, *68*, 213-4.

VARIABLES:

$T/K = 277.15 - 308.15$
$P/kPa = 101.325$

PREPARED BY:

M. E. Derrick
A. L. Cramer

EXPERIMENTAL VALUES:

Temperature t/°C	 T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
4.00	277.15	19.33	0.373	0.378
15.00	288.15	19.46	0.370	0.390
24.98	298.13	19.31	0.362	0.395
35.00	308.15	19.88	0.367	0.414

Smoothed Data: $\ln x_1 = -6.017 - 0.6519/(T/100)$

T/K	Mol Fraction $x_1 \times 10^4$
278.15	19.27
283.15	19.35
288.15	19.43
293.15	19.50
298.15	19.58
303.15	19.65
308.15	19.72

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The degassed liquid was saturated with nitrogen gas having a pressure near 1 atm. The volume of gas absorbed by the liquid was determined by P-V measurements in a gas buret (1).

A thermostated gas buret was used for solution measurements. A thermostated pipet containing a magnetic stirrer was used as a solvent reservoir. The liquid volume was determined by the difference in volume between the pipet and the mercury. The connection between the buret and pipet prevents gas and solvent vapor from mixing.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. General Dynamic Corp., passed through cold trap.

(2) 1,1,2-Trichloro-1,2,2-trifluoroethane. Union Carbide Co. Distilled, purity checked by ultraviolet absorbance.

ESTIMATED ERROR:

$\delta T/K = 0.02$
$\delta x_1/x_1 = 0.003$

REFERENCES:

1. Kobatake, Y.; Hildebrand, J. H. *J. Phys. Chem.* 1961, *65*, 331.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Chlorobenzene; C_6H_5Cl; [108-90-7]

ORIGINAL MEASUREMENTS:

Horiuti, J.

Sci. Pap. Inst. Phys. Chem. Res. (Jpn) 1931/32, *17*, 125-256.

VARIABLES:

T/K = 233.45 - 353.45

Total P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
233.45	0.349	0.0813	0.0695
253.45	0.366	0.0838	0.0778
273.15	0.392	0.0881	0.0881
293.15	0.420	0.0926	0.0994
313.25	0.450	0.0973	0.1116
333.20	0.487	0.1032	0.1259
353.45	0.521	0.1081	0.1399

Smoothed Data: $\ln X_1 = -12.41926 + 4.99558/(T/100) + 2.73200 \ln (T/100)$

Standard error about the regression line = 1.83×10^{-6}

T/K	Mol Fraction $X_1 \times 10^3$
233.15	0.348
243.15	0.357
253.15	0.368
263.15	0.379
273.15	0.392
283.15	0.405
293.15	0.419

T/K	Mol Fraction $X_1 \times 10^3$
303.15	0.434
313.15	0.450
323.15	0.467
333.15	0.485
343.15	0.503
353.15	0.522

The Ostwald coefficient was measured at a total pressure of one atm. The Bunsen coefficient and the mole fraction solubility values were calculated by the compiler for a gas pressure of one atm assuming the gas to behave ideally and the Ostwald coefficient to be independent of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas buret, a solvent reservoir, and an absorption pipet. The volume of the pipet was determined at various miniscus heights by weighing a quantity of water. The miniscus height was read with a cathetometer.

The dry gas introduced into the degassed solvent. The gas and solvent are mixed with a magnetic stirrer until saturation. Care taken to prevent solvent vapor from mixing with the solute gas in the gas buret. The volume of gas was determined from a gas buret reading, the volume of the solvent was determined from the miniscus height in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared in the laboratory by heating sodium azide (Kahlbaum, recrystalized and dried). Gas dried over phosphorous pentoxide.

(2) Chlorobenzene. Kahlbaum. Dried, and distilled. Normal boiling point 131.96°C.

ESTIMATED ERROR:

$\delta T/K = 0.05$

If the gas and solution are assumed to be ideal the fitted equation gives the following thermodynamic values.

T/K	ΔG^o/kJ mol^{-1}	ΔH^o/J mol^{-1}	ΔS^0/J K^{-1} mol^{-1}	ΔC_p^o/J K^{-1} mol^{-1}
273.15	17.817	2051	-57.72	22.71
298.15	19.234	2619	-55.73	22.71

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Chlorohexane; $C_6H_{13}Cl$; [544-10-5]

ORIGINAL MEASUREMENTS:

Guerry, D. Jr.

Ph.D. thesis, 1944
Vanderbilt University
Nashville, TN

VARIABLES:

T/K = 293-298
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	8.02	0.131	0.141
298.15	8.19	0.133	0.145

The Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified (2) so that small solvent samples (2 cm^3) could be used with almost complete recovery of the sample.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Ohio Chemical Co. Oil pumped, 99.8 per cent pure.

(2) 1-Chlorohexane. Eastman Kodak Co. Purified, distilled from P_2O_5 in a N_2 atm. B.p. (746.6 mmHg) t/°C 134.66 (corr.). Refractive index, density, and vapor pressure data are in the thesis.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D. *J. Biol. Chem.* 1939, *130*, 545.
2. Ijams, C. C. Ph.D. thesis, 1941 Vanderbilt University

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hexafluorobenzene; C_6F_6; [392-56-3]

ORIGINAL MEASUREMENTS:

Evans, F.D.; Battino, R.

J. Chem. Thermodyn. 1971, *3*, 753-60.

VARIABLES:

T/K = 282.94 - 297.85
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

	$X_1 \times 10^3$	Coefficient α	Coefficient L
282.94	1.799	0.356	0.369
282.94	1.794	0.343	0.368
297.56	1.808	0.351	0.382
297.85	1.783	0.346	0.377

The Bunsen coefficients were calculated by the compiler.

The solubility values were adjusted to an oxygen partial pressure of 101.325 kPa (1 atm) by Henry's law.

Smoothed Data: $\Delta G^o/\text{J mol}^{-1} = -RT \ln X_1 = -34.1 + 52.682\ T$

Std. Dev. $\Delta G^o = 14.3$, Coef. Corr. = 0.9996

$\Delta H^o/\text{J mol}^{-1} = -34.1$, $\Delta S^o/\text{J K}^{-1}\text{ mol}^{-1} = -52.682$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/\text{J mol}^{-1}$
278.15	1.80	14,621
283.15	1.80	14,884
288.15	1.79	15,146
293.15	1.79	15,410
298.15	1.79	15,673

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing: Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination: The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Products and Chemicals Co. 99.6 per cent.

(2) Hexafluorobenzene. Imperiel Smelting Co., Avnomouth, U.K. GC purity 99.7%, density, $\rho_{298.15} = 1.60596 \text{ g cm}^{-3}$. Purification described *Anal. Chem.* 1968, *40*, 224.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/\text{mmHg} = 0.5$
$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1-Bromoheptane; $C_7H_{15}Br$; [629-04-9]

ORIGINAL MEASUREMENTS:

Ijams, C. C.

Ph.D. thesis, 1941
Vanderbilt University
Nashville, TN

VARIABLES:

T/K = 298.15
P/kPa = 101.325

PREPARED BY:

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.675	0.0964	0.1052

The mole fraction and Ostwald coefficient values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified so that small solvent sample (2 cm^3) could be used with almost 100 per cent recovery of the solvent.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. Purity 99.5 per cent.

(2) 1-Bromoheptane. Purified. Vapor pressure and boiling point also reported in the thesis.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D. *J. Biol. Chem.* 1939, *130*, 545.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Undecafluoro (trifluoromethyl)-cyclohexane or perfluoromethyl cyclohexane; C_7F_{14}; [355-02-2]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Hildebrand, J. H.

J. Am. Chem. Soc. 1949, *71*, 3147-50.

VARIABLES:

$T/K = 298.05 - 298.15$
Total $P/kPa = 101.325$

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

	$X_1 \times 10^3$	Coefficient α	Coefficient L
298.05	3.25	0.371	0.405
298.15	3.36	0.384	0.419

One value from the paper was rejected.

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Stuart Oxygen Co. 99.996 percent N_2.

(2) Undecafluoro(trifluoromethyl)-cyclohexane. E. I. duPont Co. Distilled, boiling point 76.5 - 76.6 at 760 mmHg.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.
2. Gjaldbaek, J. C. *Acta Chem. Scand.* 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hexadecafluoroheptane or
Perfluoroheptane; C_7F_{16};
[335-57-9]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Hildebrand, J. H.

J. Am. Chem. Soc. 1949, *71*, 3147-50.

VARIABLES:

$T/K = 275.13 - 321.75$
Total $P/kPa = 101.325$

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
275.13	3.98	0.406	0.409
275.28	4.01	0.409	0.412
275.60	3.96	0.404	0.408
277.25	3.99	0.406	0.412
298.06	3.90	0.384	0.419
298.12	3.93	0.387	0.422
320.06	3.82	0.362	0.424
321.75	3.82	0.362	0.426

The mole fraction and Ostwald solubility values were calculated by the compiler.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -679.41 + 48.394T$

Std. dev. $\Delta G^o = 11.0$, Coef. Corr. = 0.9998

$\Delta H^o/J\ mol^{-1} - -679.41$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -48.394$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
273.15	4.00	12,539
283.15	3.96	13,023
293.15	3.92	13,507
298.15	3.90	13,749
303.15	3.88	13,991
313.15	3.85	14,475
323.15	3.82	14,959

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorped volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Stuart Oxygen Co. 99.996 percent N_2.

(2) Hexadecafluoroheptane. E. I. duPont Co. Distilled, boiling point 82.3 - 82.4°C, at 753.7 mmHg.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

2. Gjaldbaek, J. C.
Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Decafluorobis (trifluoromethyl) cyclohexane or perfluoro dimethylcyclohexane; C_8F_{16}; Isomer not specified.

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Hildebrand, J. H.

J. Am. Chem. Soc. 1949, *71*, 3147-50.

VARIABLES:

T/K = 298.10 - 320.25

Total P/kPa = 101.325

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	3.19	0.329	0.359
311.12	3.20	0.330	0.376
313.67	3.16	0.319	0.366
320.25	3.19	0.319	0.374

The mole fraction and Ostwald solubility values were calculated by the compiler.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -79.059 + 48.056\ T$

Std. dev. $\Delta G^o = 2.3$, Coef. Corr. = 0.9999

$\Delta H^o/J\ mol^{-1} = -79.06$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -48.06$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
298.15	3.19	14,249
308.15	3.18_5	14,730
318.15	3.18	15,210

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorped volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Dansk Itl-og Brint Fabrik. Contained less than 0.13 percent oxygen.

(2) Decafluorobis (trifluoromethyl)-cyclohexane. E. I. duPont Co. Distilled, boiling point 102.4 - 102.6 at 760.0 mmHg.

ESTIMATED ERROR:

$\delta T/K = 0.05$

$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

2. Gjaldbaek, J. C.
Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) FC-80, which is mostly a mixture of isomers of perfluorobutyltetrahydrofuran. For example, 2,2,3,3,4,4,5-heptafluorotetrahydro-5(nonafluorobutyl)furan; $C_8F_{16}O$; [335-36-4]

ORIGINAL MEASUREMENTS:

Sargent, J. W.; Seffl, R. J.

Fed. Proc. 1970, *29*, 1699 - 1703.

VARIABLES:

T/K = 298-310
Total P/kPa = 101.325

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Nitrogen Solubility	
t/°C	T/K	g O_2 1000 g^{-1}	cm^3 O_2 100 cm^{-3}
25	298.15	0.216	33.4
37	310.15	0.217	34.0

The authors solubility, cm^3 N_2 100 cm^{-3}, appears to be the Ostwald coefficient times 100.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The equilibrium apparatus is a 50 cm^3 three neck flask equipped with a water condenser, a thermometer, and a gas dispersing tube extending below the fluid surface level. Between 25 and 35 cm^3 of solvent are placed in the flask. Gas is bubbled through the solvent for 2 - 3 h. An 80 microliter sample is slowly taken into a gas tight syringe. The sample is injected into a gas chromatograph. The results of three sampling and analyses are averaged.

The chromatograph is an F and M Model 720 equipped with a thermal conductivity detector at 320 °C, and a 6' by ¼" stainless steel column packed with 13X molecular sieve at room temperature. The apparatus is calibrated with pure gas samples.

Details of the procedure were furnished by R. D. Danielson of the 3 M Co.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Commercial cylinder.

(2) FC-80. Minnesota Mining and Manufacturing Co. All H in an organic compound are replaced by F by Simons electrochemical process (1)

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta c/c = 0.01$ (reproducibility)
$= 0.05$ (absolute)

REFERENCES:

1. Simons, J. H., Editor *Fluorine Chemistry* Academic Press, New York, 1950.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Heptafluorotetrahydro(nonafluorobutyl)-furan or Perfluorobutyl perfluorotetrahydrofuran or FC-80; $C_8F_{16}O$; [40464-54-8]

ORIGINAL MEASUREMENTS:

Tham, M. K.; Walker, R. D. Jr.; Modell, J. H.

J. Chem. Eng. Data 1973, *18*, 385-6.

VARIABLES:

T/K = 298.15 - 323.15

Total P/kPa = 101.325

PREPARED BY:

T. D. Kittredge
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	4.30	0.411	0.449
303.15	4.18	0.396	0.439
310.15	4.03	0.378	0.429
313.15	4.00	0.373	0.428
323.15	3.80	0.349	0.413

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -3910.8 + 58.430\ T$

Std. dev. $\Delta G^o = 6.9$, Coef. corr. = 0.9998

$\Delta H^o/J\ mol^{-1} = -3910.8$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -58.430$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
298.15	4.30	13,510
303.15	4.19	13,802
308.15	4.08	14,094
313.15	3.98	14,386
318.15	3.89	14,679
323.15	3.80	14,971

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure described by Shoor, Walker and Gubbins (1) were used. The solvent was placed in a saturator immersed in a constant temperature bath. The gas was dispersed through the liquid by a fritted glass disk at a rate of about 40 cm^3 m^{-1}. After an initial equilibration period of 30 minutes, samples were withdrawn with a Hamilton microliter syringe at 15 minute intervals and analyzed chromatographically (Perkin-Elmer 900 gas chromatograph with thermal conductivity detector). The solubility at one atmosphere partial pressure of the gas was the mean value of three consecutive samples which agreed within the limits of experimental error.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Minimum purity 99.6 per cent.

(2) FC-80. Minnesota Mining and Manufacturing Co. A mixture of several isomers. The authors also measured the density and viscosity of the solvent at several temperatures. At 298.15 K the density is 1.7657 g cm^{-3} and the viscosity is 1.3953 centipoise.

ESTIMATED ERROR:

$\delta T/K = 0.05$

$\delta X_1/X_1 = 0.005$ (compiler)

REFERENCES:

1. Shoor, S. K.; Walker, R. D. Jr.; Gubbins, K. E. *J. Phys. Chem.* 1969, *73*, 312.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,1,1,2,2,3,3,4,4,5,5,6,6-Trideca-fluoro-6-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethoxy]-hexane or Perfluoro-1-isopropoxy hexane or Caroxin-F; $C_9F_{20}O$; [37340-18-4] or [41719-16-8]

ORIGINAL MEASUREMENTS:

Tham, M. K.; Walker, R. D. Jr.; Modell, J. H.

J. Chem. Eng. Data 1973, *18*, 385-6.

VARIABLES:

$T/K = 298.15 - 323.15$
Total $P/kPa = 101.325$

PREPARED BY:

T. D. Kittredge
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	5.10	0.398	0.434
303.15	5.05	0.391	0.434
310.15	4.97	0.381	0.433
313.15	4.92	0.375	0.430
323.15	4.80	0.361	0.427

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\Delta G^\circ/J\ mol^{-1} = -RT \ln X_1 = -1976.7 + 50.498\ T$

Std. dev. $\Delta G^\circ = 5.0$, Coef. corr. = 0.9998

$\Delta H^\circ/J\ mol^{-1} = -1976.7$, $\Delta S^\circ/J\ K^{-1}\ mol^{-1} = -50.498$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^\circ/J\ mol^{-1}$
298.15	5.71	13,079
303.15	5.04	13,332
308.15	4.98	13,584
313.15	4.92	13,837
318.15	4.86	14,089
323.15	4.81	14,341

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure described by Shoor, Walker and Gubbins (1) were used. The solvent was placed in a saturator immersed in a constant temperature bath. The gas was dispersed through the liquid by a fritted glass disk at a rate of about 40 $cm^3\ m^{-1}$. After an initial equilibration period of 30 minutes, samples were withdrawn with a Hamilton microliter syringe at 15 minute intervals and analyzed chromatographically (Perkin-Elmer 900 gas chromatograph with thermal conductivity detector). The solubility at one atmosphere partial pressure of the gas was the mean value of three consecutive samples which agreed within the limits of experimental error.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Minimum purity 99.6 per cent.

(2) Caroxin-F. Allied Chemical Corp. Purity > 99.9 per cent as supplied. The authors also measured the density and viscosity of the solvent at several temperatures. At 298.15 K the density is 1.7449 g cm^{-3} and the viscosity is 1.5405 centipoise.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.005$ (Compiler)

REFERENCES:

1. Shoor, S. K.; Walker, R. D. Jr.; Gubbins, K. E. *J. Phys. Chem.* 1969, *73*, 312.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,1,2,2,3,3,4,4-Octafluoro-1,4-bis(1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethoxy) butane or Perfluoro-1,4-diisopropoxy butane or Caroxin-D; $C_{10}F_{22}O_2$; [23228-90-2]

ORIGINAL MEASUREMENTS:

Tham, M. K.; Walker, R. D. Jr.; Modell, J. H.

J. Chem. Eng. Data 1973, *18*, 385-6.

VARIABLES:

T/K = 298.15 - 323.15
Total P/kPa = 101.325

PREPARED BY:

T. D. Kittredge
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	5.00	0.345	0.377
303.15	4.94	0.338	0.375
310.15	4.89	0.331	0.376
313.15	4.83	0.326	0.374
323.15	4.75	0.316	0.374

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -1663.9 + 49.631\ T$

Std. dev. ΔG^o = 5.93, Coef. corr. = 1.000

$\Delta H^o/J\ mol^{-1} = -1663.9$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -49.631$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
298.15	5.00	13,134
303.15	4.95	13,382
308.15	4.89	13,630
313.15	4.84	13,878
318.15	4.79	14,126
323.15	4.75	14,374

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure described by Shoor, Walker and Gubbins (1) were used. The solvent was placed in a saturator immersed in a constant temperature bath. The gas was dispersed through the liquid by a fritted glass disk at a rate of about 40 $cm^3\ m^{-1}$. After an initial equilibration period of 30 minutes, samples were withdrawn with a Hamilton microliter syringe at 15 minute intervals and analyzed chromatographically (Perkin-Elmer 900 gas chromatograph with thermal conductivity detector). The solubility at one atmosphere partial pressure of the gas was the mean value of three consecutive samples which agreed within the limits of experimental error.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Minimum purity 99.6 per cent.

(2) Caroxin-D. Allied Chemical Corp. Purity > 99.9 per cent as supplied. The authors also measured the density and viscosity of the solvent. At 298.15 K the density is 1.7465 g cm^{-3} and the viscosity is 2.0579 centipoise.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.005$ (Compiler)

REFERENCES:

1. Shoor, S. K.; Walker, R. D.; Gubbins, K. E. *J. Phys. Chem.* 1969, *73*, 312.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) L-1822, which is a mixture of mostly 10-carbon fluorocarbons, including cyclic, open chain, and branched molecules.

ORIGINAL MEASUREMENTS:

Sargent, J. W.; Seffl, R. J.

Fed. Proc. 1970, *29*, 1699-1703.

VARIABLES:

T/K = 298.15, 310.15
Total P/kPa = 101.325

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Nitrogen Solubility	
t/°C	T/K	g O_2 1000 g^{-1}	cm^3 O_2 100 cm^{-3}
25	298.15	0.184	30.6
37	310.15	0.162	27.8

The authors solubility, cm^3 N_2 100 cm^{-3}, appears to be the Ostwald coefficient times 100.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The equilibrium apparatus is a 50 cm^3 three neck flask equipped with a water condenser, a thermometer, and a gas dispersing tube extending below the fluid surface level. Between 25 and 35 cm^3 of solvent are placed in the flask. Gas is bubbled through the solvent for 2 - 3 h. An 80 micro-liter sample is slowly taken into a gas tight syringe. The sample is injected into a gas chromatograph. The results of three sampling and analyses are averaged.

The chromatograph is an F and M Model 720 equipped with a thermal conductivity detector at 320 °C, and a 6' by ¼" stainless steel column packed with 13X molecular sieve at room temperature. The apparatus is calibrated with pure gas samples.

Details of the procedure were furnished by R. D. Danielson of the 3 M Co.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Commercial cylinder.

(2) L-1822. Minnesota Mining and Manufacturing Co. All H in an organic compound are replaced by F by Simons electrochemical process (1)

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta c/c = 0.01$ (reproducibility)
$= 0.05$ (absolute)

REFERENCES:

1. Simons, J. H., Editor *Fluorine Chemistry* Academic Press, New York, 1950.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Various solvents, see below

ORIGINAL MEASUREMENTS:

Gorbachev, V. M.; Tret'yakov, G. V.

Zavodsk. Lab. 1966, *32*, 796-8.

VARIABLES:

T/K = 293

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

Substance	C_6H_6	CCl_4	CH_3SiCl_3	$GeCl_4$	$SiCl_4$
		L^a at	20°C	(293 K)	
Standard C_6H_6	0.1162^b	0.155	0.190	0.208	0.224
Standard CCl_4	0.114	0.1572^b	0.184	0.208	0.225

[a] Ostwald coefficient.

[b] Literature values (1).

[c] The Ostwald coefficients for nitrogen in each solvent (columns) were determined from ratios against a standard of either benzene or carbon tetrachloride

[d] Benzene; C_6H_6; [71-43-2]
Carbon tetrachloride; CCl_4; [56-23-5]
Methyl trichloro silane; CH_3SiCl_3; [75-79-6]
Germanium tetrachloride; $GeCl_4$; [10038-98-9]
Silicon tetrachloride; $SiCl_4$; [10026-04-7]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility of N_2 in the investigated liquids was determined by gas chromatography. Chromatographs of equal volumes of a standard liquid (C_6H_6 or CCl_4) saturated with N_2 and the investigated saturated liquid were obtained. Solubilities were calculated from a ratio of nitrogen peak height and liquid peak area of the standard and investigated liquids and the known solubility of N_2 in the standard liquid.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta L/L = \pm 0.03$, compiler's estimate

REFERENCES:

(1) Horiuti, J.
Sci. Papers. Inst. Phys. Chem. Res. (Tokyo) 1931, *17*, 125.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Solvents containing sulfur: Carbon disulfide; CS_2; [75-15-0] Sulfinylbismethane or dimethyl sulfoxide; C_2H_6OS; [67-68-5]	EVALUATOR: H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1981, December

CRITICAL EVALUATION:

The solubility of nitrogen in carbon disulfide is reported in four papers. Just's (1) values at 293.15 and 298.15 K are 34 to 38 per cent lower than the modern values and should be rejected. The other three papers originated from the laboratory of J. H. Hildebrand over a 23 year period. Gjaldbaek and Hildebrand (2) reported solubility values at 298.04 and 298.11 K in 1949, Kobatake and Hildebrand (3) reported four values between 279.37 and 304.35 K in 1961, and Powell (4) reported values over the 273.15 to 303.15 K temperature interval in 1971. Powell reported a solubility value only at 298.15 K and gave the slope of a plot of log x_1 *vs.* log T.

At 298.15 K the mole fraction solubility values at 101.325 kPa (1 atm) nitrogen partial pressure from the three papers (2, 3, 4) agree within 0.7 percent. The smoothed data of Kobatake and Hildebrand (3) and Powell (4) agree within 0.5 per cent at the temperatures between 283.15 and 303.15 K. The recommended solubility values are based on the four solubility values of Kobatake and Hildebrand.

The equation for use between 278.15 and 303.15 K is

$$\log x_1 = -6.4402 - 5.8881/(T/100\ \mathrm{K})$$

with a standard error about the regression line of 2.03×10^{-7}.

The temperature independent thermodynamic changes in enthalpy and entropy for the transfer of one mole of nitrogen from the gas phase at a partial pressure of 101.325 kPa to the infinitely dilute solution are

$$\Delta H_1^\circ/\mathrm{kJ\ mol^{-1}} = 4.895 \text{ and } \Delta S_1^\circ/\mathrm{J\ K^{-1}mol^{-1}} = -53.5.$$

The smoothed solubility values and the Gibbs energy of solution are given in Table 1.

Table 1. Solubility of nitrogen in carbon disulfide of a nitrogen partial pressure of 101.325 kPa. Recommended values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature.

T/K	Mol Fraction $10^4 x_2$	ΔG_1°/kJ mol^{-1}
278.15	1.922	19.789
283.15	1.995	20.057
288.15	2.068	20.325
293.15	2.142	20.593
298.15	2.215	20.860
303.15	2.288	21.128

Only one solubility value is reported for nitrogen + sulfinylbismethane (dimethyl sulfoxide). The mole fraction solubility of 8.33×10^{-5} at 298.15 K and 101.325 kPa nitrogen pressure reported by Dymond (5) is classed as tentative.

References:
1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.
2. Gjaldbaek, J. C.; Hildebrand, J. H. *J. Am. Chem. Soc.* 1949, *71*, 3147.
3. Kobatake, Y.; Hildebrand, J. H. *J. Phys. Chem.* 1961, *65*, 331.
4. Powell, R. J. *J. Chem. Eng. Data* 1972, *17*, 302.
5. Dymond, J. H. *J. Phys. Chem.* 1967, *71*, 1829.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Carbon disulfide; CS_2; [75-15-0]	Just, G. *Z. Phys. Chem.* 1901, *37*, 342-67.

VARIABLES:	PREPARED BY:
T/K = 293-298 P/kPa = 101.325	M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	1.327	0.04929	0.05290
298.15	1.453	0.05369	0.05860

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Carbon disulfide. No information.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W. *Z. Physik. Chem.* 1890, *6*, 141.

2. Steiner, *Ann. Phys. (Leipzig)* 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon disulfide; CS_2; [75-15-0]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Hildebrand, J. H.

J. Am. Chem. Soc. 1949, *71*, 3147-50.

VARIABLES:

T/K = 298.04 - 298.11
Total P/kPa = 101.325

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
298.04	0.223	0.0822	0.0897
298.11	0.223	0.0823	0.0898

The mole fraction and Ostwald solubility values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as the confining liquid. The solvents were degassed in the apparatus. Details are in references 1 and 2.

The absorbed volume of gas was calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent was determined by the weight of displaced mercury.

The saturation of the liquid with the gas was carried out close to atmospheric pressure. The solubility values were reported for one atmosphere gas pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Stuart Oxygen Co. 99.996 percent N_2.

(2) Carbon disulfide. Mallinckrodt Chemical Co. Analytical reagent grade, boiling point 45.80 - 45.85 at 750.1 mmHg.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta X_1/X_1 = 0.015$

REFERENCES:

1. Lannung, A.
   J. Am. Chem. Soc. 1930, *52*, 68.
2. Gjaldbaek, J. C.
   Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon Disulfide; CS_2; [75-15-0]

ORIGINAL MEASUREMENTS:

Kobatake, Y.; Hildebrand, J. H.

J. Phys. Chem. 1961, *65*, 331-5.

VARIABLES:

T/K = 279.37 - 304.35
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
279.37	0.1941	0.0733	0.0750
288.56	0.2072	0.0775	0.0819
298.15	0.2215	0.0819	0.0894
304.35	0.2307	0.0847	0.0944

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\Delta G^\circ/\text{J mol}^{-1} = -RT \ln X_1 = 4890.5 + 53.563\ T$

Std. Dev. $\Delta G^\circ = 1.9$, Coef. Corr. = 1.000

$\Delta H^\circ/\text{J mol}^{-1} = 4890.5$, $\Delta S^\circ/\text{J K}^{-1}\text{ mol}^{-1} = -53.563$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^\circ/\text{J mol}^{-1}$
283.15	0.1995	20,057
288.15	0.2068	20,325
293.15	0.2142	20,593
298.15	0.2215	20,860
303.15	0.2288	21,128

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas-measuring buret, an absorption pipet, and reservoir for solvent. The buret is thermostated at 25°C, the pipet at any temperature from 5 to 30°C.

The solvent is degassed by freezing with liquid nitrogen, evacuating, then boiling with a heat lamp. The solvent never comes into contact with stopcock grease.

The amount of gas is determined by P-V measurements in the gas buret before and after admission of the gas into the pipet. No solvent vapor is allowed into the buret system. The solvent is magnetically stirred for up to 24 hours until equilibrium is reached.

Ideal gas behavior and Henry's law are assumed to calculate the mole fraction solubility at a gas partial pressure of one atm.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Linde Oxygen Co. Standard grade, 99.9 % nitrogen.

(2) CS_2. Analytical Reagent shaken with Hg, $HgCl_2$, distilled, Mallinckrodt Chemical Works.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.003$

REFERENCES:

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Carbon Disulfide; CS_2; [75-15-0]	**ORIGINAL MEASUREMENTS:** Powell, R. J. *J. Chem. Eng. Data* 1972, *17*, 302-4.
VARIABLES: T/K = 273.15 - 318.15 P/kPa = 101.325	**PREPARED BY:** P. L. Long

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L	$R\frac{\Delta \log X_1}{\Delta \log T} = N$
298.15	2.22	0.0821	0.0896	4.00

The author states that solubility measurements were made between 273.15 and 318.15 K, but only the solubility at 298.15 was given in the paper. The slope $R(\Delta \log X_1/\Delta \log T)$ was given. The smoothed data below were calculated by the compiler from the slope in the form:

$$\log x_1 = \log(2.22 \times 10^{-4}) + (4.00/R)\log(T/298.15)$$

with $R = 1.9872$ cal K^{-1} mol^{-1}.

T/K	Mol Fraction $x_1 \times 10^4$
273.15	1.86
278.15	1.93
283.15	2.00
288.15	2.07
293.15	2.15
298.15	2.22
303.15	2.30

The Bunsen and Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Dymond and Hildebrand (1) apparatus which uses an all glass pumping system to spray slugs of degassed solvent into the gas. The amount of gas dissolved is calculated from the initial and final gas pressures. The solvent is degassed by freezing and pumping followed by boiling under reduced pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Manufacturers research grade, dried over $CaCl_2$ before use.

(2) Carbon disulfide. No source given. Spectrochemical grade.

ESTIMATED ERROR:

$\delta N/\text{cal } K^{-1} \text{ mol}^{-1} = 0.1$

$\delta x_1/x_1 = 0.002$

REFERENCES:

1. Dymond, J. H.; Hildebrand, J. H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sulfinylbismethane or Dimethyl Sulfoxide; C_2H_6OS (CH_3SOCH_3); [67-68-5]

ORIGINAL MEASUREMENTS:

Dymond, J. H.

J. Phys. Chem. 1967, *71*, 1829-31.

VARIABLES:

T/K = 298.15

P/kPa = 101.325

PREPARED BY:

M. E. Derrick

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.833	0.0262	0.0286

The Bunsen and Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The liquid is saturated with the gas at a gas partial pressure of 1 atm.

The apparatus is that described by Dymond and Hildebrand (1). The apparatus uses an all-glass pumping system to spray slugs of degassed solvent into the gas. The amount of gas dissolved is calculated from the initial and final gas pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. General Dynamics Corp. Dried.

(2) Dimethyl Sulfoxide. Matheson, Coleman, and Bell Co. Spectroquality reagent, dried, and a fraction frozen out. Melting pt.: 18.37°C.

ESTIMATED ERROR:

REFERENCES:

1. Dymond, J.; Hildebrand, J. H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sulfurhexafluoride; SF_6; [2551-62-4]

ORIGINAL MEASUREMENTS:

Miller, H. C.; Verdelli, L.S.; Gall, J. F.

Ind. Eng. Chem. 1951, *43*, 1126-9.

VARIABLES:

T/K = 300

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P^b/psig	α^a/cm^3(STP) cm^{-3} atm^{-1}	% by wt.^{c}	% by vol.^{c}
356		0	0
365	2.	0.2	0.60
383	2.3	0.41	2.1
400	2.1	0.597	3.04
420	1.9	0.807	4.07

[a] Bunsen coefficient at 27°C (300K). Pressures up to 420 psig were used.

[b] Total pressure.

[c] Of nitrogen in liquid sulfur hexafluoride at 27°C (300 K).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A container with liquid SF_6 at 27°C was pressurized with various amounts of nitrogen which dissolved. This was heated up to 50°C where both substances were in the gas phase. By pressure and volume measurements the Bunsen coefficient could be calculated. The paper also reports on the physical properties of SF_6.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) "Purified." Orthobaric liquid density of 1.30 g/ml at 26°C. t_c/°C = 45.5; ρ_c/g cm^{-3} = 0.727; P_c/atm = 36.8.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.10$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Nitromethane; CH_3NO_2; [75-52-5]

ORIGINAL MEASUREMENTS:

Friedman, H. L.

J. Am. Chem. Soc. 1954, *76*, 3294-7.

VARIABLES:

T/K =298.00
P/kPa =98.33

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
298.00	2.01	0.083	0.091

The author measured the Ostwald coefficient at about 700 mmHg nitrogen pressure. The Bunsen coefficient and the mole fraction solubility at 101.325 kPa (1 atm) nitrogen pressure were calculated by the compiler with the assumptions that the gas is ideal and that Henry's law is obeyed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method was essentially that employed by Euken and Herzberg (1). Modifications included a magnetic stirring device instead of shaking the saturation vessel, and balancing the gas pressure against a column of mercury with electrical contacts instead of balancing the gas pressure against the atmosphere.

The solvent was degassed by vacuum. The procedure, repeated 5 to 10 times, was to alternate 5 to 15 s evacuation and rapid stirring to produce cavitation.

To measure the solubility, the gas, presaturated with solvent vapor, was brought into contact with about 80 cm^3 of solvent in the absorption vessel. Initial conditions were established by a time extrapolation. Solubility equilibrium was approached from both under- and super-saturation by varying the rate.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. The gas was dried over CaH_2 and CaO.

(2) Nitromethane. Source not given. Distilled, dried by filtering at 253 K.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta P/mmHg = 0.3$
$\delta L/L = 0.03$

REFERENCES:

1. Eucken, A.; Herzberg, G. *Z. Phys. Chem.* 1950, *195*, 1.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) N-Methylacetamide; C_3H_7NO; [79-16-3]

ORIGINAL MEASUREMENTS:

Wood, R. H.; DeLaney, D. E.

J. Phys. Chem. 1968, *72*, 4651-4.

VARIABLES:

T/K = 308.15 - 343.15
P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

The authors obtained the equation

$$\ln X_1 = -245.7/(T/K) - 7.514$$

by a linear regression of their experimental data. The equation can be rearranged to

$$\Delta G° = - RT \ln X_1 = 245.7R + 7.514\ RT$$

The experimental data were not included in the paper. They are available in a thesis (1). The smoothed mole fraction argon solubilities at 101.325 kPa N_2 gas and five degree intervals between 308.15 and 343.15 K were given in the paper. The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data:

T/K	Mol Fraction[a] $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
308.15	2.461	0.7139	0.8054
313.15	2.492	0.7198	0.8252
318.15	2.523	0.7256	0.8451
323.15	2.554	0.7313	0.8652
328.15	2.583	0.7364	0.8847
333.15	2.613	0.7417	0.9046
338.15	2.641	0.7463	0.9239
343.15	2.669	0.7509	0.9434

[a] These values were given by the authors and are slightly different than those calculated from their equation given above. These values are too large by about 1.5 ppt, which is less than the experimental error.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A gas buret was connected to a solvent buret through a three-way capillary stopcock. A measured volume of gas was transferred to a known volume of solvent; when equilibrium was reached the total pressure and volume of the system was measured (1). The apparatus and procedure were checked by measuring the solubility of Ar in H_2O at 298.15 K. The Bunsen coefficient of 0.03105 checked well with the literature (2).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Purity 99.99 per cent.

(2) N-Methylacetamide. Source not given. Recrystallized three times in a dry box. Typically had a water content of 0.04 mol per cent after a solubility run.

ESTIMATED ERROR:

Duplicate runs checked to within 0.5 per cent.

REFERENCES:

1. DeLaney, D. E.
M. S. Thesis, University of Delaware, 1968.

2. Ben-Naim, A.; Baer, S.
Trans. Faraday Soc. 1963, *59*, 2735; *ibid.* 1964, *60*, 1736.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Nitric acid, propyl ester or 1-propyl nitrate; $C_3H_7NO_3$; [627-13-4]	Amster, A. B.; Levy, J. B. *J. Am. Rocket Soc.* 1959, *29*, 870-1.
VARIABLES: T/K= "Room temperature" P/kPa= 28.0-85.3	PREPARED BY: M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

Pressure P/mmHg[1]	P/kPa	Solubility[1] mol g^{-1} x 10^6	Mol Fraction x_1 x 10^4	Bunsen Coefficient α	Ostwald Coefficient L
210	28.0	1.8	1.9	0.16	0.17
210	28.0	1.8	1.9	0.16	0.17
220	29.3	1.8	1.9	0.15	0.16
220	29.3	1.4	1.5	0.12	0.13
420	56.0	3.0	3.2	0.13	0.14
420	56.0	3.1	3.3	0.13	0.14
440	58.7	3.0	3.2	0.12	0.13
440	58.7	2.6	2.7	0.10	0.11
620	82.7	4.8	5.0	0.14	0.15
620	82.7	4.4	4.6	0.13	0.14
620	82.7	4.5	4.7	.13	0.14
640	85.3	4.4	4.6	0.12	0.13

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[1] The compiler read values of pressure and solubility from a graph in the author's paper. The pressure is total pressure minus the equilibrium vapor pressure of pure nitric acid propyl ester.

The compiler calculated the mole fraction, Bunsen coefficient, and Ostwald coefficient values assuming a temperature of 293.15 K. Density values for the solvent were available at the temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of an absorption flask connected by a flexible spiral to a mercury filled capillary (1).

A weighed quantity of liquid is placed in the flask. The gas is added , and shaken with the degassed liquid. The volume of the gas is taken as the flask volume minus the solvent volume. The solubility is calculated from

$$\text{Solubility/mol } g^{-1} = V\Delta P/WRT$$

where V is the gas volume,
ΔP is the pressure change on gas dissolution,
W is the weight of solvent,
T is the temperature, and
R the gas constant.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Technical grade, water pumped, 99.5 per cent. Passed through a drying tube.

(2) Nitric acid, propyl ester. Source and purity not given.

ESTIMATED ERROR:

δP/mmHg = 5
δT/K = 2
$\delta\alpha$ α = 0.15

REFERENCES:

1. Levy, J. B.; Taft, R. W. jr. Aaron, D.; Hammett, L. P. *J. Am. Chem. Soc.* 1953, *75*, 3955.

COMPONENTS:	ORI
(1) Nitrogen; N_2; [7727-37-9] (2) Cyclic amines; C_4H_9N, C_5H_5N, and $C_5H_{10}N$	Gué Ph Va Na

VARIABLES:	PRE
T/K = 293-298 P/kPa = 101.325	

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bun Coef
Pyrrolidine; C_4H_9N; [1		
293.15	3.54	0
298.15	3.68	0
Pyridine; C_5H_5N; [110		
293.15	2.41	0
298.15	2.50	0
Piperidine; $C_5H_{11}N$; [		
293.15	4.13	C
298.15	4.22	C

The Ostwald coefficients wer compiler.

AUXILIARY IN

METHOD/APPARATUS/PROCEDURE:

The apparatus was a modified Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co.

The procedure of Van Slyke (1) for pure liquids was modified (2) so that small solvent samples (2 cm^3) could be used with almost complete recovery of the sample.

An improved temperature control system was used.

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SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Ohio Chemical Co. Oil pumped, 99.8 per cent pure.

(2) Cyclic amines. The pyridine and pyrrolidine were distilled from BaO under a N_2 atmosphere. The piperidine was distilled from KOH under a N_2 atmosphere. Experimental data on refractive index, density and vapor pressure are in the thesis.

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ORIGINAL MEASUREMENTS:

Just, G.

] *Z. Phys. Chem.* 1901, *37*, 342-67.

PREPARED BY:

M. E. Derrick
H. L. Clever

Bunsen Coefficient α	Ostwald Coefficient L
0.05667	0.06082
0.05731	0.06255

' Ostwald coefficient at a
mHg. The compiler assumed
to be independent of
d the mole fraction and
es at 101.325 kPa (1 atm)
gas.

RY INFORMATION

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Nitrobenzene. No information.

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ed

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzenamine; C_6H_7N; [62-53-3]

Nitrobenzene; $C_6H_5NO_2$; [98-95-3]

ORIGINAL MEASUREMENTS:

Metschl, J.

J. Phys. Chem. 1924, *28*, 417-37.

VARIABLES:

T/K = 298.15
p/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
Benzenamine or aniline; C_6H_7N; [62-53-3]			
298.15	1.3	0.033	0.036
Nitrobenzene; $C_6H_5NO_2$; [98-95-3]			
298.15	2.6	0.056	0.061

The compiler calculated the mole fraction and Ostwald coefficient values.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The degassed solvent is saturated with nitrogen at 6 to 10 different pressures between 1.5 and 4.5 atm.

The pressure is reduced to one atm, and the "supersaturated gas" is shaken out of the solvent and measured.

The slope of a plot of the volume of gas reduced to standard conditions shaken out of 100 cm^3 of solvent *vs.* the pressure of saturation is nearly identical to the solubility-pressure graph (Henry's law). The slope of the curve is used to obtain the Bunsen coefficient. From the method of calculation the value represents the volume of gas shaken out of the solvent when the pressure is reduced from 2 to 1 atm.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in the presence of calcium dichromate in aqueous solution.

(2) Aniline. Allowed to stand over KOH, then distilled.

Nitrobenzene. Chemically pure. Allowed to stand over calcium chloride, then distilled.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzenamine or aniline; C_6H_7N; [62-53-3]

ORIGINAL MEASUREMENTS:

Just, G.

Z. Phys. Chem. 1901, *37*, 342-67.

VARIABLES:

T/K = 292-298
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L
293.15	1.13	0.02788	0.02992
298.15	1.15	0.02816	0.03074

The author measured the Ostwald coefficient at a pressure of about 746 mmHg. The compiler assumed the Ostwald coefficient to be independent of pressure, and calculated the mole fraction and Bunsen coefficient values at 101.325 kPa (1 atm) partial pressure of the gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Ostwald apparatus as modified by Timofejew (1), and Steiner (2) is used. The apparatus consists of a gas buret, an absorption flask, and a mercury manometer. The system is thermostated with a water jacket.

The gas is introduced into the degassed liquid. The gas volume absorbed is determined by the gas buret. The solvent volume is determined at the end of the experiment by pouring the solvent into a graduated flask.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Prepared by the reaction of sodium nitrite and ammonium nitrate in aqueous solution in the presence of calcium dichromate.

(2) Benzenamine. No information given.

ESTIMATED ERROR:

$\delta L/L = 0.03$ (compiler)

REFERENCES:

1. Timofejew, W.
Z. Physik. Chem. 1890, *6*, 141.

2. Steiner,
Ann. Phys. (Leipzig) 1894, *52*, 275.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,1,2,2,3,3,4,4,4-Nonafluoro-N,N-bis(nonafluorobutyl)-1-butanamine; $(C_4F_9)_3N$; [311-89-7]

ORIGINAL MEASUREMENTS:

Kobatake, Y.; Hildebrand, J. H.

J. Phys. Chem. 1961, *65*, 331-5.

VARIABLES:

T/K = 283.83 - 303.60
P/kPa = 101.325

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
283.83	3.537	0.230	0.239
287.18	3.524	0.227	0.239
293.56	3.502	0.223	0.240
298.15	(3.490)	0.220	0.240
299.15	3.488	0.219	0.240
303.60	3.474	0.216	0.240

The Bunsen and Ostwald coefficients were calculated by the compiler.

Smoothed Data: $\Delta G^o/J\ mol^{-1} = -RT \ln X_1 = -638.71 + 49.183\ T$

Std. Dev. $\Delta G^o = 0.84$, Coef. Corr. = 0.9992

$\Delta H^o/J\ mol^{-1} = -638.71$, $\Delta S^o/J\ K^{-1}\ mol^{-1} = -49.183$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G^o/J\ mol^{-1}$
283.15	3.538	13,288
288.15	3.521	13,534
293.15	3.505	13,779
298.15	3.490	14,025
303.15	3.475	14,271

The value in ( ) is assumed to be the authors smoothed value.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a gas-measuring buret, an absorption pipet, and reservoir for solvent. The buret is thermostated at 25°C, the pipet at any temperature from 5 to 30°C.

The solvent is degassed by freezing with liquid nitrogen, evacuating, then boiling with a heat lamp. The solvent never comes into contact with stop-cock grease.

The amount of gas is determined by P-V measurements in the gas buret before and after admission of the gas into the pipet. No solvent vapor is allowed into the buret system. The solvent is magnetically stirred for up to 24 hours until equilibrium is reached.

Ideal gas behavior and Henry's law are assumed to calculate the mole fraction solubility at a gas partial pressure of one atm.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Linde Oxygen Co. Standard grade, 99.9 % nitrogen.

(2) $(C_4F_9)_3N$. Minnesota Mining and Manufacturing Co. dried, fractionated, b.p. 178.5 - 179.0°C.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.003$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) FC-47, which is largely perfluorotributylamine or 1,1,2,2,3,3,4,4,4-nonafluoro-N,N-bis(nonafluorobutyl)-1-butanamine; $C_{12}F_{27}N$; [311-89-7]

ORIGINAL MEASUREMENTS:

Sargent, J. W.; Seffl, R. J.

Fed. Proc. 1970, *29*, 1699 - 1703.

VARIABLES:

T/K = 298-310
Total P/kPa = 101.325

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Nitrogen Solubility	
t/°C	T/K	g O_2 1000 g^{-1}	cm^3 O_2 100 cm^{-3}
25	298.15	0.174	28.4
37	310.15	0.171	28.6

The authors solubility, cm^3 N_2 100 cm^{-3}, appears to be the Ostwald coefficient times 100.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The equilibrium apparatus is a 50 cm^3 three neck flask equipped with a water condenser, a thermometer, and a gas dispersing tube extending below the fluid surface level. Between 25 and 35 cm^3 of solvent are placed in the flask. Gas is bubbled through the solvent for 2 - 3 h. An 80 microliter sample is slowly taken into a gas tight syringe. The sample is injected into a gas chromatograph. The results of three sampling and analyses are averaged.

The chromatograph is an F and M Model 720 equipped with a thermal conductivity detector at 320 °C, and a 6' by ¼" stainless steel column packed with 13X molecular sieve at room temperature. The apparatus is calibrated with pure gas samples.

Details of the procedure were furnished by R. D. Danielson of the 3 M Co.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Commercial cylinder.

(2) FC-47. Minnesota Mining and Manufacturing Co. All H in an organic compound are replaced by F by Simons electrochemical process (1)

ESTIMATED ERROR:

$\delta T/K = 0.1$
$\delta c/c = 0.01$ (reproducibility)
$= 0.05$ (absolute)

REFERENCES:

1. Simons, J. H., Editor
Fluorine Chemistry
Academic Press, New York, 1950.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,1,2,2,3,3,4,4,4-nonafluoro-N,N-bis(nonafluorobutyl)-1-butanamine (Perfluorotributylamine); $C_{12}F_{27}N$; [311-89-7]

ORIGINAL MEASUREMENTS:

Powell, R. J.

J. Chem. Eng. Data 1972, *17*, 302-4.

VARIABLES:

T/K = 288.15 - 318.15

N_2 P/kPa = 101.325

PREPARED BY:

P. L. Long

EXPERIMENTAL VALUES:

T/K	Mol Fraction $x_1 \times 10^4$	Bunsen Coefficient α	Ostwald Coefficient L	$R\frac{\Delta \log X_1}{\Delta \log T} = N$
298.15	42.36	0.267	0.292	-0.35

The author states that solubility measurements were made between 288.15 and 318.15 K, but only the solubility at 298.15 was given in the paper. The slope $R(\Delta \log X_1/\Delta \log T)$ was given. The smoothed data below were calculated by the compiler from the slope in the form:

$$\log x_1 = \log(42.36 \times 10^{-4}) - (0.35/R)\log(T/298.15)$$

with R = 1.9872 cal K^{-1} mol^{-1}.

T/K	Mol Fraction $x_1 \times 10^4$
288.15	42.62
293.15	42.49
298.15	42.36
303.15	42.23
308.15	42.11
313.15	41.99
318.15	41.88

The Bunsen and Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Dymond and Hildebrand (1) apparatus which uses an all glass pumping system to spray slugs of degassed solvent into the gas. The amount of gas dissolved is calculated from the initial and final gas pressures. The solvent is degassed by freezing and pumping followed by boiling under reduced pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Manufacturers research grade, dried over $CaCl_2$ before use.

(2) Perfluorotributylamine. Minnesota Mining & Mfg. Co., Column distilled, used portion with b.p. = 447.85 - 448.64 K, & single peak GC.

ESTIMATED ERROR:

δN/cal K^{-1} mol^{-1} = 0.1

$\delta x_1/x_1 = 0.002$

REFERENCES:

1. Dymond, J. H.; Hildebrand, J. H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrazine; NH_2NH_2; [302-01-2]

ORIGINAL MEASUREMENTS:

Chang, E. T.; Gokcen, N. A.; Poston, T. M.

J. Phys. Chem. 1968, *72*, 638 -42.

VARIABLES:

$T/K = 278.15 - 308.15$
$P/kPa = 106.31 - 209.92$

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Nitrogen Pressure P_1/atm	Henry's Constant[1] $10^5 K/atm^{-1}$	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient α	Ostwald Coefficient L
278.15	1.1453	0.49	0.56		
	2.0836	0.58	1.21		
	1.0	0.54 av.	0.54	0.0038	0.0039
293.15	1.0492	0.66	0.69		
	1.1120	0.64	0.71		
	1.9719	0.74	1.45		
	2.0619	0.73	1.51		
	1.0	0.69	0.69	0.0049	0.0039
308.18	1.0842	0.78	0.84		
	2.1112	0.85	1.80		
	1.0	0.82 av.	0.82	0.0056	0.0064

[1] Henry's constant, $K/atm^{-1} = x_1/(P_1/atm)$.

The solubility values at 101.325 kPa (1 atm) were calculated by the compiler from the average Henry's constant.

T/K	Mol Fraction $x_1 \times 10^5$	Gibbs Energy $\Delta G°/kJ\ mol^{-1}$
278.15	0.54	28.06
288.15	0.62	28.71
298.15	0.72	29.36
308.15	0.82	30.00

Smoothed Data: Mole fraction solubility of nitrogen in hydrazine at one atm N_2 pressure.

$$\ln x_1 = -1206.46/(T/K) - 7.7956$$

$$\Delta H°/kJ\ mol^{-1} = 10.0;\ \Delta S°/JK^{-1}\ mol^{-1} = -64.8$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solvent was degassed under vacuum in the previously weighed apparatus. Apparatus and degassed solvent weighed. Gas was introduced into the apparatus at a known P and T. The liquid was stirred, and the pressure was observed until there was no further change. Hydrazine did not appear to decompose with time as did the substituted hydrazines.

The apparatus was of all glass construction. It consisted of three calibrated volumes for the measurement of the gas, a container for the solvent, which was stirred with a glass enclosed magnet, and a manometer for measuring the pressure with a microslide cathetometer. The solvent container had a capacity for 100 g of solvent with a 5 ml gas space above the liquid surface. The apparatus sections were calibrated to $\pm$ 0.0002-3 cm^3 (1). There are no additional solubility data in the author's other discussions (2,3) of the system.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No information given.

(2) Hydrazine. No information on source. It was freshly distilled before use. The density was measured, and fitted to the equation:

$$\rho/g\ ml^{-1} = 1.02492 - 0.000865t/C.$$

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.01$
$\delta X_1/X_1 = 0.05$

REFERENCES:

1. Chang, E. T.; Gokcen, N. A. *J. Phys. Chem.* 1966, *70*, 2394.
2. Chang, E. T.; Gokcen, N. A.; Poston, T. M. *J. Spacecr. Rockets* 1969, *6*, 1177.
3. Gokcen, N. A.; Chang, E. T. *J. Chem. Ed.* 1977, *54*, 368.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methylhydrazine; $NHCH_3NH_2$; [60-34-4]

ORIGINAL MEASUREMENTS:

Chang, E. T.; Gokcen, N. A. Poston, T. M.

J. Phys. Chem. 1968, *72*, 638 - 42.

VARIABLES:

T/K = 253.24 - 298.14

P/kPa = 99.16 - 211.32

PREPARED BY:

H. L. Clever
P. L. Long

EXPERIMENTAL VALUES:

	Nitrogen Pressure P_1/atm	Henry's Constant[1] $10^5K/atm^{-1}$	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient α	Ostwald Coefficient L
253.24	0.9786	6.62	6.48		
	2.0042	6.68	13.39		
	1.0	6.65 av.	6.65	0.0296	0.0274
273.15	1.1052	7.55	8.34		
	1.9863	7.56	15.02		
	1.0	7.56 av.	7.56	0.0329	0.0329
298.14	1.0577	9.25	9.78		
	2.0856	9.33	19.46		
	1.0	9.29	9.29	0.0392	0.0428

---

[1] Henry's constant, $K/atm^{-1} = x_1/(P_1/atm)$. The solubility values at one atm nitrogen pressure were calculated by the compiler from the value of the average Henry's constant.

Smoothed Data: Mole fraction of nitrogen in methyl hydrazine at one atm N_2 pressure.

$\ln x_1 = -558.58/(T/K) - 7.422$

$\Delta H°/kJ\ mol^{-1} = 4.64$;

$\Delta S°/J\ K^{-1}\ mol^{-1} = -61.7$

T/K	Mol Fraction $x_1 \times 10^5$	$\Delta G°/kJ\ mol^{-1}$
258.15	6.87	20.57
268.15	7.45	21.19
278.15	8.03	21.81
288.15	8.61	22.43
298.15	9.18	23.04

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solvent was degassed under vacuum in the previously weighed apparatus. Apparatus and degassed solvent were weighed. Gas was introduced into the apparatus at a known P and T, the liquid stirred, and the pressure observed until there was no further change. Equilibrium was established within 10 m and the P was followed for 40 m. Substituted hydrazines appear to decompose with time. For decomposing solvents the P was followed for up to 2 h, and the solubility value was corrected for the gaseous decomp. prod.

The apparatus was of all Pyrex glass construction. It consisted of three calibrated volumes for the measurement of the gas, a container for the solvent, which was stirred with a glass enclosed magnet, and a manometer with a microslide cathetometer for measuring the pressure. The solvent container had a capacity for 100 g of solvent with a 5 ml gas space above the liquid surface. The apparatus sections were calibrated to ± 0.0002 - 3 cm^3 (1). See comment on page 232 about additional references.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No information given.

(2) Methylhydrazine. Source not given. Distilled prior to use. Denstiy, $\rho/g\ ml^{-1} = 0.89338 - 0.000943t/°C$.

ESTIMATED ERROR:

$\delta T/K = 0.03$

$\delta P/mmHg = 0.01$

$\delta X_1/X_1 = 0.05$

REFERENCES:

1. Chang, E. T.; Gokcen, N. A. *J. Phys. Chem.* 1966, *70*, 2394.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,1-Dimethylhydrazine; $N(CH_3)_2NH_2$; [57-14-7]

ORIGINAL MEASUREMENTS:

Chang, E. T.; Gokcen, N. A.
Poston, T. M.

J. Phys. Chem. 1968, *72*, 638 - 42.

VARIABLES:

T/K = 253.05 - 293.16
P/kPa = 101.38 - 209.92

PREPARED BY:

H. L. Clever
P. L. Long

EXPERIMENTAL VALUES:

T/K	Nitrogen Pressure P_1/atm	Henry's Constant[1] 10^5K/atm^{-1}	Mol Fraction $x_1 \times 10^5$	Bunsen Coefficient α	Ostwald Coefficient L
253.05	1.2330	29.71	36.64		
	1.9703	29.66	58.44		
	1.0	29.7 av.	29.7	0.0919	0.0851
273.15	1.0005	32.57	32.59		
	1.3281	32.74	43.48		
	2.0717	32.86	68.08		
	1.0	32.7 av.	32.7	0.0990	0.0990
293.16	1.1587	36.85	42.70		
	1.9251	37.04	71.30		
	1.0	36.9 av.	36.9	0.108	0.116

[1] Henry's constant, K/atm^{-1} = X_1/P_1/atm). The solubility values at 1.0 atm nitrogen pressure were calculated by the compiler from the average value of Henry's constant.

Smoothed Data: Mole fraction solubility of nitrogen at one atm nitrogen pressure.

$\ln x_1 = -404.66/(T/K) - 6.5297$

$\Delta H°/\text{kJ mol}^{-1} = 3.36$;

$\Delta S°/\text{J K}^{-1}\text{ mol}^{-1} = -54.3$

T/K	Mol Fraction $x_1 \times 10^5$	$\Delta G°/\text{J mol}^{-1}$
258.15	30.4	17.38
268.15	32.2	17.92
278.15	34.1	18.47
288.15	35.8	19.01
298.15	37.6	19.55

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solvent was degassed under vacuum in the previously weighed apparatus. Apparatus and degassed solvent were weighed. Gas was introduced into the apparatus at a known P and T, the liquid stirred, and the pressure observed until there was no further change. Equilibrium was established within 10 m and the P was followed for 40 m. Substituted hydrazines appear to decompose with time. For decomposing solvents the P was followed for up to 2 h, and the solubility value was corrected for the gaseous decomp. prod. The apparatus was of all Pyrex glass construction. It consisted of three calibrated volumes for the measurement of the gas, a container for the solvent, which was stirred with a glass enclosed magnet, and a manometer with a microslide cathetometer for measuring the pressure. The solvent container had a capacity for 100 g of solvent with a 5 ml gas space above the liquid surface. The apparatus sections were calibrated to ± 0.0002 - 3 cm^3 (1). See comment on page 232 about additional references.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No information given.

(2) 1,1-Dimethylhydrazine. Source not given. Distilled just prior to use.

Density, ρ/g ml^{-1} = 0.80980 - 0.001030 t/°C

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/\text{mmHg} = 0.01$
$\delta X_1/X_1 = 0.05$

REFERENCES:

1. Chang, E. T.; Gokcen, N. A. *J. Phys. Chem.* 1966, *70*, 2394.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrazine; NH_2NH_2; [302-01-2]

(3) 1,1-Dimethylhydrazine; $N(CH_3)_2NH_2$; [57-14-7]

ORIGINAL MEASUREMENTS:

Chang, E. T.; Gokcen, N. A.

J. Phys. Chem. <u>1968</u>, *72*, 2556 -62.

VARIABLES:

T/K = 273.15 - 303.15
P/kPa = 50.66 - 253.31

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Mol Fraction 1,1-Dimethylhydrazine/x_3	Gibbs Energy $\Delta G°$/cal mol^{-1} = -RT ln K/atm^{-1}	Henry's Constant[1] K/atm^{-1} = $X_1/(P_1/atm)$ 10^5K/atm^{-1} at 288.15K
0.0	2360 + 15.60 T/K	0.623
0.1	1830 + 15.59 T/K	1.60
0.2	1450 + 15.60 T/K	3.10
0.3	1200 + 15.46 T/K	5.14
0.4	1150 + 14.82 T/K	7.74
0.5	1140 + 14.18 T/K	10.87
0.6	1100 + 13.72 T/K	14.7
0.7	1050 + 13.38 T/K	19.0
0.8	980 + 13.16 T/K	24.0
0.9	900 + 13.03 T/K	29.5
1.0	800 + 13.00 T/K	35.7

[1] The Henry's constant is numerically equal to the mole fraction solubility at 101.325 kPa (1 atm).

The Gibbs energy equation was fitted to data taken in the 273.15 - 303.15 K temperature range.

The Henry's constant is based on data measured over the 0.5 - 2.5 atm pressure range. The values in the Table above are the Henry's constant at 288.15 K. Values at other temperatures can be calculated from the Gibbs energy equation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solvent was degassed under vacuum in the previously weighed apparatus. Apparatus and degassed solvent were weighed. Gas was introduced into the apparatus at a known P and T, the liquid stirred, and the pressure observed until there was no further change. Equilibrium was established within 10 m and the P was followed for 40 m. Substituted hydrazines appear to decompose with time. For decomposing solvents the P was followed for up to 2 h, and the solubility value was corrected for the gaseous decomp. product.

The apparatus was of all Pyrex glass construction. It consisted of three calibrated volumes for the measurement of the gas, a container for the solvent, which was stirred with a glass enclosed magnet, and a manometer with a microslide cathetometer for measuring the pressure. The solvent container had a capacity for 100 g of solvent with a 5 ml gas space above the liquid surface.

SOURCE AND PURITY OF MATERIALS:

The source and purity of the materials were not given. The density and refractive index of the solvent components and several of their mixtures are given. The solvents were freshly distilled before use.

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/mmHg = 0.01$
$\delta X_1/X_1 = 0.05$

REFERENCES:

1. Chang, E. T.; Gokcen, N. A. *J. Phys. Chem.* <u>1966</u>, *70*, 2394.

The apparatus sections were calibrated to ± 0.0002 - 3 cm^3 (1).

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,2-Dimethylhydrazine; $NHCH_3NHCH_3$; [540-73-8]

ORIGINAL MEASUREMENTS:

Chang, E. T.; Gokcen, N. A.
Poston, T. M.

J. Phys. Chem. 1968, *72*, 638 - 42.

VARIABLES:

T/K = 273.15 - 298.15
P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

The authors made no experimental measurements on this system. The authors give an estimated Gibbs energy equation for the solution of nitrogen in 1,2-dimethylhydrazine. They used logical assumptions to find a linear relationship between the Gibbs energy of solution of nitrogen in hydrazine, methylhydrazine, and 1,1-dimethylhydrazine as a function of $1/r^{12}$, where r is the distance of approach of solvent and solute molecules. The value of r in each solvent was determined from a simple cell model. The linear relationship was extrapolated to obtain the estimated value of the Gibbs energy of solution of nitrogen in 1,2-dimethylhydrazine. The estimated equation is

$$\Delta G°/\text{cal mol}^{-1} = -(R/\text{cal K}^{-1}\text{ mol}^{-1})(T/K)\ \ln\ (K/\text{atm}^{-1}) = 1300 + 8.51\ (T/K)$$

where K is the Henry's constant defined as $K/\text{atm}^{-1} = X_1/(P/\text{atm})$. The Henry's constants tabulated below were calculated from the equation by the compiler. They are numerically equal to the mole fraction solubility at one atm N_2 pressure.

T/K	Henry's Constant $10^5K/\text{atm}^{-1}$
273.15	126
278.15	131
283.15	137
288.15	143
293.15	148
298.15	154

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Estimated data, see above.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Octamethylcyclotetrasiloxane; $C_8H_{24}O_4Si_4$; [556-67-2]

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; McHale, J. L.; Battino, R.; Wilhelm, E.

Fluid Phase Equil. 1978, *2*, 225-30.

VARIABLES:

T/K = 292-313

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	$10^3x_1{}^a$	L^b
292.15	2.624	0.2035
292.15	2.537	0.1967
292.15	2.541	0.1970
298.15	2.499	0.1963
298.30	2.588	0.2034
298.55	2.448	0.1925
313.11	2.579	0.2090

[a] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[b] Ostwald coefficient.

[c] At 298.15 K smoothed values are: $x_1 = 2.551 \times 10^{-3}$; $\Delta H_1^\circ = 368$ J mol^{-1}, $\Delta S_1^\circ = -48.5$ J K^{-1} mol^{-1}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, et al. (3). Degassing: Up to 1000 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is stirred rapidly and vacuum applied intermittently through a liquid nitrogen trap until the permanent gas residual pressure drops to 5 microns. Solubility determination: The degassed solvent is passed in a thin film down a glass spiral tube containing the solute gas plus the solvent vapor at a total pressure of ca. 1 atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson, 99.999%

(2) General Electric Co.; density is 0.9500 g cm^{-3} for distilled solvent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$

$\delta x_1/x_1 = \pm 0.01$

REFERENCES:

1. Morrison, T.J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F.D.; Danforth, W.F. *J. Am. Oil. Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Animal and vegetable oils

ORIGINAL MEASUREMENTS:

Vibrans, F. C.

Oil and Soap 1935, *12*, 14 -5.

VARIABLES:
$T/K = 296 - 318$

PREPARED BY:
P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility, cm^3 (273.15 K, 1 atm) H_2 100 cm^{-3}					
	Experiment					Av.
Corn oil						
296.15-299.15	6.38	6.32	6.23			6.31
318.15	6.38	6.26	6.26	6.35	6.40	6.33
Cottonseed oil						
296.15-299.15	6.06	6.20				6.13
318.15	6.06	6.22				6.14
Hydrogenated cottonseed oil						
318.15	6.60	6.62	6.76	6.84		6.70
Steam rendered lard						
318.15	6.23	6.22				6.22

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Van Slyke manometric method (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. From commercial cylinders. Source or purity not stated.

(2) Corn oil. Commercial sample bought on market. Representative of its class.

Cottonseed oil. Commercial sample bought on market. Representative of its class.

Lard. From a mixture of killing and cutting fats. Steam rendered.

ESTIMATED ERROR:

$\delta T/K = 3$ at room temperature
2 at 318 K
$\delta c/c = 0.04$ (author)

REFERENCES:

1. Van Slyke, D. D.; *et al.* *J. Biol. Chem.* 1924, *61*, 523 and 575.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Animal and vegetable oils

ORIGINAL MEASUREMENTS:

Schaffer, P. S.; Haller, H. S.

Oil and Soap 1943, *20*, 161 - 2.

VARIABLES:

T/K = 313-333
P/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	cm^3 (273.15 K, 1 atm) N_2 100 cm^{-3}
Cottonseed oil	
313.15	6.2
Butter oil	
313.15	8.9
333.15	7.9
Lard	
313.15	6.6

The author's solubility unit is the Bunsen coefficient x 100.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a reaction flask connected to a water jacketed gas buret, a mercury leveling bulb, and a differential manometer. The reaction vessel is attached to a shaking mechanism in an air bath.

A 50 cm^3 sample of oil is placed in the falsk. Heat and vacuum are applied to remove dissolved gases. The sample is cooled to the temperature of the measurement. Nitrogen gas is admitted, and a zero reading is taken. The sample is shaken until the sample takes up no more gas at a pressure of 1 atm. Three determinations were made on each sample.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. From commercial cylinder, used as received.

(2) Cottonseed oil. Good grade commercial product.

Butter oil. Obtained from butter prepared in the lab from fresh cream

Lard. Good grade commercial product.

ESTIMATED ERROR:

$\delta T/K = 0.5$
$\delta c/c = 0.003$ (authors, error among three determinations)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Soybean Oil

ORIGINAL MEASUREMENTS:

Tomoto, N.; Kusano, K.

Yukagaku 1967, *16*, 108-13.

Chem. Abstr. 1953, *66*, 1061412.

VARIABLES:

T/K = 303-343

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	$10^2\alpha^b$/cm (STP) cm^{-3} atm^{-1}
30	303	8.60
50	323	6.85
70	343	5.22

[a] Calculated by compiler.

[b] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Described in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Saponification value: 192.0; acid value: 0.17; iodine value: 128.5; unsaponifiable: 0.33%; d_{30}: 0.9132 g cm^{-3}; M.W.: 877 g mol^{-1}; molar volume: 960.4 cm^3 mol^{-1}.

ESTIMATED ERROR:

$\delta\alpha/\alpha$ = ±0.02, compiler's estimate.

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Olive Oil	Rubin Battino Department of Chemistry Wright State University Dayton, OH 45435 U.S.A.

CRITICAL EVALUATION:

Four groups (1-4) have studied the nitrogen/olive oil system and with some disparity between their results. We have rejected the single value determined by Ikels (3) as being too low. The remaining data were smoothed in two ways by least squares analysis to yield:

$$\ln x_1 = -5.6757 - 0.58383/(T/100K) \qquad (1)$$

$$L = 1.9886 \times 10^{-3} + 2.3052 \times 10^{-4} (T/K) \qquad (2)$$

where x_1 is the mole fraction solubility at 101 kPa partial pressure of gas and L is the Ostwald coefficient. The fit for both equations was to 3.1% in the solubility (one standard deviation divided by the solubility at the mid-point between 285 and 328 K). Smoothed values for both solubility units at 5K intervals are presented in the table. These are tentative values.

T/K	$10^3 x_1$	$10^2 L$	T/K	$10^3 x_1$	$10^2 L$
283.15	2.79	6.73	308.15	2.84	7.30
288.15	2.80	6.84	313.15	2.85	7.42
293.15	2.81	6.96	318.15	2.85	7.53
298.15	2.82	7.07	323.15	2.86	7.65
303.15	2.83	7.19	328.15	2.87	7.76

References

1. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830-3.
2. Power, G. G.; Stegall, H. *J. Appl. Physiology* 1970, *29*, 145-9.
3. Ikels, K. G. *DDC Report No. SAM-TDR-64-1* 1964.
4. Davidson, D.; Eggleton, P.; Foggie, P. *Quart. J. Exptl. Physiol.* 1952, *37*, 91-105.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Olive Oil, Tetralin, Oleic acid, Ethyl palmitate (liquid), Lard

ORIGINAL MEASUREMENTS:

Davidson, D.; Eggleton, P.; Foggie, P.

Quart. J. Exptl. Physiol. 1952, 37, 91-105.

VARIABLES:

T/K = 298-323

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	L^b
	Olive Oil	
25.2	298.4	0.0686
	Tetralin	
25.2	298.4	0.0638
	Oleic Acid	
25.2	298.4	0.085
	Ethyl Palmitate (liquid)	
25.2	298.4	0.109
	Lard (liquid)	
50	323	0.07

[a] Calculated by compiler.

[b] Ostwald coefficient.

[c] Tetralin: 1,2,3,4-Tetrahydronaphthalene; $C_{10}H_{12}$; [119-64-2]

[d] Oleic Acid: (Z)-9-Octadecenoic acid; $C_{18}H_{34}O_2$; [112-80-1]

[e] Ethyl Palmitate: Hexadecanoic acid, ethyl ester; $C_{18}H_{36}O_2$; [628-97-7]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Combined with diffusion measurements. Measurement based knowing gas and liquid phase volumes and the initial (before any gas dissolves) pressure and the final equilibrium pressure.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta L/L = \pm 0.08$, compiler's estimate.
$\delta T/K = \pm 0.01$, but reported to 0.1°C or 1°C.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]
(2) Olive oil, fats
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Ikels, K. G.
DDC, Report No. SAM-TDR-64-1
1964.

VARIABLES:

T/K = 311

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Substance	t/°C	T^a/K	$10^2\alpha^a$
Water	37.6	310.8	1.206
Olive Oil	37.4	310.6	6.092
Human fat (pooled)	37.4	310.6	6.170
Human fat (individual)	37.4	310.6	6.109
Dog fat	37.4	310.6	6.092

[a] Calculated by compiler.

[b] Bunsen coefficient in units of cm^3(STP) $cm^{-3}atm^{-1}$. These values are the means of multiple measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Combination of van Slyke and gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.
(2) Human adipose tissue from the abdominal region within 3-4 h of post-mortem. Density of pooled sample was 0.906 g cm^{-3}. Density of olive oil was 0.907 g cm^{-3} at 310K.
(3) Distilled.

ESTIMATED ERROR:

$\delta\alpha/\alpha$ = ±0.01, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Olive oil

ORIGINAL MEASUREMENTS:

Battino, R.; Evans, F. D.; Danforth, W. F.

J. Am. Oil Chem. Soc. 1968, *45*, 830-3.

VARIABLES:

$T/K = 297.93 - 327.71$

$P/kPa = 101.325$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Ostwald Coefficient L
297.93	2.94	0.0674_8	0.0736_0
298.04	3.00	0.0688_0	0.0750_7
307.95	2.88	0.0657_7	0.0741_5
318.20	2.84	0.0644_5	0.0750_5
327.71	2.82	0.0636_1	0.0763_2

Smoothed Data: $\Delta G^{\circ}/J\ mol^{-1} = -RT \ln X_1 = -1460.7 + 53.314\ T$

Std. Dev. $\Delta G^{\circ} = 23$, Coef. Corr. = 0.9992

$\Delta H^{\circ}/J\ mol^{-1} = -1460.7$, $\Delta S^{\circ}/J\ K^{-1}\ mol^{-1} = -53.314$

T/K	Mol Fraction $X_1 \times 10^3$	$\Delta G\ /J\ mol^{-1}$
298.15	2.96	14,435
308.15	2.90	14,968
318.15	2.85	15,501
328.15	2.80	16,034

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is based on the design by Morrison and Billett (1) and the version used is a modification of the apparatus of Clever, Battino, Saylor and Gross (2).

Degassing. The solvent is sprayed into an evacuated chamber of an all glass apparatus; it is stirred and heated until the pressure drops to the vapor pressure of the liquid.

Solubility Determination. The degassed liquid passes in a thin film down a glass spiral tube at a total pressure of one atm of solute gas plus solvent vapor. The gas absorbed is measured in the attached buret system, and the solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. min. vol. % purity 99.999.

(2) Olive oil. A. U.S.P., Fisher Scientific Company., 0.58% free fatty acid.
B. Nutritional Biochemicals Corp., 0.30% free fatty acid. The density was measured and fitted to the equation $\rho/g\ cm^{-3} = 0.9152 - 0.000468t/C$. The average mol wt is 884 ± 45 (3).

ESTIMATED ERROR:

$\delta T/K = 0.03$

$\delta P/mmHg = 0.5$

$\delta X_1/X_1 = 0.005$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Clever, H. L.; Battino, R.; Saylor, J. H.; Gross, P. M. *J. Phys. Chem.* 1957, *61*, 1078.
3. Johnson, L. F.; Shoolery, J. N. *Anal. Chem.* 1962, *34*, 1136.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Olive oil.

ORIGINAL MEASUREMENTS:

Power, G.G.; Stegall, H.

J. Appl. Physiology 1970, *29*, 145-9.

VARIABLES:

T/K = 285-310

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	S.D.*	No. of measurements
310.15	0.0643	0.0005	5
298.15	0.0633	0.0005	5
285.15	0.0622	0.0002	5

* Standard deviation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Liquid saturated with gas in a stirred cell. 5.0 cm^3 samples of liquid removed in a calibrated syringe and amount of gas extracted by two extraction in a van Slyke apparatus determined. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Matheson Co. sample, purity better than 99.7 mole per cent.

(2) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

REFERENCES:

1. Power, G.G.

   J. Appl. Physiology. 1968, *24*, 468.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Human blood, plasma

ORIGINAL MEASUREMENTS:

Farhi, L.E.; Edwards, A.W.T.; Homma, T.

J. Appl. Physiol. 1963, *18*, 97-106.

VARIABLES:

$T/K = 310$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Subject	t/°C	T^a/K	$10^2\alpha^b$	Hematocrit
		Human blood		
TV	37.25	310.40	1.285	43.7
TV	37.35	310.50	1.260	
TV	37.45	310.60	1.299	43.2
LF	37.35	310.50	1.260	43.7
LF	37.35	310.50	1.260	
LF	37.20	310.35	1.261	46.5
AE	37.35	310.50	1.248	42.7
AE	37.25	310.40	1.250	41.8
AE	37.20	310.35	1.238	38.5
AE	37.25	310.40	1.242	
AE	37.30	310.45	1.272	
AE	37.40	310.55	1.248	
DH	37.40	310.55	1.276	47.5
WR	37.10	310.25	1.291	46.5
SF	37.10	310.25	1.282	46.5
ML	37.35	310.50	1.292	44.2
HR	37.20	310.35	1.268	48.9
RM	37.40	310.55	1.270	43.2
		Human Plasma		
TV	37.25	310.40	1.215	
AE	37.25	310.40	1.195	

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used a combination of the van Slyke method and gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) From nine normal healthy men aged 22-48 years.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$, compiler's estimate

$\delta T/K = \pm 0.05$

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Human blood, plasma	Farhi, L.E.; Edwards, A.W.T.; Homma, T. *J. Appl. Physiol.* 1963, *18*, 97-106.

EXPERIMENTAL VALUES:

continued

[a] Calculated by compiler.

[b] Bunsen coefficient in units of $cm^3 (STP)\ cm^{-3}\ atm^{-1}$.

[c] The average value of the Bunsen coefficient at 37.30°C (310.45K) was 0.01277 at a hematocrit of 45.2.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Human blood

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

ORIGINAL MEASUREMENTS:

Christoforides, C.; Hedley-Whyte, J.

Fed. Proc. 1970, *29*, A330.

VARIABLES:

T/K = 298-310

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

α^a/cm^3(STP) cm^{-3} atm^{-1}

	25°C (298K)	37°C (310K)
Human blood	0.0145	0.0139
Water	0.0147	0.0128

[a] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Measured by "standard Van Slyke manometry."

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) C.C. Hb 15.4g/100ml

(3) No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.01$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hemoglobin

ORIGINAL MEASUREMENTS:

Conant, J. B.; Scott, N. D.

J. Biol. Chem. 1926, *68*, 107-21

VARIABLES:

T/K ≅ 296

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Material Used		c_{Hb}/ (g/100 cm^3)	$10^3\alpha^a$	cm^3 N_2 absorbed /g Hb
Solution 4.	Horse Hb. Undiluted.	22.5	4.7	0.021
Solution 4.	Diluted to 2/3 concentration.	15.0	3.1	0.020
Solution 4.	Diluted to 1/3 concentration.	7.5	1.7	0.023
Solution 12.	Undiluted	15.9	4.1	0.026
Solution 12.	Diluted 1/2.	7.95	2.1	0.026
Solution 5.	Laked with toluene.	12.23	3.4	0.028
Solution 6.	After shaking with toluene.	8.0	2.3	0.029
Solution 6.	Same as above, laked with water.	8.0	1.1	0.013
Solution 7.	Cow Hb in water.	13.6	2.7	0.020
Solution 8.	Same as above, shaken with toluene.	16.1	3.9	0.021
Solution 7.	M/10 with NaCl.	12.8	3.1	0.024
Solution 7.	M/10 with phosphate buffer.pH=6.12.	12.8	2.3	0.018
Solution 7.	With phosphate buffer. pH=6.98.	12.8	2.4	0.019
Solution 7.	M/10 with borate buffer. pH=8.41.	12.8	3.6	0.028
Solution 7.	With borate buffer. pH=9.08.	12.8	2.9	0.023
Solution 9.	Purified horse Hb, isoelectric.	4.5	1.5	0.034
Solution 10.	Same as above, phosphate buffer. pH=6.12.	8.0	3.8	0.047
Solution 11.	Same as above, borate buffer. pH=8.41	8.5	3.7	0.044

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Van Slyke method used.

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) Horse hemoglobin except for solutions 7 and 8 which were cow hemoglobin. Details in paper.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.08$, compiler's estimate.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Hemoglobin	Conant, J. B.; Scott, N. D. *J. Biol. Chem.* 1926, *68*, 107-21.

continued

[a] Bunsen coefficient in cm^3(STP) cm^{-3} atm^{-1}.
[b] cm^3 N_2 at STP.
[c] At "room temperature." About 23°C (296 K).

P_{N_2}/mmHg	$P^a_{N_2}$/kPa	Solubility^b	P_{N_2}/mmHg	$P^a_{N_2}$/kPa	Solubility^b
Solution 5			Solution 9		
585	78.0	0.0279	585	78.0	0.0359
66.6	8.88	0.0127	585	78.0	0.0325
66.6	8.88	0.0151	62.6	8.35	0.0271
9.6	1.28	0.0088	62.6	8.35	0.0271
9.6	1.28	0.0113	12.3	1.64	0.0237
			12.3	1.64	0.0257

[a] Calculated by compiler.
[b] cm^3 N_2 at STP dissolved per gram of hemoglobin.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ox blood and serum

ORIGINAL MEASUREMENTS:

Findlay, A.; Creighton, H.J.M.

Biochem. J. 1910, *5*, 294-305.

VARIABLES:

T/K = 298
P/kPa = 101-209

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Density of soln. /g cm^{-3}	p_{N_2}/mmHg	p_{O_2}/MPa	Solubility, S^+
		Deaerated Ox Blood		
298.15	1.066	757	0.101	0.0041
		979	0.131	0.0080
		1089	0.145	0.0108
		1241	0.165	0.0135
		1367	0.182	0.0143
		1564	0.209	0.0165
		Deaerated Ox Serum		
298.15	1.028	734	0.0979	0.0008
		891	0.119	0.0014
		1056	0.141	0.0020
		1250	0.167	0.0034
		1368	0.182	0.0047
		1529	0.204	0.0065

+ Solubility, S, given as $\frac{\text{Conc. of gas in the liquid phase}}{\text{Conc. of gas in the gas phase}}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas buret and absorption pipet similar to that of Geffcken (1) except that the manometer tube was longer to give the higher pressures.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by heating a mixture of sodium nitrite and ammonium chloride.

(2) Obtained from slaughter house. Deaerated blood and serum kept under a reduced pressure of ~2 kPa for one hour.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S/S = \pm 2\%$

(estimated by compiler).

REFERENCES:

1. Geffcken, G.

Z. Phys. Chem. 1904, *49*, 257.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ox erythrocytes and horse hemoglobin; see below

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Dillon, R. T.; Margaria, R.

J. Biol. Chem. 1934, *105*, 571-96.

VARIABLES:

T/K = 298
Concentration

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Suspension or Solution[a]	Gas Mixture[b]	$P^c_{N_2}$ / mmHg	$P^d_{N_2}$ / kPa	$10^2\alpha^e$	$10^2\alpha^f_{Hb}$
1. Laked cells	Air	581	77.5	1.527	1.96
2. Suspension		575	76.7	1.523	1.89
5. Suspension		576	76.8	1.527	1.93
6. Hb crystals		576	76.8	1.507	1.64
6. Hb crystals		578	77.1	1.515	1.67
1. Suspension	Air + tank O_2	119.4	15.9	1.54	2.1
4. Laked cells		99.0	13.2	1.63	1.9
4. Suspension		60.3	8.04	1.54	2.1
5. Suspension		39.4	5.25	1.56	2.3
1. Suspension[g]		34.6	4.61	1.71	3.3
4. Suspension		22.7	3.03	1.57	2.3
4. Laked cells	Air + pure O_2	93.5	12.5	1.48	1.7
3. Suspension		39.2	5.23	1.57	2.3
3. Suspension		38.0	5.07	1.58	2.4
1. Suspension[g]		14.5	1.93	1.21	
5. Suspension	Air + pure CO_2	95.6	12.8	1.49	1.6
5. Suspension		63.5	8.47	1.51	1.8
5. Suspension		60.7	8.09	1.33	0.6
2. Suspension		31.2	4.16	1.46	1.7
5. Suspension		25.5	3.40	1.52	2.1

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solutions were saturated with gas using the rotating double tonometer method of Austin, et al. (1). 2-2.5 h were allowed for saturation. The amount of dissolved nitrogen was determined using the method of Van Slyke and Neil (2).

SOURCE AND PURITY OF MATERIALS:

(1) From air or from diluted mixtures with air (see footnotes).

(2) From ox blood or in one case horse hemoglobin.

ESTIMATED ERROR:

$\delta T/K = \pm 0.04$
$\delta\alpha/\alpha = \pm 0.01$, compiler's estimate (declines with decreasing partial pressure of nitrogen)

REFERENCES:

(1) Austin, J.H.; Cullen, G.E.; Hastings, A.B.; McLean, F.C.; Peters, J.D.; Van Slyke, D.D. *J. Biol. Chem.* 1922, *54*, 134.
(2) Van Slyke, D.D.; Neil, J.M. *J. Biol. Chem.* 1924, *61*, 523.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ox erythrocytes and horse hemoglobin; see below	Van Slyke, D. D.; Dillon, R. T.; Margaria, R. *J. Biol. Chem.* 1934, *105*, 571-96.

EXPERIMENTAL VALUES:

continued

[a] See following table for composition of these suspensions or solutions keyed to the indexing number.

[b] Nitrogen from air or air diluted with tank oxygen (99.6% from Linde Air Products Company), pure oxygen (made from heating a mixture of $KClO_3$ and MnO_2 and 99 + % pure), or pure carbon dioxide (99.8 + %) made in a Kipp generator.

[c] Partial pressure of nitrogen.

[d] Calculated by compiler.

[e] Bunsen coefficient, cm^3(STP) cm^{-3} atm^{-1}. Precision poorer as nitrogen partial pressure is decreased.

[f] cm^3(STP) nitrogen taken up by one gram of hemoglobin.

[g] Authors state that these measurements are of poorer precision.

Composition of Solutions and Cell Suspensions

Cell Suspension Number	Blood Sample Number	Hb[a] Concentration	O_2 Capacity	Salt NaCl	Concentration[c] $NaHCO_3$	H_2O Content[d]
1	1	15.5	20.7	177		0.870
2	1	15.1	20.2	97	79	0.881
3	2	15.3	20.5	176		0.874
4	3	15.5	20.5	177		0.870
5	3	15.5	20.6	109	69	0.874
6e	4	14.5		56	47	0.885

[a] Calculated by the approximate formula, Hb concentration in gram per 100 cm^3 = O_2 capacity x 0.746.

[b] Oxygen capacity in volume per cent.

[c] Concentrations are in millimoles per kilogram of water.

[d] Concentration in grams of water per cm^3 of solution.

[e] Solution of crystallized horse hemoglobin. All other suspensions are of ox erythrocytes.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Blood from eel, cod, trout, and man

ORIGINAL MEASUREMENTS:

Steen, J. B.

Acta Physiol. Scand. 1963, *58*, 124-37.

VARIABLES:

T/K = 280-293
P/kPa =101.325

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Blood Source	pH Range	Number of Analyses	Volume per cent Nitrogen[1] Range	Volume per cent Nitrogen[1] Average
279.65	Eel	6.20 - 7.60	19	1.57 - 1.73	1.65
		7.60 - 8.50	19	1.71 - 1.85	1.81
293.15		6.60 - 8.50	10	1.46 - 1.55	1.49
279.65	Cod	6.40 - 8.50	10	1.62 - 1.68	1.66
279.65	Trout	6.40 - 8.50	12	1.64 - 1.75	1.74
279.65	Man	6.40 - 8.60	10	2.00 - 2.11	2.04

[1] At atm nitrogen

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Blood equilibrated with pure nitrogen or admixed with CO_2 and/or O_2. The pH was adjusted by adding 0.17 M lactic acid or 0.17 M NaOH.

The gas was presaturated with water vapor by bubbling through an isotonic NaCl solution.

The content of nitrogen was estimated by the method of Edwards, Scholander, and Roughton (1,2)

At a pH of 7.5 - 7.7 there is a sudden significant decrease in the solubility of both argon and nitrogen in eel blood (fig 7 in paper).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Purified.

(2) Blood. Eel blood from female eels kept in running fresh water before heart puncture. Eel, *Anguilla vulgaris*. Cod blood from codfish, *Gadus callarias*, kept in aerated seawater at 12 ^0C before heart puncture. Trout blood from rainbow trout, *Salmo irrideus*, kept in running tap water at 10 ^0C before heart puncture. Human blood was supplied by the author.

ESTIMATED ERROR:

$\delta T/K = 1$

REFERENCES:

1. Roughton, F. J. W.; Scholander, P. F. *J. Biol. Chem.* 1943, *148*, 541, 573.

2. Edwards, G. A.; Scholander, P. F.; Roughton, F. J. W. *J. Biol. Chem.* 1943, *148*, 565.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Rabbit brain and blood and saline solution.	ORIGINAL MEASUREMENTS: Ohta, Y.; Ar, A.; Farhi, L.E. *J. Appl. Physiology*, 1979, *46*, 1169-70.
VARIABLES: T/K = 310	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	No. of animals
	"Saline"	
310.15	0.0121 ± 0.0001	5
	Blood	
310.15	0.0124 ± 0.0001	5
	Brain	
310.15	0.0140 ± 0.0003	5

The partial pressure of nitrogen was not given but was considerable less than one atmosphere.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saline, rabbit blood and brain were saturated by passing humidified gas through three vessels in series. Brain was prepared by manually squeezing out blood from the brain of a freshly killed rabbit. Volume of brain determined by saline displacement. The tissue was homogenized and diluted with an equal volume of 5% low foam detergent Blood sample was heparinized. Samples of each of the three solutions were analysed by GC using helium carrier gas, a molecular sieve column and a thermal conductivity detector.

SOURCE AND PURITY OF MATERIALS:

See under method.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Protein Solutions, Plasma (3) Water; H_2O; [7732-18-5]	Stoddard, J. L. *J. Biol. Chem.* <u>1926-27</u>, *71*, 629-92.
VARIABLES:	**PREPARED BY:**
T/K = 293	R. Battino

EXPERIMENTAL VALUES:

Substance	Concentration/ (g/100 cm^3)	$10^2\alpha^a$/ cm^3(STP) $cm^{-3}atm^{-1}$
Hemoglobin	9.284	1.613
Plasma protein	5.972	1.516
	5.772	1.5185
	6.56	1.514
	5.115	1.54
	6.308	1.526
	5.795	1.502
	5.70	1.441
	6.401	1.522
	5.580	1.525
Water		1.561

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[a] Bunsen coefficient. All solubilities reported are averages of multiple measurements.

[b] All measurements at 20°C (298.2K).

[c] The average for all measurements in plasma protein solutions was an α value of 0.01516.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
A manometric/volumetric apparatus was used which the paper describes exhaustively.	(1) No details given. (2) From blood from a healthy horse. (3) Distilled.
	ESTIMATED ERROR:
	$\delta\alpha/\alpha$ = ±0.01, compiler's estimate.
	REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Plasma, cell-plasma suspensions, see below.

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Dillon, R. T.; Margaria, R.

J. Biol. Chem. 1934, *105*, 571-96.

VARIABLES:

T/K = 311
Concentration

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

All Measurements at 38°C (311.95 K)

Liquid Phase	Ox Blood	$P_{N_2}^{a}$ /mmHg	$P_{N_2}^{b}$ /kPa	$10^2\alpha^c/cm^3(STP)\ cm^{-3}\ atm^{-1}$
Plasma[d]	A	553.0	73.73	1.141
	B	554.7	73.95	1.163
	C	559.2	74.55	1.164
Plasma-Cell	C	558.2	74.42	1.216
Mixture[e]	A	534.0	71.19	1.224
	C	556.7	74.22	1.265
	A	550.7	73.42	1.299
	B	552.6	73.67	1.339
	C	556.1	74.14	1.366
	A	552.0	73.59	1.391
	C	556.0	74.13	1.395
Cells (extrapolated)				1.46

[a] Partial pressure of nitrogen.

[b] Calculated by compiler.

[c] Bunsen coefficient.

[d] Ox plasma.

[e] Ox erythrocytes.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solutions were saturated with gas using the rotating double tonometer method of Austin, et al. (1). 2-2.5 h were allowed for saturation. The amount of dissolved nitrogen was determined using the method of Van Slyke and Neil (2).

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) From ox blood - see paper for details on preparation.

ESTIMATED ERROR:

$\delta T/K = \pm 0.04$
$\delta\alpha/\alpha = \pm 0.01$, compiler's estimate

REFERENCES:

1. Austin, J.H.; Cullen, G.E.; Hastings, A.B.; McLean, F.C.; Peters, J.D.; Van Slyke, D.D. *J. Biol. Chem.* 1922, *54*, 134.
2. Van Slyke, D.D.; Neil, J.M. *J. Biol. Chem.* 1924, *61*, 523.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Leguminous hemoglobin

ORIGINAL MEASUREMENTS:

Ewing, G. J.; Ionescu, L. V.

J. Phys. Chem. 1972, *76*, 591-6.

VARIABLES:

T/K = 278-298

P/MPa = 0-0.5

PREPARED BY:

R. Battino.

EXPERIMENTAL VALUES:

t/°C	T^a/K	H^b/(atm/mol)
5	278	1070 ± 70
15	288	1410 ± 30
25	298	1600 ± 80

[a] Calculated by compiler.

[b] Henry's law constants obtained over a 0-5 atm partial pressure of nitrogen range.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubilities determined as described in reference 2. Henry's law constants were calculated from the quantity of nitrogen dissolved in each experimental run.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) From soybean root following similar procedure to reference 1. Average molecular weight of 15,600 g mol^{-1}.

ESTIMATED ERROR:

REFERENCES:

1. Ellfolk, N. Acta Chem. Scand. 1960, 14, 609.
2. Maestas, S.; Ewing, G. J. J. Phys. Chem. 1970, 74, 2341.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Serum albumin

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

ORIGINAL MEASUREMENTS:

Shkol'nikova, R. I.

Uch. Zap. Leningr. Gos. Univ., Ser. Khim. Nauk. 1959, Nr. 18, 64 - 86.

Chem. Abstr. 1961, *55*, 25443b.

VARIABLES:

T/K = 283.15 - 313.15
P/kPa = 101.325
serum albumin/wt % = 0.575 - 1.99

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	serum albumin/wt %			
	0.575		1.15	
	Bunsen Coefficient	Ostwald Coefficient	Bunsen Coefficient	Ostwald Coefficient
283.15	14.2	14.7	13.1	13.6
288.15	13.5	14.2	12.4	13.1
293.15	11.7	12.6	10.8	11.6
298.15	11.4	12.4	10.2	11.1
303.15	10.9	12.1	10.1	11.0
308.15	10.5	11.8	9.9	10.8
313.15	10.2	11.7	9.8	10.2

T/K	serum albumin/wt %			
	1.68		1.99	
	Bunsen Coefficient	Ostwald Coefficient	Bunsen Coefficient	Ostwald Coefficient
283.15	12.4	12.8	12.1	12.5
288.15	11.9	12.5	11.2	11.8
293.15	9.4	10.1	9.1	9.7
298.15	9.3	10.1	8.8	9.6
303.15	9.2	10.2	8.5	9.4
308.15	9.1	10.2	8.1	9.1
313.15	9.0	10.1	8.0	9.1

The enthalpy of solution of nitrogen was calculated from the temperature coefficient of the Bunsen coefficient. It is 3060, 1250, 890, 300, and 410 cal mol^{-1} in water, and 0.575, 1.15, 1.68, and 1.99 wt % serum albumin respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung were modified (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Stated to be near 100 percent.

(2) Serum albumin. No information.

(3) Water. No information.

ESTIMATED ERROR:

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Phosphate buffer and human red cell ghost in phosphate buffer.	Power, G.G.; Stegall, H. *J. Appl. Physiology*, 1970, *29*, 145-9.
VARIABLES:	PREPARED BY:
T/K = 310	C.L. Young

EXPERIMENTAL VALUES:

T/K	Bunsen coefficient, α	S.D.*	No. of measurements
	Phosphate Buffer		
310.15	0.01247	0.00006	4
	Ghosts suspension in phosphate buffer		
310.15	0.01302	0.00003	5

* Standard deviation.

$\alpha°$ghost = (α ghosts suspension $-\alpha$ buffer) / g ghosts cm^{-3}
= 0.096 ± 0.006

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

5 to 12 cm^{-3} samples placed in a stirrer cell and gas, saturated with water vapor passed through liquid for 30-60 mins. Samples of saturated liquid withdrawn and transferred to Van Slyke apparatus. Dissolved gas removed under reduced pressure. Red cell ghosts prepared by centrifugation of human blood and lysing the cells using phosphate buffer of pH 7.4. Ghost separated by high speed centrifugation. Washed with phosphate buffer containing 0.01 M sodium nitrite.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson sample, purity better than 99.7 mole per cent.

(2) See method.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

REFERENCES:

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Human urine	ORIGINAL MEASUREMENTS: Farhi, L. E.; Edwards, A. W. T.; Homma, T. *J. Appl. Physiol.* 1963, *18*, 97-106.
VARIABLES: T/K = 310	PREPARED BY: R. Battino

EXPERIMENTAL VALUES:

Subject	t/°C	T^a/K	Specific gravity	$10^2\alpha^b$
DH	37.40	310.55	1.004	1.221
WR	37.15	310.30	1.006	1.208
SF	37.15	310.30	1.011	1.185
TV	37.45	310.60	1.020	1.120
ML	37.35	310.50	1.022	1.118
HR	37.25	310.40	1.022	1.107
RM	37.40	310.55	1.022	1.101
LF	37.25	310.40	1.033	1.039

[a] Calculated by compiler.

[b] Bunsen coefficient in units of cm^3(STP) cm^{-3} atm^{-1}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used the Van Slyke method combined with gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) From air.

(2) From eight normal healthy men aged 22-48 years.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

(3) Cholest-5-en-3β-ol or Cholesterol; $C_{27}H_{46}O$; [57-88-5]

ORIGINAL MEASUREMENTS:

Byrne, J. E.; Battino, R.; Danforth, W. F.

J. Chem. Thermodyn. 1974, *6*, 245-50.

VARIABLES:

T/K = 310.65
Total P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mass Fraction Cholesterol W_3	Ostwald Coefficient L	"Salting Out" Parameter $k = (1/W_3) \log (L_o/L_w)$
310.64	0.0	0.1323	
310.69	0.0	0.1328	
310.62	0.0528	0.129	
310.63	0.0528	0.130	0.19 ± 0.17
310.57	0.1069	0.119	
310.65	0.1069	0.117	0.49 ± 0.09
310.65	1.0	0.061*	

*Extrapolated nitrogen solubility in hypothetical liquid cholesterol.

L_o and L_w are the nitrogen Ostwald coefficients in benzene and in the benzene + cholesterol solution, respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing: Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid nitrogen trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination: The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. 99.995 per cent.

(2) Benzene. J. T. Baker Analyzed Reagent Grade. 99.9 mol per cent, thiophene free.

(3) Cholesterol. Source not given. Recrystalized from benzene.

ESTIMATED ERROR:

$\delta T/K = 0.01$
$\delta P/mmHg = 0.5$
$\delta L_o/L_o = 0.01$
$\delta L_w/L_w = 0.02$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

(3) Lecithin

ORIGINAL MEASUREMENTS:

Byrne, J. E.; Battino, R.; Danforth, W. F.

J. Chem. Thermodyn. 1974, *6*, 245-50.

VARIABLES:

T/K = 310.65
Total P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mass Fraction Lecithin W_3	Ostwald Coefficient L	"Salting Out" Parameter $k = (1/W_3) \log (L_o/L_w)$
310.64	0.0	0.1324	
310.69	0.0	0.1328	
310.64	0.1993	0.115	
310.65	0.1993	0.116	0.30 ± 0.04
310.65	1.0	0.066*	

*Extrapolated nitrogen solubility in hypothetical liquid lecithin.

L_o and L_w are the nitrogen Ostwald coefficients in benzene and in the benzene + lecithin solution, respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing: Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid nitrogen trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination: The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. 99.995 per cent.

(2) Benzene. J. T. Baker Analyzed Reagent Grade. 99.9 mol per cent, thiophene free.

(3) Lecithin. Nutritional Biochemicals Corp. Vegetable source, about 95 per cent, used as received.

ESTIMATED ERROR:

$\delta T/K = 0.01$
$\delta P/\text{mmHg} = 0.5$
$\delta L_o/L_o = 0.01$
$\delta L_w/L_w = 0.02$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:

(1)Nitrogen; N_2; [7727-37-9]

(2)Benzene; C_6H_6; [71-43-2]

(3)Cephalin

ORIGINAL MEASUREMENTS:

Byrne, J. E.; Battino, R.; Danforth, W. F.

J. Chem. Thermodyn. 1974, *6*, 245-50.

VARIABLES:

T/K = 310.65
Total P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mass Fraction Cephalin W_3	Ostwald Coefficient L	"Salting Out" Parameter $k = (1/W_3) \log (L_o/L_w)$
310.64	0.0	0.1323	
310.69	0.0	0.1328	
310.60	0.2003	0.118	
310.63	0.2003	0.112	0.31 ± 0.05
310.65	1.0	0.065*	

*Extrapolated nitrogen solubility in hypothetical liquid cephalin.

L_o and L_w are the nitrogen Ostwald coefficients in benzene and in the benzene + cephalin solution, respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing: Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid nitrogen trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination: The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co., Inc. 99.995 per cent.

(2) Benzene. J. T. Baker Analyzed Reagent Grade. 99.9 mol per cent, thiophene free.

(3) Cephalin. Nutritional Biochemicals Corp. Homostatic phospatide obtained from bovine brain tissue, used as received.

ESTIMATED ERROR:

$\delta T/K = 0.01$
$\delta P/mmHg = 0.5$
$\delta L_o/L_o = 0.01$
$\delta L_w/L_w = 0.02$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Lipoidal suspension. (3) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Grollman, A. *J. Biol. Chem.* 1929, *82*, 317-25.
VARIABLES: T/K = 311	PREPARED BY: R. Battino

EXPERIMENTAL VALUES:

	37.5°C (310.7K)
Substance	$10^2\alpha^a$
Water	1.28
Lipoidal Suspension[b]	1.33

[a] Bunsen coefficient in units of cm^3(STP) cm^{-3} atm^{-1}.

[b] Made up of 0.3 g blood lipid in 100 cm^3 water.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: The Van Slyke method was used.	SOURCE AND PURITY OF MATERIALS: (1) No details given. (2) Extracted from rabbit or dog blood with petroleum ether and ethyl ether. (3) No details given.
	ESTIMATED ERROR: $\delta\alpha/\alpha$ = ±0.02, compiler's estimate.
	REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Urea; CH_4N_2O; [57-13-6]

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

ORIGINAL MEASUREMENTS:

Braun, L.

Z. Phys. Chem. 1900, *33*, 721-41.

VARIABLES:

T/K = 278-298
Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Wt. of urea per 100g soln./g	Bunsen coefficient, α
278.2	15.650	0.01749
	14.365	0.01836
	11.900	0.01793
	11.664	0.01782
	10.240	0.01835
	9.418	0.01897
	6.897	0.01979
	6.409	0.01987
	5.194	0.01982
	5.145	0.01969
	2.460	0.02003
	2.287	0.01992
	0.000	0.02173
283.2	15.650	0.01621
	14.365	0.01657
	11.900	0.01671
	11.664	0.01633
	10.240	0.01732
	9.418	0.01758
	6.897	0.01827
	6.409	0.01832
	5.194	0.01890
	5.145	0.01819
	2.460	0.01889
	2.287	0.01841
	0.0	0.02003

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Ostwald method, using gas buret and pipet. Measurement of volume of gas before and after absorption. Vapor pressure of water was allowed for assuming Raoult's law. Solution was degassed. Concentration of salt solution estimated by titration with silver nitrate solution.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.03$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Urea; CH_4N_2O; [57-13-6]

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

ORIGINAL MEASUREMENTS:

Braun, L.

Z. Phys. Chem. 1900, *33*, 721-41.

EXPERIMENTAL VALUES:

T/K	Wt. of urea per 100g soln./g	Bunsen coefficient, α
288.2	15.650	0.01503
	14.365	0.01514
	11.900	0.01486
	11.664	0.01504
	10.240	0.01601
	9.418	0.01580
	6.897	0.01649
	6.409	0.01666
	5.194	0.01678
	5.145	0.01651
	2.460	0.01715
	2.287	0.01708
	0.0	0.01789
293.2	15.650	0.01396
	14.365	0.01406
	11.900	0.01385
	11.664	0.01395
	10.240	0.01465
	9.418	0.01455
	6.897	0.01510
	6.409	0.01507
	5.194	0.01523
	5.145	0.01509
	2.460	0.01576
	2.287	0.01552
	0.0	0.01621
298.2	15.650	0.01300
	14.365	0.01334
	11.900	0.01296
	11.664	0.01315
	10.240	0.01316
	9.418	0.01328
	6.897	0.01369
	6.409	0.01373
	5.194	0.01376
	5.145	0.01350
	2.460	0.01396
	2.287	0.01390
	0.0	0.01432

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Urea; CH_4N_2O or $(NH_2)_2CO$; [57-13-6]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-24.

VARIABLES:

T/K = 293.25, 293.40

N_2 P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	$C_{CH_4N_2O}$/mol dm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.18	293.33	0	---	--	1.565[2]
20.25	293.40	1.0	664.4	5.34	1.490
20.10	293.25		683.6	5.40	1.465
20.18	Av.				1.477 Av.

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at the stated pressure.

[2] Average of four runs, see Hüfner's N_2 + H_2O data sheet.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, described in reference (1), was the Bunsen absorption type. It consisted of an absorption flask, which holds 409.94 cm^3 of solvent, and gas burets.

The final partial pressure of the gas ranged between 648.6 and 720.7 mmHg. The author reported both the volume of gas absorbed at the final pressure in 409.94 cm^3 of solvent reduced to 273.15 K and 760 mmHg, and the Bunsen coefficient, which was calculated assuming Henry's law.

Urea name is harnstoff in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Argon free.

(2) Urea. Source not given.

(3) Water. Pure.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Glycine; $C_2H_5NO_2$ or $CH_2(NH_2)COOH$; [56-40-6]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-24.

VARIABLES:

T/K = 293.25 - 293.43

N_2 P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	$C_{C_2H_5NO_2}$/mol dm^{-3}	Gas Pressure mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.18	293.33	0	---	--	1.565[2]
20.28	293.43	1.0	679.9	4.29	1.170
20.1	293.25		679.3	4.51	1.231
20.1	293.25		691.2	4.61	1.236
20.16 Av.					1.212 Av.

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at the stated pressure.

[2] Average of four runs, see Hüfner's N_2 + H_2O data sheet.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, described in reference (1), was the Bunsen absorption type. It consisted of an absorption flask, which holds 409.94 cm^3 of solvent, gas burets.

The final partial pressure of the gas ranged between 648.6 and 720.7 mmHg. The author reported both the volume of gas absorbed at the final pressure in 409.94 cm^3 of solvent reduced to 273.15 K and 760 mmHg, and the Bunsen coefficient, which was calculated assuming Henry's law.

D-Glycine name glykoholl (amino-essigsäure) in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Argon free.

(2) Glycine. Merck.

(3) Water. Pure.

ESTIMATED ERROR:

$\delta T/K$ = 0.01

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) D-Alanine; $C_3H_7NO_2$ or $CH_3CH(NH_2)COOH$; [338-69-2]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-24.

VARIABLES:

T/K = 293.33

N_2 P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	Temperature T/K	$C_{C_3H_7NO_2}$/mol dm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.18	293.33	0	---	--	1.565[2]
20.18	293.33	1.0	674.5	4.38	1.204
20.2	293.35		684.1	4.51	1.222
20.19 Av.					1.213 Av.

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at the stated pressure.

[2] Average of four runs, see Hüfner's N_2 + H_2O data sheet.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, described in reference (1), was the Bunsen absorption type. It consisted of an absorption flask, which holds 409.94 cm^3 of solvent, and gas burets.

The final partial pressure of the gas ranged between 648.6 and 720.7 mmHg. The author reported both the volume of gas absorbed at the final pressure in 409.94 cm^3 of solvent reduced to 273.15 K and 760 mmHg, and the Bunsen coefficient, which was calculated assuming Henry's law.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Argon free.

(2) D-Alanine. Merck.

(3) Water. Pure.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) (R*,R*)-1,2,3,4-Butanetetrol; $C_4H_{10}O_4$; [7493-90-5]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-24.

VARIABLES:

T/K = 293.25 - 293.50

N_2 P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	$C_{C_4H_{10}O_4}$/mol dm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.18	293.33	0	---	--	1.565[2]
20.1	293.25	1.0	672.3	4.79	1.321
20.3	293.45		707.0	4.91	1.287
20.35	293.50		672.4	4.92	1.356
20.25 Av.					1.321 Av.

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at the stated pressure.

[2] Average of four runs, see Hüfner's N_2 + H_2O data sheet.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, described in reference (1), was the Bunsen absorption type. It consisted of an absorption flask, which holds 409.94 cm^3 of solvent, and gas burets.

The final partial pressure of the gas ranged between 648.6 and 720.7 mmHg. The author reported both the volume of gas absorbed at the final pressure in 409.94 cm^3 of solvent reduced to 273.15 K and 760 mmHg, and the Bunsen coefficient, which was calculated assuming Henry's law.

(R,R)-1,2,3,4-Butanetetrol name erythrit (erythritol) in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Argon free.

(2) Erythritol. Merck.

(3) Water. Pure.

ESTIMATED ERROR:

δT/K = 0.01

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) L-Arabinose, $C_5H_{10}O_5$; [5328-37-0]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-24.

VARIABLES:

T/K = 293

N_2 P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	$C_{C_5H_{10}O_5}$/mol dm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.18	293.33	0	---	--	1.565[2]
20.15	293.30	1.0	680.40	4.47	1.218
20.28	293.43		676.78	4.34	1.189
20.21 Av.					1.203 Av.

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at the stated pressure.

[2] Average of four runs, see Hüfner's N_2 + H_2O data sheet.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, described in reference (1), was the Bunsen absorption type. It consisted of an absorption flask, which holds 409.94 cm^3 of solvent, and gas burets.

The final partial pressure of the gas ranged between 648.6 and 720.7 mmHg. The author reported both the volume of gas absorbed at the final pressure in 409.94 cm^3 of solvent reduced to 273.15 K and 760 mmHg, and the Bunsen coefficient, which was calculated assuming Henry's law.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Argon free.

(2) L-Arabinose. Merck.

(3) Water. Pure.

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) D-Fructose; $C_6H_{12}O_6$; [57-48-7]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611- 24.

VARIABLES:

T/K = 293.40
N_2 P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	$c_{C_6H_{12}O_6}$/mol dm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.18	293.33	0	---	--	1.565[2]
20.25	293.40	1.0	648.6	4.27	1.221

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at the stated pressure.

[2] Average of four runs, see Hüfner's N_2 + H_2O data sheet.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, described in reference (1), was the Bunsen absorption type. It consisted of an absorption flask, which holds 409.94 cm^3 of solvent, and gas burets.

The final partial pressure of the gas ranged between 648.6 and 720.7 mmHg. The author reported both the volume of gas absorbed at the final pressure in 409.94 cm^3 of solvent reduced to 273.15 K and 760 mmHg, and the Bunsen coefficient, which was calculated assuming Henry's law.

D-Fructose name Fruchtzucker or levulose in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Argon free.

(2) D-Fructose. Merck.

(3) Water. Pure

ESTIMATED ERROR:

$\delta T/K = 0.01$

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) D-Glucose; $C_6H_{12}O_6$; [50-99-7]

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

ORIGINAL MEASUREMENTS:

Hüfner, G.

Z. Physik. Chem. 1907, *57*, 611-24.

VARIABLES:

T/K = 293.20 - 293.57

N_2 P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	$c_{C_6H_{12}O_6}$/mol dm^{-3}	Gas Pressure/ mmHg	Absorbed Gas Volume[1]	Bunsen Coefficient $\alpha \times 10^2$
20.18	293.33	0	----	--	1.565[2]
20.25	293.40	0.25	693.9	5.56	1.485
20.10	293.25		697.0	5.57	1.482
20.25	293.40		680.2	5.40	1.472
20.2 Av.					1.480 Av.
20.05	293.20	0.50	681.3	5.05	1.374
20.2	293.35		675.8	4.98	1.366
20.3	293.45		704.5	5.17	1.361
20.3	293.45		700.2	5.36	1.419
20.21 Av.					1.380 Av.
20.42	293.57	1.00	672.1	4.51	1.244
20.10	293.25		688.3	4.45	1.199
20.20	293.35		720.7	4.67	1.201
20.15	293.30		704.3	4.74	1.248
20.05	293.20		688.2	4.38	1.180
20.18 Av.					1.215 Av.

[1] Volume of gas reduced to 273.15 K and 760 mmHg absorbed in 490.94 cm^3 solution at the stated pressure.

[2] Average of four runs, see Hüfner's N_2 + H_2O data sheet.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus, described in reference (1), was the Bunsen absorption type. It consisted of an absorption flask, which holds 409.94 cm^3 of solvent, and gas burets.

The final partial pressure of the gas ranged between 648.6 and 720.7 mmHg. The author reported both the volume of gas absorbed at the final pressure in 409.94 cm^3 of solvent reduced to 273.15 K and 760 mmHg, and the Bunsen coefficient, which was calculated assuming Henry's law.

D-glucose name tranbenzucker (grape sugar) in the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Argon free.

(2) D-Glucose. Source not given.

(3) Water. Pure.

ESTIMATED ERROR:

δT/K = 0.01

REFERENCES:

1. Hüfner, G. *Archiv. F. Anatomie und Physiologie, Physiolog. Abtly.* 1894, *5*, 191.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Gelatin

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

ORIGINAL MEASUREMENTS:

Shkol'nikova, R. I.

Uch. Zap. Leningr. Gos. Univ., Ser. Khim. Nauk. 1959, Nr. 18, 64 - 86.

Chem. Abstr. 1961, *55*, 25443b.

VARIABLES:

T/K = 283.15 - 313.15
P/kPa = 101.325
Gelatin/wt % = 1 - 10

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Gelatin/wt % 1		Gelatin/wt % 5	
	Bunsen Coefficient	Ostwald Coefficient	Bunsen Coefficient	Ostwald Coefficient
283.15	15.6	16.2	14.3	14.8
288.15	14.2	14.9	13.6	14.1
293.15	13.0	14.0	12.5	13.5
298.15	12.6	13.8	11.4	12.4
303.15	11.5	12.8	10.4	11.5
308.15	10.7	12.1	9.8	11.1
313.15	10.1	11.6	9.2	10.6

T/K	Gelatin/wt % 10	
	Bunsen Coefficient	Ostwald Coefficient
283.15	13.8	14.3
288.15	12.2	13.0
293.15	10.8	11.6
298.15	10.2	11.1
303.15	9.8	10.9
308.15	8.3	9.4
313.15	7.2	8.2

The enthalpy of solution of nitrogen was calculated from the temperature coefficient of the Bunsen coefficient. It is 3060, 2540, 2590, and 3820 cal mol^{-1} in water, and 1, 5, and 10 wt % gelatin respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung were modified (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Source not given. Stated to be near 100 percent.

(2) Gelatin. No information.

(3) Water. No information.

ESTIMATED ERROR:

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sucrose; $C_{12}H_{22}O_{11}$; [57-50-1]

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

ORIGINAL MEASUREMENTS:

Müller, C.

Z. Physik. Chem. 1912, *81*, 483-503.

VARIABLES:

$T/K = 290\text{-}291$
$P/kPa = 101.325$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T^a/K	Weight Percentage Sucrose	Ostwald Coeff.[b] 10^2L	Bunsen Coeff.[c] $10^2\alpha$
289.95	11.38	1.520	1.432
290.05	20.00	1.309	1.233
290.15	29.93	1.089	1.025
290.95	30.12	1.100	1.033
291.15	47.89	0.791	0.742
290.85	48.57	0.701	0.658

[a] Temperature reported to 0.1°C.

[b] Ostwald coefficient calculated by compiler.

[c] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water is degassed by pumping under vacuum. The absorption vessel is about 600 cm^3 and is separately thermostatted from the buret gas measuring system. Both are connected by a copper capillary tube. Gas uptake is read on the gas burets. The absorption flask volume and all liquid volumes were calibrated using mercury. The original paper contains details of operation and a drawing of the apparatus. Solubilities were also measured in pure water, glycerol and chloral hydrate.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen - from heating potassium nitrite and ammonium nitrite. Washed with potassium hydroxide solution, ferrous sulfate solution and sulfuric acid; and finally passed through a glowing copper tube.

(2) Sucrose - chemically pure from Merck in Darmstadt.

(3) Water - no comment by author.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.01$, estimate by compiler.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sulfur dioxide; O_2S; [7446-09-5]

ORIGINAL MEASUREMENTS:

Dornte, R.W.; Ferguson, C.V.

Ind. Eng. Chem. 1939, *31*, 112-3.

VARIABLES:

T/K = 213-253

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/°C	T/K^a	K^b Static	K^c Circ.
-60	213.2	2.86	2.24
-60	213.2		1.97
-60	213.2		2.23
-50	223.2	6.35	4.50
-50	223.2		4.32
-40	233.2	14.0	7.55
-40	233.2	10.6	8.00
-40	233.2		8.09
-30	243.2	27.2	
-20	253.2	56.6	26.7

[a] Calculated by compiler.

[b] Kuenan coefficient, cm^3(STP) of gas dissolved in 1 g of solvent at 101.325kPa partial pressure of gas static method.

[c] Kuenan coefficient, circulation method. Authors give $\log_{10}K = 8.729-8180/(4.58\ T/K)$ as a smoothing equation to ±10%.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consisted of a gas buret, a differential manometer, and two 10 cm^3 bulbs. The bulbs were in a dewar flask whose temperature was controlled manually by adding dry ice. Measurements could be taken while the gas was circulating or static. Gas uptake was read on the buret. Corrections were applied for the lines being at different temperatures.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta K/K = \pm 0.1$
$\delta T/K = \pm 0.5$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Nitrous oxide; N_2O; [10024-97-2]

ORIGINAL MEASUREMENTS:

Steinberg, M.; Manowitz, B.; Pruzansky, J.

US AEC BNL-542 (T-140).
Chem. Abstr. 1959, *53*, 21242g

VARIABLES:

T/K = 186.15 - 243.65

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/^{\circ}$C	Temperature T/K	Solubility Coefficient[1]	Henry's Constant[2] H/atm	Mol Fraction[3] $10^3 x_1$
-87	186.15	0.93	-	1.41
-80	193.15	0.87	-	1.33
-72	201.15	-	670	1.49
-56	217.15	1.17	-	1.82
-45	228.15	0.85	-	1.34
-35.5	237.65	1.03	-	1.65
-33	240.15	-	560	1.79
-29.5	243.65	-	560	1.79
+32	305.15	0.99[4]	-	1.75

---

[1] The solubility coefficient units are $cm^3(288.15\ K)cm^{-3}atm^{-1}$. The gas volume is reduced to 288.15 K and 1 atm and the solvent volume is for the temperature of the measurement.

[2] Henry's constant, $H/\text{atm} = (p_1/\text{atm})/x_1$. The values are apparently from the data smoothed by the authors.

[3] The mole fraction values were calculated for a gas partial pressure of 101.325 kPa (1 atm) by the compiler. The density values were estimated from a single value given in the *International Critical Tables*, Vol. III.

[4] Solubiluty coefficient value calculated by the authors from literature value based on the average residual nitrogen in liquid nitrous oxide cylinders. No reference given.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

See earlier paper for some details of the procedure(1). The measurements were made using a modified McDaniel method (2), a static method.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen.

(2) Nitrous oxide.

No information.

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm\ 0.05 - 0.10$ (compiler)

REFERENCES:

1. Steinberg, M.; Manowitz, B. *Ind. Eng. Chem.* 1959, *51*, 47.
2. Furman, N.H. "Scott's Standard Methods of Chemical Analysis," vol. II, 5th ed., Van Nostrand, New York, 1939.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Nitrogen Oxide; N_2O_4; [10544-72-6]

ORIGINAL MEASUREMENTS:

Chang, E. T.; Gokcen, N. A.

J. Phys. Chem. 1966, *70*, 2394-9.

NASA Accession No. N66-14076, Rept. No. ATN=64-(9228)-4, 22p (1964). *From Sci. Tech. Aerospace Rept. 4(4)*, 640(1964).

VARIABLES:

T/K = 262.02 - 303.16

N_2 P/kPa = 35.50 - 197.58

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Smoothed Data: Mole fraction solubility at 1 atm N_2 pressure.

$$\ln x_1 = -360.31/(T/K) - 6.106$$

$$\Delta H°/\text{kJ mol}^{-1} = 3.00, \quad \Delta S°/\text{J K}^{-1}\text{ mol}^{-1} = -50.8$$

T/K	Mol Fraction 10^4x_1	Gibbs Energy $\Delta G°/\text{kJ mol}^{-1}$
263.15	5.67	16.36
268.15	5.81	16.61
273.15	5.96	16.86
278.15	6.10	17.12
283.15	6.24	17.37
288.15	6.38	17.63
293.15	6.52	17.88
298.15	6.66	18.13
303.15	6.79	18.39

The mole fraction solubility of one atm N_2 pressure is numerically the value of Henry's constant at that temperature.

The authors discuss the system further, but present no additional solubility data (1,2).

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solvent was degassed under vacuum in the previously weighed apparatus. Apparatus and degassed solvent were weighed. Gas was introduced into the apparatus at a known P and T, the liquid stirred, and the pressure observed until there was no further change. Equilibrium was established within 10 m and the P was followed for 40 m.

The apparatus was of all glass construction. It consisted of three calibrated volumes for the measurement of the gas, a container for the solvent, which was stirred with a glass enclosed magnet, and a manometer for measuring the pressure with a microslide cathetometer. The solvent container had a capacity for 100 g of solvent with a 5 ml gas space above the liquid surface. The apparatus sections were calibrated to ± 0.0002-3 cm^3.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No source given.

(2) Nitrogen Oxide. Source not given. Research grade. 99.5% min. purity. Density,

$$\rho/\text{g ml}^{-1} = 1.4916 - 0.00226\ t/°\text{C}.$$

ESTIMATED ERROR:

$\delta T/K = 0.03$
$\delta P/\text{mmHg} = 0.01$
$\delta x_1/x_1 = 0.05$

REFERENCES:

1. Chang, E. T.; Gokcen, N. A.; Poston, T. M. *J. Spacecr. Rockets* 1969, *6*, 1177.
2. Gokcen, N. A.; Chang, E. T. *J. Chem. Ed.* 1977, *54*, 368.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Nitrogen oxide; N_2O_4; [10544-72-6]

ORIGINAL MEASUREMENTS:

Chang, E. T.; Gokcen, N. A.

J. Phys. Chem. 1966, *70*, 2394-9.

NASA Accession No. N66-14076, Rept. No. ATN-64-(9228)-4, 22p (1964). *From Sci. Tech. Aerospace Rept. 4(4),* 640(1964).

EXPERIMENTAL VALUES: continued

T/K	Nitrogen Pressure p_1/atm	Henry's Constant[1] 10^4K/atm^{-1}	Mol Fraction 10^4x_1	Bunsen Coefficient α/cm^3 (STP) cm^{-3} atm^{-1}	Ostwald Coefficient L/cm^3 cm^{-3}
262.02	0.5916	5.54	3.28		
	0.6186	5.56	3.44		
	1.2964	5.69	7.38		
	1.3192	5.69	7.51		
	1.9440	5.61	10.91		
	1.9500	5.68	11.08		
	1.0		5.62	0.208	0.199
273.15	0.3504	5.96	2.09		
	0.3811	6.09	2.32		
	0.4716[2]	6.00	2.83		
	0.6830	5.94	4.06		
	0.8972	6.01	5.39		
	0.9389[2]	6.00	5.63		
	1.4283	6.02	8.60		
	1.5043	5.95	8.95		
	1.7951	6.00	10.77		
	1.0		5.99	0.218	0.218
298.15	0.3801	6.50	2.47		
	0.5909	6.52	3.85		
	0.7222	6.67	4.82		
	0.7393	6.60	4.88		
	0.8457	6.55	5.54		
	1.1125	6.66	7.41		
	1.3032	6.59	8.59		
	1.0		6.58	0.230	0.251
303.16	0.5604[2]	6.80	3.81		
	0.8380[2]	6.85	5.74		
	1.0		6.85	0.238	0.268

---

[1] Henry's constant, $K/\text{atm}^{-1} = X_1/(P_1/\text{atm})$

[2] Data from a new apparatus having a greater degree of accuracy, but similar to the original apparatus.

The values at 101.325 kPa (1.0 atm) partial pressure nitrogen were calculated by the compiler from the average value of Henry's constant.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Oils.	Baldwin, R. R.; Daniel, S. G.; *J. Appl. Chem.*, 1952, *2*(Apr.),161-5. *J. Inst. Petrol.*, London, 1953, *39*, 105-24.
VARIABLES:	**PREPARED BY:**
T/K = 273.15 - 373.15 P/kPa = 101.325	P.L. Long H.L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
Oil A1, viscosity 615 centistokes at 100°F, mean mol wt 670.		
293.15	0.0662	0.0711
Oil A2, viscosity 268 centistokes at 100°F, mean mol wt 610.		
273.15	0.0632	0.0632
293.15	0.0664	0.0713
333.15	0.0738	0.0901
373.15	0.0739	0.100
Oil A3, viscosity 181 centistokes at 100°F, mean mol wt 570.		
293.15	0.0717	0.0770
Oil A4, viscosity 80.3 centistokes at 100°F, mean mol wt 530.		
293.15	0.0748	0.0803
Oil A5, viscosity 34.9 centistokes at 100°F, mean mol wt 400.		
273.15	0.0773	0.0773
293.15	0.0762	0.0818
333.15	0.0785	0.0957
373.15	0.0818	0.1113
Oil B1, viscosity 260 centistokes at 100°F, mean mol wt 630.		
293.15	0.0644	0.0691

METHOD/APPARATUS/PROCEDURE:

The method consists of two operations: Saturation of the liquid with the gas under consideration; and determination of the amount of dissolved gas in the liquid saturated with the gas. All gases were passed through a liquid air trap to remove water and CO_2 vapors before passage through the liquid. All gases were passed through a long coil, thermostated, before the saturation process.

Oil or similar liquid is deaerated by passing it through a continuously evacuated vessel. Gas is then passed through the liquid to saturation. Liquid is then degassed, and transferred to a storage burette, disconnected from the degassing apparatus, thermostated, and saturated with the desired gas. Burette is now connected to another degassing apparatus, portions of the oil degassed and gas collected.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen.From commercial cylinders, and gas analysis on a Bone and Wheeler apparatus shows it to be at least 99.5% pure; no source given.

(2) Oils. The oils conform to DTD-472B specifications. Composition and physical properties of the oils are given in the appendix of the 1953 paper. The molecular weights were determined by freezing point depression in naphthalene to within ±5 percent.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Mineral oil	Rodman, C. J.; Maude, A. H. *Trans. Am. Electrochem. Soc.* 1925, *47*, 71 - 92.
VARIABLES: T/K = 298.15, 353.15 p_1/kPa = 101.3 (760 mmHg)	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/^0C$	Temperature T/K	Bunsen Coefficient $\alpha/cm^3(STP)cm^{-3}atm^{-1}$	Ostwald Coefficient $L/cm^3\ cm^{-3}$	Solubility g kg^{-1}
25	298.15	0.0848	0.0925	0.127
80	353.15	0.0916	0.1185	0.144

These values appear in the International Critical Tables, McGraw-Hill Book Co., New York and London, Vol. III, pp. 261 - 270 where they are credited to an industrial report edited by A. H. Maude.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of an 180 cm^3 absorption bottle connected to a 100 cm^3 gas buret. The absorption bottle sits in a thermostat, which is attached to a shaking machine.

A weighed sample of oil is introduced into the absorption vessel. The sample is degassed by vacuum taking care to avoid excessive foaming. The gas is brought into the system. An initial buret reading taken, and the shaker is started and reading taken every 5 minutes until 2 or 3 constant readings are obtained.

SOURCE AND PURITY OF MATERIALS:

1. Nitrogen. No information.

2. Mineral oil. A Pennsylvania base oil, 96 per cent saturated hydrocarbons, and distilling between 300 and 400 ^0C. Density at 25 ^0C = 0.840 and at 80 ^0C = 0.800 g cm^{-3}. As a commercial product the oil is known as "Wemco A".

ESTIMATED ERROR:

REFERENCES:

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Mineral oil, white	ORIGINAL MEASUREMENTS: Kubie, L. S. *J. Biol. Chem.* 1927, *72*, 548-8.
VARIABLES: T/K = 295.15 - 295.65 P/kPa = 101.325	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α/cm^3 (STP) cm^{-3}atm^{-1}
295.15- 295.65	0.071 ± 0.002

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The appartaus was the constant volume Van Slyke and Neill type (1).

Saturation was attained by bubbling the gas through the oil for several hours.

A 1.990 ± 0.007 cm^3 volume of saturated solution was analyzed. The Van Slyke correction factor for unextracted and redissolved gas was 1.04.

SOURCE AND PURITY OF MATERIALS:

(1) Oxygen. Commercial cylinder.

(2) Mineral oil. "Amalie" brand, L. Sonneborn Sons, Inc., NY. A medicinal white oil which meets US Pharmacopeia standards. Prepared by fractional distillation from a naphthalene base, unsaturated hydrocarbons removed. Specific gravity 0.890 - 0.895 at 15 °C, viscosity 285 at 100 °F.

ESTIMATED ERROR:

$\delta T/K = 1$

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *56*, 523.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Paraffin oil

ORIGINAL MEASUREMENTS:

Nasini, A. G.; Corinaldi, G.

Soc. Ital. Prog. Sci. Atti Rium. 1932, *20*, 264-6.

VARIABLES:

T/K = 305.15
Total P/kPa = 101.325

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
305.15	.0736	.0822

The Ostwald coefficient was calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure were based on those of Lannung (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Laboratory preparation from ammonium nitrate followed by "conventional purification".

(2) Paraffin oil. Density, $\rho_{288.15} = 0.87$ g cm^{-3}.

ESTIMATED ERROR:

$\delta T/K = 0.1$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Paraffin Oil	Luther, H; Rottger, H. *Elektrotech. Z.* <u>1957</u>, *A78*, 462-4.
VARIABLES:	**PREPARED BY:**
T/K = 318 P/kPa = 27-103	R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	P/mm Hg	S/cm³ g⁻¹
45	318	200	0.023
45	318	300	0.034
45	318	500	0.054
45	318	700	0.076
45	318	770	0.084

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility determined by an appartus described in the paper by a combined volume and pressure measurement.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Molecular weight of 357 g mol⁻¹, d_{20}=0.8420 g cm⁻³, n_D^{20}= 1.4597.

ESTIMATED ERROR:

$\delta S/S = \pm 0.05$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Paraffin oil and a 50:50 mixture of 1-decanol and 1-dodecanol

ORIGINAL MEASUREMENTS:

Luther, H.; Hiemenz, W.

Chem. Ingr.-Tech. 1957, *29*, 530-5.

VARIABLES:

T/K = 293-355

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	$10^4 x_1{}^b$	H^c	$10^6 S^d$	$10^2 L^e$
		Paraffin Oil			
20	293	16.4	608		
20.0	293.2			1.89	8.33
41.0	314.2			1.87	8.82
61.5	334.7			1.83	9.20
82.0	355.2			1.80	9.57
		Alcohol Mixture[f]			
20	293	6.2	1621		
20.0	293.2			1.69	7.54
41.0	314.2			1.93	9.28
61.5	334.7			2.07	10.5
82.0	355.2			2.24	12.0

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325kPa partial pressure of gas.

[c] Henry's law constant, P_1/atm=(H/atm)x_1.

[d] Solubility in mol cm^{-3} at P_{N2}=400 torr.

[e] Ostwald coefficient.

[f] 50 mol % 1-decanol + 50 mol % 1-dodecanol.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubilities determined by an apparatus described in the paper by a combined pressure and volume measurement.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Paraffin oil - density of 0.8795 g cm^{-3} and molecular weight of 405 g mol^{-1}.

(3) Alcohol mixture is 50 mol % 1-decanol + 50 mol % 1-dodecanol.

ESTIMATED ERROR:

$\delta H/H = \pm 0.05$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Paraffin wax

ORIGINAL MEASUREMENTS:

Ridenour, W. P.; Weatherford, W. D.; Capell, R. G.

Ind. Eng. Chem. 1954, *46*, 2376-81.

VARIABLES:

T/K = 349.55
P/kPa = 35.26 - 103.19

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Pressure/ mmHg	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Solubility Coefficient cm^3 N_2 (STP) g^{-1} wax
349.55	264.5	0.506	0.071	0.033
	442.7	0.906	0.076	0.058
	590.5	1.27	0.080	0.081
	774.0	1.66	0.080	0.106
	760.0	(1.66)	0.080	0.104

The mole fraction solubility at a nitrogen partial pressure of 760 mmHg was calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to the equilibrium adsorption apparatus described by Brunauer, Emmett, and Teller (1) for the measurement of the surface area of a solid catalyst.

A weighed amount of wax was placed in the apparatus. The gas and solvent were equilibrated for 20 to 60 minutes. The gas volume in the buret system was calculated from the ideal gas law.

The results of the absorption measurements were checked by a desorption measurement. The two measurements agreed very well.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.96% N_2, 0.04 % O_2.

(2) Paraffin wax. Described as 122°F English melting point wax. Molecular weight 350, actual melt point 123.2°F (323.8 K), density 0.7716 g cm^{-3} at 293.3 K and 0.7662 g cm^{-3} at 298.0 K.

ESTIMATED ERROR:

$\delta T/K = 2.$
$\delta P/mmHg = 0.2$
$\delta\alpha/cm^3 = 0.004$ (low pressure)
-0.001 (high pres.)

REFERENCES:

1. Brunauer, S.; Emmett, P. H.; Teller, E.
J. Am. Chem. Soc. 1938, *60*, 309.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Petrowax A

ORIGINAL MEASUREMENTS:

Ridenour, W. P.; Weatherford, W. D.; Capell, R. G.

Ind. Eng. Chem. 1954, *46*, 2376-81.

VARIABLES:

$T/K = 354.75$
$P/kPa = 32.88 - 105.26$

PREPARED BY:

A. L. Cramer
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Pressure/ mmHg	Mol Fraction $X_1 \times 10^3$	Bunsen Coefficient α	Solubility Coefficient cm^3 N_2 (STP) g^{-1} wax
354.75	246.4	0.54	0.040	0.016
	419.3	1.27	0.056	0.038
	654.4	2.11	0.058	0.063
	789.5	2.57	0.060	0.077

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to the equilibrium adsorption apparatus described by Brunauer, Emmett, and Teller (1) for the measurement of the surface area of a solid catalyst.

A weighed amount of wax was placed in the apparatus. The gas and solvent were equilibrated for 20 to 60 minutes. The gas volume in the buret system was calculated from the ideal gas law.

The results of the absorption measurements were checked by a desorption measurement. The two measurements agreed very well.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Air Reduction Co. 99.96% N_2, 0.04% O_2.

(2) Petrowax A. Molecular weight 750, melting point 159.6°F (352.8 K) density 0.8039 g cm^{-3} at 355.6 K and 0.7662 g cm^{-3} at 370.2 K.

ESTIMATED ERROR:

$\delta T/K = 2.$
$\delta P/mmHg = 0.2$
$\delta\alpha/cm^3 = 0.004$ (low pressure)
-0.001 (high pres.)

REFERENCES:

1. Brunauer, S.; Emmett, P. H.; Teller, E.
J. Am. Chem. Soc. 1938, *60*, 309.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Hydrocarbon fuels	Baldwin, R. R.; Daniel, S. G. *J. Appl. Chem.* 1952, *2*,161-5. *J. Inst. Petrol*, London, 1953, *39*, 105-24.
VARIABLES: T/K = 273.15 - 293.15 P/kPa = 101.325	PREPARED BY: P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
100 octane fuel D		
293.15	0.204	0.219
Kerosene		
293.15	0.1185	0.127
273.15	0.116	0.116

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

1. Degassing. The liquid was deaerated by passage through a continuously evacuated vessel. The liquid was saturated with gas, then degassed again.

2. Saturation of liquid with gas. The gas was passed through a liquid air trap to remove water and carbon dioxide, then through a long coil thermostated at the temperature of the solubility measurement, and then bubbled through the liquid up to five hours.

3. Determination of the amount of gas liberated under vacuum from a known volume of the saturated liquid. The saturated liquid is placed in a vessel attached to a calibrated buret. The whole apparatus was initially evacuated. The gas released from the liquid was transferred to the calibrated buret by a Töpler pump. Five operations and transfers recover all but a trace of the gas. The last trace (2-5%) removed by boiling the liquid.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Commercial cylinder, source not given. 99.5 per cent pure by gas analysis on Bone and Wheeler apparatus.

(2) 100 Octane Fuel. Molecular weight estimated to be 100. Kerosene. Mean molecular weight measured, obtained 165.

ESTIMATED ERROR:

$\delta P/P = 0.01$

$\delta \alpha/\alpha = 0.01$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrocarbon fuels and oil

ORIGINAL MEASUREMENTS:

Logvinyuk, V. P.; Makarenkov, V. V.; Malyshev, V. V.; Panchenkov, G. M.

Khim. Tekhnol. Topl. Masel 1970, *15*, (No. 5), 27-9.
Chem. Technol. Fuels Oils (Eng.trans) 1970, *15*, 353-5.

VARIABLES:

T/K= 253.15 - 365.15
N_2 P/kPa= 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
Hydrocarbon fuel, T-1, density ρ_4^{20} = 0.816		
253.15	0.122	0.113
273.15	0.122	0.122
293.15	0.122	0.131
323.15	0.099	0.117
Hydrocarbon fuel, TS-1, density ρ_4^{20} = 0.775		
293.15	0.129	0.138
Hydrocarbon fuel, T-6, density ρ_4^{20} = 0.84		
253.15	0.099	0.092
273.15	0.099	0.099
293.15	0.114	0.122
323.15	0.114	0.135
365.15	0.099	0.132
Hydrogenated fuel, ρ_4^{20} = 0.832		
293.15	0.114	0.122
Oil, MK-8, density ρ_4^{20} = o.855		
293.15	0.076	0.082

The compiler calculated the Ostwald coefficients.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure were described in reference (1) which was not available to the compiler.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No information given.

(2) Fuels and oil. Solvent densities in text above.

ESTIMATED ERROR:

δα/α = 0.06 (authors)

REFERENCES:

1. Gogitidize, L. D.;Logvinyuk, V. P.; Makarenkov, V.V.; Panchenkov, G.M.; Malyshev, V.V.; Yakovlevskii, V.V. *"Method of Evaluating the Operating Properties of Jet Fuels and Lubricating Materials" (Russ.), Mashinostroenie** 1966.

**Mashinostroenie*, see *Izv. Vyssh. Uchebn. Zaved., Mashinostr.*

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Petroleum	Gniewosz, S.; Walfisz, A. *Z. Phys. Chem.* 1887, *1*, 70-2.
VARIABLES: T/K = 283-293 Pressure ="Atmospheric"	PREPARED BY: M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
283.15	0.135	0.140
293.15	0.117	0.126

The Ostwald coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consisted of an absorption flask connected to a gas buret by a flexible lead capillary. The system was thermostated in a large water bath.

The volume of nitrogen absorbed in a known volume of degassed petroleum was directly measured on the gas buret.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No information.

(2) Petroleum. Russian petroleum. Cleaned by boiling in a large copper flask.

ESTIMATED ERROR:

$\delta\alpha/\alpha = 0.05$ (compiler)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Amsco 123-15

ORIGINAL MEASUREMENTS:

Steinberg, M.; Manowitz, B.

Ind. Eng. Chem. 1959, *51*, 47 - 51.

VARIABLES:

$T/K = 218.15 - 373.15$

$P/kPa = 101.325$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Absorption Coefficient β
218.15	0.125
297.15	0.126
373.15	0.136

The authors define the absorption coefficient as the volume of gas, corrected to 288.15 K and 101.325 kPa, absorbed under a total system pressure of 101.325 kPa per unit volume (at 288.15 K) of solvent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Van Slyke Method.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Matheson Co.

(2) Amsco 123-15. American Mineral Spirits Co. No. 140. Paraffin 59.6 wt %, naphthene 27.3 wt %, and aromatics 13.2 wt %.

ESTIMATED ERROR:

$\delta\beta/\beta = 0.05 - 0.10$ (authors)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Crude oils from U.S.S.R.

ORIGINAL MEASUREMENTS:

Safranova, T. P.; Zhuze, T. P.

Khim. i. Tekhnol. Top. Liv. Masel 1958, 41-6.

Chem. Abstr. 1958, *52*, 8518e.

VARIABLES:

T/K = 373

P/MPa = 5.1 - 30.4

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

Crude Oil	$\alpha/cm^3(STP)cm^{-3}\ atm^{-1}$ at t/°C = 100(373 K) P/atm 50	 100	 200	 300
(1) "Surakhanskaya otbornaya"	0.101	0.091	0.078	0.080
(2) "Nebitdagskaya"	0.077	0.075	0.066	0.064
(3) "Romashinskaya"	0.118	0.100	0.088	0.087
P/MPa (compiler)	5.07	10.1	20.3	30.4

Crude Oil	Density d_4^{20}	Viscosity /cs	Fraction <200°C %	Fraction 200-300°C %
(1)	0.8494	5.14	18	23.5
(2)	0.8713	8.70	20	20
(3)	0.8530	6.54	25	19.5

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a thermostated steel vessel (450 cm^3) equipped with a magnetic stirrer, heaters, temperature controls, auxilliary pumps and analytical equipment.

The amounts of liquid and gas were determined volumetrically. The original paper contains details and a drawing of apperatus.

SOURCE AND PURITY OF MATERIALS:

(1) Stated to contain 3.09% of air

(2) See details above.

ESTIMATED ERROR:

REFERENCES:

NITROGEN SOLUBILITIES ABOVE 200 kPa

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

EVALUATOR:

Colin L. Young,
School of Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

June 1981

CRITICAL EVALUATION:

The most extensive studies of the solubility of nitrogen in water are those of Wiebe *et al.* (1), (2), Krase and coworkers (3), (4) and of Smith and coworkers (5), (6), (7). The data of Smith and coworkers (5), (6), (7) agree within about 2% with those of Wiebe *et al.* (2). However, there are larger discrepancies between the data of Krase and coworkers (3), (4) and Wiebe *et al.* (2). There is also some uncertainty with regard to the data of Suciu (8), McKee (9) and Suciu, Zoss and Sibbitt (10) which are classified as doubtful. The relatively low pressure data of Pray *et al.* (11) were incorporated with additional new data to give the data reported in references (8) and (10). The data of Smith and coworkers (5), (6), (7) and Wiebe *et al.* (1), (2) are classified as recommended for the temperature range 298.15 K to 398.15 K. Above this temperature range up to 513 K, the data of Saddington and Krase (4) are the most reliable and are classified as tentative. The data of Pray *et al.* (11) give an indication of the solubility at higher temperatures but must be regarded with some caution.

The data of Bassett and Dode (12) cover pressures up to 450 MPa but are rejected since it appears that the water became contaminated with oil from the high pressure compressor. These workers' data disagree with the data of Wiebe *et al.* (2) at 100 MPa. Bassett and Dode found that the solubility of nitrogen in water at 18°C initially increased with increasing pressure and then decreased with further increases in pressure. This finding is supported by work by Tsiklis and Maslennikova (13) who found similar behaviour at 330°C. These latter workers (13) found the system showed the phenomenon of gas-gas immiscibility of the second kind.

The data of Frolich *et al.* (14) are not of high accuracy and are presented in graphical form. Consequently these data are rejected for the present system.

References

1. Wiebe, R.; Gaddy, V. L.; Heins, C. *Ind. Eng. Chem.* 1932, *24*, 927.
2. Wiebe, R.; Gaddy, V. L.; Heins, C. *Ind. Eng. Chem.* 1933, *55*, 947.
3. Goodman, J. B.; Krase, N. W. *Ind. Eng. Chem.* 1931, *23*, 401.
4. Saddington, A. W.; Krase, N. W. *J. Am. Chem. Soc.* 1934, *56*, 353.
5. Smith, N. O.; Kelemen, S.; Nagy, B. *Geochim. Cosmochim. Acta* 1962, *26*, 921.
6. O'Sullivan, T. D.; Smith, N. O.; Nagy, B. *Geochim. Cosmochim. Acta* 1966, *30*, 617.
7. O'Sullivan, T. D.; Smith, N. O. *J. Phys. Chem.* 1970, *74*, 1460.
8. Suciu, S. *Ph.D. Thesis*, 1951, Purdue University.
9. McKee, O. L. Jr. *Ph.D. Thesis*, 1953, Purdue University.
10. Suciu, S. N.; Zoss, L. M.; Sibbitt, W. L. *Am. Soc. Mech. Eng.* Paper No. 53-A-64. Presented at the Annual Meeting, New York, 1953.
11. Pray, H. A.; Schweichert, C. E.; Minnich, B. H. *Ind. Eng. Chem.* 1952, *44*, 1147.
12. Bassett, J.; Dode, M. *Compt. Rend.* 1936, *203*, 775.
13. Tsiklis, D. S.; Maslennikova, V. Ya. *Doklady Akad. Nauk. SSSR* 1965, *161*, 645.
14. Frolich, P. K.; Trauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Goodman, J. B. and Krase, N. W.,
Ind. Eng. Chem., 1931, *23*, 401-4/

VARIABLES:

T/K = 273-442
P/MPa = 10.1-30.4

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^3 Mole fraction of nitrogen in water, $10^3 x_{N_2}$	T/K	P/bar	10^3 Mole fraction of nitrogen in water, $10^3 x_{N_2}$
273.15	101.3	1.04	353.15	202.6	1.62
	126.7	1.26		304.0	2.04
	202.6	2.27	373.15	101.3	0.681
	304.0	2.57		126.7	0.835
298.15	101.3	0.764		202.6	1.61
	126.7	1.03		304.0	2.08
	202.6	1.97	417.15	101.3	0.732
	304.0	2.32		126.7	0.928
323.15	101.3	0.716		207.6	0.91
	126.7	0.885		304.0	2.47
	102.6	1.78	442.15	101.3	0.771
	304.0	2.13		126.7	1.09
353.15	101.3	0.667		202.6	2.35
	126.7	0.821		304.0	2.73

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Magnetically stirred equilibrium cell of about ∿ 0.02 ℓ. Pressure measured with dead weight gauge. Copper block thermostat used at temperatures above 273.15K. Cell charged with gas and liquid; after equilibrium established liquid sample removed from bottom of cell and amount of dissolved gas estimated volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample oxygen; carbon dioxide and water vapor removed before use.

(2) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\mathrm{bar} = \pm 0.5$;

$\delta x_{N_2} = \pm 1\text{-}2\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V. L. ; Heins, C.
Ind. Eng. Chem. 1932, *24*, 927.

VARIABLES:

T/K = 298
P/MPa=2.53-101.3

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	10^3 × Mole fraction of nitrogen in liquid, $10^3x_{N_2}$
298.15	25.33	0.249
	50.66	0.267
	101.33	0.903
	202.65	1.616
	303.97	2.180
	506.62	3.160
	810.60	4.361
	1013.25	5.076

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

One pass flow method with two vessel adsorption train. Second vessel used as source of sample for analysis. Pressure measured with dead weight gauges. Measurements taken both for a high pressure and low pressure approach to equilibrium. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Best commercial sample purified by passage over finely divided copper. Major impurity argon and traces of oxygen.

(2) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.5$;
$\delta x_{N_2} = \pm 1\%$.

REFERENCES:

1. Wiebe, R. ; Gaddy, V. L. : Heins C. *Ind. Eng. Chem.* 1931, *23*, 401.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Wiebe, R., Gaddy, V. L.; Heins, C.

J. Am. Chem. Soc. 1933, *55*, 947.

VARIABLES:

T/K = 298-373

P/MPa = 2.5-101.3

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	10^2 Mole fraction of nitrogen in liquid, $10^2 x_{N_2}$	T/K	*P*/bar	10^2 Mole fraction of nitrogen in liquid, $10^2 x_{N_2}$
298.15	25.33	0.0249	348.15	25.33	0.0181
	50.66	0.0481		50.66	0.0353
	101.33	0.0902		101.33	0.0676
	202.65	0.1610		202.65	0.1236
	303.97	0.2183		303.97	0.1721
	506.62	0.3163		506.62	0.2554
	810.60	0.4364		810.60	0.3604
	1013.25	0.5083		1013.25	0.4222
323.15	25.33	0.0195	373.15	25.33	0.0190
	50.66	0.0381		50.66	0.0369
	101.33	0.0722		101.33	0.0704
	202.65	0.1306		202.65	0.1300
	303.97	0.1807		303.97	0.1816
	506.62	0.2651		506.62	0.2707
	810.60	0.3717		810.60	0.3819
	1013.25	0.4356		1013.25	0.4450

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

One pass flow method with two vessel adsorption train. Second vessel used as source of sample for analysis. Pressure measured with dead weight gauges. Measurements taken both for a high pressure and low pressure approach to equilibrium. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.9 mole percent; major impurity argon, trace of oxygen.

(2) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{N_2} = \pm 1\%$.

REFERENCES:

1. Wiebe, R. Gaddy, V. L.; Heins, C. *Ind. Eng. Chem.* 1931, *23*, 401.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Saddington, A. W.; Krase, N. W.

J. Am. Chem. Soc. 1934, *56*, 353-61.

VARIABLES:

T/K = 338-503

P/MPa = 10.1-30.4

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}
338.15	101.3	0.000700
353.15	101.3	0.000698
398.15	101.3	0.000855
453.15	101.3	0.001173
483.15	101.3	0.001297
513.15	101.3	0.001446
323.15	202.7	0.001290
353.15	202.7	0.001248
373.15	202.7	0.001302
423.15	202.7	0.001550
473.15	202.7	0.002343
513.15	202.7	0.003119
323.15	304.0	0.001834
343.15	304.0	0.001730
378.15	304.0	0.001853
408.15	304.0	0.002230
438.15	304.0	0.002783
503.15	304.0	0.004313

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Single pass flow system with five pipet adsorption train. Last pipet used as source of sample for analysis. Temperature measured with three chromel-alumel thermocouples. Pressure measured with dead weight piston gauge. Gas bubbled through water for at least three hours. Liquid phase sample allowed to expand and volume of gas measured. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample passed through charcoal adsorption trap.

(2) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{N_2} = \pm 0.002$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Suciu, S.
Ph. D. thesis, 1951
Purdue University

VARIABLES:

T/K = 397.0 - 535.9
Total P/kPa = 10,440

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°F	Temperature T/K	Pressure psig[1]	Nitrogen Solubility $S/cm^3(STP)\ g^{-1}$	Vapor Composition $c_{H_2O}/mol\ dm^{-3}$
255	397.0	1500	1.05	0.16
303	423.7		1.35	0.30
392	473.15		2.18	0.98
505	535.9		2.50	2.67

[1] Total pressure in pounds per square inch gage. Equivalent to 103 atm or 10,440 kPa.

The values above were read from large scale graphs (Fig 9 and 10) in the thesis by the compiler. The curves were drawn using Suciu's own data plus the values from Saddington, A. W.; Krase, N. W. *J. Am. Chem. Soc.* 1934, *56*, 353, and from Pray, H. A. H.; Schweickert, C. E.; Minnich, B. H. Battelle Memorial Institute, BMI-T-25, 1950

The work was carried out in the Department of Mechanical Engineering under the direction of W. L. Sibbitt.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption apparatus was a stainless steel high pressure bomb. It consisted of three chambers arranged in line axially, and connected by valve openings for control. There was a vapor chamber, a two phase chamber, and a liquid chamber. The entire bomb with valves was kept at the temperature of the measurement. The system was inside a 1½ inch aluminum cover.

The bomb was charged with water and the gas. There was a flexible lead to the high pressure gas supply to the pressure could be maintained at a constant value. The apparatus was rocked through a 60 degree angle at 30 oscillations per minute until equilibrium was established.

The vapor phase was analysed by exoanding the compressed gas and vapor mixture from the vapor chamber through a drying train and a wet test meter.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Purchased in standard steel gas bottles usually pressurized at 2100 psig.

(2) Water. No information given.

ESTIMATED ERROR:

The solubility values were reproducible to 1 % with a maximum deviation of 3 %.

METHOD (continued)

The liquid phase was analysed by slowly transferring the contents of the liquid chamber to a buret system at atmospheric pressure and room temperature. The gas volume was measured, the water absorbed and weighed.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Pray, H. A.; Schweichert, C. E.; Minnich, B. H.

Ind. Eng. Chem. 1952, *44*, 1146-51.

VARIABLES:

$T/K = 533\text{-}589$
$P/MPa = 1.03\text{-}3.45$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^3 Mole fraction of nitrogen in water, $10^3 x_{N_2}$
533.1	10.34	0.31
	34.47	0.89
588.7	10.34	0.39
	20.68	1.11
	34.47	1.66

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell of 3 ℓ capacity; pressure measured with dead weight gauge and temperature measured using chromel-alumel thermocouple. Cell contents equilibrated and liquid sample removed. The amount of dissolved gas estimated volumetrically.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 1$; $\delta P/bar = \pm 1$;

$\delta x_{N_2} = \pm 1\text{-}5\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

McKee, O. L. Jr.
Ph. D. thesis, 1953
Purdue University

VARIABLES: T/K = 273-295

Total P/kPa = 3450 - 20,680

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Total Pressure P/lb in^{-2}	Temperature t/°F	T/K	Nitrogen Solubility S/cm^3(STP) g^{-1}	Temperature t/°F	T/K	Nitrogen Solubility S/cm^3(STP) g^{-1}
500	32	273.15	0.71	72	295.4	0.53
			0.76			0.76
1000	32	273.15	1.41	71	294.8	0.99
			1.43			1.38
1500	32	273.15	2.00	71	294.8	1.43
			2.05			1.37
2000	32	273.15	2.47	71	294.8	1.77
			2.53			1.76
3000	32	273.15	3.51	70	294.3	2.42
			3.53			2.37
				71	294.8	2.44

The work was carried out in the Department of Mechanical Engineering under the direction of W. L. Sibbitt.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus of Zoss (1) modified to improve the temperature control at 32 °F, and to improve the sampling of the liquid and vapor phases.

Total Pressure:

P/lb in^{-2}	P/atm	P/kPa
500	34.0	3450
1000	68.0	6895
1500	102.1	10340
2000	136.1	13790
3000	204.1	20680

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. No information given.

(2) Water. Distilled. Boiled three hours prior to use.

ESTIMATED ERROR: Calculated by author:

Solubility	Max Error
0.8	16.3 %
1.5	3.5
3.5	2.0

REFERENCES:

1. Zoss, L. M.
Ph. D. thesis, 1952
Purdue University

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Eichelberger, W. C.

Ind. Eng. Chem. 1955, *47*, 2223-8.

VARIABLES:

T/K = 338
P/MPa = 7.1-20.3

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psig	$P_{N_2}{}^a$/MPa	Solubility[b]
1010	7.063	0.68
1370	9.545	0.91
1475	10.27	0.97
2230	15.47	1.39
2810	19.47	1.69
2930	20.30	1.76

[a] Calculated by compiler. Partial pressure of nitrogen (absolute).

[b] Solubility in units of ml N_2 (STP) per ml water at 65°C (338.2 K) Gas volumes not corrected for non-ideality of gas at pressure of measurement.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A pressure vessel is charged up to pressure with gas and liquid and rocked for several hours. After equilibration a sample is removed into a gas buret where the liquid and gas volumes are measured at atmospheric pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Tank.

(2) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
δSolubility/Solubility = ±0.03, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Smith, N. O.; Kelemen, S.; Nagy, B.

Geochim. Cosmochim. Acta 1962, *26*, 921-6.

VARIABLES:

$T/K = 303$
$P/MPa = 1.1-5.9$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^3 Mole fraction of nitrogen in liquid, $10^3 x_{N_2}$
303.15	11.0	0.110
	31.0	0.335
	40.7	0.428
	50.5	0.552
	59.0	0.637

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell. Pressure measured with a Bourdon pressure gauge. Cell charged with boiled water; gas admitted to known pressure. Cell contents allowed to equilibrate. Final pressure measured and used to calculate amount of gas dissolved. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.6 mole per cent.

(2) Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} = \pm 0.3$;

$\delta x_{N_2} = \pm 0.02 \times 10^{-4}$ (estimated by compiler).

REFERENCES:

1. Duffy, J. R.; Smith, N. O.; Nagy, B. *Geochim. Cosmochim. Acta* 1961, *24*, 23-31.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

O'Sullivan, T. D.; Smith, N. O.

Geochim. Cosmochim. Acta 1966, *30*, 617-9.

VARIABLES:

T/K = 325
P/MPa = 10.1-60.8

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	10^3 Mole fraction of nitrogen in liquid, $10^3 x_{N_2}$
324.65	101.3	0.810
	202.6	1.47
	304.0	2.05
	405.3	2.54
	506.6	3.00
	607.9	3.44

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Large steel autoclave (∿ 4.5 ℓ) cell. Pressure measured with Bourdon gauge. Temperature measured with iron-constantan thermocouple. Cell charged with liquid, compressed gas added. After equilibrium attained, samples removed and analysed using volumetric techniques. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.90 mole per cent.

(2) Distilled and de-ionised.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 1$;

$\delta x_{N_2} = \pm 10^{-5}$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

O'Sullivan, T. D.; Smith, N. O.

J. Phys. Chem. 1970, *74*, 1460-6.

(Correction in *J. Phys. Chem.* 1970, *74*, 4612.)

VARIABLES:

T/K = 324-398
P/MPa = 10.1-61.6

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^3 Mole fraction of nitrogen in liquid, $10^3\ x_{N_2}$
324.65	101.3	0.799
	202.6	1.454
	304.0	2.017
	405.3	2.49
	506.6	2.92
	607.9	3.35
375.65	102.3	0.777
	203.7	1.447
	306.0	2.005
	408.3	2.52
	509.7	2.98
	612.0	3.37
398.15	104.4	0.808
	206.7	1.492
	309.0	2.047
	410.4	2.57
	513.7	3.06
	616.1	3.51

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Large steel autoclave (∿ 4.51 ℓ) cell. Pressure measured with Bourdon gauge. Temperature measured with iron-constantan thermocouple. Cell charged with liquid, compressed gas added. After equilibrium obtained, samples removed and analysed using volumetric techniques. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson Co. sample, purity 99.996 mole per cent.

(2) Distilled and de-ionised, air removed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\text{bar} = \pm 0.05\%$;

$\delta x_{N_2} = \pm 0.4\%$.

REFERENCES:

1. O'Sullivan, T. D.; Smith, N.O. *Geochem. Cosmochim. Acta* 1966, *30*, 617-9.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Magnesium Sulfate; $MgSO_4$; [7487-88-9]

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

ORIGINAL MEASUREMENTS:

Smith, N. O.; Kelemen, S.; Nagy, B.

Geochim. Cosmochim. Acta 1962, *26*, 921-6.

VARIABLES:

T/K = 303
P/MPa = 1.5-7.0
Concentration

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc./10^3 mol m^{-3}	P/bar	10^4 Mole fraction of nitrogen in liquid, $10^4\,x_{N_2}$
303.15	1.25	15.17	0.65
		26.54	1.34
		40.89	2.23
		48.95	3.11
		63.09	3.51
	2.49	16.89	0.41
		45.51	1.25
		59.78	1.70
		69.84	2.28

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Rocking equilibrium cell. Pressure measured with a Bourdon pressure gauge. Cell charged with salt solution; gas admitted to known pressure. Cell contents allowed to equilibrate. Final pressure measured and used to calculate amount of gas dissolved. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.6 mole per cent.

(2) Fisher Scientific Certified Chemical.

(3) Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} \simeq \pm 0.3$; $\delta x_{N_2} = \pm 0.2 \times 10^{-4}$ (estimated by compiler).

REFERENCES:

1. Duffy, J. R.; Smith, N. O.; Nagy, B. *Geochim. Cosmochim. Acta* 1961, *24*, 23-31.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Calcium Chloride: $CaCl_2$; [10043-53-4]

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

ORIGINAL MEASUREMENTS:

Smith, N. O.; Kelemen, S.; Nagy, B. *Geochim. Cosmochim. Acta* 1962, *26*, 921-6.

VARIABLES:

T/K = 303
P/MPa = 1.2-7.3
Concentration

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc./10^3 mol m^{-3}	P/bar	10^4 Mole fraction of nitrogen in liquid phase, 10^4 x_{N_2}
303.15	0.50	12.4	1.03
		24.6	1.82
		34.5	2.86
		45.8	3.84
		54.1	4.73
		60.5	5.68
	1.75	14.8	0.56
		26.9	1.46
		38.3	2.13
		48.3	2.44
		55.8	3.10
		64.7	3.62
	3.50	16.2	0.38
		29.9	0.93
		44.3	1.37
		58.8	1.78
		66.4	2.38
		76.0	2.64
	5.60	26.2	0.32
		34.1	0.52
		54.0	0.90
		72.6	1.83

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Rocking equilibrium cell. Pressure measured with a Bourdon pressure gauge. Cell charged with salt solution; gas admitted to known pressure. Cell contents allowed to equilibrate. Final pressure measured and used to calculate amount of gas dissolved. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.6 mole per cent.

(2) Fisher Scientific Certified Chemical.

(3) Degassed

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} \simeq \pm 0.3$; $\delta x_{N_2} = 0.2 \times 10^{-4}$ (estimated by compiler).

REFERENCES:

1. Duffy, J. R.; Smith, N. O.; Nagy, B. *Geochim. Cosmochim. Acta* 1961, *24*, 23 -31.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium Sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Smith, N. O.; Kelemen, S.; Nagy, B. *Geochim. Cosmochim. Acta* 1962, *26*, 921-6.

VARIABLES:

$T/K = 303$
$P/MPa = 1.3-7.0$
Concentration

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc./10^3 mol m^{-3}	P/bar	10^4 Mole fraction of nitrogen in liquid, $10^4\ x_{N_2}$
303.15	0.50	12.6	0.79
		24.8	1.78
		42.1	3.24
		54.5	3.88
	1.25	15.5	0.58
		27.6	1.23
		47.2	2.01
		60.3	2.99
	2.10	16.5	0.38
		30.7	0.84
		45.5	1.39
		57.4	2.13
		69.8	3.18

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell. Pressure measured with a Bourdon pressure gauge. Cell charged with salt solution; gas admitted to known pressure. Cell contents allowed to equilibrate. Final pressure measured and used to calculate amount of gas dissolved. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.6 mole per cent.

(2) Fisher Scientific N.F. grade chemical.

(3) Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta P/\text{bar} \simeq \pm 0.3$; $\delta x_{N_2} = \pm 0.2 \times 10^{-4}$ (estimated by compiler).

REFERENCES:

1. Duffy, J. R.; Smith, N. O.; Nagy, B. *Geochim. Cosmochim. Acta* 1961, *24*, 23-31.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Sodium Chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Smith, N. O.; Kelemen, S.; Nagy, B. *Geochim. Cosmochim. Acta* 1962, *26*, 921-6.
VARIABLES: T/K = 303 P/MPa = 1.2-7.1 Concentration	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc./10^3 mol m^{-3}	P/bar	10^4 Mole fraction of nitrogen in liquid phase, $10^4 x_{N_2}$
303.15	1.00	12.4	0.94
		23.8	1.74
		35.2	2.56
		45.9	3.70
		55.0	4.68
		65.2	5.50
303.15	2.70	14.1	0.57
		27.2	1.29
		38.3	2.02
		51.7	2.81
		61.4	3.46
		72.6	4.14
303.15	5.47	16.9	0.32
		31.5	0.88
		44.1	1.39
		56.5	1.86
		71.2	2.72

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell. Pressure measured with a Bourdon pressure gauge. Cell charged with salt solution; gas admitted to known pressure. Cell contents allowed to equilibrate. Final pressure measured and used to calculate amount of gas dissolved. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.6 mole per cent.

(2) Fisher Scientific Certified Chemical.

(3) Degassed.

ESTIMATED ERROR:

δT/K = ±1.0; δP/bar ≃ ±0.3; δx_{N_2} = ±0.2 × 10^{-4} (estimated by compiler).

REFERENCES:

1. Duffy, J. R.; Smith, N. O.; Nagy, B. *Geochim. Cosmochim. Acta* 1961, *24*, 23-31.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium Chloride; NaCl; [7647-14-5]

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

ORIGINAL MEASUREMENTS:

O'Sullivan, T. D.; Smith, N. O.

Geochim. Cosmochim. Acta 1966, *30*, 617-9.

VARIABLES:

T/K - 325-376
P/MPa = 10.1-61.2
Concentration

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc./10^3 mol m^{-3}	P/bar	10^4 Mole fraction of nitrogen in liquid, $10^4\ x_{N_2}$
324.65	1.0	101.3	6.00
		202.6	10.9
		304.0	15.2
		405.3	19.0
		506.6	22.6
		607.9	25.9
375.65	1.0	102.3	6.10
		203.7	11.3
		306.0	15.6
		408.3	19.5
		509.7	23.0
		612.0	26.6

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Large steel autoclave (∿ 4.5 ℓ) cell. Pressure measured with Bourdon gauge. Temperature measured with iron-constantan thermocouple. Cell charged with liquid, compressed gas added. After equilibrium attained, samples removed and analysed using volumetric techniques. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.90 mole per cent.

(2) Baker analyzed reagent grade, dried at 388 K.

(3) Distilled and de-ionized.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 1$; $\delta x_{N_2} = \pm 10^{-5}$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium Chloride; NaCl; [7647-14-5]

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

ORIGINAL MEASUREMENTS:

O'Sullivan, T. D.; Smith, N. O.

J. Phys. Chem. 1970, *74*, 1460-6.

(*Corrn.-J. Phys. Chem.* 1970, *74*, 4612)

VARIABLES:

T/K = 325-398
P/MPa = 10.1-61.2
Concentration

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Conc./10^3 mol m^{-3}	P/bar	10^3 Mole fraction of nitrogen in liquid, $10^3 x_{N_2}$
324.65	1.000	101.3	0.593
		202.6	1.076
		304.0	1.497
		405.3	1.860
		506.6	2.216
		607.9	2.53
375.65		101.3	0.603
		203.7	1.113
		306.0	1.538
		408.3	1.920
		509.7	2.252
		612.0	2.60
398.15		104.4	0.632
		206.7	1.102
		309.0	1.533
		410.4	1.883
		513.7	2.231
		616.1	2.55
324.65	4.00	202.6	0.500
		304.0	0.700
		405.3	0.878
		506.6	1.034
		607.9	1.179

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Large steel autoclave (∿ 4.5 ℓ) cell. Pressure measured with Bourdon gauge. Temperature measured with iron-constantan thermocouple. Cell charged with liquid, compressed gas added. After equilibrium attained samples removed and analysed using volumetric techniques. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson Co. sample; purity 99.996 mole per cent.

(2) Baker analyzed reagent dried at 388 K.

(3) Distilled and de-ionized air removed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\text{bar} = \pm 0.05$;

$\delta x_{N_2} = \pm 0.4\%$

REFERENCES:

1. O'Sullivan, T. D.; Smith, N. O. *Geochim. Cosmochim. Acta* 1966, *30*, 617-9.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sodium Chloride, NaCl; [7647-14-5]

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

ORIGINAL MEASUREMENTS:

O'Sullivan, T. D.; Smith, N. O.

J. Phys. Chem. 1970, *74*, 1460 - 6.

(*Corrn.-J. Phys. Chem.* 1970, *74*, 4612)

EXPERIMENTAL VALUES:

continued

T/K	Conc./10^3 mol m^{-3}	P/bar	10^4 Mole fraction of nitrogen in liquid, $10^4 x_{N_2}$
375.65	4.000	203.7	0.523
		306.0	0.731
		408.3	0.899
		509.7	1.047
		612.0	1.205
398.15		206.7	0.567
		309.0	0.740
		410.4	0.921
		513.7	1.041
		616.1	1.227

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Detergent (3) Water; H_2O; [7732-18-5]	Enns, T.; Scholander, P. F.; Bradstreet, E. D. *J. Phys. Chem.* 1965, *69*; 389-91.
VARIABLES: T/K = 298 P/MPa = 0-10	**PREPARED BY:** R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	P^b = 0 (0 MPa)	P^b = 34 atm (3.45MPa)	P^b = 68 atm (6.89MPa)	P^b = 102 atm (10.34MPa)
			Water		
25	298.15	733	773	802	843
25	298.15	705	744	777	811
25	298.15	732	769	806.5	844
			Detergent		
25	298.15	712	742	774	811

[a] Calculated by compiler.

[b] Hydrostatic pressure.

[c] The values in the table are the nitrogen equilibrium pressures in units of mm Hg. The table shows the effect of hydrostatic pressure on the nitrogen equilibrium pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water was gas-extracted before the experiment. Nitrogen at the desired initial pressure was dissolved in it at controlled temperature. The equilibrium vessel was shaken for 0.5 to 1 h during the nitrogen uptake. The solution was then transferred to a syringe which had teflon tubing attached to it. Pressure was then measured by a null point measurement of the pressure developed inside the teflon tube. Details and a diagram are given in the original paper.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Surface tension equal to 30% that of water.

(3) No details given.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Oxygen; O_2; [7782-44-7] (3) Cyclohexane; C_6H_{12}; [110-82-7]	Khodeeva, S. M. *Tr. Naucho-Issledov. Proekt. Inst. Azotn. Prod. Prom. Org. Sin.* <u>1971</u>, *12*, 30-39.
VARIABLES:	**PREPARED BY:**
T/K = 373-433 P/MPa = 4-11	C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	α cm^3/g^{-1}	Total Mole fraction of gases in liquid	Volume fraction of O_2 in gas phase	Volume fraction of O_2 in dissolved gas
373.15	41.3	4.18	12.1	0.043	0.082	0.118
	44.6	4.52	11.9	0.043	0.082	-
	47.5	4.81	13.3	0.048	0.082	-
	54.2	5.49	14.8	0.053	0.082	0.088
	55.0	5.57	15.3	0.054	0.082	-
	58.1	5.89	15.9	0.057	0.082	0.092
	59.8	6.06	16.8	0.060	0.082	0.113
	65.9	6.68	18.9	0.066	0.082	0.111
	67.3	6.82	19.4	0.068	0.082	-
	72.4	7.34	20.3	0.071	0.082	0.111
	73.5	7.45	21.4	0.075	0.082	0.125
	78.7	7.97	22.5	0.078	0.082	0.135
	82.8	8.39	24.2	0.083	0.082	0.113
	91.3	9.25	27.0	0.092	0.082	0.127
403.15	42.1	4.27	11.8	0.042	0.082	-
	46.8	4.74	13.5	0.048	0.082	0.118
	51.8	5.25	15.0	0.053	0.082	0.113
	57.1	5.79	16.2	0.058	0.082	0.116
	61.3	6.21	17.9	0.063	0.082	0.121
	65.6	6.65	19.3	0.068	0.082	0.127
	89.0	9.02	27.3	0.093	0.082	0.130
	96.8	9.81	30.7	0.103	0.082	0.115
	104.0	10.54	33.2	0.111	0.082	0.123

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which saturated liquid sample was stripped of gas under reduced pressure. Amount of liquid in sample determined gravimetrically. Amount of dissolved gas determined by measuring the volume at known temperature and pressure. Some details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Specially purified sample, less than 0.005 volume per cent impurity.

(2) No details given.

(3) 0.5% of α-naphthylamine added.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/atm = \pm 0.2$;

$\delta\alpha/\alpha = \pm 1\%$.

REFERENCES:

1. Khodeeva, S. M.; Dymova, R. P. *Tr. Naucho-Issledov. Proekt. Inst. Azotn. Prom. Prod. Org. Sin.* <u>1971</u>, *12*, 39.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]
(2) Oxygen; O_2; [7782-44-7]
(3) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Khodeeva, S. M.

Tr. Naucho-Issledov. Proekt. Inst. Azotn. Prod. Prom. Org. Sin. 1971, *12*, 30-39.

EXPERIMENTAL VALUES:

continued

T/K	P/atm	P/MPa	α cm^3/g^{-1}	Total Mole fraction of gases in liquid	Volume fraction of O_2 in gas phase	Volume fraction of O_2 in dissolved gas
433.15	38.7	3.92	12.2	0.044	0.082	0.122
	45.5	4.61	14.2	0.050	0.082	-
	49.4	5.01	16.0	0.056	0.082	0.117
	51.8	5.25	17.1	0.060	0.082	0.119
	60.7	6.15	20.4	0.071	0.082	0.122
	68.0	6.89	22.5	0.078	0.082	0.121
	76.3	7.73	25.5	0.088	0.082	0.120
	82.3	8.34	28.2	0.096	0.082	0.123
	87.6	8.88	30.3	0.102	0.082	0.125
373.15	45.5	4.61	12.6	0.045	0.200	-
	43.5	4.41	12.4	0.045	0.200	-
	46.5	4.71	13.5	0.048	0.200	-
	54.3	5.50	16.2	0.057	0.200	0.259
	69.2	7.01	21.2	0.074	0.200	0.248
	74.6	7.56	23.2	0.080	0.200	0.265
	80.0	8.11	25.3	0.087	0.200	0.264
	87.1	8.83	27.3	0.093	0.200	0.256
	94.6	9.59	29.1	0.099	0.200	0.266
403.15	44.6	4.52	13.0	0.046	0.200	0.266
	48.4	4.90	14.7	0.052	0.200	0.269
	54.7	5.54	16.6	0.059	0.200	0.257
	61.5	6.23	18.9	0.067	0.200	0.254
	63.4	6.42	20.2	0.071	0.200	0.273
	66.8	6.77	21.2	0.074	0.200	-
	73.1	7.41	23.3	0.081	0.200	0.252
	79.7	8.08	25.3	0.087	0.200	0.249
	86.9	8.81	28.1	0.096	0.200	0.251
	93.9	9.51	30.9	0.105	0.200	0.249
433.15	50.3	5.10	16.4	0.058	0.200	0.246
	55.9	5.66	18.8	0.066	0.200	-
	62.3	6.31	20.9	0.073	0.200	0.248
	68.2	6.91	22.9	0.079	0.200	0.236
	73.3	7.43	25.0	0.086	0.200	0.255
	82.8	8.39	27.5	0.093	0.200	-
	88.6	8.98	30.6	0.103	0.200	0.245
	95.8	9.71	33.5	0.112	0.200	0.248
	102.3	10.37	35.3	0.117	0.200	0.246

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methylcyclohexane; C_7H_{14}; [108-87-2]

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

ORIGINAL MEASUREMENTS:

Brunner, G; Peter, S.; Wenzel, H.

Chem. Eng. J. 1974, 7, 99.

VARIABLES:

T/K = 453-492
P/MPa = 17-33
Concentration

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

		Mole fraction in liquid phase			Mole fraction in gas phase		
T/K	P/bar	x_{N_2}	$x_{C_7H_{14}}$	$x_{C_7H_{16}}$	y_{N_2}	$y_{C_7H_{14}}$	$y_{C_7H_{16}}$
453.15	235	0.371	0.160	0.469	0.882	0.028	0.090
		0.336	0.329	0.335	0.885	0.054	0.061
		0.307	0.503	0.190	0.901	0.070	0.029
	275	0.454	0.138	0.408	0.869	0.031	0.100
		0.404	0.296	0.300	0.869	0.062	0.069
		0.363	0.466	0.171	0.896	0.073	0.031
	329	0.747	0.063	0.190	0.757	0.061	0.182
		0.539	0.230	0.231	0.862	0.066	0.072
		0.469	0.391	0.140	0.881	0.086	0.033
472.15	168	0.306	0.177	0.517	0.829	0.041	0.130
		0.278	0.359	0.363	0.844	0.073	0.083
		0.249	0.553	0.198	0.863	0.098	0.039
	201	0.374	0.159	0.467	0.824	0.042	0.134
		0.336	0.334	0.330	0.846	0.073	0.081
		0.297	0.514	0.189	0.867	0.095	0.038
	246	0.558	0.112	0.330	0.817	0.044	0.139
		0.441	0.282	0.277	0.839	0.077	0.083
		0.380	0.452	0.168	0.860	0.099	0.041

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell of about 1000 cm^3 capacity fitted with magnetic stirrer. Pressure measured with Bourdon gauge. Temperature measured with nickel-chromium alloy nickel thermocouple. Each phase sampled, heptane and methylcyclohexane frozen out; total amount estimated gravimetrically and composition of frozen portion determined by gas chromatography; nitrogen estimated volumetrically.

SOURCE AND PURITY OF MATERIALS:

(1) Linde sample; purity 99.98 mole per cent.

(2) Fluka sample; purity 99.4 mole per cent.

(3) Fluka sample; purity 99.7 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/bar = \pm 0.5$; δx_{N_2}, $\delta x_{C_7H_{14}}$, $\delta x_{C_7H_{16}}$, δy_{N_2}, $\delta y_{C_7H_{14}}$, $\delta y_{C_7H_{16}} = \pm 0.006$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Methylcyclohexane; C_7H_{14}; [108-87-2] (3) Heptane; C_7H_{16}; [142-82-5]	Brunner, G.; Peter. S.; Wenzel, H. *Chem. Eng. J.* 1974, 7, 99.

EXPERIMENTAL VALUES:

continued

		Mole fraction in liquid phase			Mole fraction in gas phase		
T/K	P/bar	x_{N_2}	$x_{C_7H_{14}}$	$x_{C_7H_{16}}$	y_{N_2}	$y_{C_7H_{14}}$	$y_{C_7H_{16}}$
492.15	129	0.279	0.183	0.538	0.747	0.060	0.193
		0.245	0.376	0.379	0.760	0.113	0.127
		0.221	0.575	0.204	0.771	0.164	0.065
	158	0.384	0.156	0.460	0.743	0.061	0.196
		0.320	0.339	0.341	0.775	0.107	0.118
		0.281	0.531	0.188	0.797	0.145	0.058
	198	0.559	0.111	0.330	0.569	0.108	0.323
		0.484	0.255	0.261	0.749	0.121	0.130
		0.385	0.452	0.163	0.799	0.145	0.056

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]
(2) Cyclohexanone; $C_6H_{10}O$; [108-94-1]
(3) Cyclohexanol; $C_6H_{12}O$; [108-93-0]
(4) Acetic acid; $C_2H_4O_2$; [64-19-7]

ORIGINAL MEASUREMENTS:

Khodeeva, S.M.; Dymova, R.P.

Tr.Nauch-Issled.Proekt.Inst.Azotn. Prom. Prod. Org. Sin. 1971, *12*, 18-30.

VARIABLES:

T/K = 373-448
P/MPa = 3-12
Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Wt.fractions before absorption.			*P*/atm	*P*/MPa	α^+/cm g^{-3}	Mole fraction of nitrogen § x_{N_2}
	$C_6H_{12}O$	$C_6H_{10}O$	CH_3COOH				
373.15	0.10	0.225	0.675	35.4	3.59	4.7	0.014
				50.9	5.16	6.4	0.020
				51.8	5.25	6.8	0.021
				55.9	5.66	7.2	0.022
				67.1	6.80	8.6	0.026
				84.7	8.58	10.8	0.033
				88.1	8.93	11.1	0.034
				91.9	9.31	12.1	0.037
423.15				32.9	3.33	5.1	0.016
				37.8	3.83	5.8	0.018
				41.2	4.17	6.3	0.019
				53.3	5.40	7.9	0.024
				58.2	5.90	8.9	0.027
				61.5	6.23	9.3	0.029
				107.7	10.91	15.9	0.049
				113.5	11.50	16.7	0.051
				117.2	11.88	18.9	0.058
373.15	0.20	0.52	0.28	31.0	3.14	3.8	0.014
				36.0	3.65	4.3	0.016
				38.2	3.87	4.6	0.017
				41.3	4.18	4.7	0.018
				42.0	4.26	5.1	0.019
				45.3	4.59	5.5	0.025
				54.7	5.54	6.4	0.024

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which saturated liquid sample was stripped of gas under reduced pressure. Amount of liquid in sample determined by weighing and composition determined by gas chromatography. Amount of gas dissolved determined by measuring the volume at a known temperature and pressure. Some details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Specially purified sample, less than 0.005 volume per cent impurity

(2) Distilled no impurity detected by GC.

(3) Twice distilled dried over freshly fused sodium sulfate.

(4) Chemically pure.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\text{atm} = \pm 0.2$; $\delta\alpha/\alpha = \pm 0.01$.

REFERENCES:

1. Khodeeva, S.M.; Dymova, R.P. *Tr. Naucho.Issledov.Proekt.Inst. Azotn.Prom.Prod.Org.Sin.* 1971, *12*, 39.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]
(2) Cyclohexanone; $C_6H_{10}O$; [108-94-1]
(3) Cyclohexanol; $C_6H_{12}O$; [108-93-0]
(4) Acetic acid; $C_2H_4O_2$; [64-19-7]

ORIGINAL MEASUREMENTS:

Khodeeva, S.M.; Dymova, R.P.

Tr.Nauch.-Issled.Proekt.Inst.Azotn. Prom. Prod. Org. Sin. 1971, 12, 18-30.

EXPERIMENTAL VALUES:

T/K	Wt.fractions before absorption $C_6H_{12}O$	Wt.fractions before absorption $C_6H_{10}O$	Wt.fractions before absorption CH_3COOH	P/atm	P/MPa	α^+/cm g^{-3}	Mole fraction of nitrogen § x_{N_2}
373.15	0.20	0.52	0.28	58.6	5.94	7.3	0.027
				65.5	6.64	7.7	0.029
				68.4	6.93	8.5	0.032
				70.7	7.16	8.6	0.032
423.15				31.6	3.20	4.7	0.018
				34.6	3.51	5.3	0.020
				52.2	5.29	7.2	0.027
				54.5	5.52	7.5	0.028
				66.6	6.75	9.5	0.035
				70.4	7.13	9.9	0.037
				78.3	7.93	10.7	0.040
448.15				36.5	3.70	5.7	0.021
				38.8	3.93	6.1	0.023
				51.7	5.24	7.9	0.029
				53.6	5.43	8.3	0.031
373.15	0.10	0.585	0.315	30.1	3.05	3.8	0.014
				45.0	4.56	5.8	0.021
				48.3	4.89	6.0	0.022
				58.5	5.93	7.2	0.026
				64.3	6.52	8.1	0.030
				67.2	6.81	8.2	0.030
				72.2	7.32	9.0	0.033
				74.3	7.53	9.0	0.033
				80.0	8.11	10.1	0.037
423.15				26.9	2.73	3.8	0.014
				29.7	3.01	4.4	0.016
				41.2	4.17	5.8	0.021
				44.6	4.52	6.6	0.024
				53.5	5.42	7.6	0.028
				59.0	5.98	8.4	0.031
				62.5	6.33	9.6	0.035
				66.7	6.76	9.9	0.036
				80.2	8.13	12.2	0.045
				84.5	8.56	12.5	0.046
448.15				31.9	3.23	5.3	0.019
				40.9	4.14	7.3	0.027
				47.8	4.84	8.1	0.030
				50.0	5.07	8.5	0.031
				55.7	5.64	9.6	0.035
				59.5	6.03	10.1	0.037
				66.7	6.76	11.2	0.041
				70.3	7.12	11.0	0.040
				80.0	8.11	13.5	0.049
				84.5	8.56	14.5	0.053

$^+\alpha$ = Volume of gas, measured at 273.15 K and 101.3 kPa pressure dissolved by 1g of solvent.

§ calculated by compiler.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Acetic Acid; $C_2H_4O_2$; [64-19-7]

(3) Cyclohexanone; $C_6H_{10}O$; [108-94-1]

ORIGINAL MEASUREMENTS:

Khodeeva, S.M.

Tr. Naucho-Issledov.Proekt.Inst. Azotn. Prom. Prod. Org. Sin. <u>1971</u>, *12*, 18-30.

VARIABLES:

$T/K = 348-473$
$P/MPa = 2-9$
Concentration

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Wt.per cent of cyclohexanone before absorption	P/atm	P/MPa	α^+ /$cm^3 g^{-1}$	Mole fraction of nitrogen § x_{N_2}
348.15	25	31.0	3.14	3.5	0.010
		35.3	3.58	3.9	0.012
		38.0	3.85	4.4	0.013
		43.6	4.42	4.8	0.014
		55.4	5.61	6.7	0.020
		59.5	6.03	6.3	0.019
		67.3	6.82	7.8	0.023
		69.4	7.03	8.1	0.024
		73.6	7.46	8.3	0.025
373.15	25	37.7	3.82	4.3	0.013
		40.6	4.11	4.6	0.014
		43.4	4.40	5.1	0.015
		47.0	4.76	5.4	0.016
		49.1	4.98	5.7	0.017
		51.5	5.22	6.6	0.020
		53.0	5.37	6.4	0.019
		63.3	6.41	7.5	0.022
		66.9	6.78	8.4	0.025
		76.8	7.78	9.6	0.029
		82.2	8.33	10.2	0.030
423.15		20.4	2.07	3.3	0.010
		27.8	2.82	4.2	0.012
		30.4	3.08	4.9	0.015
		33.2	3.36	5.2	0.015
		37.5	3.80	5.6	0.017
		37.8	3.83	5.9	0.018

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which saturated liquid sample was stripped of gas under reduced pressure. Amount of liquid in sample determined by weighing and composition determined by gas chromatography. Amount of dissolved gas determined by measuring the volume at a known temperature and pressure. Some details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Specially purified sample, less than 0.005 volume per cent impurity.

(2) Chemically "pure"

(3) Distilled, no impurity detected by GC.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/atm = \pm 0.2$; $\delta\alpha/\alpha = \pm 0.01$.

REFERENCES:

1. Khodeeva, S.M.; Dymova, R.P. *Tr. Naucho-Issledov. Proekt. Azotn.Prom.Prod.Org.Sin.* <u>1971</u>, *12*, 39.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Acetic Acid; $C_2H_4O_2$; [64-19-7]

(3) Cyclohexanone; $C_6H_{10}O$; [108-94-1]

ORIGINAL MEASUREMENTS:

Khodeeva, S.M.

Tr.Naucho-Issledov.Proekt.Inst. Azotn. Prom. Prod. Org. Sin. 1971, *12*, 18-30.

EXPERIMENTAL VALUES:

T/K	Wt.per cent of cyclohexanone before absorption	P/atm	P/MPa	α^+ /cm^3g^{-1}	Mole fraction of nitrogen § x_{N_2}
423.15		41.2	4.17	6.5	0.019
		42.6	4.32	6.5	0.019
		44.4	4.50	6.1	0.018
		48.4	4.90	6.5	0.019
		51.8	5.25	7.2	0.021
		56.6	5.73	7.7	0.023
		60.2	6.10	8.7	0.026
		65.5	6.64	9.2	0.027
		67.7	6.86	9.9	0.029
		75.1	7.61	11.2	0.033
		79.2	8.02	12.0	0.036
473.15		29.5	2.99	4.6	0.014
		31.2	3.16	5.2	0.015
		52.2	5.29	7.9	0.023
		55.1	5.58	8.6	0.026
		58.3	5.91	9.5	0.028
		69.9	7.08	12.0	0.036
		74.6	7.56	12.9	0.038
		79.0	8.00	14.1	0.042
		86.7	8.78	14.9	0.044
373.15	64	28.8	2.92	3.7	0.013
		40.7	4.12	5.1	0.018
		44.2	4.48	5.3	0.019
		48.0	4.86	6.0	0.021
		56.3	5.70	7.4	0.026
		63.4	6.42	8.0	0.029
		67.4	6.83	8.6	0.031
		76.6	7.76	9.8	0.035
		81.5	8.26	10.4	0.037
423.15		24.3	2.46	3.6	0.013
		40.9	4.14	5.4	0.019
		43.2	4.38	6.0	0.021
		51.9	5.26	7.4	0.026
		71.0	7.19	9.7	0.035
		74.1	7.51	10.1	0.036
		76.4	7.74	10.6	0.038

+α = Volume of gas, measured at 273.15 K and 101.3 kPa pressure dissolved by 1g of solvent.

§ calculated by compiler.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Methane; CH_4; [74-82-8]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. June 1981

CRITICAL EVALUATION:

This system has been extensively studied but since the critical temperatures of the two components are relatively similar, much of the data fall more naturally into the category of vapor-liquid equilibrium data rather than gas-liquid solubility data.

The data given in the three earliest investigations (1), (2), (3), were of limited accuracy and are rejected. The data of Vellinger and Pons (4) are also rejected because the results were limited to 190 K and were only presented in graphical form. The data of Brandt and Stroud (5) are rejected since they are of fairly low accuracy by recent standards and furthermore the data were only included in the original paper for comparison purposes and are not extensive. Sprow and Prausnitz's data (6) were limited to 97.6 K and will not be considered further.

The data of Miller *et al.* (7) and of Parrish and Hiza (8) are recommended for the temperature range 90 K to 120 K. The data of Cheung and Wang (9) cover a similar temperature and are classified as tentative since the pressure range is limited and the accuracy less than that of Miller *et al.* (7) and of Parrish and Hiza (8). The data of Stryjek *et al.* (10) and Kidnay *et al.* (11) are classified as recommended for the temperature range 120 K to 183 K. The data of Bloomer and Parent (12), (13) cover the temperature range of approximately 95 to 185 K but are less accurate than the recommended values but still of reasonable accuracy. The investigation was made using a dew point-buttle point apparatus and the results are not the most suitable for solubility evaluation. These data are therefore classified as tentative. The high pressure results of Cines *et al.* (14) show considerable scatter and differ somewhat from those of Bloomer and Parent (12), (13) and Stryjek *et al.* (10), hence are classified as doubtful. The data of Chang and Lu (15) are in fair agreement with the results of Stryjek *et al.* (10) and Bloomer and Parent (12), (13) and the results at -150°F and -240°F (122 K and 172 K) are classified as tentative.

The data of Fastovsky and Petrovsky (16) are rejected. Their work is mainly concerned with vapor-liquid equilibrium where the mole fraction of the more volatile component (nitrogen) is greater than 0.2. The limited comparison which can be made with the data of Stryjek *et al.* (10) shows that the two sets of data are consistent but the data in reference (16) are less precise.

Similarly the data of Skripka *et al.* (17) are rejected since they are limited in scope consisting mainly of data for which the mole fraction of nitrogen in the liquid phase is greater than 0.2.

References

1. McTaggart, H. A.; Edwards, E. *Trans. Roy. Soc., Canada III* 1919, *13*, 57.

2. Rysakov, M. W.; Teodarovich, V. P.; Kozyreva, O. V. *Bull. GIVD* 1934 *(2)*, 12.

3. Torochesnikova, N. S.; Levius, L. A. *Zh. Khim. Prom.* 1939, *16*, 19.

4. Vellinger, E.; Pons, E. *Comp. Rend.* 1943, *217*, 689.

continued on following page

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Methane; CH_4; [74-82-8]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. June 1981

continued

References (cont.)

5. Brandt, L. W.; Stroud, L. *Ind. Eng. Chem.* 1958, *50*, 849.

6. Sprow, F. B.; Prausnitz, J. M. *Am. Inst. Chem. Engng. J.* 1966, *12*, 780.

7. Miller, R. C.; Kidnay, A. J.; Hiza, M. J. *Am. Inst. Chem. Engng. J.* 1973, *19*, 145.

8. Parrish, W. R.; Hiza, M. J. *Adv. Cryog. Eng.* 1973, *19*, 300.

9. Cheung, H.; Wang, D. I. J. *Ind. Eng. Chem. Fundam.* 1964, *3*, 355.

10. Stryjek, R.; Chappelear, P. S.; Kobayashi, R. *J. Chem. Eng. Data* 1974, *19*, 334.

11. Kidnay, A. J.; Miller, R. C.; Parrish, W. R.; Hiza, M. J. *Cryogenics* 1975, *15*, 531.

12. Bloomer, O. T.; Parent, J. D. *Inst. Gas Technol., Res. Bull. No. 17*, 1962.

13. Bloomer, O. T.; Parent, J. D. *Chem. Eng. Prog. Symp. Ser.* 1953, *49* (6), 11.

14. Cines, M. R.; Roach, J. T.; Hogan, R. J.; Roland, C. H. *Chem. Eng. Prog. Symp. Ser.* 1953, *49* (6), 1.

15. Chang, S. D.; Lu, B. C.-Y. *Chem. Eng. Prog. Symp. Ser.* 1967, *63* (81), 18.

16. Fastovsky, V. G.; Petrovsky, Yu. V. *J. Phys. Chem. (USSR)* 1957, *31*, 2317.

17. Skripka, V. G.; Nikitina, I. E.; Zhadanovich, L. A.; Sirotin, A. G.; Ben'yaminovich, O. A. *Gazov. Prom.* 1970, *15* (12), 35.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Bloomer, O.T.; Parent, J.D. D.
Chem. Eng. Progr. Symp. Ser. 1953,
No. 6, *49*, 11.

VARIABLES:

T/K = 91-174
P/MPa = 0.1-51

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}
145.0	9.149	0.0140	163.48	23.96	0.0611
161.1	18.00	0.0140	166.37	26.52	0.0611
172.8	27.23	0.0140	166.37	26.34	0.0611
184.6	40.84	0.0140	171.76	31.15	0.0611
184.6	39.89	0.0140	176.9	36.93	0.0611
187.1	43.31	0.0140	177.1	36.93	0.0611
188.1	44.55	0.0140	180.40	40.47	0.0611
189.1	45.73	0.0140	183.15	43.82	0.0611
189.7	46.49	0.0140	186.32	47.24	0.0611
189.8	46.42	0.0140	187.01	47.82	0.0611
140.0	8.274	0.0295	187.09	47.79	0.0611
155.6	15.69	0.0295	122.83	5.87	0.1002
166.1	23.20	0.0295	141.37	12.87	0.1002
174.0	30.04	0.0295	155.17	20.96	0.1002
181.8	38.37	0.0295	163.57	27.53	0.1002
184.6	41.83	0.0295	170.39	33.74	0.1002
187.1	44.76	0.0295	172.22	35.97	0.1002
187.6	45.46	0.0295	174.81	38.56	0.1002
187.9	45.68	0.0295	177.96	42.09	0.1002
188.6	46.59	0.0295	181.36	45.62	0.1002
188.9	47.06	0.0295	183.15	47.22	0.1002
132.98	7.391	0.0611	184.26	48.04	0.1002
153.40	16.95	0.0611			(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubble point-dew point apparatus with glass equilibrium cell. Temperature measured with copper-constantan thermocouple. Pressure measured using dead weight piston balance. Gaseous mixture compressed through dew point and the bubble point by adding mercury to fixed volume. Dew and bubble points observed visually and also determined by discontinuities in pressure-volume data. Dew point data and other details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99+ mole per cent, dried.

(2) Pure sample mole per cent fractionated final purity 99.97 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.07$;
$\delta x_{N_2} = \pm 0.0005$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Bloomer, O.T.; Parent, J.D.

Chem. Eng. Progr. Symp. Ser. 1953, No. 6, *49*, 11.

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}
109.82	2.942	0.1000	145.08	43.76	0.697
103.43	2.015	0.1000	148.71	44.92	0.697
97.82	1.407	0.100	110.24	10.80	0.697
109.54	5.87	0.2879	136.99	34.83	0.697
121.54	10.43	0.2879	141.73	40.38	0.697
133.64	17.03	0.2879	117.48	15.64	0.697
143.68	23.86	0.2879	110.24	10.79	0.697
152.04	31.47	0.2879	104.68	7.86	0.697
159.65	38.33	0.2879	100.83	6.11	0.697
165.43	43.86	0.2879	131.42	28.50	0.697
168.49	47.04	0.2879	124.72	21.75	0.697
170.93	49.14	0.2879	91.21	2.972	0.6972
173.14	50.28	0.2879	137.27	40.02	0.8422
173.71	50.65	0.2879	136.71	39.67	0.8422
98.71	3.070	0.2883	137.83	40.18	0.8422
91.48	1.821	0.2883	135.43	38.76	0.8422
139.93	30.62	0.5088	132.81	35.60	0.8422
158.79	48.85	0.5088	129.58	31.38	0.8422
161.48	49.13	0.5088	125.56	26.70	0.8422
131.82	23.01	0.5088	120.26	20.90	0.8422
152.59	43.97	0.5088	113.86	15.20	0.8422
156.36	47.55	0.5088	107.82	10.86	0.8422
121.93	15.43	0.5088	101.64	7.41	0.8422
110.17	8.729	0.5088	96.89	5.31	0.8422
104.63	6.371	0.5088	129.47	35.71	0.9515
160.37	49.02	0.5088	129.74	35.85	0.9515
161.80	48.88	0.5088	128.63	34.75	0.9515
159.82	48.92	0.5088	126.40	31.65	0.9515
125.81	38.38	0.5088	132.33	27.15	0.9515
91.48	2.522	0.5095	116.92	20.15	0.9515
147.04	44.68	0.697	108.57	12.69	0.9515
148.15	45.06	0.697	100.79	7.76	0.9515
149.09	44.88	0.697	93.96	4.71	0.9515

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Cines, M. R.; Roach, J. T.;
Hogan, J. J.; Roland, C. H.

Chem. Eng. Prog. Symp. Ser.
1953, *49*, 1-10.

VARIABLES:

T/K = 135-208

P/MPa = 0.1-4

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/psia	*P*/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
135.4	20	0.138	0.079	0.748
	25	0.172	0.111	0.791
	30	0.207	0.144	0.822
	35	0.241	0.180	0.848
	40	0.276	0.221	0.868
	50	0.345	0.312	0.899
	60	0.414	0.427	0.922
	70	0.483	0.560	0.940
	80	0.552	0.682	0.954
	90	0.621	0.793	0.968
	100	0.689	0.901	0.985
146.5	25	0.172	0.032	0.427
	30	0.207	0.047	0.524
	35	0.241	0.063	0.598
	40	0.276	0.080	0.649
	50	0.345	0.115	0.721
	60	0.414	0.152	0.768
	70	0.483	0.190	0.801
	80	0.552	0.234	0.829
	90	0.621	0.283	0.851
	100	0.689	0.338	0.870
	125	0.862	0.486	0.907
	150	1.03	0.638	0.933
	175	1.21	0.780	0.955

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Vapor recirculating apparatus. Temperature measured with thermocouple and pressure with Bourdon gauge. Liquid and gaseous samples taken and analysed by gas density balance. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Mass spectrometric analysis revealed only 0.03 mole per cent oxygen.

(2) Purified natural gas, 99.67 mole per cent methane, 0.24 mole per cent nitrogen and 0.09 mole per cent ethane.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.007$;

δx_{N_2}, δy_{N_2} = ±0.009 or less.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Cines, M. R.; Roach, J. T.;
Hogan, J. J.; Roland, C. H.

Chem. Eng. Prog. Symp. Ser.
1953, *49*, 1-10.

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fraction of nitrogen in liquid x_{N_2}	in vapor, y_{N_2}
146.5	200	1.38	0.902	0.977
157.6	50	0.345	0.036	0.324
	60	0.414	0.056	0.445
	70	0.483	0.077	0.529
	80	0.552	0.099	0.586
	90	0.621	0.121	0.630
	100	0.689	0.144	0.668
	125	0.862	0.203	0.737
	150	1.03	0.272	0.782
	175	1.21	0.348	0.818
	200	1.38	0.432	0.846
	250	1.72	0.600	0.894
	300	2.07	0.763	0.934
	350	2.41	0.893	0.969
	400	2.76	0.989	0.997
161.6	50	0.345	0.014	0.163
	60	0.414	0.031	0.295
	70	0.483	0.049	0.389
	80	0.552	0.066	0.461
	90	0.621	0.085	0.519
	100	0.689	0.104	0.566
	125	0.862	0.153	0.657
	150	1.03	0.207	0.717
	175	1.21	0.266	0.760
	200	1.38	0.334	0.793
	250	1.72	0.480	0.846
	300	2.07	0.618	0.888
	350	2.41	0.744	0.922
	400	2.76	0.854	0.952
	450	3.10	0.944	0.980
168.7	70	0.483	0.008	0.079
	80	0.552	0.021	0.178
	90	0.621	0.036	0.260
	100	0.689	0.050	0.330
	125	0.862	0.086	0.460
	150	1.03	0.125	0.550
	175	1.21	0.164	0.618
	200	1.38	0.205	0.668
	250	1.72	0.301	0.739
	300	2.07	0.406	0.789
	350	2.41	0.513	0.829
	400	2.76	0.621	0.860
	450	3.10	0.725	0.888
	500	3.45	0.822	0.912
179.8	125	0.862	0.009	0.070
	150	1.03	0.036	0.210
	175	1.21	0.063	0.317
	200	1.38	0.089	0.395
	250	1.72	0.145	0.512
	300	2.07	0.206	0.592
	350	2.41	0.277	0.651
	400	2.76	0.352	0.692
	450	3.10	0.431	0.726
	500	3.45	0.509	0.752
	550	3.79	0.588	0.770
	600	4.14	0.668	0.783

(cont.)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Methane; CH_4; [74-82-8]	Cines, M. R.; Roach, J. T.; Hogan, J. J.; Roland, C. H. *Chem. Eng. Prog. Symp. Ser.* 1953, *49*, 1-10.

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fraction of nitrogen in liquid x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
190.0	200	1.38	0.006	0.040
	250	1.72	0.046	0.213
	300	2.07	0.089	0.334
	350	2.41	0.136	0.416
	400	2.76	0.185	0.479
	450	3.10	0.238	0.526
	500	3.45	0.295	0.565
	550	3.79	0.354	0.597
	600	4.14	0.415	0.620
	650	4.48	0.479	0.634
207.6	400	2.76	0.018	0.079
	450	3.10	0.049	0.162
	500	3.45	0.082	0.226
	550	3.79	0.118	0.278
	600	4.14	0.161	0.318
	650	4.48	0.215	0.351

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Cheung, H.; Wang, D. I. J.

Ind. Eng. Chem. Fund. 1964, *3*, 355.

VARIABLES:

T/K = .92-124

P/kPa = 21-567

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
91.7	0.212	0.009	0.295
91.6	0.292	0.019	0.476
	0.445	0.037	0.644
	1.147	0.147	0.861
97.2	0.361	0.009	0.230
97.1	0.478	0.018	0.405
	0.679	0.036	0.570
	1.680	0.146	0.827
104.9	0.703	0.009	0.211
105.1	0.875	0.018	0.335
105.1	1.200	0.036	0.512
105.2	2.748	0.145	0.790
114.4	1.519	0.009	0.144
114.6	1.759	0.018	0.247
114.7	2.198	0.036	0.394
	4.639	0.144	0.709
119.2	5.642	0.144	0.663
123.9	2.824	0.009	0.098
124.1	2.842	0.017	0.162
	3.786	0.035	0.304

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetic stirrer. Pressure measured on mercury manometer. Temperature measured by thermocouple. Details in source reference. Known quantity solvent added to evacuated cell. Metered quantity of solvent added. Solubility determined from equilibrium pressure and mass balance. Details in source reference.

SOURCE AND PURITY OF MATERIALS:

Not given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.0015$;

$\delta x_{N_2} = \delta y_{N_2} = \pm 2\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Chang, S. D.; Lu, B. C.-Y.

Chem. Eng. Prog. Symp. Ser. 1967, *63* (81), 18-27.

VARIABLES:

T/K = 122-171
P/MPa = 0.4-4.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
171.4	26.59	0.01720	0.06380
	26.90	0.01770	0.04630
	28.11	0.02510	0.07550
	28.76	0.03110	0.08010
	31.76	0.06380	0.1577
	31.83	0.05360	0.1496
	33.07	0.07310	0.1836
	35.49	0.1017	0.2217
	36.97	0.1081	0.2407
	36.97	0.1182	0.2477
	37.80	0.1164	0.2535
	39.90	0.1445	0.2861
	41.18	0.1634	0.2896
	43.07	0.1803	0.3105
	43.21	0.1949	0.3103
	44.69	0.1908	0.3146
122.0	3.50	0.03371	0.3599
	6.96	0.1503	0.7070

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with cell consisting of 100 ml Jerguson gauge with stainless steel body. Temperature measured using copper-constantan thermocouples, pressure measured using Bourdon gauges. Magnetic circulating pump. Details of apparatus in source ref. Cell charged vapor recirculated for 2 or more hours. Samples of vapor and liquid removed at constant pressure and analysed using gas chromatography. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson research grade, purity 99.999 mole per cent.

(2) Matheson research grade, purity 99.99 mole per cent.

ESTIMATED ERROR:

δT/K = ±0.1; δP/bar = ±0.5%;

$\delta x_{N_2} = \delta y_{N_2} \leq 10\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9];

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Miller, R. C.; Kidnay, A. J.; Hiza, M. J.

Am. Inst. Chem. Engrs. J. <u>1973</u>, *19*, 145.

VARIABLES:

T/K = 112
P/MPa = 0.2-1.3

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
112.00	1.862	-	0.4478
	1.838	0.0338	-
	2.192	-	0.5311
	2.181	0.0545	-
	4.027	-	0.7476
	4.013	0.1336	-
	4.335	-	0.7660
	4.285	0.1505	-
	5.559	-	0.8190
	5.485	0.2170	-
	6.990	-	0.8626
	6.985	0.3082	-
	9.229	-	0.9041
	9.120	0.4701	-
	9.460	-	0.9086
	9.490	0.5172	-
	10.852	-	0.9287
	10.847	0.6103	-
	11.970	-	0.9433
	11.960	0.7068	-
	12.960	-	0.9552
	12.957	0.7811	-

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor-flow apparatus. Temperature measured with platinum resistance thermometer. Pressure measured with Bourdon gauge. Gas and liquid samples analysed by gas chromatography. Details in source and refs. 1 and 2.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.02$;

δx_{N_2}, δy_{N_2} = ±1%.

REFERENCES:

1. Kidnay, A.J.; Miller, R.C.; Hiza, M.J. *Ind. Eng. Chem. Fund.* <u>1971</u>, *10*, 459.
2. Miller, R.C.; Kidnay, A.J.; Hiza, M.J. *J. Chem. Thermodynamics* <u>1972</u>, *4*, 807.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Parrish, W. R.; Hiza, M. J.
Adv. Cryog. Eng. 1973, *19*, 300.

VARIABLES:

T/K = 95-120
P/MPa = 0.2-1.0

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
95.00	2.254	0.2679	0.9216
	2.737	0.3562	0.9374
100.00	1.988	0.1329	0.8336
	2.960	0.2397	0.8907
105.00	3.649	0.2101	0.8533
	4.512	0.2869	0.8855
110.00	4.810	0.2093	0.8237
	5.916	0.2856	0.8615
115.00	5.882	0.1891	0.7782
	7.725	0.2868	0.8363
120.00	4.984	0.0977	0.6122
	7.549	0.1938	0.7458
	9.982	0.2990	0.8125

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus; details given in source and refs. 1-4. Temperature measured using platinum resistance thermometer. Pressure measured with Bourdon gauge. Mixture equilibrated and samples analysed using gas chromatography with thermal conductivity detector.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/\text{bar} = \pm 0.02$ (up to 20 bar); $= \pm 0.05$ (above 20 bar);
$\delta x_{N_2} = \delta y_{N_2} = \pm 1\%$ or ± 0.001 whichever is greater.

REFERENCES:

1. Hiza, M.J.; Duncan, A.G.
Rev. Sci. Inst. 1969, *40*, 513.
2. Duncan, A.G.; Hiza, M.J.
Adv. Cryog. Eng. 1970, *15*, 42.
3. Kidnay, A.J.; Miller, R.C.; Hiza, M.J., *Ind. Eng. Chem. Fund.* 1971, *10*, 459.
4. Miller, R.C.; Kidnay, A.J.; Hiza, M.J. *J. Chem. Thermodynamics* 1972, *4*, 807.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Stryjek, R.; Chappelear, P. S.;
Kobayashi, R.
J. Chem. Eng. Data <u>1974</u>, *19*, 334.

VARIABLES:

T/K = 114-183
P/MPa = 0.5-5.0

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen		T/K	P/bar	Mole fraction of nitrogen	
		in liquid, x_{N_2}	in vapor, y_{N_2}			in liquid, x_{N_2}	in vapor, y_{N_2}
113.71	3.44	0.089407	0.6491	149.82	34.13	0.3778	0.6480
	5.17	0.1671	0.7660		40.95	0.5034	0.6867
	6.89	0.2609	0.8290	160.93	17.24	0.009750	0.04452
	10.31	0.4984	0.8990		19.06	0.02968	0.1221
122.04	2.79	0.016538	0.19633		20.75	0.04895	0.1835
	3.44	0.03514	0.3466		24.68	0.09572	0.2986
	5.17	0.086024	0.5588		27.20	0.1257	0.3471
	6.88	0.1411	0.6655		31.37	0.1774	0.4130
	13.79	0.4283	0.8411		36.27	0.2457	0.4671
127.59	3.53	0.009745	0.1144		41.23	0.3128	0.5131
	5.17	0.04714	0.3786		44.61	0.3683	0.5284
	6.88	0.09116	0.5318		48.33	0.4382	0.5296
	13.79	0.3040	0.7662		48.88	0.4514	0.5181
138.44	6.91	0.01852	0.1499		48.95	0.4527	0.5178
	8.20	0.04106	0.2724	172.04	25.55	0.005951	0.01938
	10.34	0.08104	0.4183		26.89	0.01689	0.05251
	13.79	0.1490	0.5568		27.65	0.02446	0.07397
	20.68	0.3037	0.6983		31.23	0.05764	0.1532
	27.03	0.4593	0.7677		34.47	0.09245	0.2157
149.82	12.34	0.02838	0.1529		37.92	0.1287	0.2646
	13.96	0.05140	0.2404		41.23	0.1657	0.3009
	17.20	0.09849	0.3683		48.47	0.2599	0.3445
	20.62	0.1503	0.4579		50.33	0.3156	0.3156
	20.68	-	0.4615	177.59	31.03	0.004056	0.01200
	27.34	0.2579	0.5779				(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Vapor recycled through equilibrium cell by magnetic pump. Temperature measured with platinum resistance thermometer using Mueller bridge. Pressure measured with Heise gauge. After equilibrium established, vapor phase analysed then recycle pump stopped and liquid phase sampled. Samples of both phases analysed with a thermal conductivity detector. Details in source and refs. 1 and 2. Additional vapor-liquid equilibrium data in source.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson sample; purity 99.99 mole per cent.

(2) Purity specified as 99.99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/\text{bar} < \pm 0.07$; δx_{N_2}, $\delta y_{N_2} = \pm 0.2\text{-}1.0\%$.

REFERENCES:

1. Stryjek, R.; *Low Temperature Vapor-Liquid Equilibria of the Nitrogen-Methane, Nitrogen-Ethane and Nitrogen-Methane-Ethane Systems*, Rice University, Houston, Tex., <u>1972</u>.
2. Wichterle, I.; Kobayashi, R. *J. Chem. Eng. Data* <u>1972</u>, *17*, 4.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Stryjek, R.; Chappelear, P. S.; Kobayashi, R.

J. Chem. Eng. Data 1974, *19*, 334.

EXPERIMENTAL VALUES: continued

T/K	P/bar	Mole fraction of nitrogen		T/K	P/bar	Mole fraction of nitrogen	
		in liquid, x_{N_2}	in vapor, y_{N_2}			in liquid, x_{N_2}	in vapor, y_{N_2}
177.59	34.51	0.03257	0.07937	177.59	49.78	0.2272	0.2272
	36.82	0.05547	0.1266	183.15	39.71	0.02544	0.04931
	39.58	0.08284	0.1693		41.23	0.04160	0.07742
	41.99	0.1097	0.2023		42.95	0.05676	0.09635
	44.82	0.1391	0.2286		45.09	0.07848	0.1251
	46.61	0.1613	0.2459		46.47	0.09106	0.1357
	48.26	0.1816	0.2495		47.50	0.1060	0.1425
	48.88	0.1929	0.2488		48.26	0.1165	0.1449
	49.64	0.2026	0.2458		48.47	0.1175	0.1425

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

ORIGINAL MEASUREMENTS:

Kidnay, A. J.; Miller, R. C.; Parrish, W. R.; Hiza, M. J.

Cryogenics 1975, *15*, 531.

VARIABLES:

T/K = 112-180
P/MPa = 0.2-4.9

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
112.00	1.965	0.0376	0.4720	150.00	14.228	0.0518	0.2479
	4.725	0.1504	0.7654		18.088	0.1082	0.3938
120.00	5.234	0.1048	0.6327		22.55	0.1788	0.5026
	10.058	0.3012	0.8182		27.21	0.2510	0.5742
130.00	4.155	0.0097	0.1098	160.00	16.813	0.0095	0.0438
	4.552	0.0186	0.1862		17.968	0.0223	0.0979
	5.025	0.0292	0.2640		18.988	0.0334	0.1394
	6.594	0.0641	0.4339		19.913	0.0448	0.1742
	7.797	0.0926	0.5201		21.94	0.0684	0.2406
	10.203	0.1547	0.6316		22.10	0.0714	0.2458
	12.579	0.2188	0.7018		26.19	0.1205	0.3442
	15.038	0.2941	0.7508		30.38	0.1756	0.4184
140.00	7.221	0.0132	0.1051		33.95	0.2243	0.4657
	8.298	0.0316	0.2166		38.46	0.2820	0.5051
	9.258	0.0485	0.2952	170.00	24.47	0.0082	0.0291
	10.108	0.0637	0.3498		25.39	0.0189	0.0652
	14.056	0.1372	0.5228		26.20	0.0276	0.0889
	18.047	0.2165	0.6214		27.47	0.0399	0.1219
	21.94	0.3008	0.6850		28.43	0.0495	0.1458
150.00	10.673	0.0038	0.0224		30.36	0.0888	0.1875
	11.213	0.0106	0.0675		34.43	0.1115	0.2593
	12.908	0.0333	0.1776		38.58	0.1562	0.3135

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. Details given in source and refs. 1-4. Temperature measured using platinum resistance thermometer. Pressure measured with Bourdon gauge. Mixture equilibrated and samples analysed using gas chromatography with thermal conductivity detector.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/\text{bar} = \pm 0.02$ (up to 20 bar); $= \pm 0.05$ (above 20 bar); $\delta x_{N_2} = \delta y_{N_2} = \pm 1\%$ or ± 0.001 whichever is greater.

REFERENCES:

1. Hiza, M.J; Duncan, A.G. *Rev. Sci. Inst.* 1969, *40*, 513.
2. Duncan, A.G.; Hiza, M.J. *Adv. Cryog. Eng.* 1970, *15*, 42.
3. Kidnay, A.J.; Miller, R.C.; Hiza, M.J. *Ind. Eng. Chem. Fund.* 1971, *10*, 459.
4. Miller, R.C.; Kidnay, A.J.; Hiza, M.J. *J. Chem. Thermodynamics* 1972, *4*, 807.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2;[7727-37-9] (2) Methane; CH_4; [74-82-8]	Kidnay, A. J.; Miller. R. C.; Parrish, W. R.; Hiza, M. J. *Cryogenics* 1975, *15*, 531.

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
170.00	42.52	0.2001	0.3519	180.00	37.87	0.0434	0.0936
	46.31	0.2406	0.3743		39.45	0.0588	0.1192
	48.33	0.2729	0.3784		40.24	0.0632	0.1260
	48.95	0.2915	0.3798		42.72	0.0863	0.1572
	49.39	0.3066	0.3801		44.75	0.1083	0.1786
180.00	34.11	0.0089	0.0230		46.56	0.1254	0.1919
	35.40	0.0202	0.0494		48.70	0.1567	0.1992
	36.72	0.0327	0.0738				

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

(3) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Cosway, H. F.; Katz, D. L.

Am. Inst. Chem. Engnrs. J. 1959, *5*, 46-50.

VARIABLES:

T/K = 144-200
P/MPa = 3.5-6.9
Composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Mole fractions in liquid			Mole fractions in gas		
x_{N_2}	x_{CH_4}	$x_{C_2H_6}$	y_{N_2}	y_{CH_4}	$y_{C_2H_6}$
	T/K = 199.8		P/psia = 500	P/MPa = 3.45	
0.0956	0.0000	0.9044	0.8922	0.0000	0.1078
0.0715	0.1989	0.7296	0.6029	0.2979	0.0992
0.0000	0.6600	0.3400	0.0000	0.9300	0.0700†
	T/K = 199.8		P/psia = 1000	P/MPa = 6.89	
0.2129	0.0000	0.7871	0.9055	0.0000	0.0945
0.2064	0.1564	0.6372	0.7460	0.1642	0.0898
0.1752	0.5612	0.2636	0.3435	0.5608	0.0957
	T/K = 144.3		P/psia = 1000	P/MPa = 6.89	
0.1826	0.0000	0.8174	0.9923	0.0000	0.00766
0.2403	0.2525	0.5072	0.8810	0.1131	0.00593
0.3506	0.4499	0.1995	0.7975	0.1979	0.00463*
0.4900	0.5100	0.0000	0.7300	0.2700	0.00
0.5090	0.4910	0.0000	0.7520	0.2480	0.00 §

† Data quoted in original but taken from Bloomer, O. T.; Gami, D. C.; Parent, J. D. *Inst. Gas. Tech. Res. Bull.* 1953, *22*, 1.

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow system based on that described in ref. (1). Details of present apparatus in source and ref. (2). Temperature measured with thermocouple. Pressure measured with Bourdon gauge. High pressure magnetic circulating pump employed. Cell charged under pressure. Samples of each phase expanded to room temperature and pressure; analysed by mass spectrometry.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2 and 3) Phillips Petroleum Co. samples.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.03$;
δx, δy = ±2% (estimated by compiler).

REFERENCES:

1. Dodge, B. F.; Dunbar, A. K. *J. Am. Chem. Soc.* 1927, *49*, 591.

2. Aroyan, H. J.; Katz, D. L. *Ind. Eng. Chem.* 1951, *43*, 185.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Methane; CH_4; [74-82-8] (3) Ethane; C_2H_6; [74-84-0]	Cosway, H. F.; Katz, D. L. *Am. Inst. Chem. Engnrs. J.* 1959, *5*, 46-50.

EXPERIMENTAL VALUES:

* Data quoted in original but taken from
Bloomer, O. T.; Parent, J. D. *Chem. Eng. Progr. Symposium Ser.* 1953, No. 6, *49*, 11.

§ Data quoted in original but taken from
Cines, M. R.; Roach, J. T.; Hogan, R. J.; Roland, C. H.
Chem. Eng. Progr. Symposium Ser. 1953, No. 6, *49*, 1

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

(3) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Chang, S.D.; Lu B.C.Y.

Chem. Eng. Prog. Symp. Ser. 1967, **62**, (81) 18-27.

VARIABLES:

$T/K = 171$
$P/MPa = 0.2-2.8$
Composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

$T/K = 171.4$

Pressure /MPa	Composition, mole fraction Vapor y_{N_2}	 y_{CH_4}	 $y_{C_2H_6}$	 Liquid x_{N_2}	 x_{CH_4}	 $x_{C_2H_6}$
1.377	0.5628	0.3956	0.04158	0.04082	0.2201	0.7391
1.370	0.6222	0.3368	0.04109	0.02853	0.1686	0.8029
1.373	0.1200	0.8497	0.03357	0.009581	0.4957	0.4948
1.381	0.6241	0.3331	0.04288	0.04912	0.1873	0.7636
1.369	0.4788	0.4838	0.03748	0.03694	0.2751	0.6900
1.356	0.2000	0.7661	0.03385	0.01901	0.3888	0.5922
1.380	0.0742	0.8937	0.03213	0.00542	0.5258	0.4687
2.066	0.7065	0.2634	0.03008	0.03361	0.1648	0.8016
2.066	0.7417	0.2261	0.03213	0.04383	0.1446	0.8116
2.059	0.4193	0.5564	0.02436	0.04599	0.4182	0.5358
2.070	0.7443	0.2220	0.03371	0.04360	0.1482	0.8082
2.058	0.6457	0.3208	0.03350	0.03811	0.2259	0.7359
2.073	0.3843	0.5915	0.02421	0.04622	0.4832	0.4706
2.087	0.1884	0.7954	0.01625	0.03092	0.6674	0.3016
2.077	0.1364	0.8498	0.01387	0.02511	0.7213	0.2535
2.756	0.7693	0.1989	0.03180	0.05924	0.1564	0.7843
2.756	0.5599	0.4148	0.02533	-	-	-
2.756	0.8030	0.1669	0.03011	0.06841	0.1503	0.7813
2.770	0.7391	0.2330	0.02786	0.06195	0.2071	0.7309
2.766	0.5279	0.4504	0.02167	0.06417	0.4455	0.4903
2.763	0.3804	0.6025	0.01714	0.07453	0.6324	0.2931
2.763	0.3329	0.6511	0.01602	0.07475	0.6805	0.2448
0.3168	0.6249	0.3712	0.001856	0.03356	0.5000	0.4663
0.7894	0.8409	0.1574	0.001740	0.09687	0.3638	0.5393
1.308	0.9026	0.09737	0.000696	0.1646	0.3556	0.4800

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with cell consisting of 100 ml Jerguson gauge with stainless steel body. Temperature measured using copper-constantan thermocouples. Pressure measured using Bourdon gauges Magnetic circulating pump. Cell charged, vapor recirculated for 2 or more hours. Samples of vapor and liquid removed at constant pressure and analysed using gas chromatography. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson research grade, purity 99.999 mole per cent.

(2) Matheson research grade, purity 99.99 mole per cent.

(3) Matheson research grade, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.5\%$
$\delta x_{N_2} \simeq \delta y_{N_2} < 10\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Methane; CH_4; [74-82-8] (3) Ethane; C_2H_6; [74-84-0]	Chang, S.D.; Lu, B.C.Y. *Chem. Eng. Prog. Symp. Ser.* 1967, *62*, (81) 18-27.

EXPERIMENTAL VALUES: T/K = 171.4

Pressure /MPa	Composition, mole fraction Vapor y_{N_2}	y_{CH_4}	$y_{C_2H_6}$	Liquid x_{N_2}	x_{CH_4}	$x_{C_2H_6}$
1.797	0.9313	0.06777	0.00095	0.3188	0.2966	0.3846
2.228	0.9597	0.04133	0.00112	0.5940	0.1779	0.2281
2.364	0.9729	0.02598	0.00115	0.7605	0.1078	0.1317
2.628	0.9873	0.01144	0.001276	0.9358	0.03627	0.02793
0.1924	0.04142	0.9537	0.004872	0.07798	0.3348	0.5871
0.5695	0.8446	0.1521	0.00335	0.09513	0.3405	0.5643
1.011	0.7817	0.2169	0.001316	0.08766	0.2419	0.6705
1.591	0.9242	0.07415	0.001652	0.1659	0.2413	0.5928
1.991	0.9529	0.04571	0.001380	0.2772	0.1863	0.5365
2.124	0.9582	0.03966	0.002098	BL0.4219	0.1458	0.4323
				*TL0.5322	0.1529	0.3149
2.255	0.9700	0.02891	0.001710	0.5450	0.1644	0.2906
2.293	0.9722	0.02661	0.001161	BL0.4715	0.1513	0.3772
				0.6628	0.1418	0.1954
2.406	0.9807	0.01880	0.0005356	0.6996	0.07831	0.2221
2.453	0.9837	0.01510	0.001157	0.7509	0.06091	0.1882
0.2296	0.7110	0.2867	0.002279	0.02279	0.2783	0.6989
0.2151	0.7914	0.2086	0.003105	0.03949	0.2750	0.6855
0.4881	0.9582	0.04112	0.0006961	0.1095	0.2642	0.6263
1.018	0.9571	0.04216	0.0006863	0.1026	0.1672	0.7302
1.349	0.9673	0.03206	0.0006209	0.1507	0.1629	0.6864
1.718	0.9715	0.02675	0.0006855	0.2048	0.1469	0.6482
2.180	0.9780	0.02107	0.0008995	0.3158	0.1260	0.5582
2.424	0.9809	0.01785	0.001251	BL0.3658	0.1025	0.5317
				*TL0.7047	0.07117	0.2241
2.522	0.9901	0.008430	0.001499	0.8971	0.03577	0.06715
0.1744	0.09370	0.9045	0.001847			
0.3403	0.5256	0.4731	0.001238	0.03182	0.6916	0.2766
0.6836	0.7535	0.2456	0.0009046	0.09313	0.6348	0.2680
1.400	0.8888	0.1106	0.0006336	0.3072	0.4874	0.2054
2.296	0.9625	0.03672	0.0007767	0.8206	0.1318	0.04758
2.337	0.9641	0.03515	0.0007576	0.8396	0.1171	0.04330
2.728	0.9872	0.01229	0.0005563	0.9605	0.02907	0.01039
2.803	0.9920	0.007547	0.0004530	0.8523	0.1429	0.004819
2.470	0.9853	0.01352	0.001279	BL0.3500	0.08683	0.5632
				TL0.8496	0.06764	0.08278
2.348	0.9770	0.02171	0.001226	BL0.4389	0.1464	0.4147
				TL0.7208	0.1228	0.1564
2.337	0.9742	0.02312	0.001278	BL0.4731	0.1439	0.3830
				TL0.7217	0.1233	0.1551

BL Bottom Liquid Layer
TL Top Liquid Layer
* Taken before allow 1 hour for layers to separate

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

(3) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Gupta, M.K.; Gardner, G.C.;

J. Chem. Eng. Data 1980, *25*, 313-8.

VARIABLES:

T/K = 260-280
P/MPa = 5-9
Composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

Total pressure		Mole fractions					
p/atm	p/MPa	x_{N_2}	x_{CH_4}	$x_{C_2H_6}$	y_{N_2}	y_{CH_4}	$y_{C_2H_6}$
			T/K = 260.00				
50.05	5.071	0.0139	0.2665	0.7196	0.0533	0.5049	0.4418
50.01	5.067	0.0296	0.2205	0.7499	0.1200	0.4293	0.4507
49.90	5.056	0.0452	0.1734	0.7814	0.1940	0.3464	0.4596
50.02	5.068	0.0592	0.1300	0.8107	0.2667	0.2652	0.4681
49.92	5.058	0.0723	0.0890	0.8387	0.3396	0.1852	0.4752
50.07	5.073	0.0847	0.0486	0.8667	0.4147	0.1032	0.4821
65.13	6.599	0.1172	0.1114	0.7714	0.3811	0.1839	0.4350
65.00	6.586	0.1198	0.1021	0.7781	0.3945	0.1692	0.4362
65.09	6.595	0.1230	0.0929	0.7841	0.4091	0.1546	0.4363
64.96	6.582	0.0767	0.2400	0.6832	0.2091	0.3681	0.4227
65.08	6.594	0.0886	0.2047	0.7068	0.2541	0.3203	0.4256
65.16	6.602	0.0260	0.3897	0.5843	0.0537	0.5316	0.4147
65.02	6.588	-	-	-	0.1262	0.4574	0.4164
65.00	6.586	0.1327	0.0570	0.8103	0.4624	0.0969	0.4407
65.00	6.586	0.1351	0.0499	0.8150	0.4744	0.0848	0.4408
64.98	6.584	0.0463	0.3297	0.6240	0.1081	0.4749	0.4170
65.00	6.586	0.1494	0.0000	0.8506	0.5541	0.0000	0.4459
65.00	6.586	0.0000	0.4585	0.5415	0.0000	0.5833	0.4167

cont.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with diaphragm pump. Temperature measured with platinum resistance thermometer and pressure with Bourdon gauges. Cell stirred with double propeller stirrer. Vapor and liquid samples analysed by gas chromatography using a thermal conductivity detector. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Purity at least 99.7 mole per cent.

(2) Purity at least 99 mole per cent.

No extraneous peaks were found when samples analysed by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta p/Mpa = \pm 0.03$ up to 3.4 MPa, $\pm$ 0.1 above 3.4 MPa; δx_{N_2}, δy_{N_2} = $\pm$ 0.002

REFERENCES:

1. Somait, F.; Kidnay, A.J.
J. Chem. Eng. Data 1978, *23*, 301.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Methane; CH_4; [74-82-8] (3) Ethane; C_2H_6; [74-84-0]	Gupta, M.K.; Gardner, G.C.; *J. Chem. Eng. Data*, <u>1980</u>, *25*, 313-8.

Total pressure		Mole fractions					
p/atm	p/MPa	x_{N_2}	x_{CH_4}	$x_{C_2H_6}$	y_{N_2}	y_{CH_4}	$y_{C_2H_6}$
T/K = 260.00							
74.80	7.579	0.1734	0.0464	0.7802	0.4963	0.0703	0.4336
75.18	7.618	0.1750	0.0453	0.7797	0.4984	0.0684	0.4332
75.08	7.607	0.1645	0.0821	0.7533	0.4463	0.1221	0.4315
75.13	7.613	0.1663	0.0795	0.7542	0.4507	0.1176	0.4317
75.06	7.605	0.1532	0.1219	0.7249	0.3925	0.1773	0.4302
75.13	7.613	0.1565	0.1146	0.7290	0.4031	0.1666	0.4303
75.13	7.613	0.1415	0.1676	0.6910	0.3350	0.2357	0.4293
75.00	7.599	0.1472	0.1469	0.7058	0.3611	0.2094	0.4295
74.90	7.589	0.1349	0.1874	0.6676	0.3103	0.2606	0.4290
75.02	7.601	0.1274	0.2162	0.6564	0.2765	0.2940	0.4295
75.08	7.607	0.1141	0.2629	0.6229	0.2245	0.3442	0.4313
75.09	7.608	0.1245	0.2270	0.6484	0.2636	0.3051	0.4312
75.20	7.620	0.1040	0.3046	0.5914	0.1824	0.3811	0.4365
75.10	7.610	0.1145	0.2643	0.6213	0.2237	0.3453	0.4309
75.17	7.617	0.0926	0.3548	0.5526	0.1366	0.4143	0.4490
75.07	7.606	0.0987	0.3239	0.5775	0.1641	0.3966	0.4392
74.90	7.589	0.0878	0.3848	0.5274	0.1121	0.4245	0.4635
75.07	7.606	0.0919	0.3579	0.5502	0.1340	0.4159	0.4501
T/K = 270.00							
35.00	3.546	0.0341	0.0160	0.9500	0.2297	0.0470	0.7232
35.01	3.547	0.0285	0.0322	0.9393	0.1892	0.0936	0.7172
35.01	3.547	0.0223	0.0505	0.9272	0.1446	0.1450	0.7104
35.01	3.547	0.0196	0.0576	0.9228	0.1270	0.1652	0.7078
35.00	3.546	0.0116	0.0814	0.9069	0.0736	0.2284	0.6979
35.00	3.546	0.0077	0.0921	0.9002	0.0482	0.2572	0.6946
35.00	3.546	-	-	-	0.0797	0.2201	0.7001
50.00	5.066	0.0783	0.0231	0.8986	0.3546	0.0503	0.5951
50.00	5.066	0.0749	0.0347	0.8904	0.3335	0.0740	0.5925
50.00	5.066	0.0602	0.0766	0.8631	0.2564	0.1602	0.5834
50.00	5.066	0.0463	0.1173	0.8364	0.1862	0.2392	0.5746
50.00	5.066	0.0331	0.1535	0.8133	0.1283	0.3060	0.5657
50.01	5.067	0.0297	0.1619	0.8084	0.1139	0.3222	0.5638
50.00	5.066	0.0019	0.2361	0.7619	0.0066	0.4466	0.5468
50.00	5.066	0.0096	0.2089	0.7815	0.0362	0.4114	0.5524
50.01	5.067	0.0177	0.1948	0.7875	0.0664	0.3775	0.5561
50.00	5.066	-	-	-	0.0627	0.3807	0.5565
49.99	5.065	0.0827	0.0000	0.9173	0.3955	0.0000	0.6045
64.95	6.581	0.1213	0.0539	0.8247	0.3712	0.0906	0.5382
64.85	6.570	0.1205	0.0548	0.8247	0.3701	0.0923	0.5376
65.15	6.601	0.0937	0.1381	0.7682	0.2526	0.2192	0.5281
64.92	6.578	0.0935	0.1361	0.7704	0.2546	0.2167	0.5287
65.00	6.586	0.0948	0.1333	0.7719	0.2589	0.2124	0.5286
64.98	6.584	0.0622	0.2245	0.7133	0.1449	0.3348	0.5203
64.95	6.581	0.0610	0.2285	0.7106	0.1412	0.3375	0.5212
65.05	6.591	0.0646	0.2212	0.7142	0.1510	0.3284	0.5207
65.10	6.596	0.0343	0.3047	0.6610	0.0667	0.4152	0.5181
64.92	6.578	0.0313	0.3104	0.6583	0.0610	0.4213	0.5178
65.06	6.592	-	-	-	0.0582	0.4238	0.5180
65.00	6.586	0.0760	0.1714	0.7526	0.2026	0.2723	0.5250
65.00	6.586	0.0846	0.1633	0.7521	0.2194	0.2543	0.5263
65.00	6.586	0.1008	0.1061	0.7931	0.2921	0.1755	0.5324
75.00	7.599	0.1525	0.0716	0.7759	0.3550	0.1135	0.5306
74.97	7.596	0.1673	0.0317	0.8010	0.4200	0.0476	0.5323
74.94	7.593	0.1747	0.0080	0.8173	0.4540	0.0124	0.5339
74.90	7.589	0.1117	0.2604	0.6279	0.1444	0.2917	0.5639

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9]	Gupta, M.K.; Gardner, G.C.
(2) Methane; CH_4; [74-82-8]	
(3) Ethane; C_2H_6; [74-84-0]	*J. Chem. Eng. Data,* 1980, *25,* 313-8.

Total p/atm	pressure p/MPa	Mole fractions x_{N_2}	x_{CH_4}	$x_{C_2H_6}$	y_{N_2}	y_{CH_4}	$y_{C_2H_6}$
T/K = 270.00							
75.00	7.599	0.1130	0.2519	0.6351	0.1545	0.2891	0.5564
75.10	7.610	0.1130	0.2467	0.6403	0.1586	0.2861	0.5553
74.92	7.591	0.1213	0.2023	0.6764	0.2065	0.2556	0.5378
75.08	7.607	0.1205	0.2050	0.6745	0.2030	0.2581	0.5389
74.95	7.594	0.1331	0.1559	0.7110	0.2590	0.2089	0.5321
75.00	7.599	0.1483	0.0993	0.7524	0.3282	0.1410	0.5308
75.10	7.610	-	-	-	0.2987	0.1705	0.5307
84.90	8.602	0.2202	0.0396	0.7403	0.4034	0.0506	0.5460
85.10	8.623	-	-	-	0.4232	0.0320	0.5449
84.97	8.610	0.2229	0.0242	0.7530	0.4242	0.0316	0.5443
84.90	8.602	-	-	-	0.3534	0.0922	0.5543
84.97	8.610	0.2152	0.0918	0.6930	0.3288	0.1093	0.5619
85.10	8.623	0.2177	0.1083	0.6739	0.3024	0.1241	0.5734
85.02	8.615	0.2178	0.1106	0.6716	0.2991	0.1260	0.5749
85.17	8.630	0.2394	0.1287	0.6319	0.2602	0.1382	0.6016
84.90	8.602	-	-	-	0.3628	0.0848	0.5524
84.90	8.602	0.2153	0.0675	0.7172	0.3643	0.0837	0.5520
T/K = 280.00							
50.00	5.066	0.0709	0.0000	0.9291	0.2835	0.0000	0.7165
50.00	5.066	0.0000	0.1820	0.8180	0.0000	0.3352	0.6648
50.10	5.076	0.0609	0.0290	0.9101	0.2336	0.0600	0.7064
50.15	5.081	0.0467	0.0666	0.8866	0.1706	0.1340	0.6954
49.90	5.056	0.0296	0.1077	0.8627	0.1030	0.2113	0.6857
50.12	5.078	0.0139	0.1489	0.8372	0.0455	0.2814	0.6730
65.08	6.594	0.0900	0.1051	0.8048	0.2021	0.1575	0.6404
65.10	6.596	0.1037	0.0668	0.8295	0.2511	0.1041	0.6448
65.05	6.591	0.1173	0.0286	0.8541	0.3046	0.0460	0.6494
65.00	6.586	0.0723	0.1540	0.7737	0.1451	0.2183	0.6366
64.90	6.576	0.0565	0.1944	0.7491	0.1018	0.2620	0.6362
65.00	6.586	0.0483	0.2211	0.7306	0.0787	0.2830	0.6383
65.00	6.586	0.0530	0.2078	0.7392	0.0909	0.2725	0.6366
65.05	6.591	0.0438	0.2369	0.7193	0.0667	0.2925	0.6408
65.10	6.596	0.0471	0.2271	0.7258	0.0746	0.2861	0.6392
65.10	6.596	0.0454	0.2290	0.7256	0.0717	0.2892	0.6392
65.15	6.601	0.0425	0.2407	0.7168	0.0633	0.2947	0.6420
65.15	6.601	0.0423	0.2437	0.7139	0.0623	0.2957	0.6420
65.10	6.596	0.0400	0.2488	0.7112	0.0574	0.2985	0.6441
64.88	6.574	0.0360	0.2616	0.7024	0.0480	0.3021	0.6499
64.92	6.578	0.0394	0.2477	0.7129	0.0575	0.2989	0.6436
64.90	6.576	0.0349	0.2699	0.6951	0.0430	0.2996	0.6574
65.00	6.586	0.1277	0.0000	0.8723	0.3463	0.0000	0.6537
75.03	7.602	0.1663	0.0297	0.8040	0.3115	0.0400	0.6485
74.98	7.597	0.1573	0.0691	0.7736	0.2579	0.0873	0.6548
75.00	7.599	0.1534	0.1054	0.7412	0.2091	0.1222	0.6687
75.05	7.604	0.1566	0.1126	0.7307	0.1980	0.1260	0.6760
74.89	7.588	0.1596	0.1182	0.7222	0.1849	0.1273	0.6878
74.95	7.594	0.1580	0.1139	0.7281	0.1941	0.1255	0.6803
75.00	7.599	0.1743	0.0000	0.8257	0.3521	0.0000	0.6479

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

(3) Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Poon, D. P. L.; Lu, B. C.-Y.

Adv. Cryogen. Engng. 1973, *19*, 292-9.

VARIABLES:

$T/K = 114\text{-}122$
$P/MPa = 0.1\text{-}2{,}3$
Composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fractions in liquid		Mole fractions in vapor	
			x_{N_2}	x_{CH_4}	y_{N_2}	y_{CH_4}
114.1	70.9	0.4888	0.0245	0.0161	0.9886	0.0112
	127.2	0.8770	0.0446	0.0159	0.9901	0.0098
	193.4	1.333	0.0637	0.0136	0.9932	0.0067
	82.8	0.5709	0.0388	0.2624	0.8986	0.1013
	124.5	0.8584	0.0620	0.2606	0.9314	0.0685
	165.0	1.138	0.1252	0.2602	0.9496	0.0504
	65.8	0.4537	0.0562	0.6126	0.7851	0.2149
	101.4	0.6991	0.0989	0.5779	0.8644	0.1356
	124.1	0.8556	0.1797	0.5525	0.9074	0.0926
	16.6	0.1145	0.0000	0.9320	0.0000	0.9999
	43.4	0.2992	0.0503	0.8352	0.6241	0.3759
	41.8	0.2882	0.0525	0.8657	0.6057	0.3943
	77.6	0.5350	0.1270	0.7679	0.7902	0.2098
	131.7	0.9080	0.2999	0.6180	0.8866	0.1134
	158.3	1.091	0.4184	0.5117	0.9145	0.0855
	173.0	1.193	0.5072	0.4373	0.9283	0.0717
	185.3	1.278	0.6106	0.3566	0.9353	0.0647
	220.8	1.522	0.8059	0.1800	0.9593	0.0407
	233.7	1.611	0.8644	0.1248	0.9699	0.0301
	253.7	1.749	0.9415	0.0547	0.9811	0.0189
	260.6	1.797	0.9750	0.0248	0.9922	0.0078

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with cell consisting of 100 ml Jerguson gauge with stainless steel body. Temperature measured using copper-constantan thermocouples. Pressure measured using Bourdon gauges. Magnetic circulating pump. Cell charged, vapor recirculated for 2 or more hours and samples of vapor and liquid removed at constant pressure and analysed using gas chromatography. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson research grade sample, purity 99.997 mole per cent.

(2 and 3) Phillips Petroleum Co. sample, research grade, purity 99.99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/MPa = \pm 0.005$; $\delta x,\ \delta y = \pm 1\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

(3) Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Poon, D. P. L.; Lu, B. C.-Y.

Adv. Cryogen. Engng. 1973, *19*, 292-9.

EXPERIMENTAL VALUES:

T/K	P/psia	P/MPa	Mole fractions in liquid x_{N_2}	x_{CH_4}	Mole fractions in vapor y_{N_2}	y_{CH_4}
118.3	50.8	0.3503	0.0559	0.9126	0.5299	0.4701
	89.6	0.6178	0.1501	0.8217	0.7491	0.2509
	127.1	0.8763	0.2509	0.7187	0.8279	0.1721
	155.9	1.075	0.3559	0.6287	0.8633	0.1367
	175.8	1.212	0.4403	0.5481	0.8896	0.1104
	191.5	1.320	0.4954	0.4979	0.8938	0.1062
	214.4	1.478	0.5946	0.4007	0.9156	0.0844
	48.8	0.3365	0.0207	0.4689	0.6498	0.3501
	78.8	0.5433	0.0399	0.4499	0.7845	0.2155
	142.0	0.9791	0.0820	0.4169	0.8815	0.1184
	178.6	1.231	0.1221	0.3954	0.9022	0.0977
	19.8	0.1365	0.0000	0.7492	-	-
	106.8	0.7364	0.0970	0.6262	0.8147	0.1853
	150.5	1.038	0.1683	0.5672	0.8791	0.1209
	169.7	1.170	0.2258	0.5226	0.8969	0.1031
	193.8	1.336	0.2843	0.4869	0.9122	0.0878
	200.7	1.384	0.3033	0.4792	0.9044	0.0956
	11.8	0.0814	0.0000	0.2901	-	-
	59.0	0.4068	0.0227	0.2713	0.8067	0.1931
	102.2	0.7046	0.0470	0.2713	0.8836	0.1154
	123.7	0.8529	0.0601	0.2631	0.9098	0.0892
	147.0	1.014	0.0743	0.2531	0.9190	0.0802
	185.8	1.281	0.0967	0.2383	0.9324	0.0672
	24.6	0.1696	0.0071	0.0628	0.8782	0.1217
	64.3	0.4433	0.0199	0.0603	0.9505	0.0494
	105.3	0.7260	0.0324	0.0578	0.9671	0.0328
	140.8	0.9708	0.0443	0.0558	0.9795	0.0205
	245.9	1.695	0.0858	0.0491	0.9820	0.0179
122.2	3.5	0.0241	0.0000	0.0543	-	-
	30.6	0.2110	0.0080	0.0501	0.8948	0.1048
	64.8	0.4468	0.0190	0.0458	0.9564	0.0434
	142.8	0.9846	0.0505	0.0435	0.9794	0.0205
	15.3	0.1055	0.0000	0.2825	-	-
	67.3	0.4640	0.0203	0.2628	0.7711	0.2288
	108.6	0.7488	0.0360	0.2462	0.8591	0.1409
	145.2	1.001	0.0500	0.2388	0.8951	0.1048
	186.8	1.288	0.0767	0.2327	0.9207	0.0793
	23.2	0.1600	0.0000	0.5158	-	-
	48.3	0.3330	0.0156	0.4876	0.5374	0.4625
	88.8	0.6123	0.0378	0.4576	0.7492	0.2508
	173.8	1.198	0.0824	0.4073	0.8680	0.1319
	240.3	1.657	0.1443	0.3789	0.8875	0.1125
	26.8	0.1848	0.0000	0.7003	-	-
	51.8	0.3571	0.0215	0.6813	0.4699	0.5301
	79.4	0.5474	0.0450	0.6528	0.6528	0.3472
	199.2	1.373	0.1699	0.5419	0.8696	0.1304
	244.6	1.686	0.2678	0.4635	0.9054	0.0946
	30.1	0.2075	0.0000	0.9042	-	-
	83.8	0.5778	0.0846	0.8225	0.6484	0.3517
	137.3	0.9467	0.1853	0.7294	0.7908	0.2092
	185.1	1.276	0.3532	0.6102	0.8561	0.1439
	255.1	1.759	0.5875	0.4019	0.9023	0.0967
	327.4	2.257	0.8468	0.1510	0.9497	0.0503

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane; CH_4; [74-82-8]

(3) Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Roberts, L. R.; McKetta, J. J.

J. Chem. Eng. Data 1963, *8*, 161-3.

VARIABLES:

$T/K = 311\text{-}411$
$P/MPa = 3.4\text{-}20.7$
Composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid			Mole fractions in vapor		
		$x_{C_4H_{10}}$	x_{CH_4}	x_{N_2}	$y_{C_4H_{10}}$	y_{CH_4}	y_{N_2}
310.9	3.447	0.895	0.074	0.031	0.150	0.434	0.416
		0.856	0.131	0.013	0.149	0.691	0.160
		0.918	0.040	0.042	0.154	0.187	0.659
	6.895	0.774	0.164	0.062	0.112	0.480	0.408
		0.809	0.113	0.078	0.110	0.327	0.563
		0.746	0.214	0.044	0.115	0.609	0.276
		0.689	0.300	0.011	0.121	0.808	0.071
	10.34	0.731	0.165	0.104	0.109	0.344	0.547
		0.661	0.242	0.097	0.114	0.475	0.411
		0.567	0.384	0.049	0.128	0.708	0.164
		0.746	0.115	0.139	0.096	0.246	0.658
	13.79	0.519	0.348	0.133	0.151	0.523	0.326
		0.507	0.373	0.120	0.141	0.564	0.295
		0.451	0.456	0.093	0.152	0.638	0.210
		0.430	0.497	0.073	0.168	0.698	0.134
		0.462	0.434	0.104	0.143	0.624	0.233
		--	--	--	0.133	0.540	0.327
		0.663	0.137	0.200	0.113	0.233	0.654
		0.540	0.149	0.201	0.110	0.249	0.641
		--	--	--	0.117	0.280	0.603
	17.24	0.546	0.196	0.258	0.129	0.269	0.602
		0.456	0.302	0.242	0.146	0.399	0.455
		--	--	--	0.161	0.455	0.384

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with windowed high pressure cell. After equilibrium established fluids allowed to stand for 1 hour. Samples withdrawn and analysed either by mass spectrometry or gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Minimum purity 99.9 mole per cent.

(2) Pure grade minimum purity 99 mole per cent.

(3) Instrument grade minimum purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.06$; $\delta P/MPa = \pm 0.03$;
δx_{N_2}, δx_{CH_4}, $\delta x_{C_4H_{10}}$, δy_{N_2}, δy_{CH_4}, $\delta y_{C_4H_{10}} = \pm 0.002$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1)Nitrogen; N_2; [7727-37-9]	Roberts, L. R.; McKetta, J. J.
(2)Methane; CH_4; [74-82-8]	*J. Chem. Eng. Data* 1963, *8*, 161-3.
(3)Butane; C_4H_{10}; [106-97-8]	

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fractions in liquid			Mole fractions in vapor		
		$x_{C_4H_{10}}$	x_{CH_4}	x_{N_2}	$y_{C_4H_{10}}$	y_{CH_4}	y_{N_2}
310.9	17.24	0.400	0.379	0.221	0.175	0.472	0.353
		0.404	0.371	0.225	0.163	0.464	0.373
		0.429	0.338	0.233	0.155	0.429	0.416
	20.68	0.538	0.092	0.370	0.134	0.119	0.747
		0.508	0.136	0.356	0.158	0.167	0.675
		0.450	0.195	0.355	0.167	0.234	0.599
344.3	3.447	0.907	0.067	0.026	0.338	0.334	0.328
	6.895	0.807	0.137	0.056	0.239	0.409	0.352
		0.869	0.039	0.092	0.228	0.132	0.640
		0.883	0.022	0.095	0.230	0.073	0.697
		0.884	0.013	0.103	0.235	0.043	0.722
	10.34	0.750	0.117	0.133	0.218	0.249	0.533
		0.733	0.143	0.124	0.235	0.295	0.470
		0.699	0.192	0.109	0.228	0.386	0.386
		0.661	0.257	0.082	0.242	0.490	0.268
		0.639	0.301	0.060	0.252	0.570	0.178
		0.642	0.296	0.062	0.245	0.561	0.194
	13.79	0.554	0.323	0.123	0.281	0.462	0.257
		0.560	0.307	0.133	0.285	0.440	0.275
		0.578	0.291	0.131	0.281	0.432	0.287
		0.535	0.356	0.109	0.291	0.487	0.222
		0.713	0.070	0.217	0.217	0.122	0.661
		0.650	0.158	0.192	0.237	0.267	0.496
		0.600	0.245	0.155	0.267	0.376	0.357
		0.570	0.290	0.140	0.292	0.415	0.293
	17.34	0.507	0.203	0.290	0.347	0.237	0.416
		0.630	0.067	0.303	0.265	0.095	0.640
		0.543	0.166	0.291	0.313	0.213	0.474
		0.531	0.189	0.280	0.318	0.232	0.450
		0.952	0.0	0.048	0.604	0.0	0.396
377.6	3.447	0.934	0.051	0.015	0.588	0.273	0.139
		0.918	0.078	0.004	0.602	0.356	0.042
		0.942	0.029	0.029	0.601	0.143	0.256
	6.895	0.758	0.236	0.006	0.449	0.516	0.035
		0.810	0.144	0.046	0.439	0.358	0.203
		0.834	0.098	0.068	0.444	0.284	0.272
		0.810	0.129	0.061	0.440	0.310	0.250
		0.833	0.088	0.079	0.428	0.232	0.340
	10.34	0.730	0.089	0.181	0.415	0.162	0.423
		0.739	0.073	0.188	0.395	0.129	0.475
		0.720	0.122	0.158	0.417	0.218	0.365
		--	--	--	0.407	0.200	0.393
		0.639	0.254	0.107	0.466	0.353	0.181
		--	--	--	0.401	0.218	0.381
		0.673	0.188	0.139	0.430	0.280	0.290
		0.628	0.265	0.107	0.470	0.354	0.176
		0.640	0.246	0.114	0.455	0.357	0.188
410.9	3.447	0.989	0.002	0.009	0.943	0.014	0.043
		0.987	0.004	0.009	0.940	0.016	0.044
	6.895	0.883	0.101	0.016	0.770	0.192	0.038
		0.904	0.046	0.050	0.769	0.106	0.125
	10.34	0.849	0.052	0.099	0.754	0.080	0.166
		0.849	0.041	0.110	0.746	0.071	0.183

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethene; C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Cannon, W. A.; Robson, J.H.; English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 144-228
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	$P^a_{N_2}$/MPa	x_1^b			
		-200.2°F (144.2 K)	-150.1°F (172.0 K)	-100.1°F (199.6 K)	-50.2°F (227.5 K)
300	2.07	0.0914	0.0660	0.0481	0.0263
300	2.07	0.0900	0.0643	0.0455	0.0264
300	2.07	0.0907	0.0648	0.0455	0.0258
300	2.07	0.0907	0.0655	0.0475	0.0258
700	4.83	0.241	0.161	0.137	0.108
700	4.83	0.251	0.166	0.131	0.109
700	4.83	0.246	0.160	0.132	0.111
700	4.83	0.246	0.168	0.133	0.114

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) J. T. Baker Chemical Company, C. P. Grade, 99.0%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethene; C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Grauso, L.; Fredenslund, A.;
Mollerup, J.
Fluid Phase Equilibria 1977, *1*, 13.

VARIABLES:

T/K = 200-260
P/MPa = 0.5-11

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
200.0	4.543	0.0000	0.0000
	15.41	0.0307	0.6504
	28.94	0.0714	0.7762
	39.57	0.1058	0.8121
	60.33	0.1811	0.8294
	81.83	0.2742	0.8158
	102.64	0.3940	0.7654
	110.38	0.4735	0.7133
260.0	30.01	0.0000	0.0000
	36.80	0.0199	0.1144
	43.66	0.0413	0.1949
	52.41	0.0716	0.2595
	62.12	0.1080	0.3007
	70.92	0.1498	0.3139
	76.85	0.1939	0.2932

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. Temperature measured with platinum resistance thermometer. Pressure measured with dead weight piston balance. Coexisting samples analysed by gas chromatography. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.998 mole per cent.

(2) Purity 99.95 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P/\text{bar} = \pm 0.02\%$;
δx_{N_2}, $\delta y_{N_2} \leq \pm 0.003$.

REFERENCES:

1. Fredenslund, A.; Mollerup, J.; Christiansen, L. J. *Cryogenics* 1973, *13*, 405.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethene; C_2H_4; [74-85-1]	Gasem, K. A. M.; Hiza, M. J.; Kidnay, A. J. *Fluid Phase Equilib.* 1981, *6*, 181-9.

VARIABLES:	PREPARED BY:
T/K = 120-200 P/MPa = 0.001-9.3	C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/MPa	Mole fraction of nitrogen in liquid*, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}	T/K	*P*/MPa	Mole fraction of nitrogen in liquid*, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
120.00	0.0012	0.0000	0.0000	140.00	0.0118	0.0000	0.0000
	0.644	0.0451	1.0000		0.606	--	0.9787
	1.035	0.0719	1.0000		1.047	0.0469	0.9878
	1.503	0.1083	1.0000		1.600	0.0736	0.9917
	2.086	0.1666	1.0000		2.193	0.1038	0.9931
	2.285 **	0.2024	1.0000		2.875	0.1424	0.9925
125.28	0.0027	0.0000	0.0000		3.599	0.1947	0.9902
	0.496	0.0291	0.9970		4.299	0.2373	0.9855
	1.006	0.0601	0.9994		4.788	0.2792	--
	1.507	0.0953	1.0000		4.903	--	0.9731
	1.818	0.1129	1.0000		5.026 **	0.3019	0.9646
	2.150	0.1414	1.0000		5.045	--	0.9714
	2.635	0.1954	0.9994		5.127	0.9316	0.9737
	2.880 **	0.2282	0.9981		5.260	--	0.9682
	2.910	--	0.9996		5.360	0.9481	0.9690
	3.031	0.9188	-		5.410	0.9658	0.9717
134.00	0.0069	0.0000	0.0000	144.92	0.00182	0.0000	0.0000
	0.671	0.0338	0.9906		1.602	0.0716	0.9864
	1.666	0.0851	0.9965		3.097	0.1502	0.9882
	2.646	0.1517	0.9966		4.536	0.2357	0.9826
	3.692	0.2302	0.9918		5.110	0.2776	0.9776
	4.033	0.2516	0.9880		5.593	0.3070	0.9658
	4.110 **	0.2710	0.9900				

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. Temperature measured using a platinum resistance thermometer. Pressure measured using Bourdon gauge. Mixture equilibrated and samples analyzed using gas chromatography with a thermal conductivity detector. Details in source and refs. (1), (2) and (3).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta P/MPa = \pm 0.005$ up to 5 MPa; ± 0.02 above 5 MPa; δx_{N_2}, $\delta y_{N_2} = \pm 0.002$.

REFERENCES:

1. Kidnay, A.J.; Miller, R.C.; Parrish, W.R.; Hiza, M.J. *Cryogenics* 1975, *15*, 531.
2. Hiza, M.J.; Duncan, A.G. *Rev. Sci. Inst.* 1969, *40*, 513.
3. Duncan, A.G.; Hiza, M.J. *Adv. Cryog. Engng.* 1970, *15*, 42.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethene; C_2H_4; [74-85-1]

ORIGINAL MEASUREMENTS:

Gasem, K. A. M.; Hiza, M. J.;
Kidnay, A. J.

Fluid Phase Equilib. 1981, *6*, 181-9.

EXPERIMENTAL VALUES:

		Mole fraction of nitrogen				Mole fraction of nitrogen	
T/K	P/MPa	in liquid*, x_{N_2}	in gas, y_{N_2}	T/K	P/MPa	in liquid*, x_{N_2}	in gas, y_{N_2}
144.92	5.928	0.3502	0.9508	160.00	2.795	0.1062	0.9660
	5.978	0.3326	0.9508		3.497	0.1350	0.9676
	6.008	0.6123	0.9570		4.080	0.1615	0.9670
	6.353	0.7838	0.9574		4.830	0.2023	0.9631
	6.360	0.6376	-		6.558	0.2923	0.9473
	6.444	0.8004	0.9507		8.200	0.4315	0.9079
160.00	0.0563	0.0000	0.0000		9.342	0.6538	0.8631
	0.430	0.0167	0.8587	200.00	0.455	0.0000	0.0000
	0.580	0.0219	0.8927		0.837	0.0132	0.4166
	0.720	0.0247	0.9113		1.227	--	0.5800
	0.817	0.0285	0.9210		1.320	0.0236	0.6035
	0.897	0.0310	0.9367		1.388	--	0.6186
	1.120	0.0398	0.9391		1.576	0.0351	--
	1.152	0.0406	0.9402		1.760	0.0394	0.6860
	1.470	0.0525	0.9511		2.637	0.0648	0.7642
	1.809	0.0663	0.9567		3.797	0.1021	0.8093
	2.150	0.0797	0.9618		4.730	0.1332	0.8248

* Where liquid phase separation occurs, the liquid compositions are for the bottom liquid layer.

** Pressure at which phase separation occurs.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethane; C_2H_6; [74-84-0]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, AUSTRALIA. June 1981.

CRITICAL EVALUATION:

This system has been investigated by seven different groups. The experimental data of Stryjek *et al.* (1) for the temperature range 140-195 K, of Gupta *et al.* (2) for the temperature range 260-280 K and of Grauso *et al.* (3) for the temperature range 200-290 K are all thought to be reliable and show good agreement when interpolated or extrapolated. The older data of Eakin *et al.* (4) and (5) are more or less consistent with the data of the above three groups but show considerably more scatter. The data of Chang and Lu (6) are only reported at two temperatures and their vapor-phase concentrations of ethane are almost certainly too large being two or three times those obtained by Eakin *et al.* (4), (5); therefore, the data are classified as doubtful. However the liquid phase compositions are in fair agreement with values interpolated or extrapolated from the data of Stryjek *et al.* (1). The data of Yu *et al.* (7) on this system are not considered here as they are mainly concerned with liquid-liquid-gas equilibrium exhibited by this system at low temperatures (below 135 K). The limited data of Cannon *et al.* (8) are classified as tentative, the data being in fair agreement with the data of Grauso *et al.* (3) although considerably less accurate.

References

1. Stryjek, R.; Chappelear, P. S.; Kobayashi, R.
   J. Chem. Eng. Data 1974, *19*, 340.
2. Gupta, M. K.; Gardner, G. C.; Hegarty, M. J.; Kidnay, A. J.
   J. Chem. Eng. Data 1980, *25*, 313.
3. Grauso, L.; Fredenslund, A.; Mollerup, J.
   Fluid Phase Equilibria 1977, *1*, 13.
4. Eakin, B. E.; Ellington, R. T.; Gami, D. C.
   Inst. Gas Technol., Res. Bull. No. 26, 1955.
5. Ellington, R. T.; Eakin, B. E.; Parent, J. D.; Bloomer, O. T.
   Thermodynamic Properties of Gases, Liquids and Solids,
   Amer. Soc. Mech. Engnrs., New York, 1959, p.180.
6. Chang, S. D.; Lu, B. C. Y.
   Chem. Eng. Prog. Symp. Ser. 1967, *63* (81), 18.
7. Yu, P.; Elshayal, I. M.; Lu, B. C. Y.
   Can. J. Chem. Eng. 1969, *47*, 495.
8. Cannon, W. A.; Robson, J. H.; English, W. D.
   Report DAC-60510-F2, 1968, (Tech. Report, Douglas Missile and Space Systems Division, Astropower Laboratory.)

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Ellington, R.T.; Eakin, B.E.; Parent, J.D.; Gami, D.C.; Bloomer, O.T.

Thermodynamic Properties of Gases, Liquids and Solids, Amer. Soc. Mech. Engineers: New York, 1959, p.180.

VARIABLES:

T/K = 101-298
P/MPa - 0.7-5.5

PREPARED BY:

C.L. Young,

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}
159.9	10.34	0.0498	301.0	55.16	0.0498
170.5	13.79	0.0498	100.8	6.89	0.1501
193.5	17.24	0.0498	109.3	10.34	0.1501
213.4	20.68	0.0498	116.5	13.79	0.1501
228.7	24.13	0.0498	123.5	17.24	0.1501
240.7	27.56	0.0498	130.3	20.68	0.1501
251.0	31.03	0.0498	137.0	24.13	0.1501
260.0	34.47	0.0498	143.8	27.56	0.1501
267.7	37.92	0.0498	151.2	31.03	0.1501
274.5	41.37	0.0498	158.8	34.47	0.1501
280.8	44.82	0.0498	166.8	37.92	0.1501
286.9	48.26	0.0498	175.7	41.37	0.1501
292.7	51.71	0.0498	186.3	44.82	0.1501
297.7	55.16	0.0498	198.3	48.26	0.1501

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Dew point-bubble point apparatus with glass equilibrium cell. Temperature measured with copper-constantan thermocouple. Pressure measured using dead weight tester.

A variety of experimental procedures were adopted. Details in source and ref. 1. Bubble point taken as re-appearance of small vapor bubble on cooling at constant pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Stated purity 99.99 mole per cent.

(2) Phillips Petroleum Research grade sample; purity 99.88 mole per cent.

ESTIMATED ERROR:

$\delta T/K = 0.03$; $\delta P/\text{bar} = 0.1$; $\delta x = 0.5\%$

(estimated by compiler).

REFERENCES:

1. Eakin, B.E.;Ellington, R.T.; Gami, D.C. *Inst. Gas Technol., Res. Bull No. 26* 1955 .

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Chang, S. D.; Lu, B. C. Y.
Chem. Eng. Prog. Symp. Ser., 1967,
63(81), 18-27.

VARIABLES:

T/K = 122-171
P/MPa = 0.4-3.4

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
171.4	3.87	0.02495	0.5564
	7.22	0.03795	0.8140
	10.29	0.05210	0.8665
	14.11	0.05823	0.9081
	21.01	0.06228	0.9300
	24.52	0.07307	-
	27.83	0.1213	0.9254
	34.11	0.08764	0.9184
122.0	3.44	0.04956	0.9958
	6.82	0.05040	0.9972
	10.11	0.07889	0.9980
	13.74	0.1317	0.9985
	20.60	0.1529	0.9982

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with cell consisting of 100 ml Jerguson gauge with stainless steel body. Temperature measured using copper-constantan thermocouples. Pressure measured using Bourdon gauges. Magnetic circulating pump. Cell charged vapor recirculated for 2 or more hours. Samples of vapor and liquid removed at constant pressure and analyzed using gas chromatography. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson research grade, purity 99.999 mole per cent.

(2) Matheson research grade, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.5\%$;
$\delta x_{N_2} \simeq \delta y_{N_2} \le 10\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Cannon, W. A.; Robson, J. H.; English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

$T/K = 144-228$
$P/MPa = 2.1-4.8$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	$P^a_{N_2}$/MPa		x_1^b		
		-199.8°F (144.4 K)	-150.4°F (171.8 K)	-99.6°F (200.0 K)	-50.1°F (227.5 K)
300	2.07	0.106	0.0714	0.0571	0.0478
300	2.07	0.106	0.0747	0.0571	0.0450
300	2.07	0.105	0.0737	0.0543	0.0487
300	2.07	0.107	0.0760	0.0558	0.0467
700	4.83	0.278	0.179	0.144	0.130
700	4.83	0.268	0.173	0.137	0.127
700	4.83	0.274	0.180	0.149	0.119
700	4.83	0.264	0.175	0.141	0.116

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) J.T. Baker, C.P. grade, 99.0%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Stryjek, R.; Chappelear, P. S.; Kobayashi, R.

J. Chem. Eng. Data 1974, *19*, 340.

VARIABLES:

T/K = 139-194

P/MPa - 0.4-13.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

		Mole fraction of nitrogen				Mole fraction of nitrogen	
T/K	*P*/bar	in liquid, x_{N_2}	in vapor, y_{N_2}	T/K	*P*/bar	in liquid, x_{N_2}	in vapor, y_{N_2}
138.71	3.53	0.01882	0.98645	149.82	119.14[a]	0.7083	0.7083
	6.89	0.03870	0.99164		88.87[b]	0.465	0.9001
	10.34	0.05790	0.99338		119.14[a,b]	0.732	0.732
	13.79	0.0776	0.99409	172.04	3.62	0.01229	0.8449
	20.68	0.1192	0.99444		6.94	0.02320	0.9132
	27.56	0.1637	0.99420		13.72	0.04863	0.94746
	34.47	0.2120	0.99308		13.79	0.04845	0.94778
	69.09	0.3740	0.96216		27.56	0.09903	0.96368
	68.95	0.3897	0.95515		41.78	0.1552	0.96635
149.82	3.45	0.01563	0.96043		55.30	0.2090	0.96215
	6.93	0.03178	0.97867		68.81	0.2689	0.95600
	10.34	0.04796	0.98411		90.39	0.3755	0.92771
	13.81	0.06400	0.98752		103.42	0.4327	0.9012
	20.68	0.09698	0.98937		120.66	0.5626	0.8138
	27.56	0.1343	0.98985		124.93	0.6341	0.7704
	34.47	0.1685	0.98834		125.35[a]	0.7080	0.7080
	41.44	0.2058	0.98656	194.26	3.52	0.005715	0.4862
	55.50	0.2839	0.98097		6.92	0.01612	0.7146
	69.09	0.3531	0.95918		13.79	0.03722	0.8360
	88.87	0.4336	0.9001				(cont.)

[a] Critical point; [b] Smoothed value.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Vapor recycled through equilibrium cell by magnetic pump. Temperature measured by platinum resistance thermometer using a Mueller bridge. Pressure measured with Heise gauge. Samples of both phases analyzed with a thermal conductivity detector (1-3). After equilibrium established vapor phase analyzed then recycle pump stopped and liquid phase sampled (1-3).

SOURCE AND PURITY OF MATERIALS:

(1) Matheson sample; purity 99.99 mole per cent.

(2) Specified purity 99.99 mole per cent.

ESTIMATED ERROR:

$\delta T/K \sim 0.02$; $\delta P/bar < 1$; $\delta x_{N_2} \sim \delta y_{N_2} = 0.2\text{-}1.0\%$.

REFERENCES:

1. Stryjek, R. Monograph. Rice University, 1972.

2. Wichterle, I.; Kobayashi, R. *J. Chem. Eng. Data* 1972, *17*, 4.

3. Stryjek, R.; Chappelear, P. S.; Kobayashi, R. *J. Chem. Eng. Data* 1974 *19*, 334.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Stryjek, R.; Chappelear, P. S.; Kobayashi, R.

J. Chem. Eng. Data 1974, *19*, 340.

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
194.26	27.56	0.08081	0.8966	194.26	120.24	0.4534	0.8355
	41.51	0.1273	0.9126		121.35	0.4577	0.8304
	55.71	0.1756	0.9154		130.86	0.5510	0.7714
	69.09	0.2225	0.9126		134.17	0.6472	0.7144
	89.77	0.3024	0.8977		134.65[a]	0.6746	0.6746
	97.56	0.3338	0.8885				

[a] Critical point; [b] Smoothed value.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Grauso, L.; Fredenslund, A.; Mollerup, J.

Fluid Phase Equilibria 1977, *1*, 13.

VARIABLES:

T/K = 200-230
P/MPa = 0.2-13

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
200.0	2.182	0.0000	0.0000	230.0	119.58	0.4110	0.7047
	6.66	0.0137	0.6389		124.76	0.4543	0.6650
	10.43	0.0264	0.7533	260.0	17.12	0.0000	0.0000
	21.17	0.0647	0.8568		25.72	0.0235	0.2562
	41.54	0.1360	0.9029		31.15	0.0393	0.3478
	60.99	0.2063	0.9064		44.83	0.0796	0.4753
	80.48	0.2764	0.8981		56.46	0.1160	0.5287
	102.42	0.3751	0.8716		71.06	0.1647	0.5576
	124.79	0.5112	0.8116		88.49	0.2373	0.5558
	131.95	0.5738	0.7620		100.55	0.3077	0.5209
230.0	7.005	0.0000	0.0000	290.0	35.13	0.0000	0.0000
	10.54	0.0094	0.2927		42.68	0.0242	0.0970
	15.70	0.0240	0.4889		49.54	0.0464	0.1586
	21.56	0.0399	0.6029		55.49	0.0709	0.1940
	34.52	0.0776	0.7129		61.30	0.0936	0.2163
	54.05	0.1372	0.7660		68.32	0.1322	0.2196
	80.72	0.2265	0.7796		70.18	0.1594	0.2115
	101.77	0.3120	0.7566				

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. Temperature measured with platinum resistance thermometer. Pressure measured with dead weight piston balance. Coexisting samples analysed by gas chromatography. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.998 mole per cent.

(2) Purity 99.95 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.001$; $\delta P/\text{bar} = \pm 0.02\%$;

$\delta x_{N_2} = \delta y_{N_2} \leq \pm 0.003$.

REFERENCES:

1. Fredenslund, A.; Mollerup, J.; Christiansen, L. J. *Cryogenics* 1973, *13*, 405.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ethane; C_2H_6; [74-84-0]

ORIGINAL MEASUREMENTS:

Gupta, M.K.; Gardner, G.C.; Hegarty, M. J.; Kidnay, A. J.

J. Chem. Eng. Data 1980, *25*, 313-8.

VARIABLES:

T/K = 260-280
P/MPa = 2-10

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Total pressure p/atm	Total pressure p/MPa	Mole fraction in nitrogen in liquid x_{N_2}	Mole fraction in nitrogen in gas y_{N_2}
260.00	16.80	1.702	0.0000	0.0000
	18.10	1.834	0.0036	0.0523
	20.59	2.086	0.0106	0.1375
	22.55	2.285	0.0161	-
	25.63	2.597	0.0254	-
	35.36	3.583	0.0541	0.4065
	44.88	4.547	0.0828	0.4823
	65.05	6.591	0.1494	0.5541
	75.20	7.620	0.1873	0.5653
	84.27	8.539	0.2258	0.5632
	93.80	9.504	0.2714	0.5473
270.00	21.68	2.197	0.0000	0.0000
	23.50	2.381	0.0052	0.0523
	24.35	2.467	0.0077	0.0770
	25.13	2.546	0.0098	0.0942
	27.65	2.802	0.0157	0.1489
	28.63	2.901	0.0193	0.1698
	30.00	3.040	0.0233	0.1889
	30.40	3.080	0.0251	-
	32.52	3.295	0.0302	0.2378
	32.62	3.305	0.0302	0.2262
	34.52	3.498	0.0359	0.2636
	34.70	3.516	0.0382	0.2646
	35.26	3.573	0.0390	0.2668
	37.31	3.780	0.0435	0.2938

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with diaphragm pump. Temperature measured with platinum resistance thermometer and pressure with Bourdon gauges. Cell stirred with double propeller stirrer. Vapor and liquid samples analysed by gas chromatography using a thermal conductivity detector. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Purity at least 99.7 mole per cent.

(2) Purity at least 99 mole per cent

No extraneous peaks were found when samples analysed by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta p/MPa = \pm 0.03$ up to 3.4 MPa, $\pm$ 0.1 above 3.4 MPa; δx_{N_2}, $\delta y_{N_2} = \pm$ 0.002

REFERENCES:

1. Somait, F.; Kidnay, A.J. *J. Chem. Eng. Data* 1978, *23*, 301.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethane; C_2H_6; [74-84-0]	Gupta, M.K.; Gardner, G.C.; Hegarty, M. J.; Kidnay, A. J. *J. Chem. Eng. Data* 1980, *25*, 313-8.

	Total pressure		Mole fraction in nitrogen	
			in liquid	in gas
T/K	p/atm	p/MPa	x_{N_2}	y_{N_2}
270.00	40.39	4.093	0.0543	0.3216
	40.53	4.107	0.0563	0.3321
	41.19	4.174	0.0554	0.3339
	45.50	4.610	0.0696	0.3618
	47.42	4.805	0.0687	0.3811
	50.31	5.098	0.0848	0.3921
	53.47	5.418	0.0951	0.4156
	55.20	5.593	0.0989	0.4127
	57.70	5.846	0.1076	0.4290
	60.18	6.098	0.1165	0.4291
	65.62	6.649	-	0.4506
	70.43	7.136	0.1555	0.4545
	80.50	8.157	0.2030	0.4631
	80.59	8.166	-	0.4631
	81.42	8.250	0.2079	0.4611
	84.12	8.523	0.2263	-
	85.45	8.658	0.2306	-
	89.81	9.100	0.2572	0.4652
	90.71	9.191	0.2636	-
	93.25	9.449	0.2849	-
	93.50	9.474	-	0.4594
	93.70	9.494	0.2931	-
	96.42	9.770	-	0.4446
	96.45	9.773	-	0.4475
	96.67	9.795	0.3361	-
	97.72	9.901	0.3742	-
280.00	27.60	2.797	0.0000	0.0000
	29.50	2.989	0.0061	0.0437
	30.72	3.113	0.0097	0.0684
	31.80	3.222	0.0128	0.0866
	36.23	3.671	0.0265	0.1558
	40.32	4.085	0.0394	0.2047
	45.35	4.595	0.0556	0.2511
	51.69	5.237	0.0767	0.2943
	55.89	5.663	0.0921	0.3167
	60.20	6.100	0.1078	0.3331
	65.30	6.617	0.1284	0.3471
	71.68	7.263	0.1570	0.3542
	76.90	7.792	0.1852	0.3484
	80.25	8.131	0.2088	0.3360
	80.90	8.197	0.2162	0.3339
	82.25	8.334	0.2311	0.3177
	83.55	8.466	single phase	

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propene; C_3H_6; [115-07-1]

ORIGINAL MEASUREMENTS:

Blagoi, Yu. P.; Orobinskii, N. A.

Zhur. Fiz. Khim. 1965, *39*, 2022-4.

VARIABLES:

T/K = 79-91

P/KPa = 31-258

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$P/10^5$Pa	Mole fraction of nitrogen in liquid, x_{N_2}	T/K	$P/10^5$Pa	Mole fraction of nitrogen in liquid, x_{N_2}
90.5	0.4523	0.004	85.95	2.502	0.030
88.3	0.4123	0.004	85.75	2.474	0.030
85.55	0.3664	0.004	83.95	2.084	0.030
82.00	0.3111	0.004	83.90	2.064	0.030
90.5	0.933	0.009	81.50	1.621	0.030
85.95	0.779	0.009	79.4	1.272	0.030
82.35	0.666	0.009	85.95	2.531	0.033
83.25	1.199	0.015	85.85	2.498	0.033
81.30	1.092	0.015	84.10	2.116	0.033
78.6	0.975	0.015	82.75	1.845	0.033
90.2	2.158	0.021	82.35	1.776	0.033
87.5	1.896	0.021	79.40	1.282	0.033
84.10	1.601	0.021	79.05	1.224	0.033
79.6	1.271	0.021	85.85	2.498	0.070
89.55	2.451	0.024	84.20	2.134	0.070
86.00	2.053	0.024	82.35	1.781	0.070
81.05	1.505	0.024	78.00	1.091	0.070
87.10	2.531	0.027	85.95	2.531	0.342
85.05	2.125	0.027	83.00	1.906	0.342
81.95	1.679	0.027	79.6	1.298	0.342
86.25	2.578	0.030			

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with magnetic pump. Temperature measured with platinum resistance thermometer; pressure measured with Bourdon gauge. Samples of liquid phase analysed by gas chromatography. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/kPa = \pm 0.5$;

$\delta x_{N_2} = \pm 0.001$.

REFERENCES:

1. Blagoi, Yu. P.; Orobinskii, N. A. *Ukrain. Fiz. Zhur.* 1963, *8*, 1378.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propene; C_3H_6; [115-07-1]

ORIGINAL MEASUREMENTS:

Grauso, L.; Fredenslund, A.;
Mollerup, J.
Fluid Phase Equilibria 1977, *1*, 13.

VARIABLES:

T/K = 260-290
P/MPa = 0.4-16.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
260.0	3.829	0.0000	0.0000
	17.16	0.0234	0.7382
	36.70	0.0595	0.8461
	56.70	0.0966	0.8764
	86.32	0.1536	0.8869
	118.95	0.2195	0.8790
	149.86	0.2874	0.8617
	173.03	0.3448	0.8393
	191.11	0.3945	0.8129
	214.44	0.4882	0.7503
290.0	9.370	0.0000	0.0000
	17.32	0.0144	0.3843
	23.11	0.0248	0.5068
	31.97	0.0413	0.6069
	42.64	0.0604	0.6734
	55.37	0.0855	0.7122
	70.44	0.1148	0.7399
	86.20	0.1473	0.7500
	111.38	0.2028	0.7505
	133.14	0.2589	0.7335
	150.07	0.3171	0.7104
	165.39	0.3734	0.6677

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. Temperature measured with platinum resistance thermometer. Pressure measured with dead weight piston balance. Coexisting samples analysed by gas chromatography. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.998 mole per cent.

(2) Purity 99.99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P/\text{bar} = \pm 0.02\%$;
$\delta x_{N_2}, \delta y_{N_2} \leq 0.003$.

REFERENCES:

1. Fredenslund, A.; Mollerup, J.; Christiansen, L. J. *Cryogenics* 1973, *13*, 405.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Propane; C_3H_8; [74-98-6]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, AUSTRALIA. June 1981.

CRITICAL EVALUATION:

This system has been investigated by five groups. The study of Roof and Baron (1) was restricted to critical loci and is not considered further. Cheung and Wang (2) made a fairly limited study of the system at temperatures between 91 and 128 K at pressures up to 0.5 MPa. These data are classified as tentative but are not considered further because of their limited nature. The data of Grauso *et al.* (3) are thought to be reliable. The isotherms studied by Grauso *et al.* (3) at 230, 260 and 290 K are in good agreement with values interpolated from the data of Schindler *et al.* (4). However there are considerable differences between the data of Poon and Lu (5) and Schindler *et al.* (4). The isotherms of Poon and Lu at 114.1, 118.3 and 122.2 K are probably more accurate than those of Schindler *et al.* (4) at similar temperatures since it is probable that the sampling technique used by Schindler *et al.* (4) is less reliable for low nitrogen concentrations in the liquid than the technique used by Poon and Lu (5). Therefore the data of Grauso *et al.* (3) and Poon and Lu (5) are classified as tentative whereas the data of Schindler *et al.* (4) are classified as doubtful at low temperatures (below 250 K). The limited data of Cannon et al (6) are classified as tentative, the data being in fair agreement with the data of Grauso et al. (3) but considerably less accurate.

References

1. Roof, J. G.; Baron, J. D.
J. Chem. Eng. Data 1967, *12*, 292.

2. Cheung, H.; Wang, D. I. J.
Ind. Eng. Chem. Fund. 1964, *3*, 355.

3. Grauso, L.; Fredenslund, A.; Mollerup, J.
Fluid Phase Equilibria 1977, *1*, 13.

4. Schindler, D. L.; Swift, G. W.; Kurata, F.
Hydrocarbon Process. 1966, *45*, 205.

5. Poon, D. P. L.; Lu, B. C. Y.
Adv. Cryog. Engng. 1973, *19*, 292.

6. Cannon, W. A.; Robson, J. H.; English, W. D.;
Report DAC-60510-F2, 1968, (Tech Report, Douglas Missile and Space Systems Division, Astropower Laboratory).

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Cheung, H.; Wang, D. I. J.
Ind. Eng. Chem. Fund. 1964, *3*, 355.

VARIABLES:

T/K = 92-128

P/MPa = 0.1-0.6

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}
91.9	1.195	0.0157
91.9	4.046	0.0670
97.4	4.969	0.0610
103.7	5.838	0.0569
110.2	1.846	0.0124
128.2	2.387	0.0107

The mole fraction of nitrogen in the gas phase is essentially unity for these pressures and temperatures (authors).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetic stirrer. Pressure measured on mercury manometer. Temperature measured by thermocouple. Details of apparatus in source reference. Known quantity solvent added to evacuated cell. Metered quantity of solute added. Solubility determined from equilibrium pressure and mass balance. Details in source ref.

SOURCE AND PURITY OF MATERIALS:

Not given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.0015$;

$\delta x_{N_2} = \pm 2\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Schindler, D. L.; Swift, G. W.; Kurata, F.

Hydrocarbon Process., 1966, *45* (11), 205.

VARIABLES:

T/K = 103-353

P/MPa = 0.7 - 13.8

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
353.15	41.37	0.032	0.143	248.15	96.53	0.185	0.926
	55.16	0.053	0.230	223.15	13.79	0.025	0.9290
	68.95	0.139	0.264		41.37	0.077	0.9680
343.15	41.37	0.040	0.225		68.95	0.129	0.9686
	55.16	0.084	0.307		96.53	0.181	0.9639
	68.95	0.128	0.358	198.15	13.79	0.029	0.9812
	82.74	0.187	0.375		55.16	0.085	0.9900
333.15	41.37	0.049	0.350		68.95	0.137	0.9880
	68.95	0.128	0.475		96.53	0.186	0.9842
323.15	41.37	0.055	0.422	173.15	13.79	0.032	0.9952
	68.95	0.124	0.547		41.37	0.091	0.9965
298.15	13.79	0.009	0.239		68.95	0.142	0.9947
	41.37	0.067	0.652		96.53	0.184	0.9907
	68.95	0.127	0.728	143.15	13.79	0.046	0.9997
	96.53	0.191	0.743		41.37	0.113	0.9993
273.15	13.79	0.018	0.593		68.95	0.152	0.9962
	41.37	0.074	0.818		96.53	0.171	0.9904
	68.95	0.130	0.854		124.11	0.182	0.9852
	96.53	0.187	0.859		137.90	0.188	0.9828
248.15	13.79	0.024	0.815	123.15	13.79	0.062	0.9996
	41.37	0.078	0.914		27.58	0.111	0.9997
	68.95	0.132	0.927				

(cont.)

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Static equilibrium cell with magnetic stirrer. Temperature measured with platinum resistance thermometer; pressure measured with Bourdon gauge. Propane charged into cell, nitrogen added. Samples of both phases analysed by gas chromatography. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity dry grade, purity 99.995 mole per cent.

(2) Instrument grade, purity 99.96 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P/\mathrm{bar} = \pm 0.15$;

$\delta x_{N_2} = \pm 1.5$ to 4%; $\delta y_{N_2} = \pm 2\%$.

REFERENCES:

1. Sinor, J. E.; Schindler, D. L.; Kurata, F. *Am. Inst. Chem. Engnrs. J.* 1966, *12*, 357.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Propane; C_3H_8; [74-98-6]	Schindler, D. L.; Swift, G. W.; Kurata, F. *Hydrocarbon Process.*, 1966, **45** (11), 205.

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
123.15	41.37*	0.119	0.9947	103.15	13.79*	0.085	0.9953
	68.95*	0.128	0.9927		41.37*	0.087	0.9943
	96.53*	0.136	0.9905		68.95*	0.089	0.9933
	124.11*	0.141	0.9885		96.53*	0.091	0.9923
	137.90*	0.143	0.9877		124.11*	0.093	0.9913
103.15	6.89	0.060	-		137.90*	0.094	0.9908

* liquid-liquid insolubility.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Cannon, W. A.; Robson, J. H.; English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 172-256
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	$P_{N_2}{}^a$/MPa	$x_1{}^b$ -150.0°F (172.0 K)	 -100.0°F (199.8 K)	 -50.2°F (227.5 K)	 0.4°F (255.6 K)
300	2.07	0.0490	0.0405	0.0405	0.0355
300	2.07	0.0482	0.0393	0.0403	0.0348
300	2.07	0.0504	0.0406	0.0392	0.0342
300	2.07	0.0510	0.0424	0.0405	0.0330
700	4.83	0.112	0.107	0.104	0.0965
700	4.83	0.114	0.104	0.102	0.0970
700	4.83	0.112	0.105	0.108	0.0977
700	4.83	0.110	0.106	0.109	0.0978

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) J.T. Baker Chemical Company, C.P. grade, 99.9%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Poon, D. P. L.; Lu, B. C. Y.

Advan. Cryog. Eng. 1973, *19*, 292.

VARIABLES:

T/K = 114-122
P/MPa = 0.2-2.8

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
114.1	1.50	0.0075	0.9995	118.3	14.88	0.0621	0.9999
	1.63	0.0086	-		19.31	0.0760	0.9999
	3.41	0.0169	0.9996		20.51	0.0801	0.9999
	6.58	0.0335	0.9997		21.53	0.0854	1.0
	10.01	0.0486	0.9998	122.2	3.03	0.0107	0.9989
	13.73	0.0640	0.9999		3.57	0.0133	0.9989
	16.03	0.0736	0.9999		6.95	0.0254	0.9994
	16.52	0.0773	1.0		10.38	0.0380	0.9995
	17.79	0.0842	1.0		11.45	0.0410	0.9995
	18.00	0.0845	1.0		13.99	0.0486	0.9996
118.3	1.88	0.0079	-		19.31	0.0672	0.9999
	4.26	0.0175	0.9994		23.56	0.0812	0.9999
	7.40	0.0321	0.9994		25.48	0.0858	0.9999
	10.02	0.0433	0.9998		27.58	0.0869	1.0
	12.24	0.0511	0.9998		27.58	0.0881	1.0
	12.98	0.0557	0.9998		27.99	0.0888	1.0

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with cell consisting of 100 ml Jerguson gauge with stainless steel body. Temperature measured using copper-constantan thermocouples. Pressure measured using Bourdon gauges. Magnetic circulating pump. Cell charged, vapor recirculated for 2 or more hours and samples of vapor and liquid removed at constant pressure and analysed using gas chromatography. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson research grade sample, purity 99.997 mole per cent.

(2) Phillips Petroleum Co. sample research grade purity 99.99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.05$;

$\delta x_{N_2} = \pm 1\%$; $\delta y_{N_2} = \pm 0.0001$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Grauso, L.; Fredenslund, A.; Mollerup, J.

Fluid Phase Equilibria 1977, *1*, 13.

VARIABLES:

T/K = 230-290
P/MPa = 0.1-21.9

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
230.0	0.966	0.0000	0.0000
	4.08	-	0.7498
	19.66	0.0337	0.9343
	36.84	0.0745	0.9556
	61.17	0.1251	0.9608
	83.16	0.1676	0.9601
	107.79	0.2070	0.9545
	134.90	0.2635	0.9445
	169.44	0.3244	0.9261
	194.84	0.3774	0.9071
	213.55	0.4193	0.8882
260.0	3.103	0.0000	0.0000
	11.89	0.0183	0.7116
	21.32	0.0376	0.8225
	32.76	0.0554	0.8623
	51.23	0.0903	0.8909
	76.12	0.1389	0.9024
	103.52	0.1939	0.8997
260.0	122.15	0.2354	0.8939
	152.30	0.2993	0.8756
	179.83	0.3721	0.8478
	219.19	0.5280	0.7524
290.0	7.692	0.0000	0.0000
	20.11	0.0238	0.5438
	29.47	0.0432	0.6583
	45.71	0.0746	0.7423
	56.69	0.0968	0.7684
	75.79	0.1379	0.7904
	85.30	0.1603	0.7948
	93.23	0.1780	0.7966
	100.10	0.1932	0.7978
	111.90	0.2216	0.7938
	124.01	0.2539	0.7874
	137.13	0.2908	0.7742
	150.26	0.3310	0.7580
	159.03	0.3617	0.7410

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus. Temperature measured with platinum resistance thermometer. Pressure measured with dead weight piston balance. Coexisting samples analysed by gas chromatography. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.998 mole per cent.

(2) Purity 99.95 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P/\text{bar} = \pm 0.02\%$;

$\delta x_{N_2} \approx \delta y_{N_2} \lesssim \pm 0.003$.

REFERENCES:

1. Fredenslund, A.; Mollerup, J.; Christiansen, L. J. *Cryogenics* 1973, *13*, 405.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Butane; C_4H_{10}; [106-97-8]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, AUSTRALIA. June 1981.

CRITICAL EVALUATION:

This system has been studied by five groups of workers. The data of Lehigh and McKetta (1) were part of a more extensive study of the ternary system ethane-butane-nitrogen and are in only fair agreement with McKetta's earlier data (2). Since Lehigh and McKetta studied just one isotherm and it is not of the highest accuracy it is not considered further here. The data of Frolich *et al.* (3) are in marked disagreement with the data of other workers and are only included in view of the fact that they are often quoted and used. The data are classified as doubtful. The data of Skripka *et al.* (4), McKetta and Roberts (2) and Akers *et al.* (5) are more or less consistent and extrapolated values agree fairly well. These three sets of data are classified as tentative.

References

1. Lehigh, W. R.; McKetta, J. J.
J. Chem. Eng. Data 1966, *11*, 180.

2. Roberts, L. R.; McKetta, J. J.
Am. Inst. Chem. Engnrs. J. 1961, *7*, 173.

3. Frolich, P. K.; Tauch, E. J.; Hoban, J. J.; Peer, A. A.
Ind. Eng. Chem. 1931, *23*, 548.

4. Skripka, V. G.; Barsuk, S. D.; Nikitina, I. E.; Ben'yaninovic, O. A.
Gazov. Prom. 1964, *14*, no. 4, 41.

5. Akers, W. W.; Atwell, L. L.; Robinson, J. A.
Ind. Eng. Chem. 1954, *46*, 2539.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.; Hogan, J.J.; Peer, A. A.

Ind. Eng. Chem. 1931, *23*, 548-50.

VARIABLES:

T/K = 298
P/MPa = 1-18

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/MPa	Solubility*, *S*	Mole fraction of nitrogen,† x_{N_2}
298.15	1.0	1.35	0.00577
	2.0	2.7	0.0115
	3.0	4.0	0.0169
	4.0	5.3	0.0223
	5.0	6.65	0.0278
	6.0	8.0	0.0332
	7.0	9.3	0.0384
	8.0	10.65	0.0437
	9.0	12.0	0.0490
	10.0	13.3	0.0540
	11.0	14.65	0.0592
	12.0	16.0	0.0643
	13.0	17.3	0.0692
	14.0	18.65	0.0742
	15.0	20.0	0.0791
	16.0	21.3	0.0838
	17.0	22.65	0.0887
	18.0	24.0	0.0935

* Data taken from graph in original article. Volume of gas measured at 101.325 kPa pressure and 298.15K dissolved by unit volume of liquid measured under the same conditions.

+ calculated by compiler.

AUXILIARY INFORMATION

METHOD 'APPARATUS/PROCEDURE:

Static equilibrium cell. Liquid saturated with gas and after equilibrium established samples removed and analysed by volumetric method. Allowance was made for vapor pressure of liquid and the solubility of the gas at atmospheric pressure. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Highest purity available.

(2) Purity 98 to 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2} = \pm 5\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) n-Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Akers, W. W.; Atwell, L. L.;
Robinson, J. A.

Ind. Eng. Chem. 1954, *46*, 2539.

VARIABLES:

T/K = 311-422
P/MPa = 3.6-29.1

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
310.93	35.7	0.0394	0.8611	399.82	70.3	0.1538	0.6739
	70.0	0.0899	0.8975		104.5	0.2742	0.7173
	138.9	0.1955	0.8908		138.9	0.4678	0.6734
	178.9	0.2688	0.8879	422.04	42.6	-	0.3762
	221.8	0.3829	0.8672		49.6	-	0.4729
	277.2	0.5449	0.7996		56.5	-	0.4973
	290.9	-	0.7239		56.5	-	0.4900
366.48	35.7	0.0498	0.6664		63.4	0.1650	0.5247
	70.3	0.1282	0.7975		70.3	-	0.5486
	104.5	0.2171	0.8433		70.3	0.2167	0.5442
	173.3	0.3868	0.7912		77.2	0.2776	0.5485
	201.0	-	0.7509		84.0	0.3753	0.5429
	207.9	0.5430	0.7235		84.0	-	0.5361
399.82	35.7	0.0116	0.5084				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Vapor flow apparatus with vapor recirculating via external loop. Equilibrium established with fixed quantity of vapor and liquid. Phases analysed by thermal conductivity. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/\mathrm{bar} = \pm 0.3$;

δx_{N_2}, $\delta y_{N_2} = \pm 0.001$.

REFERENCES:

1. Akers, W. W.; Burns, J. F.; Fairchild, W. R. *Ind. Eng. Chem.* 1954, *46*, 2531.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) n-Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Roberts, L. R.; McKetta, J. J.

Am. Inst. Chem. Engnrs. J. 1961, *7*, 173.

VARIABLES:

T/K = 311-411
P/MPa = 1.6-23.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
310.9	16.3	0.025	0.759	377.6	83.0	0.148	0.585
	64.2	0.121	0.890		94.6	0.177	0.594
	124.1	0.164	0.900		128.1	0.297	0.580
	171.1	0.258	0.897		138.2	0.311	0.534
	207.4	0.332	0.979		138.9	0.311	0.526
	234.6	0.388	0.849		143.5	0.331	0.501
344.3	35.6	0.058	0.639	410.9	36.9	0.016	-
	73.4	0.105	0.776		41.1	0.034	0.144
	97.0	0.149	0.791		54.7	0.073	0.222
	118.9	0.202	0.779		57.7	0.078	0.231
	138.0	0.256	0.758		61.2	0.085	0.240
	169.0	0.321	0.757		67.6	0.113	0.243
377.6	45.6	0.066	0.479		70.7	-	0.257
	58.4	0.112	0.548				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cell fitted with sight glass. Vapor recirculated by means of piston pump. Temperature measured with thermocouple and pressure measured with Bourdon gauge. Components charged into cell and vapor recirculated for 4 hours. Samples withdrawn by mercury displacement. Details in source but no details of analysis given.

SOURCE AND PURITY OF MATERIALS:

(1) Research grade, purity better than 99.9 mole per cent.

(2) Research grade, purity over 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.06$; $\delta P/bar = \pm 0.3$;

δx_{N_2}, δy_{N_2} $= \pm 0.002$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) n-Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Skripka, V. G.; Barsuk, S. D.; Nikitina, I. E; Ben'yaminovic, O. A.

Gazov. Prom. 1964, *14*, no. 4, 41.

VARIABLES:

T/K = 153-273
P/MPa = 0.5-19.6

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
273.15	4.9	0.0008	-	213.15	117.7	0.1508	0.9922
	9.8	0.0110	0.8810		156.9	0.1894	0.9864
	39.2	0.0616	0.9308		196.1	0.2236	0.9853
	78.4	0.1195	0.9524	193.15	4.9	0.0084	0.9960
	117.7	0.1740	0.9660		9.8	0.0164	0.9982
	156.9	0.2286	0.9689		39.2	0.0590	0.9998
	196.1	0.2828	0.9689		78.4	0.1120	0.9990
253.15	4.9	0.0050	0.8750		117.7	0.1500	0.9947
	9.8	0.0132	0.9163		156.9	0.1824	0.9916
	39.2	0.0540	0.9707		196.1	0.2068	0.9905
	78.4	0.1072	0.9808	173.15	4.9	0.0100	1.000
	117.7	0.1626	0.9792		9.8	0.0186	1.000
	156.9	0.2172	0.9741		39.2	0.0606	1.000
	196.1	0.2710	0.9729		78.4	0.1072	0.9993
233.5	4.9	0.0062	0.9650		117.7	0.1388	0.9953
	9.8	0.0145	0.9800		156.9	0.1608	0.9929
	39.2	0.0552	0.9905		196.1	0.1774	0.9925
	78.4	0.1050	0.9911	153.15	4.9	0.0140	1.000
	117.7	0.1556	0.9868		9.8	0.0248	1.000
	156.9	0.2028	0.9825		39.2	0.0718	1.000
	196.1	0.2464	0.9800		78.4	0.1142	0.9999
213.15	4.9	0.0074	0.9903		117.7	0.1370	0.9965
	9.8	0.0144	0.9928		159.9	0.1484	0.9945
	39.2	0.0576	0.9972		196.1	0.1560	0.9938
	78.4	0.1080	0.9982				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus fitted with stirrer. Temperature measured with platinum resistance thermometer. Liquid and gas phases analysed by gas chromatography. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.9 mole per cent.

(2) Purity 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} \pm 1\%$; $\delta x_{N_2} = \pm 5\%$
$\delta(1-y_{N_2}) = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Methylpropane (isobutane); C_4H_{10}; [75-28-5]

(3) n-Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Ryabtsev, N. I.; Khuchua, K. S.;

Gazov. Delo 1970, 25-8

Chem Abstr. 1971, *74*, 57804X.

VARIABLES:

T/K = 258-358
P/MPa = 0.2-9.8

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

t/°C = 25 (298 K)
P^c_o /kg cm^{-2} = 2.7
n-Butane

$P^a_{N_2}$	c^b
4.9	3.2
9.6	6.1
13.3	8.2
20.1	12.4
27.6	17.0
50.5	31.8
66.7	44.8
87.9	61.2
98.9	70.5

t/°C = 45 (318 K)
P^c_o /kg cm^{-2} = 6.2
Isobutane

$P^a_{N_2}$	c^b
2.	1.3
4.5	3.3
9.5	6.8
19.5	14.2
28.3	21.4
37.1	27.9
54.5	43.1
68.0	54.4
76.0	64.1
95.0	85.3

t/°C = 25 (298 K)
P^c_o /kg cm^{-2} = 3.6
Isobutane

$P^a_{N_2}$	c^b
4.	2.8
6.7	4.5
8.8	6.0
15.1	10.5
20.0	13.6
29.6	20.5
43.2	31.3
58.8	43.8
77.0	58.6
85.0	66.7
97.0	79.0

t/°C = 0 (273 K)
P^c_o/ kg cm^{-2} = 7.0
Isobutane

$P^a_{N_2}$	c^b
11.0	7.0
17.4	11.3
31.3	20.4
52.3	36.1
68.1	48.8
86.1	65.2
99.6	77.1

t/°C = -15 (258 K)
P^c_o /kg cm^{-2} = 0.9
Isobutane

$P^a_{N_2}$	c^b
5.3	3.3
8.7	5.5
15.0	9.2
21.2	13.9
28.8	18.4
49.9	32.5
65.7	43.7
82.0	57.4
100.2	73.4

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure are described in reference 1.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Minimum pruity 99.997 per cent.

(2) Purity of 95.9-99.9 per cent.

(3) Purity of 95.9-99.9 per cent

ESTIMATED ERROR:

δT/K = ±0.1 author's estimate

REFERENCES:

1. Ryabtsev, N. I., Khuchua, R. S. *Gazov. Delo* 1968, (10), 26-8; *Chem. Abstr.* 1968, *69*, 69816h.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Methylpropane (isobutane); C_4H_{10}; [75-28-5]

(3) n-Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Ryabtsev, N. I.; Khuchua, K. S.

Gazov. Delo 1970, 25-8;

Chem. Abstr. 1971, *74*, 57804X.

EXPERIMENTAL VALUES:

continued

[a] Partial pressure of nitrogen in kg cm^{-2}.

[b] Solubility of nitrogen in cm^3, reduced to STP, per one gram of isobutane or n-butane.

[c] Pressure of isobutane or n-butane at given temperature.

[d] The solubility at different pressures for each temperature was calculated according to the following empirical relationship:

$$C^b = A\,P_{N_2}^3 + B\,P_{N_2}^2 + E\,P_{N_2}$$

where P_{N_2} is the nitrogen partial pressure in units of kg cm^{-2} and A, B, and E are constants. The values of A, B, and E are given in the following table.

System	t/°C	T/K	$10^{-5}A$	$10^{-5}B$	$10^{-5}E$
Nitrogen/ isobutane	45	318	3.31	-194.2	78741.1
	25	298	2.5	-170.0	74500.0
	0	273	0.04	-170.7	60195.0
	-15	258	1.5	- 62.0	64530.0
Nitrogen/ n-butane	25	298	0.62	54.3	59950.0

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Methylpropane; C_4H_{10}; [75-28-5]

ORIGINAL MEASUREMENTS:

Robinson, D.B.; Kalra, H.;.; Krishnan, T.: Miranda, R. D. *Proc. Annu. Conv., Gas Process. Assoc., Tech. Pap.* 1975, *54*, 25.

VARIABLES:

T/K = 283-339
P/MPa = 0.6-21

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
283.21	5.65	0.0062	0.5880	338.65	34.82	0.0547	0.6282
	9.31	0.0122	0.7390		52.81	0.0941	0.7168
	13.79	0.0198	0.8117		77.29	0.1509	0.7586
	21.37	0.0335	0.8739		108.32	0.2271	0.7637
	32.89	0.0556	0.9038		138.52	0.3125	0.7590
	52.33	0.0899	0.9293		171.61	0.4128	0.6897
	83.63	0.1486	0.9379		182.78	0.4624	0.6310
	124.38	0.2302	0.9358	390.93	31.10	0.0080	0.0512
	169.89	0.2949	0.9159		35.58	0.0236	0.1286
	207.39	0.3686	0.8942		43.78	0.0540	0.2338
338.65	12.55	0.0065	0.1799		56.12	0.1024	0.3107
	15.65	0.0111	0.3140		71.77	0.1623	0.3451
	23.37	0.0297	0.5045		88.60	0.2270	0.3520

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Cell fitted with two moveable pistons which enabled cell contents to be circulated in external line. Fitted with optical system which allowed measurement of refractive index. Temperature measured with iron-constantan thermocouple and pressure with strain gauge transducers. Components charged into cell, mixed by piston movement. Samples withdrawn and analysed by gas chromatography. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Linde sample, purity 99.9 mole per cent or better.

(2) Phillips Petroleum Research grade, purity 99.9 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.2$;

δx_{N_2}, δy_{N_2} = ±0.003.

REFERENCES:

1. Besserer, G. J.; Robinson, D. B. *Can. J. Chem. Eng.* 1971, *49*, 651.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Propane, 2-methyl-, (isobutane); C_4H_{10}; [75-28-5]

ORIGINAL MEASUREMENTS:

Kalra, H.; Ng, H.-J.; Miranda, R.D.; Robinson, D. B.

J. Chem. Eng. Data. 1978, *23*, 321-4.

VARIABLES:

$T/K = 255\text{-}394$
$P/MPa = 0.2\text{-}20.8$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid x_{N_2}	Mole fraction of nitrogen in gas y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid x_{N_2}	Mole fraction of nitrogen in gas y_{N_2}
255.37	2.38	0.0071*	0.651	310.87	66.6	0.114	0.859
	4.19	0.0066	0.802		91.2	0.171	0.870
	7.52	0.0143	0.892		123.4	0.237	0.869
	14.2	0.0251*	0.947		153.1	0.308	0.858
	24.6	0.0445	0.963		182.8	0.371	0.836
	41.4	0.0758	0.973		207.7	0.436	0.803
	69.1	0.119	0.968	338.71	12.5	0.0065	0.180
	97.3	0.165	0.967		15.7	0.0111*	0.314
	116.3	0.197	0.964		23.4	0.0297*	0.505
	138.8	0.238	0.962		34.8	0.0547	0.628
	173.1	0.290	0.957		36.7	0.0634	0.644
	205.0	0.334*	0.943		77.3	0.151*	0.759
283.21	5.69	0.0062*	0.588		104.4	0.228	0.764
	9.34	0.0122	0.739		138.7	0.324*	0.751
	13.8	0.0198	0.812		170.3	0.458	0.676
	21.4	0.0335	0.874	366.32	21.1	0.005*	0.103
	32.9	0.0556	0.904		27.2	0.026*	0.243
	52.3	0.0899	0.929		45.1	0.074*	0.445
	83.6	0.149	0.938		68.1	0.138	0.542
	124.4	0.230	0.936		93.4	0.214*	0.566
	169.9	0.295	0.916		118.9	0.233*	0.505
	207.4	0.369*	0.894	394.26	39.0	0.040	0.131
310.87	7.14	0.0056*	0.259		51.0	0.088	0.215
	11.7	0.0136*	0.525		60.9	0.130	0.247
	21.9	0.0332	0.717		64.4	0.158	0.231
	40.7	0.0679	0.818		64.9	0.166	0.230

*values did not pass the Christiansen-Fredenslund consistency text, ref.(2).

AUXILLARY INFORMATION

METHOD: /APPARATUS/PROCEDURE:

Glass windowed cell fitted with two moveable pistons which enabled cell contents to be circulated in external line. Fitted with optical system which allowed measurement of refractive index. Temperature measured with iron-constantan thermocouple and pressure with strain gauge transducer. Components charged into cell and mixed by piston movement. Samples withdrawn and analysed by gas chromatography. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Stated minimum purity 99.99 mole per cent.

(2) Phillips Petroleum sample, research grade, purity better than 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} \leqslant \pm 0.3$;

δx_{N_2}, $\delta y_{N_2} = \pm 0.005$.

REFERENCES:

1. Besserer, G.J.; Rolinson, D.B.; *Can. J. Chem. Eng.* 1971, *49*, 651.
2. Christiansen, L.J.; Fredenslund, A. *Am. Inst. Chem. Eng. J.* 1975, *21*, 49.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Three butanes, see below

ORIGINAL MEASUREMENTS:

Steinbach, H.G.; Steinbrecher, M.

Chem. Tech. (Berlin) 1966, *18*, 633.

VARIABLES:

$T/K = 273-293$
$P/MPa = 0.41-1.11$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Substance	α^a
1,3-Butadiene; C_4H_6; [106-99-0]	0.33
Isobutene; C_4H_8; [115-11-7]	0.31
n-Butane; C_4H_{10}; [106-97-8]	0.29

[a] Bunsen coefficient in cm^3 (STP) cm^{-3} atm^{-1}. Average of values measured over a pressure range of 4 to 11 atm (0.41 to 1.11 MPa) and a temperature range of 0 to 20°C (273 to 293 K). The authors state that within their experimental error of ±5% that the Bunsen coefficient changes negligibly.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The nitrogen was added to a steel bomb of 800 cm^3 capacity containing the butane. Analysis after equilibration was by gas chromatography at atmospheric pressure.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.05$

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) C_5 to C_{16} Alkanes (excluding heptane)	Colin L. Young Department of Physical Chemistry University of Melbourne Parkville, Victoria 3052 Australia. October 1980

CRITICAL EVALUATION:

The solubility of nitrogen in alkanes at low pressure and the high pressure solubility in heptane are treated separately. Data on the solubility of nitrogen in alkanes at high pressure are relatively scarce and it is not possible to recommend any data. The following data are classified as tentative.

Pentane + nitrogen	Kalra, Robinson and Besserer (1)
Hexane + nitrogen	Poston and McKetta (2)
	Baranovich and Smirnova (3)
Octane + nitrogen	Baranovich and Smirnova (3)
	Graham and Weale (4)
Decane + nitrogen	Azarnoosh and McKetta (5)
Hexadecane + nitrogen	Sultanov, Skripta and Namoit (6).

The system hexane + nitrogen was also investigated by Tsiklis and Khodeeva (7) but the study was not extensive and the work is rejected for the present purpose.

References

1. Kalra, H.; Robinson, D. B.; Besserer, G. J. *J. Chem. Eng. Data* 1977, *22*, 215.

2. Poston, R. S.; McKetta, J. J. *J. Chem. Eng. Data* 1966, *11*, 364.

3. Baranovich, Z. N.; Smirnova, A. M. *Zh. Prikl. Khim.* 1972, *45*, 2776.

4. Graham, E. B.; Weale, K. E. *Progr. Internat. Res. Thermodynamic Transport Props. Symp. on Thermophysical Props.* Princeton, *153* (1962).

5. Azarnoosh, A.; McKetta, J. J. *J. Chem. Eng. Data* 1963, *8*, 494.

6. Sultanov, R. G.; Skripta, V. G.; Namoit, A. Yu. *Gazov. Delo.* 1972, *no. 10*, 43.

7. Tsiklis, D. S.; Khodeeva, S. M. *Inzh.-Fiz. Khur. Acad. Nauk. Belorus S.S.R.* 1958, *11*, 62

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) n-Pentane; C_5H_{12}; [109-66-0]

ORIGINAL MEASUREMENTS:

Kalra, H.; Robinson, D. B.;
Besserer, G. J.

J. Chem. Eng. Data 1977, *22*, 215.

VARIABLES:

T/K = 277-378
P/MPa = 0.3-20.8

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
277.43	16.63	0.025	0.981	344.26	4.14	0.0022	0.323
	41.44	0.055	0.990		8.20	0.0086	0.622
	69.22	0.104	0.988		14.20	0.019	0.770
	104.0	0.149	0.988		21.44	0.032	0.838
	138.4	0.194	0.988		30.75	0.048	0.877
	172.6	0.223	0.987		42.20	0.066	0.901
	207.3	0.251	0.985		64.33	0.104	0.924
310.70	2.50	0.0027	0.577		92.25	0.146	0.930
	4.50	0.0055	0.757		122.1	0.196	0.931
	7.79	0.011	0.856		161.7	0.252	0.930
	13.72	0.020	0.913		207.8	0.330	0.922
	21.37	0.031	0.940	377.59	8.14	0.0032	0.179
	29.03	0.043	0.950		9.93	0.0079	0.320
	41.30	0.061	0.960		12.89	0.015	0.470
	63.57	0.095	0.968		19.03	0.035	0.609
	84.25	0.125	0.970		37.37	0.071	0.774
	105.2	0.155	0.970		65.84	0.124	0.845
	125.6	0.185	0.969		105.6	0.196	0.858
	153.2	0.223	0.967		141.1	0.266	0.862
	180.9	0.258	0.964		182.3	0.339	0.852
	207.5	0.288	0.961		207.9	0.400	0.837

AUXILIARY INFORMATION

METHOD/ APPARATUS/PROCEDURE:

Glass windowed cell fitted with two moveable pistons which enabled cell contents to be circulated in external line. Fitted with optical system which allowed measurement of refractive index. Temperature measured with iron-constantan thermocouple and pressure with strain gauge transducer. Components charged into cell, mixed by piston movement. Samples withdrawn and analysed by gas chromatography. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent.

(2) Fischer Scientific pesticide grade, purity 99.9 mole per cent or better.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\mathrm{bar} = \pm 0.2$;

$\delta x_{N_2} \simeq \delta y_{N_2} = \pm 0.005$.

REFERENCES:

1. Besserer, G. J.; Robinson, D. B. *Can. J. Chem. Eng.* 1971, *49*, 651.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2-Methylbutane; C_5H_{12}; [78-78-4]

ORIGINAL MEASUREMENTS:

Krishnan, T. R.; Kalra, H.; Robinson, D. B.

J. Chem. Eng. Data 1977, *22*, 282.

VARIABLES:

T/K = 278-377
P/MPa = 0.2-20.8

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
377.37	9.69	0.0037	0.163	310.82	2.24	0.0010	0.322
	12.24	0.0085	0.310		3.28	0.0030	0.546
	17.06	0.0205	0.486		5.21	0.0062	0.725
	28.96	0.0435	0.674		8.24	0.0113	0.824
	44.51	0.0753	0.757		13.76	0.0226	0.892
	63.32	0.112	0.805		24.10	0.0373	0.931
	90.94	0.170	0.827		37.75	0.0597	0.949
	115.38	0.221	0.835		61.12	0.0970	0.962
	158.06	0.300	0.830		96.49	0.152	0.965
	207.43	0.437	0.780		132.00	0.192	0.965
344.15	5.07	0.0027	0.255		157.65	0.244	0.961
	6.45	0.0054	0.418		181.57	0.276	0.958
	9.20	0.0106	0.583		207.77	0.305	0.953
	12.10	0.0153	0.675	277.59	1.83	0.0024	0.822
	16.65	0.0238	0.752		4.55	0.0051	0.931
	26.65	0.0420	0.831		9.89	0.0151	0.968
	39.54	0.0598	0.879		19.17	0.0354	0.982
	55.47	0.0929	0.899		32.13	0.0504	0.986
	77.74	0.130	0.912		55.61	0.0866	0.991
	109.25	0.185	0.918		91.63	0.143	0.994
	138.89	0.238	0.919		130.97	0.201	0.991
	174.44	0.297	0.916		159.85	0.240	0.985
	207.78	0.350	0.905		184.33	0.260	0.987
					205.02	0.281	0.982

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cell fitted with two moveable pistons which enabled cell contents to be circulated in external line. Fitted with optical system which allowed measurement of refractive index. Temperature measured with iron-constantan thermocouple and pressure with strain gauge transducer. Components charged into cell, mixed by piston movement. Samples withdrawn and analysed by gas chromatography. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent or better.

(2) Phillips Petroleum sample, purity better than 99.99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.2$;

δx_{N_2}, $\delta y_{N_2} = \pm 0.005$.

REFERENCES:

1. Besserer, G. J.; Robinson, D. B. *Can. J. Chem. Eng.* 1971, *49*, 651.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) n-Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Poston, R. S.; McKetta, J. J.

J. Chem. Eng. Data, 1966, *11*, 364-5.

VARIABLES:

T/K = 311-444

P/MPa = 1.7-34.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen		T/K	P/bar	Mole fraction of nitrogen	
		in liquid, x_{N_2}	in vapor, y_{N_2}			in liquid, x_{N_2}	in vapor, y_{N_2}
310.93	17.24	0.026	0.958	377.55	17.24	0.023	0.789
	34.46	0.053	0.981		34.46	0.047	0.869
	68.93	0.101	0.983		68.93	0.095	0.921
	103.39	0.137	0.989		103.39	0.150	0.928
	137.85	0.155	0.985		137.85	0.199	0.928
	172.32	0.190	0.988		172.32	0.242	0.927
	206.78	0.218	0.986		206.78	0.283	0.926
	241.25	0.253	0.984		241.25	0.335	0.911
	275.72	0.290	0.983		275.72	0.380	0.899
	310.18	0.330	0.975		310.18	0.439	0.893
	344.65	0.359	0.980		344.65	0.479	0.867
344.26	17.24	0.025	0.904	410.95	17.24	0.021	0.614
	34.46	0.051	0.942		34.46	0.049	0.771
	68.93	0.099	0.964		68.93	0.105	0.835
	103.39	0.144	0.973		103.39	0.162	0.864
	137.85	0.182	0.973		137.85	0.220	0.882
	172.32	0.211	0.972		172.32	0.282	0.884
	206.78	0.244	0.964		206.78	0.342	0.884
	241.25	0.278	0.959		241.25	0.411	0.854
	275.72	0.311	0.958		275.72	0.507	0.816
	310.18	0.330	0.960		290.94	0.576	0.777
	344.65	0.391	0.958		290.87	0.601	0.772

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Stainless steel glass windowed cell; vapor recycled using high pressure magnetic pump. Pressure measured using Bourdon gauge. Temperature measured using thermocouples. Samples of both phases withdrawn at constant pressure and analysed by gas chromatography. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Dry research grade, 99.85 mole per cent.

(2) Research grade, purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/bar = \pm 0.14$;

δx_{N_2}, δy_{N_2} = ±0.002.

REFERENCES:

1. Roberts, L. R.; Azarnoosh, A.; Wang, R.; McKetta, J. J. *J. Chem. Eng. Data* 1962, *7*, 484.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2;[7727-37-9] (2) n-Hexane; C_6H_{14};[110-54-3]	Poston, R. S.; McKetta, J. J. *J. Chem. Eng. Data* 1966, *11*, 364-5.

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
444.25	34.46	0.049	0.567	444.25	172.32	0.331	0.740
	68.93	0.116	0.739		186.93	0.398	0.708
	103.39	0.192	0.765		198.65	0.485	0.693
	137.85	0.258	0.751		201.89	0.505	0.624

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) n-Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Baranovich, Z. N.; Smirnova, A. M.

Zhur. Prikl. Khim. 1972, *45*, 2776-8.

VARIABLES:

T/K = 233-293

P/MPa = 0.2-0.7

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}
233.15	2.0	0.00184
	3.0	0.00344
	5.1	0.00590
	7.1	0.00849
253.15	2.0	0.00175
	3.0	0.00241
	5.1	0.00542
	7.1	0.00755
263.15	3.0	0.00316
	7.1	0.00821
273.15	2.0	0.00175
	3.0	0.00283
	5.1	0.00462
283.15	2.0	0.00224
	7.1	0.00862
293.15	2.0	0.00224
	3.0	0.00279
	5.1	0.00583
	7.1	0.00928

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with agitator. Liquid composition determined by stripping and measuring gas volumetrically. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;

$\delta x_{N_2} = \pm 0.2 \times 10^{-4}$ (estimated by compiler).

REFERENCES:

1. Baranovich, Z. N.; Bogdanova, L. P.; Smirnova, A. M. *Zhur. Prikl. Khim.* 1969, *42*, 1393.

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Heptane; C_7H_{16}; [142-82-5]	Colin Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. August 1980

CRITICAL EVALUATION:

This system has been investigated at high pressures by four groups. The data of Boomer *et al.* (1) are restricted to a pressure of 10.22 MPa at temperatures between 298 K and 388 K. These data are in broad agreement with the results of other workers but are not considered further because of their limited nature. The data of Akers *et al.* (2) cover the temperature range 305 K to 455 K and are broadly in agreement with the data of Peter and Eicke (3) and Brunner *et al.* (4) when interpolated to 453 K. The data of Peter and Eicke (3) cover the temperature range 376 K to 453 K and that of Brunner, Peter and Wenzel (4) cover the temperature range from 453 K to 497 K. There is rather poor agreement between the two sets of data by Peter and coworkers at 453 K. (Some very small extrapolation is needed as the actual temperatures were 453.95 K and 453.15 K.) The discrepancy is particularly large in the gas phase compositions which are considerably smaller in the nitrogen mole fraction in the 1974 paper than in the 1970 paper.

The three sets of data by Akers *et al.* (2), Peter and Eicke (3) and by Brunner *et al.* (4) are all classified as tentative but the estimated errors quoted are in all three cases too small. The liquid phase compositions are probably not, in general, better than ±5% for all three sets. The data by Figuiere et al. (5) are classed as tentative.

References:

1. Boomer, E. H.; Johnson, C. A.; Piercey, G. A. *Can. J. Research* 1938, *16B*, 396.

2. Akers, W. W.; Kohn, D. M.; Kilgore, C. H. *Ind. Eng. Chem.* 1954, *46*, 2536.

3. Peter, S.; Eicke, H. F. *Ber. Bunsenges. Phys. Chem.* 1970, *74*, 190.

4. Brunner, G.; Peter, S.; Wenzel, H. *Chem. Eng. J.* 1974, *7*, 99.

5. Figuiere, P.; Hom, J.F.; Laugier, S.; Renon, H.; Richon, D.; Szwarc, H. *Am. Inst. Chem. Engnrs. J.* 1980, *26*, 872-5.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Boomer, E. H.; Johnson, C. A.; Piercey, G. A.

Can. J. Research, 1938, *16B*, 396.

VARIABLES:

T/K = 298-388
P/MPa = 10.2

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
298.15	102.2	0.120	0.9896
328.15	102.2	0.128	0.9824
		0.133	0.9825
358.15	102.2	0.1396	0.9756
		0.1396	0.9746
388.15	102.2	0.1498	0.9495

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking autoclave stirred by steel piston falling under gravity. Samples of vapor and liquid trapped in two auxiliary high pressure cells. Equilibrium samples analysed in complicated volumetric and combustion apparatus. Details in refs. 1 and 2.

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} \pm 0.2$;

δx_{N_2}, δy_{N_2} ± 1% (estimated by compiler)

REFERENCES:

1. Boomer, E. H.; Johnson, C. A.; Argue, G. H. *Can. J. Res. B* 1937, *15*, 367.
2. Boomer, E. H.; Johnson, C. A. *Can. J. Res. B* 1937, *15*, 363.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Akers, W. W.; Kohn, D. M.;
Kilgore, C. H.

Ind. Eng. Chem., 1954, *46*, 2536.

VARIABLES:

T/K = 305-455
P/MPa = 7.0-69.1

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
305.37	71.02	0.080	0.99276	352.59	553.30	0.547	0.9592
	105.15	0.128	0.9900		691.20	0.705	0.9412
	122.31	0.145	0.9961	399.82	73.08	0.116	0.9652
	122.31	0.151	0.9975		139.41	0.213	0.9645
	139.41	0.152	0.9880		208.36	0.301	0.9772
	158.65	0.170	0.9950		277.65	0.387	0.9704
	184.16	0.201	0.9940		450.57	0.634	0.9463
	208.36	0.215	0.9950		518.83	0.721	0.828
	229.53	0.244	0.9900		518.83	0.711	0.828
	243.04	0.236	0.9930		551.93	0.723	0.834
	276.96	0.266	0.9921		620.87	0.753	-
	346.46	0.318	0.9893	455.37	77.98	0.128	0.9353
	415.75	0.363	0.9861		173.75	0.321	0.9486
	553.30	0.437	0.9782		243.04	0.442	0.9506
	691.20	0.505	0.9700		243.04	0.428	0.9541
352.59	70.33	0.096	0.9822		277.65	-	0.9379
	145.55	0.187	0.9882		277.65	0.554	-
	208.36	0.247	0.9869		309.92	-	0.818
	277.65	0.291	0.9846		435.96	0.752	-
	415.75	0.433	0.9757				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Vapor flow apparatus with vapor recirculating via external loop. Equilibrium established with fixed quantity of vapor and liquid. Phases analysed by thermal conductivity. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Dry, purity greater than 99.99 mole per cent.

(2) Phillips Petroleum Co. research grade, purity 99.58 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/\text{bar} = \pm 0.3$;

δx_{N_2}, δy_{N_2} = ± 0.001.

REFERENCES:

1. Akers, W. W.; Burns, J. F.; Fairchild, W. R. *Ind. Eng. Chem.* 1954, *46*, 2531.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Peter, S.; Eicke, H. F.

Ber. Bunsenges, Phys. Chem. 1970, *74*, 190.

VARIABLES:

T/K = 376-453
P/MPa = 0.5-61.3

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
376.35	24.5	0.0362	0.951	413.15	240.3	0.372	0.961
	49.0	0.0747	0.976		343.2	0.528	0.941
	147.1	0.217	0.973		392.3	0.639	0.861
	294.2	0.392	0.975		411.9	0.686	0.816
	392.3	0.500	0.981		416.8	0.742	-
	490.3	0.597	0.974	452.95	19.6	0.0266	0.671
	588.4	0.726	0.954		49.0	0.0831	0.852
	612.9	0.780	0.924		88.3	0.157	0.935
413.15	4.9	-	0.870		132.4	0.232	0.945
	7.8	-	0.910		215.7	0.378	0.956
	19.6	0.0323	0.923		274.6	0.502	0.925
	39.2	0.0667	0.946		304.0	0.673	0.790
	85.3	0.143	0.948		313.8	0.742	0.812
	142.2	0.234	0.955				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Details of apparatus in ref. 1. Temperature measured with platinum resistance thermometer. Cell contents stirred with magnetic stirrer. Cell contents equilibrated, sample removed at various levels in cell. Sample analysed by freezing out the hydrocarbon in an acetone/CO_2 trap and weighing. Nitrogen estimated volumetrically. Critical data in source reference.

SOURCE AND PURITY OF MATERIALS:

(1) Linde sample, purity 99.99 mole per cent.

(2) Phillips Petroleum Co. "Pure" grade, purity > 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/bar = \pm 0.5$;

$\delta x_{N_2} = \pm 0.003$; $\delta y_{N_2} = \pm 0.007$.

REFERENCES:

1. Peter, S.; Reinhartz, K. *Z. physik. Chem. NF* 1960, *24*, 103.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

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

ORIGINAL MEASUREMENTS:

Brunner, G.; Peter, S.; Wenzel, H.
Chem. Eng. J. 1974, *7*, 99.

VARIABLES:

T/K = 453-497
P/MPa = 0.5-27.8

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
453.15	53	0.101	0.827
	93	0.164	0.885
	127	0.222	0.903
	138	0.244	0.910
	190	0.328	0.882
	227	0.397	0.881
	278	0.543	0.851
472.15	44	0.075	0.735
	97	0.188	0.820
	164	0.347	0.838
	168	0.396	0.836
	187	0.416	0.837
	218	0.578	0.790
	234	0.586	0.771
497.15	48	0.087	0.598
	76	0.173	0.706
	109	0.281	0.717
	120	0.322	0.730
	142	0.403	0.721
	158	0.461	0.737
	183	0.588	0.602

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell of about 1000 cm^3 capacity magnetically stirred. Pressure measured with Bourdon gauge. Temperature measured with nickel-chromium alloy-nickel thermocouple. Each phase sampled, n-heptane frozen and amount estimated, nitrogen estimated volumetrically.

SOURCE AND PURITY OF MATERIALS:

(1) Linde sample, purity 99.98 mole per cent by gas chromatography.

(2) Fluka sample, purity 99.7 mole per cent by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\text{bar} = \pm 0.5$; δx_{N_2}, $\delta y_{N_2} = \pm 0.5\%$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Heptane; C_7H_{16}; [142-82-5]	Figuiere, P.; Hom, J. F.; Laugier, S.; Renon, H.; Richon, D.; Szwarc, H. *Am. Inst. Chem. Engnrs. J.* 1980, *26*, 872-5.
VARIABLES: T/K = 453-497 P/MPa = 1-29	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}	T/K	P/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
453.2	29.45	0.67	0.69	463.2	6.0	0.11	0.75(5)
	27.65	0.56	0.79(5)		4.3	0.07	0.69
	25.05	0.49#	0.84		3.55	0.06#	0.65
	22.3	0.43	0.86#		3.15	0.05(5)	0.61(5)
	20.1	0.39	0.87		2.1	0.02(7)#	0.48(5)
	16.1	0.305	0.88		1.2	0.008	0.170
	11.6	0.215	0.87	497.2*	13.05	0.33	0.69
	9.15	0.16(8)#	0.86(5)		11.1	0.25	0.70
	7.2	0.12	0.85		9.75	0.23	0.69
	5.6	0.09(8)#	0.83(5)		8.05	0.18	0.68#
	3.7	0.06(2)#	0.77		7.8	0.17	0.67(5)
	2.65	0.04#	0.67		6.05	0.12	0.61(5)
	2.55	0.04#	0.66		4.35	0.08	0.56
	2.1	0.03#	0.61		3.1	0.04#	0.43(5)
	1.75	0.02(3)#	0.54(5)	497.2**	2.8	0.03	0.38
	1.55	0.01(8)#	0.47(5)		3.75	0.06(3)#	0.48
463.2	23.85	0.63	0.68(5)		4.95	0.09(4)#	0.57
	20.55	0.46	0.80(5)		6.75	0.14(2)#	0.63(5)
	18.65	0.40	0.80(5)		8.6	0.19(2)#	0.69(5)
	16.55	0.35	0.80		14.05	0.36(5)	0.66(5)
	13.9	0.30	0.80(5)		14.65	0.41	0.65
	12.5	0.26(2)	0.80(5)		15.05	0.44	0.62(5)
	9.45	0.19	0.80(5)		15.48	0.49	0.59

* first set of experiments; ** second set of experiments; # smoothed values. Values in parentheses are uncertain.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Static equilibrium cell fitted with sampling valves which removed samples of 10^{-9} m^3. Samples analysed by gas chromatography. Temperature measured using thermocouples and pressure measured using pressure transducer calibrated against a dead weight gauge.	(1) Certified purity 99.9 mole per cent. (2) Certified purity 99 mole per cent as determined by GC.
	ESTIMATED ERROR: $\delta T/K = \pm 0.5$; $\delta P/MPa = \pm 0.04$; δx_{N_2}, δy_{N_2} = ±0.015.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) n-Octane; C_8H_{18}; [111-65-9]	Graham, E. B.; Weale, K. E. *Progr. Internat. Res. Thermodynamic and Transport Properties, Symposium on Thermophysical Properties* Princeton, 1962, 153.
VARIABLES: T/K = 323-373 P/MPa = 10.1-30.4	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
323.15	101.3	0.117	-	348.15	253.3	0.257	-
	126.7	0.143	-		278.6	0.277	-
	152.0	0.166	0.9975		283.7	-	0.9938
	177.3	0.188	-		304.0	0.296	-
	202.7	0.209	-	373.15	50.7	0.070	-
	228.0	0.229	-		76.0	0.102	-
	253.3	0.249	-		101.3	0.132	-
	278.6	0.267	-		121.6	-	0.9908
	283.7	-	-		126.7	0.160	-
	304.0	0.285	0.9969		152.0	0.186	0.9903
348.15	101.3	0.122	-		177.3	0.210	-
	126.7	0.148	-		202.7	0.234	0.989
	152.0	0.172	0.995		228.0	0.257	-
	177.3	0.194	-		243.2	-	0.9885
	202.7	0.216	0.9948		253.3	0.278	-
	228.0	0.237	-		283.7	-	0.989
	243.2	-	0.9945				

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Equilibrium vessel made of beryllium copper of 200 cm^3 capacity attached to small sampling vessel. Pressure measured with Bourdon gauge, oil thermostat, magnetic stirrer in equilibrium vessel. Solvent introduced into equilibrium vessel, compressed gas admitted and equilibrated. Samples analysed by gravimetric (liquid) and volumetric (gas) techniques. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample purity 99.95 mole per cent.

(2) Dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{N_2} = \pm 1\%$; $\delta y_{N_2} = \pm 0.1\%$.

REFERENCES:

1. Graham, E. B., *Ph.D. Thesis, University of London*, 1958.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) n-Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Baranovich, Z. N.; Smirnova, A. M.
Zhur. Prikl. Khim. 1972, *45*, 2776-8.

VARIABLES:

T/K = 233-293
P/MPa = 0.2-0.7

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}
233.15	2.0	0.00109
	3.0	0.00182
	5.1	0.00487
	7.1	0.00720
253.15	2.0	0.00131
	3.0	0.00233
	5.1	0.00465
	7.1	0.00749
263.15	2.0	0.00109
	3.0	0.00211
	5.1	0.00436
	7.1	0.00728
273.15	2.0	0.00116
	3.0	0.00218
	5.1	0.00473
	7.1	0.00785
293.15	2.0	0.00160
	3.0	0.00236
	5.1	0.00436
	7.1	0.00762

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with agitator. Liquid composition determined by stripping and measuring gas volumetrically. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$;
$\delta x_{N_2} = \pm 0.2 \times 10^{-4}$ (estimated by compiler).

REFERENCES:

1. Baranovich, Z. N.; Bogdanovo, L. P. Smirnova, A. M. *Zhur. Prikl. Khim.* 1969, *42*, 1393.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2,2,4-Trimethylpentane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Graham, E. B.; Weale, K. E.
Progr. Internat. Res. Thermodynamic and Transport Properties, Symposium on Thermophysical Properties
Princeton, 1962, 153.

VARIABLES:

$T/K = 323-423$
$P/MPa = 0.1-30.4$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
323.15	1.0	0.00159	-	348.15	177.3	0.252	-
	30.4	0.048	-		202.7	0.280	0.9875
	50.7	0.079	-		228.0	0.307	-
	101.3	0.149	-		253.3	0.331	0.9855
	121.6	-	0.9942		283.7	-	0.9844
	152.0	0.213	0.9951		304.0	0.396	-
	202.7	0.268	0.9962	423.15	50.7	0.092	-
	228.0	0.292	-		101.3	0.171	-
	253.3	0.314	0.9944		152.0	0.243	0.980
	278.6	0.333	-		177.3	0.278	-
	304.0	0.348	-		202.7	0.311	0.9805
348.15	50.7	0.083	-		228.0	0.343	-
	101.3	0.155	-		253.3	0.374	0.980
	152.0	0.221	0.9895		304.0	0.430	-

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Equilibrium vessel made of beryllium copper of 2×10^5 mm^3 capacity attached to small sampling vessel. Pressure measured with Bourdon gauge; oil thermostat, magnetic stirrer in equilibrium vessel. Solvent introduced into equilibrium vessel, compressed gas admitted and equilibrated. Samples analysed by gravimetric (liquid) and volumetric (gas) techniques. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.95 mole per cent.

(2) Distilled and dried.

ESTIMATED ERROR:

$\delta T/K = \pm0.1$; $\delta P/bar = \pm0.5$;
$\delta x_{N_2} = \pm1\%$; $\delta y_{N_2} \simeq \pm0.1\%$.

REFERENCES:

1. Graham, E. B. *Ph.D. Thesis, University of London*, 1958.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2,2,4-Trimethylpentane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Peter, S.; Ficke, H. F.
Ber. Bunsenges. Phys. Chem. 1970, *74*, 190.

VARIABLES:

T/K = 376-453
P/MPa = 2.0-61.8

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
376.45	19.6	0.0284	0.950
	49.0	0.0723	0.970
	98.1	0.143	0.976
	245.2	0.335	0.976
	392.3	0.485	0.980
	490.3	0.578	0.965
	588.4	0.704	0.932
	617.8	0.748	0.870
413.15	19.6	0.0301	0.866
	49.0	0.0827	0.942
	107.9	0.182	0.950
	196.1	0.306	0.956
	294.2	0.447	0.959
	382.5	0.573	0.940
	402.1	0.603	0.917
	416.8	0.706	0.849
452.95	19.6	0.0267	0.653
	49.0	0.0890	0.876
	98.1	0.181	0.934
	196.1	0.336	0.942
	274.6	0.469	0.919
	304.0	0.619	0.877
	313.8	0.730	0.836

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Temperature measured with platinum resistance thermometer. Cell contents stirred with magnetic stirrer. Cell contents equilibrated. Sample removed at various levels in cell. Sample analysed by freezing out the hydrocarbon in an acetone/carbon dioxide trap and weighing. Nitrogen estimated volumetrically. Details in ref. 1. Critical data in source ref.

SOURCE AND PURITY OF MATERIALS:

(1) Linde sample, purity 99.99 mole per cent.

(2) Shell AG sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.5$;
$\delta x_{N_2} = \pm 0.003$; $\delta y_{N_2} = \pm 0.007$.

REFERENCES:

1. Peter, S.; Reinhartz, K.
Z. Phys. Chem. N.F. 1960, *24*, 103.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Azarnoosh, A.; McKetta, J. J.

J. Chem. Eng. Data <u>1963</u>, *8*, 494.

VARIABLES:

$T/K = 311\text{-}411$
$P/MPa = 0.3\text{-}34.5$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
310.9	5.5	-	0.99676	310.9	234.4	0.2710	0.99870
	6.9	-	0.99776		234.4	0.2690	0.99950
	10.3	-	0.99756		248.2	0.2822	0.99930
	13.8	-	0.99940		275.8	0.2990	0.99850
	17.2	-	0.99964		275.8	0.3050	0.99960
	27.58	0.0385	-		275.8	0.3030	0.99870
	34.47	0.0482	0.9977		293.0	0.3180	0.99860
	46.88	0.0665	0.9993		324.1	0.3380	-
	51.71	0.0710	0.99976		344.7	0.3550	0.99680
	55.16	0.0735	-	344.3	6.9	-	0.9928
	55.16	0.0763	0.99972		10.3	-	0.9970
	68.95	0.0930	0.9997		13.8	-	0.9967
	72.39	0.1000	-		17.2	-	0.99923
	93.08	0.1242	0.99971		28.96	0.0422	-
	96.53	0.1268	0.99940		34.47	0.0513	0.9990
	117.21	0.1530	0.99940		48.26	0.0602	0.9993
	131.00	0.1715	0.99920		55.16	0.0780	-
	144.79	0.1875	0.99974		62.05	0.0890	-
	165.4	0.2130	0.99840		65.50	0.0912	0.99775
	165.4	0.2110	0.99959		82.74	0.1130	0.99910
	172.4	0.2130	0.99920		86.18	0.1186	0.9970
	182.7	0.2280	0.99980		117.21	0.1713	0.99896

(cont.)

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Stirred, static cell with windows. Pressure measured with Bourdon gauge. Cell charged with components and equilibrated. Samples analysed using gas chromatography. Details in source ref.

SOURCE AND PURITY OF MATERIALS:

(1) Minimum purity 99.9 mole per cent.

(2) Phillips Petroleum Co., research grade, purity $\geq$ 99.43 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.3$;
$\delta x_{N_2} = \pm 0.002$; $\delta y_{N_2} = \pm 0.001$ to 0.00001.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Azarnoosh, A.; McKetta, J. J.
J. Chem. Eng. Data <u>1963</u>, *8*, 494.

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
344.3	120.66	0.1630	0.99900	377.6	172.4	0.2350	0.99550
	120.66	0.1700	-		186.2	0.2410	0.99330
	137.90	0.1980	0.99871		189.6	0.2410	0.9958
	144.79	0.1935	0.99841		206.8	0.260	0.9956
	172.4	0.2190	-		227.5	0.2760	-
	172.4	0.2280	0.99817		234.4	0.2850	0.9951
	179.3	0.2270	0.99819		258.6	0.3070	0.9950
	193.1	0.2440	0.99844		268.9	0.3130	0.9945
	206.8	0.2590	0.99824		275.8	0.3230	0.9955
	206.8	0.2510	0.99845		293.0	0.3330	0.99312
	224.0	0.2755	0.99850		310.3	0.3420	0.9942
	234.4	0.2780	-		327.5	0.3650	0.9932
	241.3	0.2910	0.99802		341.3	0.370	0.9923
	258.5	0.3010	0.99757	410.9	2.8	-	0.6640
	282.7	0.3270	0.99744		4.1	-	0.8140
	293.0	0.3339	0.99649		5.5	-	0.8536
	296.5	0.3350	0.99846		6.9	-	0.9030
	310.3	0.3500	0.99660		10.3	-	0.9506
	324.1	0.3590	0.99734		17.2	0.0329	0.9268
	337.8	0.3730	0.99660		34.5	0.0550	0.98990
	344.7	0.3630	0.99500		55.2	0.0925	0.99365
377.6	5.5	-	0.9797		62.1	0.0966	-
	6.9	-	0.9847		68.9	0.1064	0.9938
	13.8	-	0.9943		93.1	0.1365	0.9910
	20.7	0.0350	0.9962		103.4	0.1520	0.99354
	34.5	0.0575	0.9965		134.4	0.1930	0.99302
	51.7	0.0682	0.9970		148.2	0.2150	-
	55.2	0.0804	-		172.4	0.2380	0.9932
	62.1	0.0925	0.9970		172.4	0.2420	0.9924
	68.9	0.1070	0.9967		203.4	0.2670	0.99336
	75.8	0.1075	0.99617		213.7	0.2770	0.9940
	96.5	0.1360	0.9939		224.1	0.2800	0.9924
	103.4	0.1520	0.99679		241.3	0.297	0.9920
	110.3	0.1590	0.99788		262.0	0.3245	0.9914
	131.0	0.1860	-		275.8	0.3320	0.9906
	137.9	0.1990	0.99614		293.0	0.3510	0.9902
	144.8	0.2030	0.99612		306.8	0.3600	-
	158.6	0.2180	0.9963		324.1	0.3820	0.9883
	158.6	0.2170	0.9870		324.1	0.3770	-
	158.6	0.2170	0.99590		344.7	0.3980	0.9860

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) n-Dodecane; $C_{12}H_{26}$; [112-40-3]

ORIGINAL MEASUREMENTS:

Rupprecht, S. D.; Faeth, G.M.

NASA CR 1981, NASA-CR-3422, 111 pp.

Chem. Abstr. 1981, 95, 153333x.

VARIABLES:

$T/K = 297\text{-}373$
$P/MPa = 1\text{-}10$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	P^a/MPa	x_1
300.15	1.03	0.0146
373.15	1.03	0.0143
298.15	2.07	0.0265
373.15	2.07	0.0296
297.15	4.82	0.0616
373.15	4.82	0.0685
297.15	10.34	0.1319
373.15	10.34	0.1404

[a] Total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A 1000 cm^3 chamber is filled with ca. 500 cm^3 of liquid. Gas is added to the desired pressure. The chamber is agitated to attain equilibrium. Temperatures are read via thermocouples and pressures via Heisse bourdon tube gages. A liquid sample is removed and allowed to de-pressurize at atmospheric pressure. The solubility is calculated from the measurement of liquid and gas volumes of the de-pressurized sample. Residual dissolved gas is considered to be negligible

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm 0.03$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Sultanov, R. G.; Skripka, V. G.; Namiot, A. Yu., *Gazov. Delo.*, 1972, *10*, 43-6.

Chem. Abstr. 1974, *80*, 38956f

VARIABLES:

T/K = 323-523
P/MPa = 5-49

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
323.15	49	0.073	-	473.15	490	0.527	-
	98	0.135	-	523.15	49	0.1135	0.985
	196	0.223	-		98	0.199	0.99
	294	0.282	-		196	0.369	0.99
	392	0.326	-		294	0.4315	0.9885
	490	0.360	-		392	0.516	0.985
373.15	49	0.078	-		441	0.555	0.9845
	98	0.142	-		490	0.593	0.983
	196	0.239	-	573.15	49	0.127	0.9595
	294	0.306	-		98	0.228	0.973
	392	0.364	-		196	0.373	0.980
	490	0.413	-		294	0.492	0.973
423.15	49	0.093	-		392	0.598	0.966
	98	0.158	-		490	0.6945	0.959
	196	0.253	-		539	0.738	0.948
	294	0.331	-		588	0.780	0.924
	392	0.399	-	523.15	49	0.150	0.902
	490	0.460	-		98	0.2695	0.929
473.15	49	0.1015	-		196	0.44	0.935
	98	0.176	-		294	0.608	0.930
	196	0.287	-		392	0.837	0.869
	294	0.377	-		393.7	0.855	0.855
	392	0.455	-				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetic stirrer, details in ref. 1. Samples of coexisting phases analysed by freezing out n-hexadecane and estimating nitrogen volumetrically.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) "Pure sample"; boiling point 286.3-287.3 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$; $\delta P/\text{bar} = \pm 1$;

$\delta x_{N_2} \simeq \delta y_{N_2} = \pm 0.002$ (estimated by compiler).

REFERENCES:

1. Sultanov, R. G.; Skripka, V. G.; Namiot, A. Yu. *Gazov. Prom.* 1971, *16* (4), 6.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Cyclohexane; C_6H_{12}; [110-82-7]	Khodeeva, S.M. *Tr. Naucho-Issledov. Proekt. Inst. Azotn. Prom. Prod. Org. Sin.* 1971, *12*, 30-9.
VARIABLES:	PREPARED BY:
T/K = 373-433 P/MPa = 5-10	C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	α^+/cm^3g^{-1}	Mole fraction of nitrogen in liquid, x_{N_2}
373.15	78.2	7.92	21.0	0.073
	84.2	8.53	23.1	0.080
	88.8	9.00	24.3	0.084
	94.2	9.54	26.0	0.089
	101.6	10.29	28.5	0.097
403.15	46.9	4.75	12.5	0.045
	49.8	5.05	13.9	0.050
	53.0	5.37	14.8	0.053
	62.2	6.30	17.5	0.064
	69.2	7.01	19.8	0.069
	76.7	7.77	22.4	0.078
	79.2	8.02	22.8	0.079
	83.2	8.43	24.7	0.085
	99.7	10.10	29.5	0.100
433.15	64.9	6.58	20.6	0.072
	69.4	7.03	21.2	0.074
	73.6	7.46	24.6	0.084
	80.7	8.18	26.9	0.092
	88.6	8.98	28.3	0.096

+ α = Volume of gas, measured at 273.15 K and 101.3 kPa pressure dissolved by 1g of solvent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which saturated liquid sample was stripped of gas under reduced pressure. Amount of liquid in sample determined by weighing. Amount of dissolved gas determined by measuring the volume at a known temperature and pressure. Some details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Specially purified sample, less than 0.005 volume per cent.

(2) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/atm = \pm 0.2$
$\delta x_{N_2} = \pm 1\%$.

REFERENCES:

1. Khodeeva, S.M.; Dymova, R.P. *Tr. Naucho-Issledov.Proekt.Inst. Azotn.Prom. Prod. Org. Sin.* 1971, *12*, 39.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Wild, J.D.; Sridhar, T. Potter, O.E.

Chem. Eng. J. 1978, *15*, 209-14.

VARIABLES:

T/K = 300-443

P/MPa = 0.1-1.9

PREPARED BY:

C. L. Young, R. Battino

EXPERIMENTAL VALUES:

t/°C	T/K	Pressure range (psi gauge)	10^4Henry's Law Constant /atm^{-1}	10^4 x Mole fraction x_{N_2} §
35	308	110-260	8.11	0.1233
80.5	353.7	110-258	9.461	0.1057
110	383	110-255	10.7	0.0935
133	406	110-242	11.4	0.0877
150	423	102-260	12.7	0.0787
170	443	152-268	12.9	0.0775
26.5	299.7	0+	7.82	0.1279
35	308.0	0+	8.17	0.1224
45	318.0	0+	8.32	0.1202
59.5	332.5	0+	8.94	0.1119

\+ Solubilities determined by gas chromatography

§ Calculated mole fraction at 1 atm partial pressure assuming Henry's law obeyed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Liquid saturated with gas and after equilibrium established samples removed and analysed by a volumetric method. Allowance was made for the vapor pressure of the liquid and the solubility of the gas at atmospheric pressure. Details in source and ref. (1). In chromatographic method samples of cyclohexane saturated with nitrogen were analysed on a molecular sieve column using helium carrier gas and a thermal conductivity detector.

SOURCE AND PURITY OF MATERIALS:

(1) High purity, oxygen free.
(2) Distilled, boiling point 80.7°C Chromatographic analysis revealed 0.1 mole per cent of hydrocarbon impurity. Refractive index of 1.4201.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{N_2} = \pm 1.0\%$

REFERENCES:

1. Frolich, P.K.; Tauch, E.J.; Hogan, J.J.; Peer, A.A.

Ind. Eng. Chem. 1931, *23*, 548.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methylcyclohexane; C_7H_{14};
[108-87-2]

ORIGINAL MEASUREMENTS:

Peter, S.; Eicke, H. F.

Ber. Bunsenges. Phys. Chem. 1970, *74*, 190.

VARIABLES:

T/K = 376-453
P/MPa = 2.0-88.2

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
376.45	29.4	0.0293	0.949
	49.0	0.0488	0.966
	294.2	0.281	0.976
	490.3	0.428	0.976
	686.5	0.531	0.973
	882.6	0.630	0.975
413.15	19.6	0.0217	0.856
	49.0	0.0589	0.935
	294.2	0.331	0.959
	490.3	0.511	0.963
	686.5	0.648	0.967
	882.6	0.759	0.965
452.95	29.4	0.0340	0.762
	49.0	0.0630	0.856
	98.1	0.139	0.934
	294.2	0.387	0.950
	490.3	0.596	0.953
	637.4	0.730	0.929
	676.7	0.791	0.900
	686.5	0.809	0.846

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Temperature measured with platinum resistance thermometer. Cell contents stirred with magnetic stirrer. Cell contents equilibrated, sample removed at various levels in cell. Sample analysed by freezing out the hydrocarbon in an acetone/carbon dioxide trap and weighing. Nitrogen estimated volumetrically. Details in ref. 1. Critical data in source ref.

SOURCE AND PURITY OF MATERIALS:

(1) Linde sample, purity 99.99 mole per cent.

(2) Phillips Petroleum pure grade sample, minimum purity 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.5$; $\delta x_{N_2} = \pm 0.003$; $\delta y_{N_2} = \pm 0.007$.

REFERENCES:

1. Peter, S; Reinhartz, K.
Z. Phys. Chem., N.F. 1960, *24*, 103.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methylcyclohexane; C_7H_{14}; [108-87-2]

ORIGINAL MEASUREMENTS:

Brunner, G.; Peter, S.; Wenzel, H.
Chem. Eng. J. 1974, *7*, 99.

VARIABLES:

T/K = 453-492
P/MPa = 5.2-37.1

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
453.15	85	0.102	0.882
	130	0.174	0.905
	141	0.178	0.911
	271	0.335	0.904
	371	0.433	0.866
472.15	67	0.082	0.835
	84	0.120	0.862
	139	0.184	0.866
	151	0.216	0.883
	212	0.285	0.874
	281	0.395	0.855
	320	0.483	0.843
492.15	52	0.064	0.699
	102	0.146	0.791
	153	0.235	0.818
	209	0.346	0.825
	221	0.383	0.818
	245	0.488	0.796
	256	0.470	0.806
	277	0.650	0.698
	290	0.629	0.658

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell of about 1000 cm^3 capacity, magnetically stirred. Pressure measured with Bourdon gauge. Temperature measured with nickel chromium alloy-nickel thermocouple. Each phase sampled; methylcyclohexane frozen and amount estimated; nitrogen estimated volumetrically.

SOURCE AND PURITY OF MATERIALS:

(1) Linde sample; purity 99.98 mole per cent by gas chromatography.

(2) Fluka sample; purity 99.4 mole per cent by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\text{bar} = \pm 0.5$;

$\delta x_{N_2}, \delta y_{N_2} = \pm 5\%$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Miller. P.; Dodge, B.F.

Ind. Eng. Chem. 1940, *32*, 434-8.

VARIABLES:

$T/K = 303-423$
$P/MPa = 6.2-30.7$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	Mole fraction of Nitrogen Liquid, x_{N_2}	 Vapor, y_{N_2}
303.15	120.7	0.0509	
	218.1	0.08345	
	297.5	0.1051	
348.15	61.3	0.0345	0.97547
	109.0	0.0598	0.98022
	155.5	0.08165	0.98048
	208.0	0.1062	0.97953
	252.2	0.1265	0.97767
	298.4	0.1458	0.97547
373.15	61.9	0.0396	0.9534
	106.3	0.0663	0.96265
	155.5	0.0945	0.96547
	198.3	0.1165	0.96383
	269.0	0.1550	-
	301.6	0.1750	-
398.15	63.6	0.0430	0.9168
	103.6	0.0711	0.9347
	151.4	0.1037	0.9406
	201.5	0.1388	0.93945
	201.5	0.1379	0.9409
	251.0	0.1716	0.9391
	303.1	0.2044	0.93495
423.15	297.0	0.2396	-

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Single pass flow system. Nitrogen bubbled through a series of three pressure cylinders, two being presaturators the third being an equilibrium cell which was continually agitated. Gas phase analysed by freezing out benzene and estimating nitrogen volumetrically. Liquid sample analysed using same principle.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample.

(2) Merck C.P. grade, thiophene-free fractionally crystallized, distilled and dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{atm} = \pm 0.2$; $\delta x_{N_2} = \pm 0.0005$; $\delta y_{N_2} = \pm 0.0001$.
(estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen, N_2; [7727-37-9]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Krichevskii, I. R.; Efremova, G. D.
Zhur. Fiz. Khim. 1948, *22*, 1116.

VARIABLES:

T/K = 288
P/MPa = 2.7-78.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}
288.15	27.2	0.0116
	50.0	0.0204
	99.1	0.0395
	143.9	0.0547
	196.6	0.0717
	260.4	0.0886
	306.0	0.100
	482.3	0.139
	543	0.150
	570	0.154
	785	0.191

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetic stirrer. Pressure measured with Bourdon gauge. Sample of liquid analysed by separating the two components, weighing the benzene and estimating the nitrogen volumetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Dried.

(2) Dried and purified by fractional crystallisation; final purity 99.65 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = 0.35\%$;
$\delta x_{N_2} = \pm 0.5\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Tsiklis, D.S.; Shenderei, L.I.; El'natanov, A.I.

Khim Prom. 1963, 348-53.

Khim. Promysl. 1963, 348-53.

Chem. Abstr. 1963, *59*, 14647F.

VARIABLES:

T/K = 473-548

P/MPa = 1.5-40.5

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

		Mole fraction in gas $x_{C_7H_8}$					Mole fraction in liquid $x_{C_7H_8}$				
P^a/MPa	P/atm	205°C (478K)	215°C (488K)	225°C (498K)	250°C (523K)	275°C (548K)	205°C (478K)	215°C (488K)	225°C (498K)	250°C (523K)	275°C (548K)
1.52	15	0.610	0.700	0.775			0.995	0.992	0.995		
2.53	25	0.430	0.500	0.575	0.705	0.905	0.985	0.980	0.985	0.990	0.995
4.05	40	0.305	0.350	0.410	0.500	0.675	0.965	0.965	0.970	0.965	0.970
6.08	60	0.225	0.260	0.310	0.360	0.495	0.945	0.945	0.945	0.940	0.940
8.11	80	0.165	0.200	0.215	0.275	0.330	0.920	0.925	0.920	0.910	0.940
10.13	100	0.300	0.160	0.155	0.220	0.225	0.900	0.900	0.895	0.880	0.908
15.20	150	0.075	0.105	0.125	0.170	0.260	0.845	0.895	0.840	0.800	0.775
20.27	200	0.070	0.085	0.105	0.155	0.275	0.790	0.785	0.765	0.735	0.695
25.33	250	0.065	0.090	0.115	1.175[b]	0.400	0.745	0.725	0.700	0.665	0.600
30.40	300	0.065	0.105	0.115	0.195		0.695	0.675	0.645	0.590	
40.53	400	0.115	0.175	0.240			0.580	0.560	0.500		

[a] Calculated by compiler.

[b] Probably 0.175.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility was measured in a thermostatted autoclave. Samples of solution and gas phase were analyzed for nitrogen and toluene (1).

SOURCE AND PURITY OF MATERIALS:

(1) Purified from oxygen by ammoniacal copper solution.

(2) Purified by extraction with H_2SO_4, Na amalgam and water. Dried with P_4O_{10}.

ESTIMATED ERROR:

$\delta x/x = \pm 0.03$, compiler's estimate.

REFERENCES:

(1) Tsiklis, D.S.; Kofman, A.M., *Russ. J. Phys. Chem.* 1961, *35*, 1120.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Krichevskii, I.R.; Lebedeva, E.S.

Zhur. Fiz. Khim. 1947, *21*, 715-7.

VARIABLES:

T/K = 273-343
P/MPa = 4.9-30.0

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}
273.15	49.0	0.0109
	99.1	0.0211
	147	0.0304
	197	0.0391
298.15	49.0	0.0116
	99.1	0.0229
	147	0.0321
	197	0.0418
	245	0.0505
323.15	49.0	0.0123
	99.1	0.0243
	147	0.0346
	197	0.0452
	245	0.0542
	295	0.0634
343.15	49.0	0.0131
	99.1	0.0260
	147	0.0373
	197	0.0489
	245	0.0598
	284	0.0687

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not clear from original paper.

SOURCE AND PURITY OF MATERIALS:

(1) Contained 0.4 mole per cent oxygen.

(2) Purity better than 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.5\%$; $\delta x_{N_2} = \pm 1\%$. (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ethanol; C_2H_6O; [64-17-5]	Frolich, P. K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A. *Ind. Eng. Chem.* 1931, *23*, 548-50.
VARIABLES: T/K = 298 P/MPa = 1-17	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility*, S	Mole fraction of nitrogen† x_{N_2}
298.15	1.0	1.2	0.0029
	2.0	2.3	0.0055
	3.0	3.3	0.0079
	4.0	4.2	0.0100
	5.0	5.15	0.0122
	6.0	6.05	0.0143
	7.0	7.0	0.0165
	8.0	7.95	0.0187
	9.0	8.9	0.0209
	10.0	9.85	0.0231
	11.0	10.85	0.0254
	12.0	11.85	0.0276
	13.0	12.8	0.0298
	14.0	13.7	0.0318
	15.0	14.5	0.0336
	16.0	15.4	0.0356
	17.0	16.2	0.0374

* Data taken from graph in original article. Volume of gas measured at 101.325 kPa pressure and 298.15 K dissolved by unit volume of liquid measured under the same conditions.

† Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Liquid saturated with gas and after equilibrium established samples removed and analysed by volumetric method. Allowance was made for vapor pressure of liquid and the solubility of the gas at atmospheric pressure. Details in source.

SOURCE AND PURITY OF MATERIALS:

Stated that the materials were the highest purity available.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2} = \pm 5\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 4-Methyl-1,3-dioxolan-2-one (Propylene carbonate); $C_4H_6O_3$; [108-32-7]

ORIGINAL MEASUREMENTS:

Shakhova, S. F.; Zubchenko, Yu. P.; Kaplan, L. K.

Khim. Prom. 1973, *49*, 108.

VARIABLES:

T/K = 283-323
P/MPa = 6.4-12.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	vol$^{\alpha *}$/vol
283.15	66.67	0.00849	2.25
	83.39	0.0104	2.76
	90.28	0.0111	2.95
	95.14	0.0115	3.06
	107.91	0.0130	3.46
298.15	63.73	0.00886	2.35
	75.49	0.0101	2.68
	77.92	0.0107	2.84
	80.96	0.0112	2.97
	88.25	0.0117	3.10
	91.70	0.0121	3.22
	100.72	0.0136	3.62
	112.77	0.0154	4.11
323.15	63.23	0.00987	2.62
	71.64	0.0111	2.95
	79.34	0.0120	3.18
	91.09	0.0138	3.69
	102.84	0.0155	4.13
	109.32	0.0162	4.33
	115.21	0.0168	4.50
	125.04	0.0181	4.82

* quoted in original paper, appears to be volume of gas at T/K = 273.15 and P = 1 atmosphere absorbed by unit volume of liquid at room temperature.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Mixture stirred by ball in rocking autoclave. Samples of liquid analysed by volumetric method. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent.

(2) Distilled; purity 99.9 mole per cent determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{N_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexanone; $C_6H_{10}O$;
[108-94-1]

ORIGINAL MEASUREMENTS:

Khodeeva, S. M.; Dymova, R. P.
Tr. Naucho-Issledov. Proekt. Inst. Azotn. Prom. Org. Sin. 1971, *12*, 39-46.

VARIABLES:

T/K = 348-473
P/MPa = 4-10

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
348.15	39.7	4.02	0.018	-
	42.3	4.29	0.019	-
	45.0	4.56	0.021	-
	47.2	4.78	-	0.997
	51.6	5.23	-	0.998
	55.3	5.60	0.025	-
	59.6	6.04	0.027	-
	64.5	6.54	-	0.993
	68.5	6.94	-	0.995
	72.3	7.33	0.032	-
	78.7	7.97	-	0.991
	82.4	8.35	-	0.992
	90.2	9.14	0.038	-
	93.1	9.43	0.038	-
373.15	24.0	2.43	0.013	-
	34.9	3.54	0.017	-
	38.7	3.92	-	0.992
	42.4	4.30	-	0.989
	47.1	4.77	0.023	-
	49.4	5.01	0.023	-
	53.0	5.37	-	0.991
	57.2	5.80	-	0.989

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method in which saturated liquid sample was stripped of gas under reduced pressure. Amount of liquid in sample determined by weighing and amount of gas dissolved by measuring the volume at known temperature and pressure. Some details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Specially purified sample, less than 0.005 volume per cent impurity.

(2) Distilled, no impurity detected by GC.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta P/\text{atm} = \pm 0.2$;
$\delta x_{N_2} = \pm 1\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Cyclohexanone; $C_6H_{10}O$; [108-94-1]

ORIGINAL MEASUREMENTS:

Khodeeva, S. M.; Dymova, R. P.

Tr. Naucho-Issledov. Proekt. Inst. Azotn. Prom. Org. Sin. 1971, *12*, 39-46.

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
373.15	62.3	6.31	0.030	-
	64.8	6.57	0.032	-
	65.0	6.59	0.034	-
	68.3	6.92	-	0.990
	71.6	7.25	-	0.989
	77.2	7.82	0.043	-
	80.2	8.13	0.041	-
	83.2	8.43	-	0.991
	84.6	8.57	-	0.988
	90.4	9.16	-	0.986
	92.4	9.36	0.049	-
	96.1	9.74	0.045	-
423.15	46.0	4.66	0.027	-
	47.1	4.77	-	0.980
	48.8	4.94	0.028	-
	53.4	5.41	-	0.987
	57.3	5.81	-	0.978
	65.5	6.64	0.039	-
	68.3	6.92	0.041	-
	68.6	6.95	0.040	-
	71.0	7.19	0.041	-
	73.7	7.47	0.044	-
	74.6	7.56	-	0.977
	75.1	7.61	-	0.975
	76.6	7.76	-	0.979
	77.4	7.84	-	0.982
	80.1	8.12	-	0.982
	81.0	8.21	-	0.975
	84.3	8.54	-	0.979
	86.5	8.76	0.051	-
	92.0	9.32	0.054	-
473.15	47.4	4.80	0.036	-
	49.8	5.05	0.035	-
	56.4	5.71	0.038	-
	56.9	5.77	0.038	-
	61.9	6.27	-	0.963
	65.9	6.68	-	0.958
	67.9	6.88	-	0.961
	71.8	7.28	-	0.967

COMPONENTS: (1) Nitrogen; N_2; [7727-37-9] (2) Pentanedioic acid, -dimethyl ester, (dimethyl glutarate); $C_7H_{12}O_4$; [1119-40-0]	ORIGINAL MEASUREMENTS: Shakhova, S. F.; Zubchenko, Yu. P.; Kaplan, L. K. *Khim. Prom.* 1973, *49*, 108-10.
VARIABLES: T/K = 313 P/MPa = 5.6-14.2	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	$vol^{\alpha *}/vol$
313.15	55.9	0.0246	3.83
	86.8	0.0355	5.60
	110.3	0.0451	7.18
	142.3	0.0580	9.37

* quoted in original paper, appears to be volume of gas at T/K = 273.14 and *P* = 1 atmosphere absorbed by unit volume of liquid at room temperature.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE: Mixture stirred by ball in rocking autoclave. Sample of liquid analysed by a volumetric method. Details in source.	SOURCE AND PURITY OF MATERIALS: (1) Purity 99.99 mole per cent. (2) Analytic grade sample.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta P/bar = \pm 0.1$; $\delta x_{N_2} = \pm 5\%$ (estimated by compiler).
	REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,2,3-Propanetriol, triacetate; (Glycerol triacetate); $C_9H_{14}O_6$; [102-76-1]

ORIGINAL MEASUREMENTS:

Shakhova, S. F.; Zubchenko, Yu. P.; Kaplan, L. K.

Khim. Prom. 1973, *49*, 108-10.

VARIABLES:

T/K = 288-323
P/MPa = 6.8-14.7

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	$vol^{\alpha *}$/vol	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	$vol^{\alpha *}$/vol
288.15	80.96	0.0286	3.49	308.15	97.58	0.0381	4.69
	82.38	0.0303	3.70		105.88	0.0410	5.07
	90.69	0.0320	3.92		120.68	0.0458	5.63
	91.19	0.0318	3.89		143.68	0.0544	6.81
	92.12	0.0331	4.06	323.15	79.13	0.0391	3.91
	101.53	0.0354	4.35		102.03	0.0523	5.23
	109.53	0.0358	4.40		107.40	0.0551	5.51
	111.05	0.0375	4.61		107.91	0.0549	5.49
	131.92	0.0449	5.57		108.11	0.0617	6.17
308.15	67.69	0.0273	3.33		124.53	0.0630	6.30
	82.88	0.0346	4.24		135.88	0.0691	6.91
	94.13	0.0369	4.54		146.62	0.0730	7.30

* Values quoted in original paper, appears to be the volume of gas at T/K = 273.15 and P = 1 atmosphere absorbed by unit volume of liquid at room temperature.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Mixture stirred by ball in rocking autoclave. Sample of liquid analysed by volumetric method. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent.

(2) Distilled and dried; purity 99.4 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{N_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 2,5,8,11,14-Pentaoxapentadecane, (Tetramethylene glycol dimethylester); $C_{10}H_{22}O_5$; [143-24-8]

ORIGINAL MEASUREMENTS:

Zubchenko, Yu.P.; Shakhova, S.F.

Tr. N.-i.i Proekt.In-ta Azat. Prom-sti i Produktov Organ. Sinteza 1975, (33), 13-15.

Chem. Abstr. 1977, *86*, 89113K.

VARIABLES:

T/K = 313

P/MPa = 2.8-14.0

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	α+ vol/vol	Mole fraction of nitrogen in liquid, x_{N_2}
313.15	27.15	2.79	1.73	0.0146
	49.4	5.01	2.97	0.0247
	79.4	8.05	4.68	0.0384
	111.3	11.27	6.80	0.0549
	138.4	14.02	7.99	0.0639

\+ quoted in original paper, appears to be volume of gas at T/K = 273.15 and *P* = 1 atmosphere absorbed by unit volume of liquid at room temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Mixture stirred by ball in rocking autoclave. Sample of liquid analysed by a volumetric method. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent.

(2) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/atm = \pm 0.1$;

$\delta x_{N_2} = \pm 5\%$.

(estimated by compiler).

REFERENCES:

1. Shakhova, S.F.; Zubchenko, Yu.P.; Kaplan, L.K.

   Khim. Prom. 1973, *5*, 108.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) 1,2-Epoxyethane (ethylene oxide); C_2H_4O; [75-21-8]

ORIGINAL MEASUREMENTS:

Hess, L. G.; Tilton, V. V.

Ind. Eng. Chem. 1950, *42*, 1251-8.

VARIABLES:

T/K = 303-318K
P/MPa = 0.21-0.48

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	P/psig	P^a/MPa	Solubility[b]
30	303	30	0.21	0.02
30	303	40	0.28	0.1
30	303	50	0.34	0.19
45	318	50	0.34	0.11
45	318	60	0.41	0.18
45	318	70	0.48	0.25

[a] Calculated by compiler.

[b] In weigh per cent of nitrogen in 1,2-epoxyethane at pressure indicated.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

These are average values of solubility as determined on a laboratory scale and using apparatus and procedures similar to that of Wan and Dodge (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

Solubility values are crude.

REFERENCES:

1. Wan, S.W.; Dodge, B.F.
Ind. Eng. Chem. 1940, *32*, 95.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane, chlorodifluoro-;
$CHClF_2$; [75-45-6]

ORIGINAL MEASUREMENTS:

Maslennikova, V. Ya.; Goryunova, N. P.; Tsiklis, D. S.

Zhur. Fiz. Khim. 1967, *41*, 735.

VARIABLES:

T/K = 295-333
P/MPa = 2.5-19.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
295.15	25.3	0.035	0.59
	50.7	0.085	0.74
	76.0	0.135	0.79
	101.3	0.185	0.80
	126.7	0.24	0.79
	152.0	0.315	0.763
	177.3	0.41	0.705
	194.5	0.57	0.57
313.15	25.3	0.025	0.365
	50.7	0.085	0.585
	76.0	0.14	0.66
	101.3	0.205	0.685
	126.7	0.29	0.673
	152.0	0.42	0.61
	162.1	0.515	0.515
333.15	25.3	0.003	0.045
	50.7	0.067	0.39
	76.0	0.14	0.52
	101.3	0.23	0.545
	126.7	0.39	0.48
	128.7	0.435	0.435

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given in source. Ref. 1 given as reference in which apparatus described. It is not clear which of the several apparatus described were used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen containing up to 0.5 mole per cent oxygen.

(2) Technical grade sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.05$; δx_{N_2}, $\delta y_{N_2} = \pm 0.01$ (estimated by compiler).

REFERENCES:

1. Tsiklis, D. S. *Technique of Physico-chemical Experiment at High and Ultra High Pressures*, Isd. Khimiya, Moscow, 1965.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane, chlorodifluoro-;
$CHClF_2$; [75-45-6]

ORIGINAL MEASUREMENTS:

Nohka, J.; Sarashina, E.; Arai, Y.; Saito, S.

J. Chem. Eng. Japan 1973, *6*, 10.

VARIABLES:

T/K = 273-348
P/MPa = 2.5-21.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
273.15	25.3	0.0367	0.755	298.15	154.2	0.315	0.730
	50.7	0.0842	0.852		165.9	0.347	0.704
	76.0	0.129	0.873		174.0	0.382	0.680
	101.3	0.177	0.876		179.0	0.409	0.660
	126.7	0.227	0.869		185.9	0.463	0.618
	144.3	0.265	0.859	323.15	30.4	0.0217	0.258
	160.5	0.301	0.845		50.7	0.0638	0.472
	183.1	0.350	0.825		76.0	0.121	0.561
	200.8	0.399	0.801		101.3	0.185	0.580
	215.3	0.447	0.766		130.7	0.291	0.540
298.15	25.3	0.0268	0.498		134.4	0.327	0.524
	50.7	0.0749	0.688		139.3	0.359	0.507
	50.7	0.0753	0.697	348.15	43.9	0.0261	0.149
	76.0	0.125	0.741		49.7	0.0429	0.198
	95.8	0.164	0.755		64.3	0.0820	0.278
	101.3	0.178	0.763		74.0	0.114	0.308
	101.3	0.181	0.761		82.6	0.145	0.316
	126.7	0.232	0.753		91.2	0.198	0.281
	142.4	0.279	0.748				

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static cell fitted with magnetic stirrer. Temperature measured with liquid in glass thermometer and pressure measured with Bourdon gauge. After equilibrium established vapor and liquid samples analysed by gas chromatography. Details in refs. 1 and 2.

SOURCE AND PURITY OF MATERIALS:

(1) Purity better than 99.9 mole per cent.

(2) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; δx_{N_2}, $\delta y_{N_2} = \pm 1\%$ (estimated by compiler).

REFERENCES:

1. Kaminishi, G.; Arai, Y.; Saito, S.; Maeda, S. *J. Chem. Eng. Japan* 1968, *1*, 109.

2. Sarashina, E.; Arai, Y.; Saito, S. *J. Chem. Eng. Japan* 1971, *4*, 377.

COMPONENTS:

(1) Nitrogen; N_2; [7727-39-9]

(2) Methane, dichlorodifluoro-;
CCl_2F_2; [75-71-8]

ORIGINAL MEASUREMENTS:

Maslennikova, V. Ya.; Goryunova, N. P.; Tsiklis, D. S.

Zhur. Fiz. Khim. 1967, *41*, 735.

VARIABLES:

$T/K = 295\text{-}348$
$P/MPa = 2.5\text{-}17.8$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
295.15	25.3	0.07	0.665
	50.7	0.105	0.82
	76.0	0.165	0.855
	101.3	0.223	0.863
	126.7	0.29	0.86
	152.0	0.37	0.83
	178.3	0.61	0.61
323.15	25.3	0.03	0.44
	50.7	0.10	0.635
	76.0	0.155	0.693
	101.3	0.24	0.705
	126.7	0.325	0.70
	152.0	0.465	0.635
	157.1	0.65	0.65
348.15	25.3	0.015	0.18
	50.7	0.095	0.48
	76.0	0.16	0.545
	101.3	0.26	0.55
	126.7	0.405	0.495
	129.7	0.45	0.45

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE;

Few details given in source. Ref. 1 given as reference in which apparatus described. It is not clear which of the several apparatus described were used.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen containing up to 0.5 mole per cent oxygen.

(2) Technical grade sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.05$; δx_{N_2}, $\delta y_{N_2} = \pm 0.01$ (estimated by compiler).

REFERENCES:

1. Tsiklis, D. S. *Technique of Physico-chemical Experiment at High and Ultra High Pressures*, Isd. Khimiya, Moscow, 1965.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane, tetrachloro- (Carbon tetrachloride); CCl_4; [56-23-5]

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A.

Ind. Eng. Chem. 1931, *23*, 548-50.

VARIABLES:

T/K = 298
P/MPa = 1.0-12.0

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility*, S	Mole fraction of nitrogen in liquid, x_{N_2}†
298.15	1.0	1.55	0.0061
	2.0	3.05	0.0120
	3.0	4.6	0.0179
	4.0	6.1	0.0236
	5.0	7.65	0.0295
	6.0	9.2	0.0352
	7.0	10.7	0.0407
	8.0	12.25	0.0464
	9.0	13.75	0.0517
	10.0	15.3	0.0572
	11.0	16.8	0.0625
	12.0	18.35	0.0679

* Data taken from graph in original article. Volume of gas measured at 101.325 kPa pressure and 298.15 K dissolved by unit volume of liquid measured under the same conditions.

† Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Liquid saturated with gas and after equilibrium established samples removed and analysed by volumetric method. Allowance was made for vapor pressure of liquid and the solubility of the gas at atmospheric pressure. Details in source.

SOURCE AND PURITY OF MATERIALS:

Stated that the materials were the highest purity available.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{N_2} = \pm 5\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Methane, tetrafluoro-; CF_4;
[75-73-0]

ORIGINAL MEASUREMENTS:

Eckert, C. A.; Prausnitz, J. M.
Am. Inst. Chem. Eng. J. 1965, *11*,
886.

VARIABLES:

T/K = 70-116
P/kPa = 28-862

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in vapor, y_{N_2}
69.57	0.2958	0.452	0.999+
69.90	0.2782	0.268	0.999+
75.81	0.6116	0.185	0.999
78.06	0.3570	0.067	0.999
85.28	1.7580	0.516	0.999
81.51	1.1363	0.238	0.999
81.83	0.6327	0.113	0.996
85.28	1.7580	0.479	0.999
89.96	1.1570	0.105	0.998
95.33	3.717	0.329	0.997
107.94	8.619	0.564	0.992
116.24	1.9443	0.025	0.963

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with a heavy-wall glass cell. Temperature measured with thermocouple. Pressure measured with Bourdon gauge. Samples of both phases analysed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson sample, purity 99.998 mole per cent.

(2) DuPont sample, purity 99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.007$ up to 2 bar; ± 0.02 above 2 bar; δx_{N_2}, $\delta y_{N_2} = \pm 0.005$ or better.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2 [7727-37-9]

(2) Chlorotrifluoromethane; $CClF_3$; [75-72-9]

(2') Tetrafluoromethane; CF_4; [75- 73-0]

ORIGINAL MEASUREMENTS:

Chaikovskii, V.F.; Zakharov, N.D.; Grezin, A.K.; Matyash, Yu. I.

Kholod. Tekh. Tekhnol 1976, *22*, 51-4.

Chem. Abstr. 1977, *86*, 74947n.

VARIABLES:

T/K = 193.15 - 253.15
P/MPa = 3.0-9.5

PREPARED BY:

V. Katovic

EXPERIMENTAL VALUES:

	Mole Fraction of Nitrogen					
	In Liquid	In Gas	In Liquid	In Gas	In Liquid	In Gas
P/MPa	x_{N_2}	y_{N_2}	x_{N_2}	y_{N_2}	x_{N_2}	y_{N_2}
Freon-14; CF_4; Tetrafluoromethane						
	T/K = 193.15		T/K = 198.15		T/K = 203.15	
3.4	0.189	0.610	0.168	0.535	0.145	0.460
3.6	0.206	0.631	0.185	0.560	0.163	0.490
3.8	0.224	0.641	0.202	0.577	0.180	0.513
4.0	0.241	0.651	0.220	0.590	0.198	0.530
4.2	0.258	0.655	0.238	0.597	0.215	0.540
4.4	0.275	0.657	0.255	0.601	0.235	0.546
4.6	0.292	0.659	0.272	0.603	0.253	0.550
4.8	0.310	0.660	0.290	0.605	0.270	0.551
5.0	0.327	0.660	0.307	0.605	0.287	0.551
5.2	0.345	0.659	0.327	0.604	0.310	0.546
5.4	0.363	0.656	0.347	0.601	0.335	0.533
5.6	0.387	0.652	0.370	0.594	0.365	0.511
5.8	0.413	0.646	0.400	0.577	0.413	0.460
6.0	0.442	0.633	0.450	0.535		
6.2	0.490	0.600				

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubilities were determined using an apparatus described in the paper. The composition of the liquid and gas phase was determined by a gas chromatographic method.

SOURCE AND PURITY OF MATERIALS:

(1) 99.9% pure.
(2) 99.5% pure.
(2') 99.5% pure.

ESTIMATED ERROR:

$\delta T/K = 0.1$, estimate by author
$\delta x/x = \pm 0.02$, compiler's estimate

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Chlorotrifluoromethane; $CClF_3$; [75-72-9]

(2') Tetrafluoromethane; CF_4; [75-73-0]

ORIGINAL MEASUREMENTS:

Chaikovskii, V.F.; Zakharov, N.D.; Grezin, A.K.; Matyash, Yu. I.

Kholod. Tekh. Tekhnol 1976, *22*, 51-4.

Chem. Abstr. 1977, *86*, 74947n.

EXPERIMENTAL VALUES: continued

P/MPa	In Liquid x_{N_2}	In Gas y_{N_2}	In Liquid x_{N_2}	In Gas y_{N_2}
Freon-13; $CClF_3$; Chlorotrifluoromethane				
	T/K = 233.15		T/K = 258.15	
3.0	0.120	0.710	0.090	0.550
3.5	0.145	0.740	0.115	0.590
4.0	0.170	0.770	0.140	0.625
4.5	0.195	0.780	0.160	0.645
5.0	0.220	0.795	0.185	0.665
5.5	0.240	0.805	0.210	0.675
6.0	0.265	0.810	0.235	0.680
6.5	0.290	0.815	0.260	0.680
7.0	0.315	0.815	0.285	0.680
7.5	0.340	0.820	0.310	0.685
8.0	0.365	0.815	0.330	0.670
8.5	0.385	0.810	0.355	0.660
9.0	0.410	0.805	0.380	0.650
9.5	0.440	0.795		

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Pyrrolidinone, 1-methyl-;
(N-methylpyrrolidinone); C_5H_9NO;
[872-50-4]

ORIGINAL MEASUREMENTS:

Shakhova, S. F.; Zubchenko, Yu. P.;
Kaplan, L. K.

Khim. Prom. 1973, *49*, 108-10.

VARIABLES:

T/K = 283-333
P/MPa = 4.3-13.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	α^* vol/vol	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	α^* vol/vol
283.15	52.49	0.0085	1.99	298.15	92.21	0.0158	3.73
	66.67	0.0104	2.43		100.51	0.0168	3.95
	66.67	0.0108	2.54		106.49	0.0178	4.20
	75.49	0.0119	2.80		107.40	0.0183	4.33
	82.88	0.0128	3.00		114.80	0.0194	4.58
	85.82	0.0134	3.16		124.53	0.0215	5.10
	99.60	0.0159	3.75	333.15	52.99	0.0112	2.63
	106.90	0.0172	4.05		73.06	0.0147	3.47
	107.40	0.0170	4.00		81.47	0.0163	3.83
	111.86	0.0175	4.12		92.21	0.0180	4.26
298.15	42.66	0.0074	1.72		100.21	0.0188	4.43
	52.99	0.0095	2.23		103.45	0.0203	4.80
	62.25	0.0115	2.69		120.17	0.0233	5.53
	81.36	0.0141	3.32		134.86	0.0264	6.29

* Values quoted in original paper, appears to be volume of gas at T/K = 273.15 and P = 1 atmosphere absorbed by unit volume of liquid at room temperature.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Mixture stirred by ball in rocking autoclave. Sample of liquid analysed by a volumetric method. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent.

(2) Purity 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{N_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) 2-Pyrrolidinone, 1,5-dimethyl- (5-methyl-N-methylpyrrolidinone); $C_6H_{11}NO$; [5075-92-3]	Shakhova, S. F.; Zubchenko, Yu. P.; Kaplan, L. K. *Khim. Prom.* 1973, *49*, 108-10.
VARIABLES:	**PREPARED BY:**
T/K = 283-323 P/MPa = 7.5-14.2	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	vol$^{\alpha *}$/vol
283.15	85.32	0.0191	3.96
	102.95	0.0232	4.85
	118.14	0.0262	5.48
298.15	74.58	0.0189	3.93
	89.26	0.0220	4.58
	90.28	0.0220	4.58
	103.96	0.0256	5.35
	106.90	0.0258	5.41
	113.79	0.0265	5.55
	123.62	0.0290	6.10
	124.53	0.0290	6.08
323.15	84.81	0.0232	4.85
	104.47	0.0289	6.06
	124.12	0.0325	6.81
	141.75	0.0356	7.53

* quoted in original paper, appears to be volume of gas at T/K = 273.15 and P = 1 atmosphere absorbed by unit volume of liquid at room temperature.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Mixture stirred by ball in rocking autoclave. Sample of liquid analysed by a volumetric method. Details in source.	(1) Purity 99.9 mole per cent. (2) Purity 99.3 mole per cent.
	ESTIMATED ERROR:
	$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{N_2} = \pm 5\%$ (estimated by compiler).
	REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Dog blood.

ORIGINAL MEASUREMENTS:

Hawkins, J.A.; Shilling, C.W.

J. Biol. Chem. 1936, *113*, 273-8.

VARIABLES:

$T/K = 311$
$P/kPa = 100-600$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

$t/^{\circ}C = 38$

P^+/mmHg	P^+/bar	O_2 capacity	Water Content /g cm^{-3}	L	L_0 /$cm^3 g^{-1}$
715	0.953	20.14	0.8069	0.0138	0.0171
1481	1.975			0.0136	0.0169
3071	4.094			0.0136	0.0169
4508	6.010			0.0134	0.0166
701	0.935	20.06	0.8965	0.0141	0.0157
1460	1.947			0.0142	0.0158
3006	4.008			0.0135	0.0151
4524	6.032			0.0138	0.0154
712	0.949	21.55	0.7767	0.0139	0.0179
1471	1.961			0.0127	0.0164
3006	4.008			0.0137	0.0176
4434	5.912			0.0135	0.0174
698	0.931	Not given	Not given	0.0148	
1474	1.965			0.0146	
4494	5.992			0.0142	

P^+ partial pressure of nitrogen

L Ostwald coefficient

L_0 Volume of nitrogen absorbed per gram of water.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Blood collected from cannulated femoral artery of dogs anesthetized with nembutal. Experiment carried out in a recompression chamber. Blood saturated with nitrogen and amount estimated using a Van Slyke apparatus (1).

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Oxalated and used immediately or chilled to 0°C and kept in stoppered container and used within a day.

ESTIMATED ERROR:

$\delta T/K = \pm 0.005$; $\delta L = \pm 0.05$
(estimated by compiler)

REFERENCES:

1. Van Slyke, D.D.; Neill, J.M.
J. Biol. Chem. 1924, *61*, 523.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ox blood.

ORIGINAL MEASUREMENTS:

Hawkins, J.A.; Shilling, C.W.

J. Biol. Chem. 1936, *113*, 273-8.

VARIABLES:

T/K = 311
P/kPa = 76-606

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

$t/^{0}C = 38$

P^{+}/mmHg	P^{+}/bar	O_2 capacity	Water Content /g cm^{-3}	L	L_0 /cm^3g^{-1}
567	0.756	15.70	0.8223	0.0135	0.0164
1562	2.082			0.0133	0.0162
2913	3.884			0.0126	0.0154
703	0.937	18.18	0.8113	0.0140	0.0173
1510	2.013			0.0137	0.0169
2936	3.914			0.0132	0.0163
4215	5.620			0.0133	0.0164
699	0.932	18.50	0.8079	0.0134	0.0166
2960	3.946			0.0132	0.0163
4472	5.962			0.0128	0.0158
701	0.935	20.01	0.8799	0.0132	0.0150
2967	3.956			0.0132	0.0150
4544	6.058			0.0124	0.0141
698	0.931	18.86	0.8122	0.0133	0.0164
4461	5.948			0.0133	0.0164

P^{+} partial pressure of nitrogen

L Ostwald coefficient

L_0 Volume of nitrogen absorbed per gram of water.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Blood collected from jugular vein of calves. Experiment carried out in a recompression chamber. Blood saturated with nitrogen and amount estimated using a Van Slyke apparatus (1).

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Oxalated and used immediately or chilled to $0^{0}C$ and kept in stoppered container and used within a day.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05; \delta L = \pm 0.001.$

(estimated by compiler)

REFERENCES:

1. Van Slyke, D.D.; Neill, J.M. *J. Biol. Chem.* 1924, *61*, 523.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Oxygen; O_2; [7782-44-7]

(3) Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Muirbrook, N. K.; Prausnitz, J. M.

Am. Inst. Chem. Engnrs. J. 1965, *11*, 1092-6.

VARIABLES:

T/K = 273
P/MPa = 5-11

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

			Mole fractions					
			in liquid			in gas		
T/K	P/psi	P/MPa	x_{N_2}	x_{O_2}	x_{CO_2}	y_{N_2}	y_{O_2}	y_{CO_2}
273.15	755	5.21	0.006	0.031	0.963	0.048	0.174	0.778
	822	5.67	0.007	0.042	0.951	0.043	0.220	0.737
	974	6.72	0.032	0.040	0.928	0.151	0.170	0.679
	952	6.56	0.031	0.036	0.933	0.158	0.154	0.688
	1064	7.34	0.050	0.033	0.917	0.217	0.127	0.656
	1035	7.14	0.051	0.028	0.921	0.228	0.110	0.662
	1174	8.09	0.047	0.062	0.891	0.166	0.207	0.627
	1104	7.61	0.040	0.055	0.905	0.154	0.200	0.646
	1185	8.17	0.051	0.058	0.891	0.186	0.189	0.625
	1340	9.24	0.080	0.055	0.865	0.242	0.151	0.607
	1440	9.93	0.082	0.081	0.837	0.214	0.183	0.603
	1535	10.58	0.087	0.105	0.808	0.186	0.207	0.607

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating flow apparatus in which liquid from bottom of cell is returned to top of cell. The samples of both phases were analysed as vapor. Carbon dioxide removed with "Ascarite" and oxygen removed by reaction with copper at 200 °C. Details in source.

SOURCE AND PURITY OF MATERIALS:

All components were Coleman grade and had specified purity of at least 99.99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; δx, δy = ±1%

(estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Oxygen fluoride; OF_2; [7783-41-7]

ORIGINAL MEASUREMENTS:

Cannon, W. A.; Robson, J. H.; English, W. D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 145-172
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	$P^a_{N_2}$/MPa	$x_1{}^b$		
		-199.4°F (144.6 K)	-175.1°F (158.1 K)	-149.3°F (172.4 K)
300	2.07	0.231	0.141	0.0617
300	2.07	0.234	0.140	0.0645
300	2.07	0.228	0.143	0.0571
300	2.07	0.228	0.140	0.0615
600	4.14	0.617[c]		
600	4.14	0.616[c]		
700	4.83	0.604	0.509	0.362
700	4.83	0.622	0.494	0.356
700	4.83		0.496	0.359
700	4.83		0.499	0.356

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

[c] Said to be measurements at 600 psia, but appear to be too high (compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) Allied Chemical Corporation, 98.5%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrogen sulfide; H_2S;
[7783-06-4]

ORIGINAL MEASUREMENTS:

Besserer, G. J.; Robinson, D. B.
J. Chem. Eng. Data 1975, *20*, 157.

VARIABLES:

T/K = 256-344
P/MPa = 1.2-20.7

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
344.26	71.2	0.0148	0.148
	86.5	0.0290	0.242
	103.6	0.0448	0.281
	120.7	0.0636	0.321
	137.9	0.0849	0.342
	155.1	0.111	0.357
	172.4	0.146	0.330
	177.2	0.161	0.331
321.87	34.7	0.0000	0.000
	40.7	0.0040	0.108
	54.5	0.0129	0.265
	69.4	0.0220	0.364
	85.5	0.0325	0.429
	102.5	0.0451	0.478
	119.8	0.0571	0.516
	139.8	0.0702	0.525
	157.0	0.0825	0.538
	172.4	0.0979	0.539
	189.6	0.113	0.543
	206.8	0.126	0.533
300.04	20.7	0.0000	0.000
	35.2	0.0071	0.332
300.04	51.4	0.0153	0.488
	70.0	0.0239	0.576
	87.2	0.0317	0.628
	103.2	0.0401	0.653
	120.6	0.0495	0.674
	137.5	0.0570	0.684
	155.0	0.0663	0.691
	172.9	0.0762	0.695
	189.7	0.0844	0.694
	206.8	0.0957	0.693
277.65	11.7	0.0000	0.000
	17.3	0.0035	0.271
	34.1	0.0102	0.582
	52.7	0.0186	0.698
	68.3	0.0241	0.743
	86.2	0.0314	0.769
	103.5	0.0377	0.791
	121.0	0.0416	0.798
	137.9	0.0468	0.806
	155.1	0.0540	0.810
	172.4	0.0586	0.806
	189.8	0.0642	0.811

(cont.)

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Cell fitted with two moveable pistons which enabled cell contents to be circulated in an external line. Fitted with optical system which allowed measurement of refractive index. Temperature measured with iron-constantan thermocouple and pressure with strain gauge transducer. Components charged into cell and mixed by piston movement. Samples withdrawn and analysed by gas chromatography. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity sample with stated purity of 99.993 mole per cent.

(2) Matheson sample, CP grade purity better than 99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.2$;

δx_{N_2}, δy_{N_2} = ±0.003.

REFERENCES:

1. Besserer, G. J.; Robinson, D. B.
Can. J. Chem. Eng. 1971, *49*, 651.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrogen sulfide; H_2S; [7783-06-4]

ORIGINAL MEASUREMENTS:

Besserer, G. J.; Robirson, D. B.
J. Chem. Eng. Data 1975, *20*, 157.

EXPERIMENTAL VALUES:

continued

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
277.65	206.8	0.0685	0.809	256.43	121.8	0.0312	0.887
256.43	17.7	0.0049	0.625		138.4	0.0348	0.887
	34.3	0.0084	0.776		155.8	0.0385	0.892
	53.3	0.0145	0.839		172.9	0.0390	0.891
	69.6	0.0176	0.866		190.2	0.0430	0.886
	86.5	0.0230	0.873		207.0	0.0448	0.890
	104.5	0.0268	0.881				

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrogen sulfide; H_2S; [7783-06-4]

ORIGINAL MEASUREMENTS:

Kalra, H.; Krishnan, T. R.; Robinson, D. B.

J. Chem. Eng. Data 1976, *21*, 222.

VARIABLES:

T/K = 200-228
P/MPa = 0.1-13.8

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
200.15	1.41	0.0005	0.6542
	5.16	0.0011	0.9022
	10.40	0.0019	0.9507
	17.11	0.0027	0.9680
	27.65	0.0040	0.9788
	47.99	0.0069	0.9858
	70.12	0.0089	0.9873
	97.22	0.0111	0.9872
	137.48	0.0135	0.9843
228.00	3.34	0.0004	0.3804
	4.83	0.0008	0.5658
	8.17	0.0017	0.7379
	17.21	0.0033	0.8653
	34.27	0.0066	0.9285
	55.30	0.0103	0.9452
	83.08	0.0153	0.9540
	110.7	0.0200	0.9555
	137.5	0.0232	0.9564

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cell fitted with two moveable pistons which enabled cell contents to be circulated in external line. Fitted with optical system which allowed measurement of refractive index. Temperature measured with iron-constantan thermocouple and pressure with strain gauge transducer. Components charged into cell, mixed by piston movement. Samples withdrawn and analysed by gas chromatography. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Linde sample, purity 99.99+ mole per cent.

(2) Matheson sample, purity 99.8+ mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.2$;
δx_{N_2}, $\delta y_{N_2} = \pm 0.003$.

REFERENCES:

1. Besserer, G. J.; Robinson, D. B. *Can. J. Chem. Eng.* 1971, *49*, 651.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Chlorine trifluoride; ClF_3; [7790-91-2]

ORIGINAL MEASUREMENTS:

Cannon, W.A.; Robson, J.H.; English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missle & Space Systems Division, Astropower Laboratory.)

VARIABLES:

$T/K = 200\text{-}283$

$P/MPa = 2.1\text{-}4.8$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	$P^a_{N_2}$/MPa	$10^2\ x_1{}^b$			
		-99.1°F (200.3K)	-49.8°F (227.7K)	-0.2°F (255.3K)	50.3°F (283.3K)
300	2.07	0.729	0.837	0.867	1.04
300	2.07	0.790	0.867	0.917	1.07
300	2.07	0.760	0.994	0.950	1.07
300	2.07	0.802	0.961	0.850	1.10
700	4.83	1.93	1.81	1.98	2.34
700	4.83	1.88	1.87	2.13	2.40
700	4.83	1.87	1.81	2.04	2.49
700	4.83	1.94	1.83	2.14	2.48

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) Allied Chemical, MIL-0-81399, 99.0%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Chlorine pentafluoride; ClF_5; [13637-63-3]

ORIGINAL MEASUREMENTS:

Sukhoverkhov, V. F.; Garanin, V. F.; Podzolko, L. G.

Doklady Chem. Akad. Nauk SSR, 1979, *246*, 1379-83.

Chm. Abstr. 1979, *91*, 113159f.

VARIABLES:

T/K = 293
P/MPa = 0.5-9

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P/MPa	Solubility/volume per cent
0.49	1.62
1.13	2.40
2.26	4.41
3.72	5.91
5.98	7.80
7.95	12.40
8.88	11.80

[a] At 20°C or 293 K.

[b] Extrapolation to zero pressure gave a Henry's Law constant of 42.8 MPa/mole fraction.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturation and equilibration were carried out in a thermostatted conical nickel vessel of 42 cm^3 capacity. Equilibration took about 48 h. Analysis was by gas-adsorption chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) 99.9 vol. per cent.

(2) 99.9 per cent or better by gas chromatography

ESTIMATED ERROR:

δSolubility/Solubility = ±0.015, authors' estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Chlorine pentafluoride; ClF_5; [13637-63-3]

ORIGINAL MEASUREMENTS:

Cannon, W. A.; Robson, J. H.; English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Sapce Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 200-283
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	$P^a_{N_2}$/MPa	x_1^b -100.0°F (199.8 K)	x_1^b -50.8°F (227.2 K)	x_1^b 0.0°F (255.4 K)	x_1^b 50.3°F (283.3 K)
300	2.07	0.0357	0.0331	0.0333	0.0291
300	2.07	0.0366	0.0326	0.0340	0.0311
300	2.07	0.0340	0.0330	0.0336	0.0294
300	2.07	0.0348	0.0323	0.0333	0.0289
700	4.83	0.0834	0.0745	0.0754	0.0775
700	4.83	0.0825	0.0731	0.0769	0.0752
700	4.83	0.0802	0.0748	0.0758	0.0758
700	4.83	0.0808	0.0747	0.0776	0.0760

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) Probable purity greater than 99% by weight.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Perchloryl fluoride; ClF_6; [56077-96-4]

ORIGINAL MEASUREMENTS:

Cannon, W. A.; Robson, J. H.; English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

$T/K = 172-256$
$P/MPa = 2.1-4.8$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

		x_1 [b]			
P_{N_2}/psia	P_{N_2} [a]/MPa	-150.0°F (172.0 K)	-100.1°F (199.8 K)	-50.3°F (227.4 K)	0.0°F (255.4 K)
300	2.07	0.0568	0.0495	0.0448	0.0400
300	2.07	0.0543	0.0500	0.0460	0.0382
300	2.07	0.0592	0.0487	0.0443	0.0388
300	2.07	0.0598	0.0504	0.0446	0.0387
700	4.83	0.128	0.115	0.109	0.0960
700	4.83	0.130	0.114	0.107	0.0964
700	4.83	0.131	0.111	0.108	0.0948
700	4.83	0.126	0.113	0.105	0.0942

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) Pennsalt Chemical Company, 99.8%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Sulphur Dioxide; SO_2; [7446-09-5]

ORIGINAL MEASUREMENTS:

Dean, M. R.; Walls, W. S.
Ind. Eng. Chem. 1947, *39*, 1049.

VARIABLES:
$T/K = 241\text{-}301$
$P/MPa = 1.6\text{-}3.6$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
301.48	35.5	0.0143	0.843
301.48	35.5	0.0134	0.849
209.26	15.5	0.0051	0.693
253.15	17.4	0.0055	0.958
241.10	35.5	0.0078	0.989
241.10	18.1	0.0033	0.972

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Twin steel static cell. Pressure and volume of cell varied by introducing mercury. Pressure measured with Bourdon gauge. Analysis of samples of both gas and liquid phases carried out by Orsat analysis. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Purity about 99.7 mole per cent.

(2) Refrigeration grade sample from Virginia Smelting Co. Purity about 99.6 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.1$; $\delta x_{N_2} = \pm 0.0003$; $\delta y_{N_2} = \pm 0.002$ (estimated by compiler).

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Nitrogen; N_2; [7727-37-9] (2) Ammonia; NH_3; [7664-41-7]	Colin L. Young, School of Chemistry University of Melbourne Parkville, Victoria 3052 Australia. November 1981

CRITICAL EVALUATION:

This system has been studied in detail by Wiebe and coworkers (1), (2) and by Lindroos and Dodge (3). The data of Wiebe and coworkers cover the pressure range 2.5 to 100 MPa whereas the data of Lindroos and Dodge are for a higher pressure range from 98 to 380 MPa. There is moderate agreement between the two sets of data although the data of Lindroos and Dodge are less precise. The data of Heise (4), which are limited to 298.15 K, are in fair agreement with those of Wiebe and Tremearne (1). All four sets of data are classified as tentative. There are a considerable number of studies of the phase equilibria of this system which are not evaluated in detail here since they do not fall into the category of gas solubility.

Tskilis (5) studied the solubility of ammonia in nitrogen at 75°C and 80°C at pressures between 10 and 450 MPa and made a limited study of the solubility of nitrogen in ammonia at 75°C between 165 and 260 MPa. Krichevskii and coworkers (6), (7) have also made a study of the phase behaviour of this mixture.

Matous, Sobr and Novak (8) studied the quaternary system argon + methane + nitrogen + ammonia. These data are not evaluated here.

Cannon, Robson and English (9) studied the solubility of nitrogen in ammonia at temperatures between 200 K and 283 K at pressures of 2 MPa and 4.8 MPa. Their data are classified as tentative. While the data are broadly consistent with the data of Wiebe and coworkers (1), (2) no detailed comparison is possible because of the lack of any other data over an overlapping range of temperature and pressure.

References:

1. Wiebe, R.; Tremearne, T. H. *J. Amer. Chem. Soc.* 1933, *55*, 975.
2. Wiebe, R.; Gaddy, V. L. *J. Amer. Chem. Soc.* 1937, *59*, 1984.
3. Lindroos, A. E.; Dodge, B. F. *Chem. Eng. Progr. Symp. Ser. No. 3* 1952, *48*, 10.
4. Heise, F. *Ber. Bunsenges Phys. Chem.* 1972, *76*, 938.
5. Tskilis, D. S. *Trudy Gos. Inst. Azot. Prom.* 1951, *3*, 12.
6. Krichevskii, I. R.; Bol'shakov, P. E. *Zh. Fiz. Khim.* 1941, *15*, 184.
7. Krichevskii, I. R.; Efremova, G. D. *Zh. Fiz. Khim.* 1952, *26*, 1117.
8. Matous, J.; Sobr, J.; Novak, J. P. *Coll. Czech. Chem. Comm.* 1970, *35*, 3757.
9. Cannon, W. A.; Robson, J. H.; English, W. D. Report DAC-60510-F2, 1968. (Tech. Report, Douglas Missile and Space Systems Division Astropower Laboratory).

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Wiebe, R.; Tremearne, T. H.

J. Amer. Chem. Soc. 1933, 55, 975-8.

VARIABLES:

T/K = 298
P/MPa = 3-101

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Solubility, $S^{\dagger}$	*Mole fraction of nitrogen in liquid, x_{N_2}
298.15	2.5	2.22	0.00168
	5.1	5.73	0.00434
	10.1	12.04	0.00907
	20.3	22.48	0.01679
	40.5	37.02	0.02736
	60.8	45.43	0.03337
	81.1	51.10	0.03738
	101.3	54.83	0.03999

* Calculated by compiler.

† Volume of gas reduced to 273.15 K and 1 atmosphere pressure, dissolved by 1 gram of ammonia.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell. Pressure measured with dead weight tester. Liquid samples analysed by stripping out nitrogen at low pressures and low temperatures.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.9 mole per cent, impurity argon and trace of oxygen.

(2) Water content 0.07 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/MPa = \pm 0.5\%$;
$\delta x_{N_2} = \pm 1\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V.L.

J. Am. Chem. Soc. 1937, *59*,1984-7.

VARIABLES:

T/K = 273-373
P/MPa = 5.1-101.3

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^2x Mole fraction of nitrogen in liquid, $10^2x_{N_2}$
273.15	101.32	0.597
	202.65	1.032
	405.30	1.553
	607.95	1.860
	810.60	2.088
	1013.25	2.206
323.15	50.66	0.501
	101.32	1.289
	202.65	2.680
	405.30	4.730
	607.95	6.052
	810.60	6.877
	1013.25	7.362
348.15	101.32	1.598
	202.65	4.045
	405.30	8.398
	607.95	11.910
	810.60	14.265
	1013.25	15.518
363.15	354.64	11.170
	506.62	19.095
	557.29	24.660
373.15	101.32	1.534
	202.65	6.155
	303.97	12.798
	329.31	15.202

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell. Pressure measured with dead weight tester. Liquid samples analysed by stripping out nitrogen at low pressure and low temperatures. Details in ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given but thought to be of high purity as in ref. 1.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/bar = \pm 0.1$;
$\delta x_{N_2} = \pm 0.5\%$. (estimated by compiler)

REFERENCES:

1. Wiebe, R.; Tremearne, T.H. *J. Amer. Chem. Soc.* 1933, *55*,975.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Lindroos, A. E.; Dodge, B. F.
Chem. Eng. Progr. Symp. Ser. No. 3,
1952, *48*, 10.

VARIABLES:

T/K = 303-383
P/MPa = 76-381

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen* in liquid, x_{N_2}	in gas, y_{N_2}	T/K	P/bar	Mole fraction of nitrogen* in liquid, x_{N_2}	in gas, y_{N_2}
303.15	1073	-	0.915	323.15	2867	-	0.060
	1062	0.044	-		2841	0.915	-
	1241	0.049	-		3301	-	0.062
	1231	-	0.916		3271	0.912	-
	1845	0.062	-		3814	-	0.073
	1832	-	0.954		3807	0.938	-
	2272	-	0.054	348.15	1098	0.147	-
	2257	0.941	-		1086	-	0.689
	2927	0.942	-		1364	-	0.728
	2913	-	0.050		1359	0.158	-
	3060	0.885	-		1834	0.148	-
	3042	-	0.051		1818	-	0.776
	3655	0.959	-		2094	-	0.150
	3628	-	0.048		2084	0.792	-
323.15	984	0.072	-		2276	0.903	-
	973	-	0.849		2264	-	0.096
	1161	0.071	-		2871	-	0.116
	1159	-	0.858		2856	0.908	-
	1370	-	0.867		3256	-	0.072
	1362	0.074	-		3230	0.921	-
	1851	0.082	-		3716	0.916	-
	1837	-	0.908		3704	-	0.106
	2276	0.919	-	358.15	1121	0.259	-
	2265	-	0.077				(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Details in source. High pressure static cell fitted with stirrer. Pressure measured with manganin resistance gauge.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.99 mole per cent.

(2) Purity 99.98 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 10$; $\delta x_{N_2} = \delta y_{N_2} = \pm 0.5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Ammonia; NH_3; [7664-41-7]	Lindroos, A. E.; Dodge, B. F. *Chem. Eng. Progr. Symp. Ser. No. 3*, 1952, *48*, 10.

EXPERIMENTAL VALUES:

continued

T/K	*P*/bar	Mole fraction of nitrogen* in liquid x_{N_2}	Mole fraction of nitrogen* in gas, y_{N_2}	T/K	*P*/bar	Mole fraction of nitrogen* in liquid, x_{N_2}	Mole fraction of nitrogen* in gas, y_{N_2}
358.15	1114	-	0.522	373.15	1781	-	0.360
	1353	-	0.562		1892	0.386	-
	1345	0.244	-		1979	-	0.360
	1369	-	0.641		1934	0.409	-
	1364	0.276	-		1920	-	0.362
	1834	0.236	-		1902	0.496	-
	1823	-	0.654		1988	-	0.395
	2099	0.739	-		2060	0.472	-
	2084	-	0.186		2031	-	0.378
	2101	-	0.218		2090	-	0.382
	2087	0.674	-		2084	0.489	-
	2295	-	0.127		2094	-	0.356
	2274	0.801	-		2084	0.830	-
	2313	-	0.202		2148	0.809	-
	2298	0.609	-		2145	-	0.317
	3329	0.921	-		2217	-	0.190
	3312	-	0.080		2194	0.915	-
	3806	0.925	-		2283	0.892	-
	3780	-	0.103		2275	-	0.260
365.15	1369	-	0.587		2340	-	0.149
	1367	0.569	-		2317	0.829	-
	1654	-	0.361		2535	-	0.162
	1642	0.365	-		2525	0.916	-
	1829	0.465	-		2556	0.808	-
	1819	-	0.627		2525	-	0.132
	1841	-	0.641		2817	-	0.145
	1834	0.647	-		2803	0.916	-
	1931	-	0.443		3305	-	0.120
	1921	0.452	-		3285	0.917	-
	1928	0.462	-		3791	0.922	-
	1920	-	0.471		3779	-	0.115
	1930	-	0.502	383.15	2053	0.429	-
	1923	0.514	-		2042	-	0.425
	1930	0.545	-		2505	0.404	-
	1923	-	0.537		2494	-	0.403
	1982	-	0.541		2851	0.404	-
	1949	0.547	-		2840	-	0.398
	2076	0.559	-		3059	0.568	-
	2066	-	0.548		3045	-	0.207
	2111	-	0.312		3311	-	0.137
	2101	0.548	-		3289	0.915	-
	2243	0.579	-		3498	-	0.154
	2222	-	0.282		3482	0.916	-
	2300	0.899	-		3801	0.918	-
	2276	-	0.176		3782	-	0.147
	3315	0.920	-	323.15	763	0.065	-
	3302	-	0.098		758	0.068	-
	3756	0.925	-		754	0.073	-
	3701	-	0.116		703	0.052	-
373.15	1795	0.364	-		988	0.072	-

* This mixture exhibits the barotropic effect therefore the term "liquid" should be interpreted as "more dense phase".

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Cannon, W.A.; Robson, J.H.; English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 200-283
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

		$10^2\ x_1$			
P_{N_2}/psia	$P^a_{N_2}$/MPa	-100.0°F (199.8 K)	-50.0°F (244.3 K)	0.0°F (255.4 K)	50.0°F (283.2 K)
300	2.07	0.026	0.070	0.104	0.136
300	2.07	0.028	0.078	0.094	0.130
300	2.07	0.034	0.064	0.102	0.131
300	2.07	0.031	0.060	0.100	0.122
700	4.83	0.065	0.130	0.236	0.353
700	4.83	0.071	0.142	0.222	0.342
700	4.83	0.072	0.140	0.220	0.334
700	4.83	0.071	0.133	0.222	0.352

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) J. T. Baker Chemical Company, 99.9%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Argon; Ar; [7440-37-1] + Methane; CH_4; [74-82-8] + Nitrogen; N_2; [7727-37-9]

(2) Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Matous, J.; Sobr, J.; Novak, J.P.

Coll. Czech. Chem. Commun. 1970, *35*, 3757-61.

VARIABLES:

T/K = 243-303
P/MPa = 2.8-4.7

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

t/°C	T^a/K	S°/ml g^{-1}	10^3x_1
	46.5 atm	(4.71 MPa)	
-30	243.15	5.40	4.09
0	273.15	8.30	6.27
10	283.15	8.90	6.73
30	303.15	9.90	7.48
	27.3 atm	(2.77 MPa)	
-30	243.15	3.55	2.69
-20	253.15	4.00	3.03
-10	263.15	4.35	3.30
0	273.15	4.70	3.56
10	283.15	4.75	3.60
20	293.15	4.80	3.64
30	303.15	4.65	3.53

[a] Calculated by compiler.

[b] S° is N cm^3/g NH_3. Presumably N cm^3 is at STP.

[c] Mole fraction of gaseous mixture (all components) dissolved at indicated total gas pressure. Composition of the gaseous mixture was 12.9 mol per cent Ar, 26.5 mol per cent CH_4 and 60.6 mol per cent N_2.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking autoclave apparatus. Details in paper.

SOURCE AND PURITY OF MATERIALS:

(1) Supplied by MCHZ - Ostrava: Ar - 99.99%; N_2 - 99.99%; CH_4 - 95-96% (remainder N_2).

(2) Better than 99%. Distilled twice.

ESTIMATED ERROR:

$\delta x/x = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Ammonia; NH_3; [7664-41-7]

ORIGINAL MEASUREMENTS:

Heise, F.

Ber. Bunsenges. Phys. Chem. 1972, 76, 956.

VARIABLES:

T/K = 298
P/MPa = 3.0-20.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor, y_{N_2}
298.15	29.5	0.00209	0.6283
	58.4	0.00515	0.7848
	85.45	0.00800	0.8422
	205.1	0.01780	0.9074

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static rocking equilibrium cell. Liquid and gas samples removed after equilibrium established. Samples analysed by freezing out ammonia in liquid nitrogen trap. Details in source and ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Messer-Griessheim sample, purity better than 99.95 mole per cent.

(2) Gerling and Holtz sample, purity better than 99.8 mole per cent as determined by gas chromatography and mass spectrometry.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.3$ below 100 bar; ± 0.6 above 100 bar; δx_{N_2}, δy_{N_2} = ±2% (estimated by compiler).

REFERENCES:

1. Heise, F.; *Dissertation*, Göttingen, 1971.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Nitrous oxide; N_2O; [10024-97-2]

ORIGINAL MEASUREMENTS:

Zeininger, H.

Chemie-Ing.-Techn. 1972, *44*, 607-12.

VARIABLES:

T/K = 213-253
P/MPa = 0.6-8.2

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$P/10^5$Pa	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}	T/K	$P/10^5$Pa	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
213.15	5.7	<0.01	0.198	233.15	59.9	0.072	0.705
	10.4	<0.01	0.537		67.6	0.096	0.739
	16.3	0.008	0.700		75.0	0.109	0.749
	22.6	0.026	0.780		81.2	0.124	0.786
	29.2	0.023	0.807	253.15	23.8	<0.01	0.179
	35.3	0.052	0.827		28.0	<0.01	0.269
	42.6	0.058	0.828		32.4	0.012	0.382
	47.9	0.083	0.833		36.1	0.023	0.412
	56.8	0.087	0.852		39.2	0.023	0.464
	66.0	0.106	0.857		43.6	0.027	0.484
	73.4	0.151	0.863		46.3	0.027	0.507
233.15	16.3	<0.01	0.407		51.6	0.055	0.523
	19.3	<0.01	0.445		56.9	0.053	0.524
	24.1	<0.01	0.532		63.0	0.075	0.549
	31.9	<0.01	0.632		69.8	0.084	0.570
	41.6	0.042	0.660		75.2	0.093	0.594
	47.5	0.058	0.689		82.0	0.102	0.603
	52.7	0.062	0.704				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell stirred with a steel ball. Samples of gas and liquid phases removed and analysed by mass spectrometry. Care was taken to avoid large changes in pressure during sampling by taking small samples. Details in source.

SOURCE AND PURITY OF MATERIALS:

Nitrous oxide was "pure" as determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/10^5 Pa = \pm 0.2$;
$\delta x_{N_2} = \pm 0.008$; $\delta y_{N_2} = \pm 0.009$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Nitryl Fluoride; FNO_2; [10022-50-1]

ORIGINAL MEASUREMENTS:

Cannon, W. A.; Robson, J. H.; English, W. D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 172-256
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	$P^a_{N_2}$/MPa	$10^2x_1{}^b$ -149.5°F (172.3 K)	 -99.1°F (200.3 K)	 -49.6°F (227.7 K)	 0.8°F (255.8 K)
300	2.07	3.04	1.91	1.92	1.34
300	2.07	2.75	2.05	1.86	1.41
300	2.07	2.78		1.92	
300	2.07	2.98		1.86	
700	4.83	6.58	4.95	4.26	4.20
700	4.83	6.66	4.69	4.33[c]	4.28

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

[c] Measured at 680 psia (4.69 MPa).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) Ozark Mahoning Company, 95%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Nitrogen trifluoride; NF_3; [7783-54-2]

ORIGINAL MEASUREMENTS:

Cannon, W. A.; Robson, J. H.; English, W. D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 133-172
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	P_{N_2}[a] /MPa	x_1[b] -220.2°F (133.0 K)	-199.6°F (144.5 K)	-175.1°F (158.1 K)	-150.1°F (172.0 K)
300	2.07	0.441	0.264	0.183	0.134
300	2.07	0.446	0.264	0.192	0.133
300	2.07	0.432	0.268	0.183	0.135
300	2.07	0.434	0.264	0.183	0.137
700	4.83		0.715	0.522	0.382
700	4.83		0.713	0.535	0.367
700	4.83		0.731	0.531	0.394
700	4.83		0.731	0.526	0.389

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) Air Products and Chemicals, 99.8%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Tetrafluorohydrazine; N_2F_4; [10036-47-2]

ORIGINAL MEASUREMENTS:

Cannon, W.A.; Robson, J.H.; English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 144-228
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	$P^a_{N_2}$/MPa	$x_1{}^b$ -200.2°F (144.2 K)	 -150.2°F (171.9 K)	 -100.7°F (199.4 K)	 -50.1°F (227.5 K)
300	2.07	0.189	0.111	0.0893	0.0611
300	2.07	0.190	0.112	0.0904	0.0634
300	2.07	0.183	0.114	0.0899	0.0634
300	2.07	0.182	0.112	0.0875	0.0619
700	4.83	0.421	0.240	0.206	0.167
700	4.83	0.421	0.240	0.209	0.167
700	4.83	0.425	0.257	0.206	0.166
700	4.83	0.425	0.253	0.215	0.165

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade; 99.9%.

(2) Air products and chemicals, 99.5% by weight.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:	EVALUATOR:
(1)Nitrogen; N_2; [7727-37-9] (2)Carbon dioxide; CO_2; [124-38-9]	Colin L. Young, School of Chemistry, University of Melbourne, Parkville, Victoria 3052, Australia. November 1981

CRITICAL EVALUATION:

This system has been studied in detail by Zenner and Dana (1) at 273, 232 and 218 K. Their measurements are in good agreement with the data of Somait and Kidnay (2) at 270 K and the limited data of Arai *et al.* (3) who studied this mixture at 253, 273 and 288 K. Kaminishi and Toriumi (4) studied this system at a series of temperatures between 233 and 298 K while their data are not of the highest accuracy there is fair agreement both with Zenner and Dana's results (1) at 273 K and with the results of Arai *et al.* (3) at 253 K. The data of Yorizane *et al.* (5) are in agreement with those of Zenner and Dana at 273 K. The data in these five papers (1-5) are in substantial agreement and are classified as tentative. The data of Somait and Kidnay (2) are almost certainly the most reliable of these five sets of data. We do not feel that any particular set of data is sufficiently accurate and over a sufficiently wide range of temperature and pressure to be classified as recommended.

The data of Krichevskii *et al.* (6) cover the temperature range 288 to 303 K. Their data are not in good agreement with the data of Arai *et al.* (3) at 288 K and are not of the highest accuracy. Their data are therefore classified as doubtful.

Tskilis (7) studied the phase behaviour of this system at pressures between 400 and 700 MPa at 273 K. These data are not generally considered to be solubility data and are not evaluated here. The data of Abdulayev (8) and Kulikov (9) are presented in the form of graphs only and are not considered further.

References

1. Zenner, G. H.; Dana, L. I. *Chem. Eng. Progr. Symp. Ser. No. 44* 1963, *59*, 36.
2. Somait, F. A.; Kidnay, A. J. *J. Chem. Eng. Data* 1978, *23*, 301.
3. Arai, Y.; Kaminishi, G.; Saito, S. *J. Chem. Eng. Japan* 1971, *2*, 113.
4. Kaminishi, G.; Toriumi, T. *Kogyo Kagaku Zaashi.* 1966, *69*, 175.
5. Yorizane, M.; Yoshimura, S.; Masuoka, M. *Kagaku Kogaku* 1970, *34*, 953.
6. Krichevskii, I. R.; Khazonova, N. E.; Lesnevskaya, L. S.; Sandalova, L. Yu. *Khim. Prom.* 1962, *38*, 169.
7. Tsiklis, D. S. *Zh. Fiz. Khim.* 1946, *20*, 18.
8. Abdulayev, Ya. A. *Zh. Fiz. Khim.* 1939, *13*, 986.
9. Kulikov, N. E. *Tr. Gork. Politekh. Inst.* 1969, *25*, 18.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon Dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Krichevskii, I. R.; Khazonova, N. E.; Lesnevskaya, L. S.; Sandalova, L. Yu.

Khim. Prom. 1962, *38*, 169.

VARIABLES:

$T/K = 288\text{-}303$
$P/MPa = 6.1\text{-}10.2$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES: (SMOOTHED)

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
288.15	60.8	0.025	0.090
	70.9	0.050	0.158
	81.1	0.074	0.195
	91.2	0.102	0.210
	101.3	0.161	0.205
	101.5	0.187	0.187
293.15	60.8	0.009	0.032
	70.9	0.037	0.104
	81.1	0.068	0.143
	91.2	0.102	0.159
	98.8	0.140	0.140
298.15	70.9	0.024	0.055
	81.1	0.059	0.099
	91.2	0.086	0.100
	92.2	0.093	0.093
301.15	70.9	0.006	0.012
	81.1	0.043	0.063
	86.1	0.060	0.067
	87.1	0.064	0.064
303.15	76.0	0.015	0.026
	81.1	0.031	0.041
	84.1	0.033	0.033

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static cell fitted with magnetic stirrer. Pressure measured with Bourdon gauge. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/\text{bar} = \pm 0.3$;
$\delta x_{N_2} \approx \delta y_{N_2} = \pm 0.003$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Zenner, G. H.; Dana, L. I.

Chem. Eng. Prog. Symp. Ser. 1963, 59, No. 44, 36-41.

VARIABLES:

T/K = 218-273
P/MPa = 0.1-1.4

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}	T/K	P/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	Mole fraction of nitrogen in gas, y_{N_2}
273.15	6.04	0.0521	0.2885	232.85	12.64	0.219	0.765
	6.03	0.0512	0.292		9.68	0.155	0.756
	4.83	0.0265	0.198		7.97	0.121	0.756
	6.31	0.058	0.310		6.66	0.096	0.738
	7.99	0.0952	0.373		13.89	0.268	0.708
	9.59	0.1408	0.396		13.06	0.237	0.747
	10.97	0.1923	0.3845	218.15	1.28	0.009	0.525
	11.66	0.228	0.354		2.28	0.023	0.710
	11.86	0.2975	0.3045		3.85	0.048	0.804
232.85	3.55	0.0375	0.628		5.85	0.066	0.836
	1.76	0.0208	0.372		7.83	0.117	0.844
	11.97	0.168	0.740		9.87	0.1522	0.847
	9.88	0.141	-		11.77	0.1892	0.830
	7.52	0.109	0.740		13.16	0.218	0.815
	10.23	0.1565	0.746		13.15	0.2183	0.813
	11.11	0.1857	0.753				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static bomb. Pressure measured with dead weight tester. Temperature measured with resistance thermometer. Samples of liquid and gas analysed by removing carbon dioxide from sample with potassium hydroxide solution. Nitrogen determined volumetrically.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Purified - no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/MPa = \pm 0.05$;

δx_{N_2}, δy_{N_2} = ±0.002 (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon dioxide; CO_2;
[124-38-9]

ORIGINAL MEASUREMENTS:

Kaminishi, G.; Toriumi, T.

Kogyo Kagaku Zaashi 1966, *69*, 175-8.

VARIABLES:

$T/K = 233-298$
$P/MPa = 0.4-1.3$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	in gas, y_{N_2}
298.15	7.42	-	0.067
293.15	8.22	-	0.144
	8.44	0.072	0.148
	8.84	0.090	0.152
288.15	7.42	0.051	0.175
	8.44	0.083	0.202
273.15	7.42	0.076	0.353
	9.63	0.133	0.395
	11.01	0.188	0.377
	11.38	0.215	0.366
253.15	3.70	-	0.382
	5.27	0.059	0.509
	6.84	0.095	0.568
	10.18	-	0.596
	11.73	0.210	0.582
	12.74	0.246	0.557
233.15	5.07	0.066	0.700

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with agitator. Pressure measured with Bourdon gauge. After equilibrium established sample removed and analysed by volumetric and gravimetric techniques. Carbon dioxide absorbed in potassium hydroxide solution.

SOURCE AND PURITY OF MATERIALS:

Better than 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/MPa = \pm 0.01$;
δx_{N_2}, δy_{N_2} $= \pm 0.003$ (estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Yorizane, M.; Yoshimura, S.; Masuoka, H.

Kagaku Kogaku 1970, *34*, 953-7.

VARIABLES:

$T/K = 273$

$P/MPa = 3.5-11.8$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P_{total}/MPa	Mole fraction of nitrogen in liquid, x_{N_2}	in vapor y_{N_2}
273.15	3.49	0.0	0.0
	4.05	0.015	0.0964
	4.05	0.011	0.0910
	5.07	0.031	0.215
	6.08	0.0561	0.290
	6.08	0.0510	0.300
	7.09	0.0710	0.347
	8.11	0.0967	0.370
	8.11	0.101	0.375
	9.12	0.126	0.392
	9.63	0.145	0.390
	10.13	0.158	0.397
	11.15	0.200	0.390
	11.65	0.251	0.356
	11.75	0.272	0.338
	11.82	0.297	0.297

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

Vapor recycle equilibrium cell with magnetic pump. Temperature measured with platinum resistance thermometer and pressure measured with Bourdon gauge. Vapor and liquid sampled simultaneously and expanded to 200 cm^3 at room temperature, analysed using GC. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.03$; δx_{N_2}, $\delta y_{N_2} = \pm 0.003 - 0.005$. (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Arai, Y.; Kaminishi, G.; Saito, S.
J. Chem. Eng. Japan 1971, *2*, 113.

VARIABLES:

T/K = 253-288
P/MPa = 7.1-14.3

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen in liquid, x_{N_2}
253.15	89.8	0.132
	106.2	0.174
	127.9	0.243
	143.2	0.347
273.15	71.1	0.071
	94.5	0.128
	118.0	0.254
288.15	77.8	0.060
	90.9	0.103
	96.3	0.132
	97.6	0.155

Dew point data also given in source.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Glass capillary cell fitted with magnetic stirrer. Pressure measured with a dead weight gauge. Temperature measured with mercury in glass thermometer. Details in source. Mixtures of known composition charged into cell. Bubble point determined from plots of volume against pressure. Dew point determined visually. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Nippon Sanso Industry Co. sample, purity 99.9 mole per cent.

(2) Showa Tansan Industry Co. sample, purity > 99.9 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta P/\text{bar} = \pm 0.1$;

$\delta x_{N_2} \simeq \pm 1\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Somait, F.A. Kidnay, A.J.

J. Chem. Eng. Data. 1978, *23*, 301-5.

VARIABLES:

T/K = 270
P/MPa = 3.2-12.3

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fraction of nitrogen		T/K	P/bar	Mole fraction of nitrogen	
		in liquid x_{N_2}	in gas y_{N_2}			in liquid x_{N_2}	in gas, y_{N_2}
270.00	31.99	0.0000	0.0000	270.00	86.13	0.1142	0.4139
	34.25	0.0040	0.0472		89.82	0.1231	0.4190
	36.27	0.0078	0.0851		92.92	0.1319	0.4173
	38.00	0.0108	0.1140		96.26	0.1430	0.4210
	39.52	0.0135	0.1331		102.04	0.1585	0.4188
	41.22	0.0168	0.1598		107.14	0.1769	0.4134
	42.05	0.0182	0.1683		110.53	0.1904	0.4094
	42.81	0.0197	0.1783		112.52	0.1986	0.4061
	45.90	0.0263	0.2156		115.49	0.2142	0.3986
	47.60	0.0289	0.2323		118.18	-	0.3857
	47.74	0.0292	0.2325		118.86	0.2332	0.3800
	51.52	0.0368	0.2674		118.86	0.2360	0.3808
	56.99	0.0476	0.3069		119.48	0.2486	0.3762
	60.49	0.0545	0.3280		120.24	0.2454	0.3720
	64.44	0.0630	0.3473		120.73	0.2505	0.3664
	70.93	0.0778	0.3770		121.35	0.2556	0.3640
	77.21	0.0921	0.3961		121.96	-	0.3524
	83.80	0.1080	0.4126		123.41	0.3530	0.3530

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with diaphragm pump. Temperature measured with platinum resistance thermometer and pressure with Bourdon gauge. Cell stirred with two propeller stirrer. Vapor and liquid samples analysed by gas chromatography using a thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.015$ up to 100 bar; ±0.1 above 100 bar; δx_{N_2}; $\delta y_{N_2} = \pm 0.002$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Carbon dioxide; CO_2; [124-38-9]

(3) Hydrogen sulfide; H_2S; [7783-06-4]

(4) Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Rousseau, R. W.; Matange, J. N.; Ferrell, J. K.

Am. Inst. Chem. Engnrs. J. 1981, *27*, 605-13.

VARIABLES:

T/K = 258-273
P/MPa = 1-4

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

		Mole fractions						
		in liquid				in vapor		
P/atm	P/MPa	x_{CH_3OH}	x_{CO_2}	x_{N_2}	x_{H_2S}	x_{CO_2}	x_{N_2}	x_{H_2S}
			T/K = 258.15					
9.3	0.94	0.908	0.074	0.003	0.015	0.544	0.403	0.052
20.8	2.11	0.768	0.210	0.003	0.019	0.611	0.365	0.024
29.6	3.00	0.646	0.331	0.005	0.021	0.589	0.400	0.010
40.1	4.06	0.742	0.235	0.008	0.016	0.458	0.542	---
			T/K = 273.15					
9.2	0.93	0.900	0.085	0.002	0.013	0.685	0.284	0.031
21.2	2.15	0.743	0.234	0.002	0.021	0.801	0.165	0.035
29.0	2.94	0.696	0.283	0.003	0.018	0.774	0.204	0.022
39.8	4.03	0.687	0.285	0.007	0.020	0.585	0.376	0.039

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Recirculating vapor-liquid equilibrium cell. Pressure in cell measured with Heise gauge calibrated against a dead weight tester. Temperature measured with copper-constantan thermocouple. Composition of gas and liquid samples determined by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.999 mole per cent.

(2) Purity 99.99 mole per cent.

(3) A 15.1 mole per cent mixture in pure nitrogen.

(4) Purity 99.95 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.01$;

δx, $\delta y = \pm 0.005$ (estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Diborane; B_2H_6; [19287-45-7]

ORIGINAL MEASUREMENTS:

Cannon, W.A.; Robson, J.H.; English, W.D.
Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

T/K = 144-227
P/MPa = 2.1-4.8

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

P_{N_2}/psia	P_{N_2} ^{a}/MPa	x_1 ^{b} -200.0°F (144.3K)	x_1 ^{b} -149.9°F (172.1K)	x_1 ^{b} -99.8°F (199.9K)	x_1 ^{b} -50.4°F (227.4K)
300	2.07	0.114	0.0768	0.0613	0.0423
300	2.07	0.115	0.0775	0.0605	0.0406
300	2.07	0.114	0.0788	0.0578	0.0396
300	2.07	0.116	0.0781	0.0592	0.0395
700	4.83	0.284	0.195	0.166	0.140
700	4.83	0.284	0.196	0.168	0.140
700	4.83	0.294		0.166	0.137
700	4.83	0.294		0.166	0.139

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated nitrogen partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 200 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high pruity grade, 99.9%.

(2) Callery Chemical Company, 99.0%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Trimethylborane; C_3H_9B; [593-90-8]

ORIGINAL MEASUREMENTS:

Cannon, W.A.; Robson, J.H.: English, W.D.

Report DAC-60510-F2. Contract NAS7-548 (1968). (Tech. Report Douglas Missile & Space Systems Division, Astropower Laboratory.)

VARIABLES:

$T/K = 200\text{-}283$
$P/MPa = 2.1\text{-}4.8$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

			$10^2 x_1$[b]		
P_{N_2}/psia	$P^a_{N_2}$/MPa	-99.8°F (199.9 K)	-45.5°F (230.1 K)	0.0°F (255.4 K)	50.0°F (283.2 K)
300	2.07	3.88	3.68	3.65	3.60
300	2.07	3.98	3.68	3.78	3.60
300	2.07	4.04	3.70	3.77	3.46
300	2.07	4.02	3.66	3.72	3.38
700	4.83	8.60	8.40	8.28	8.94
700	4.83	8.74	8.48	8.18	9.08
700	4.83				9.06
700	4.83				9.18

[a] Calculated by compiler.

[b] Mole fraction solubility at indicated partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 20 cm^3 of liquid propellant was condensed into a pressure vessel of about 1 liter capacity. Nitrogen was added to the proper pressure and the apparatus agitated for about one hour. A sample of the liquid phase was withdrawn and flashed to a gas at a lower temperature. The gas sample was then analyzed by gas chromatography.

SOURCE AND PURITY OF MATERIALS:

(1) Air Products and Chemicals, high purity grade, 99.9%.

(2) Orgmet Chemical, Hempstead, New Hampshire, 95-98%.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta P/P = \pm 0.02$
$\delta x_1/x_1 = \pm 0.02$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]
(2) Methane; CH_4; [74-82-8]
(3) Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Sarashina, E.; Arai, Y.;
Saito, S.
J. Chem. Eng. Japan 1971, *4*, 377.

VARIABLES:

T/K = 233-273
P/MPa = 6-10

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

			Mole fraction			
			in liquid		in vapor	
T/K	*P*/atm	*P*/MPa	x_{N_2}	x_{CH_4}	y_{N_2}	y_{CH_4}
273.15	60	6.08	0.037	0.013	0.229	0.046
			0.032	0.033	0.169	0.116
			0.023	0.052	0.124	0.170
			0.015	0.075	0.072	0.237
	80	8.11	0.079	0.026	0.306	0.064
			0.071	0.050	0.253	0.120
			0.060	0.077	0.205	0.169
			0.057	0.091	0.182	0.196
			0.049	0.112	0.149	0.237
			0.038	0.146	0.100	0.290
			0.030	0.165	0.075	0.315
			0.024	0.179	0.061	0.334
			0.020	0.190	0.047	0.344
	100	10.13	0.141	0.004	0.381	0.007
			0.132	0.039	0.316	0.070
			0.126	0.082	0.247	0.123
			0.125	0.103	0.220	0.149
			0.120	0.115	0.200	0.158
253.15	60	6.08	0.052	0.038	0.342	0.195
			0.032	0.110	0.174	0.374
			0.024	0.131	0.113	0.439

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static cell fitted with magnetic stirrer. Temperature measured with liquid in glass thermometer and pressure measured with Bourdon gauge. Gas-liquid chromatography was used to analyse the equilibrium compositions.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta P/MPa = \pm 0.01$;
δx, δy = ±2%
(estimated by compiler).

REFERENCES:

1. Kaminishi, G.; Arai, Y.; Saito, S.; Maeda, S. *Chem. Eng. Japan* 1968, *1*, 109.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]
(2) Methane; CH_4; [74-82-8]
(3) Carbon dioxide; CO_2; [124-38-9]

ORIGINAL MEASUREMENTS:

Sarashina, E.; Arai, Y.;
Saito, S.
J. Chem. Eng. Japan 1971, *4*, 377.

EXPERIMENTAL VALUES:

			Mole fraction			
			in liquid		in vapor	
T/K	P/atm	P/MPa	x_{N_2}	x_{CH_4}	y_{N_2}	y_{CH_4}
253.15	80	8.11	0.102	0.022	0.525	0.062
			0.094	0.046	0.439	0.144
			0.086	0.072	0.372	0.210
			0.075	0.117	0.289	0.297
			0.071	0.135	0.259	0.324
			0.065	0.153	0.230	0.348
			0.054	0.206	0.169	0.409
			0.047	0.240	0.127	0.456
			0.035	0.282	0.092	0.494
			0.028	0.312	0.066	0.510
	100	10.13	0.136	0.097	0.393	0.182
			0.131	0.143	0.331	0.239
			0.127	0.163	0.301	0.259
			0.123	0.178	0.277	0.280
233.15	60	6.08	0.063	0.044	0.561	0.168
			0.059	0.080	0.444	0.279
			0.046	0.126	0.286	0.439
			0.034	0.174	0.205	0.521
			0.024	0.223	0.124	0.610
	80	8.11	0.104	0.023	0.682	0.060
			0.100	0.064	0.574	0.176
			0.086	0.108	0.464	0.279
			0.086	0.197	0.332	0.406
			0.083	0.228	0.285	0.449
			0.066	0.236	0.247	0.486
			0.064	0.318	0.185	0.541
			0.059	0.398	0.121	0.589
	100	10.13	0.144	0.127	0.486	0.244
			0.139	0.174	0.399	0.316
			0.140	0.206	0.368	0.339
			0.148	0.224	0.361	0.349
			0.156	0.246	0.345	0.357

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Methane; CH_4; [74-82-8] (3) Carbon Dioxide; CO_2; [124-38-9]	Somait, F.A.; Kidnay, A.J. *J. Chem. Eng. Data.* 1978, *23*, 301-5.

VARIABLES:	PREPARED BY:
T/K = 270 P/MPa = 4.6-8.6	C.L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Mole fractions in liquid			Mole fractions in gas		
		x_{N_2}	x_{CH_4}	x_{CO_2}	y_{N_2}	y_{CH_4}	y_{CO_2}
270.00	45.60	0.0000	0.0538	0.9462	0.0000	0.2300	0.7700
		0.0129	0.0271	0.9599	0.0959	0.1251	0.7791
		0.0226	0.0060	0.9714	0.1850	0.0269	0.7881
		0.0250	0.0000	0.9750	0.2115	0.0000	0.7885
	60.79	0.0000	0.1226	0.8774	0.0000	0.3519	0.6481
		0.0071	0.1071	0.8858	0.0336	0.3145	0.6520
		0.0093	0.1024	0.8883	0.0441	0.3035	0.6525
		-	-	-	0.1173	0.2233	0.6594
		0.0239	0.0690	0.9072	0.1237	0.2178	0.6585
		0.0297	0.0564	0.9139	0.1563	0.1822	0.6615
		0.0442	0.0240	0.9318	0.2508	0.0815	0.6677
		0.0461	0.0192	0.9347	0.2656	0.0655	0.6689
		0.0560	0.0000	0.9440	0.3290	0.0000	0.6710
	86.13	0.1142	0.0000	0.8858	0.4139	0.0000	0.5861
		0.0887	0.0671	0.8442	0.2689	0.1406	0.5905
		0.0885	0.0688	0.8428	0.2656	0.1433	0.5912
		0.0667	0.1233	0.8099	0.1747	0.2322	0.5931
		0.0652	0.1302	0.8046	0.1670	0.2394	0.5936
		0.0600	0.1442	0.7958	0.1473	0.2592	0.5936
		-	-	-	0.1172	0.2874	0.5954
		0.0422	0.1929	0.7649	0.0877	0.3105	0.6018
		0.0408	0.1959	0.7634	0.0825	0.3161	0.6014
		0.0301	0.2322	0.7377	0.0535	0.3374	0.6091
		0.0152	0.2863	0.6985	0.0210	0.3474	0.6316
		0.0155	0.2864	0.6981	0.0208	0.3479	0.6313

cont.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Recirculating vapor flow apparatus with diaphragm pump. Temperature measured with platinum resistance thermometer and pressure with Bowdon gauge. Cell stirred with two propeller stirrer. Vapor and liquid samples analysed by gas chromatography using a thermal conductivity detector. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

δT/K = ±0.2; δP/bar = ±0.015 up to 100 bar; ±0.1 above 100 bar; δx, δy = ± 0.002.

REFERENCES:

COMPONENTS	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9]	Somait, F.A.; Kidnay, A.J.
(2) Methane; CH_4; [74-82-8]	*J. Chem. Eng. Data.* 1978, *23*, 301-5.
(3) Carbon Dioxide; CO_2; [124-38-9]	

EXPERIMENTAL VALUES:

T/K	P/bar	Mole fractions in liquid			Mole fractions in gas		
		x_{N_2}	x_{CH_4}	x_{CO_2}	y_{N_2}	y_{CH_4}	y_{CO_2}
270.00	86.13	0.0112	0.3026	0.6862	-	-	-
		0.0076	0.3280	0.6645	0.0097	0.3323	0.6579
	96.26	0.1430	0.0000	0.8570	0.4210	0.0000	0.5790
		-	-	-	0.3237	0.0897	0.5866
		0.1216	0.0696	0.8088	0.2900	0.1207	0.5893
		0.1159	0.0818	0.8023	0.2611	0.1452	0.5937
		0.1092	0.0993	0.7915	0.2326	0.1711	0.5963
		0.1079	0.1085	0.7836	0.2248	0.1769	0.5983
		0.1090	0.1098	0.7812	0.2238	0.1775	0.5986
		0.1045	0.1287	0.7668	0.1988	0.1975	0.6037
		0.1015	0.1522	0.7463	0.1728	0.2166	0.6107
		-	-	-	0.1631	0.2205	0.6164
		0.0971	0.1635	0.7394	0.1597	0.2239	0.6164
		0.0941	0.1705	0.7355	0.1482	0.2287	0.6231
		0.0961	0.1741	0.7298	0.1475	0.2281	0.6243
		0.0946	0.1743	0.7311	0.1445	0.2297	0.6259
		0.0947	0.1810	0.7243	0.1398	0.2332	0.6270
		0.0947	0.1781	0.7272	0.1384	0.2318	0.6298
		0.0948	0.1868	0.7185			
		0.0944	0.1882	0.7174	0.1313	0.2329	0.6359
		0.0945	0.1905	0.7151	0.1303	0.2335	0.6363
		0.0956	0.1941	0.7102	0.1286	0.2333	0.6380
		0.0944	0.1982	0.7075	0.1224	0.2336	0.6440
		0.0960	0.2008	0.7032	0.1198	0.2313	0.6490
		0.0986	0.2098	0.6915	0.1152	0.2306	0.6542
		0.1045	0.2260	0.6696	0.1045	0.2260	0.6696
	111.46	0.1950	0.0000	0.8050	0.4080	0.0000	0.5920
		0.1897	0.0415	0.7688	0.3285	0.0594	0.6121
		0.1898	0.0613	0.7489	0.2929	0.0808	0.6263
		0.1917	0.0640	0.7443	0.2861	0.0825	0.6314
		0.2643	0.0921	0.6436	0.2643	0.0921	0.6436

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Santowax R;

ORIGINAL MEASUREMENTS:

Grové, N.H.; Whiteley, F.J.
J. Appl. Chem. 1960, *10*, 101.

VARIABLES:

T/K = 507-682
P/MPa = 0.2-0.5

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/bar	Solubility*	Ostwald Coefficient
507	3.93	13.0	0.131
510	2.54	7.0	0.110
511	1.84	5.3	0.115
600	2.16	9.3	0.187
600	2.98	12.3	0.179
609	4.72	22.7	0.210
679	2.49	12.3	0.223
679	3.45	16.3	0.214
682	5.38	29.0	0.224

*moles of nitrogen per mg of Santowax R.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Static cell with null pressure transducer. Pressure measured with Bourdon gauge. Temperature measured with thermocouple. Sample placed in cell and gas added at room temperature. Cell then heated to experimental temperature. Pressures on both sides of transducer kept approximately equal. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Analysis by infra-red method showed sample to be 11.8% o-terphenyl, 56.3% m-terphenyl, 29.3% p-terphenyl, 2.6% diphenyl and higher polyphenyls. Obtained from Monsanto Chemicals Ltd.

ESTIMATED ERROR:

$\delta T/K = \pm 1$; $\delta P/\text{bar} = \pm 0.01$; $\delta(\text{solubility}) = \pm 10\%$

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrocarbon Blend (Heavy naphtha)

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A.

Ind. Eng. Chem. 1931, *23*, 548-50.

VARIABLES:

$T/K = 298$
$P/MPa = 1.0-14.2$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Solubility*, S
298.15	10	1.0	1.05
	20	2.0	2.15
	30	3.0	3.3
	40	4.1	4.5
	50	5.1	5.45
	60	6.1	6.4
	70	7.1	7.2
	80	8.1	8.0
	90	9.1	8.9
	100	10.1	9.85
	110	11.1	10.65
	120	12.2	11.4
	130	13.2	12.75
	140	14.2	14.15

* Volume of gas measured at 101.325 kPa pressure and 298.15 K dissolved by unit volume of liquid measured under the same conditions.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Liquid saturated with gas and after equilibrium established samples removed and analysed by volumetric method. Allowance was made for vapor pressure of liquid and the solubility of the gas at atmospheric pressure. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen was of the highest purity available.

(2) Density 0.8003 g cm^{-3}, vapor pressure 80 mmHg at 298.15 K.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 5\%$.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Hydrocarbon Blend (Gas oil)

ORIGINAL MEASUREMENTS:

Frolich, P. K.; Tauch, E. J.; Hogan, J. J.; Peer, A. A.

Ind. Eng. Chem. 1931, *23*, 548-50.

VARIABLES:

T/K = 298
P/MPa = 1.0-14.2

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	*P*/atm	*P*/MPa	Solubility*, *S*
298.15	10	1.0	1.1
	20	2.0	2.2
	30	3.0	3.25
	40	4.1	4.25
	50	5.1	5.25
	60	6.1	6.2
	70	7.1	7.15
	80	8.1	8.05
	90	9.1	8.85
	100	10.1	9.65
	110	11.1	10.45
	120	12.2	11.25
	130	13.2	12.05
	140	14.2	12.8

* Volume of gas measured at 101.325 kPa pressure and 298.15 K dissolved by unit volume of liquid measured under the same conditions.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell. Liquid saturated with gas and after equilibrium established samples removed and analysed by volumetric method. Allowance was made for vapor pressure of liquid and the solubility of the gas at atmospheric pressure. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen was of the highest purity available.

(2) Density 0.8319 g cm^{-3}, vapor pressure 2 mmHg at 298.15 K.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 5\%$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Fuel RJ-1	Findl, E.; Brande, H.; Edwards, H. U. S. Dept. Comm., Office Tech. Ser. Report No. *AD 274 623*, 1960, 216 pp. *Chem. Abstr.* 1963, *58*, 6628c.
VARIABLES: T/K = 310.9 - 533.2 p_1/kPa = 172.4 - 274.4 (25 - 398 psia)	**PREPARED BY:** H. L. Clever

METHOD/APPARATUS/PROCEDURE

The solubility apparatus was constructed of two concentric glass tubes sealed at the end by invar steel caps and silicone O-rings. The caps had attachments for flexible tubes to admit solvent and gas, and to circulate the thermostating fluid.

The inner tube was of *TRUE-BORE* glass tubing. It contained the solvent and a glass ball 0.0083 inch smaller than the tube diameter. The ball was used for both stirring on gas dissolution and viscosity measurements on the gas saturated solution. A steel scale beside the inner tube allowed determination of the solvent volume to within 0.3 per cent.

The thermostating liquid (white mineral oil) circulated in the space between the two tubes.

The solvent was initially saturated with air. The amount of dissolved air was known from a previous Orsat analysis.

The solute gas was contained in a steel bottle at 700 psig maintained at a temperature of 150 ± 1°F. There were two pressure gages. A differential gage between the gas bottle and a reference bottle to measure the pressure drop when gas was admitted to the apparatus, and a Bourdon gage to measure the final total pressure in the cell.

The solvent was added to the cell until the vapor/liquid ratio reached about 0.15. The cell and its contents were heated to the temperature of the measurement. The gas was admitted, and the test cell rocked for 10 minutes more than the time required to reach a stable pressure. The amount of gas dissolved was calculated from the pressure drop in the gas reservoir and the total pressure in the cell. The partial pressure of the gas in the cell was calculated taking into account the initial dissolved air, the solvent vapor pressure, and the compressibility of the gas. Both the Ostwald coefficient and the volume of gas at standard conditions per unit weight of solvent were calculated.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: (continued)

The results were presented in large scale graphs. The results on the data sheets are values read from the graphs by the compiler.

Other experimental details and results were in an earlier report of the authors (1).

SOURCE AND PURITY OF MATERIALS:

(1) Nitrogen. Stated to be of high purity.

(2) Fuel. The fuel was specified as MIL-F-25558 Grade RJ-1 formerly designated as Shell UMF, Grade C. A table of fuel characteristics was included in the report.

ESTIMATED ERROR:

$\delta T/°F = \pm 1$
$\delta p/\text{lb in}^{-2} = \pm 1$
$\delta L/L = \pm 0.02$ (minimum), max. ≈ 0.05

REFERENCES:

1. Schlagel, L. A.; Findl, E.; Edwards, H.
Ing Er. Rept. 183, Thompson Products, Inc. Inglewood Lab., Inglewood, CA, USA, Aug 19, 1955.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Nitrogen; N_2; [7727-37-9] (2) Fuel RJ-1	Findl, E.; Brande, H.; Edwards, H. U. S. Dept. Comm., Office Tech. Ser. Report No. *AD 274 623*, 1960, 216 pp. *Chem. Abstr.* 1963, *58*, 6628c.

EXPERIMENTAL VALUES: continued

Temperature		Nitrogen Pressure	Kuenen Coefficient	Ostwald Coefficient
t/°C	T/K	p_1/psia		L/cm^{3}cm^{-3}
100	310.9	12.5	--	0.101
		12.6	--	0.095
		59.0	--	0.085
		60.0	--	0.100
		110.0	0.79	0.100
		121.0	0.77	0.090
		209.0	1.38	0.094
		222.0	1.52	0.099
		309.0	2.27	0.104
		309.0	2.34	0.110
		408.0	2.87	0.100
		410.0	3.18	0.110
				(0.100)[1]
200	366.5	15.0	--	0.152
		59.0	0.51	0.139
		108.0	0.88	0.127
		109.0	0.94	0.139
		208.0	1.80	0.140
		209.0	1.80	0.139
		309.0	2.55	0.131
		309.0	2.71	0.141
		406.0	3.69	0.144
				(0.141)[1]
300	422.0	56.0	--	0.175
		106.0	1.12	0.185
		205.0	1.97	0.166
		205.0	2.18	0.188
		307.0	3.08	0.175
		307.0	3.26	0.186
		404.5	4.27	0.190
		405.0	4.19	0.180
				(0.182)[1]
400	477.6	106.0	1.12	--
		198.0	2.13	0.197
		200.0	2.15	0.200
		300.0	3.30	0.208
		397.5	4.52	0.213
		400.0	4.41	0.208
				(0.205)[1]
500	533.2	19.0	0.30	--
		81.0	1.04	0.247
		183.0	2.43	0.241
		184.0	2.55	0.258
		285.0	3.70	0.245
		287.5	3.71	0.257
		380.0	5.21	0.265
		382.5	5.05	0.266
				(0.258)[1]

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[1] From author's line through the Ostwald coefficient values. psia ≡ pounds per square inch absolute. One lb in^{-2} ≡ 6.89476 kPa.

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Jet A(79) fuel

ORIGINAL MEASUREMENTS:

Rupprecht, S. D.; Faeth, G.M.

NASA CR 1981, NASA-CR-3422, 111 pp.

Chem. Abstr. 1981, *95*, 153333x.

VARIABLES:

T/K = 298-374
P/MPa = 1-10

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	P^a/MPa	x_1
298.15	1.03	0.0094
373.15	1.03	0.0116
298.65	2.07	0.0196
373.65	2.07	0.0240
298.40	4.82	0.0458
373.15	4.82	0.0558
296.65	10.34	0.1006
373.15	10.34	0.1186

[a] Total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A 1000 cm^3 chamber is filled with ca. 500 cm^3 of liquid. Gas is added to the desired pressure. The chamber is agitated to attain equilibrium. Temperatures are read via thermocouples and pressures via Heisse bourdon tube gages. A liquid sample is removed and allowed to de-pressurize at atmospheric pressure. The solubility is calculated from the measurement of liquid and gas volumes of the de-pressurized sample. Residual dissolved gas is considered to be negligible.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) 0.8381 sp. gr. at 60°F.
Boiling range is 434.82-600.93K

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm 0.03$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Nitrogen; N_2; [7727-37-9]

(2) Jet A(80) fuel

ORIGINAL MEASUREMENTS:

Rupprecht, S.D.; Faeth, G.M.

NASA CR 1981, NASA-CR-3422, 111 pp.

Chem. Abstr. 1981, 95, 153333x.

VARIABLES:

T/K = 298-373
P/MPa = 1-10

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	P^a/MPa	x_1
299.15	1.03	0.0121
373.15	1.03	0.0135
298.65	2.07	0.0251
373.15	2.07	0.0286
298.65	4.82	0.0594
373.15	4.82	0.0680
299.15	10.34	0.1242
373.15	10.34	0.1381

[a] Total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A 1000 cm^3 chamber is filled with ca. 500 cm^3 of liquid. Gas is added to the desired pressure. The chamber is agitated to attain equilibrium. Temperatures are read via thermocouples and pressures via Heisse bourdon tube gages. A liquid sample is removed and allowed to de-pressurize at atmospheric pressure. The solubility is calculated from the measurement of liquid and gas volumes of the de-pressurized sample. Residual dissolved gas is considered to be negligible.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) 0.8095 sp.gr. at 60°F.
Boiling range 444.26-547.59K.

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm 0.03$ compiler's estimate

REFERENCES:

AIR SOLUBILITIES

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Air (2) Water; H_2O; [7732-18-5]	Baldwin, R. R.; Daniel, S. G. *J. Appl. Chem.* 1952, *2*, 161-5. *J. Inst. Petrol., London* 1953, *39*, 105-24.
VARIABLES: $T/K = 293.15$ $p_1/kPa = 101.325$	PREPARED BY: P. L. Long H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/°C$	Temperature T/K	Bunsen Coefficient $\alpha/cm^3(STP)cm^{-3}atm^{-1}$	Ostwald Coefficient $L/cm^3\ cm^{-3}$
20.0	293.15	0.01858	0.01994
		0.01875	0.02012

The compiler calculated the Ostwald coefficient values from the author's Bunsen coefficients.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

1. Degassing. The liquid is deaerated by passage through a continously evacuated vessel. The liquid is saturated with the gas, then degassed again.

2. Saturation of the liquid with the gas. The gas is passed through a liquid air trap to remove water and carbon dioxide, then through a thermostated coil to bring it to the temperature of the experiment, and then bubbled through the liquid for up to five hours.

3. To determine the amount of gas dissolved in the saturated liquid, the saturated liquid is placed in an evacuated vessel and buret system. The gas released by the liquid is transferred to the buret. Five transfer operations recover all but a trace of the gas. The last trace (2 - 5 %) is recovered by boiling the liquid.

SOURCE AND PURITY OF MATERIALS:

(1) Air. From compressed air line. Dried and freed from CO_2.

(2) Water. Distilled.

ESTIMATED ERROR:

$\delta p/p = \pm 0.01$
$\delta\alpha/\alpha = \pm 0.01$

REFERENCES:

COMPONENTS:

(1) Air

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

ORIGINAL MEASUREMENTS:

McKee, O. L. Jr.

Ph. D. thesis, 1953
Purdue University
W. Lafayette, IN USA

VARIABLES:

T/K = 273.15, 294.8
Total p/kPa = 3,450 - 20,680

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/^{\circ}$F	Temperature T/K	Total Pressure p/lb in^{-2}	Air Solubility S/cm^3(STP) g^{-1}		
32	273.15	500	0.73	0.79	
		1000	1.52	1.72	1.75
		1500	2.29	2.44	2.46
		2000	2.95	3.10	2.97
		3000	4.15	4.19	
71	294.8	500	0.44		
		1000	1.12	1.17	
70	294.3	1500	1.64	1.65	
71	294.8	2000	2.13	2.10	
66	292.0	3000	2.72		
67	292.6		2.97		
71	294.8		2.85		

The maximum error is estimated to range from about 5 per cent at 0.75 to about 2 per cent at a solubility value of 4.0.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus of Zoss (1) was used with modifications to improve the temperature control at 32 F, and to improve the sampling of the liquid phase.

Total Pressure:

p/lb in^{-2}	p/atm	p/kPa
500	34.0	3450
1000	68.0	6895
1500	102.1	10340
2000	136.1	13790
3000	204.1	20680

1 atm ≡ 101.325 kPa ≡ 14.6960 lb in^{-2}

SOURCE AND PURITY OF MATERIALS:

(1) Air. Source not given.

(2) Water. Distilled water. Boiled for three hours before use.

ESTIMATED ERROR:

See statement under the table above.

REFERENCES:

1. Zoss, L. M.
Ph. D. Thesis, 1952.
Purdue University
W. Lafayette, IN USA

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Air (2) Water; H_2O; [7732-18-5]	Eichelberger, W.C. *Ind. Eng. Chem.* 1955, *47*, 2223-8.
VARIABLES: T/K = 298-338 P/MPa = 6.8-24.2	PREPARED BY: R. Battino

EXPERIMENTAL VALUES:

Temperature	P_{Air}/psig	$P_{Air}{}^a$/MPa	Solubility^b	Temperature	P_{Air}/psig	$P_{Air}{}^a$/MPa	Solubility^b
65°C	970	6.787	0.78	45°C	1010	7.063	0.91
(338.2 K)	1475	10.27	1.14	(318.2 K)	1310	9.131	1.13
	1645	11.44	1.27		1950	13.54	1.61
	1935	13.44	1.42		2200	15.27	1.78
	2430	16.85	1.73		2540	17.61	2.02
	3430	23.74	2.27		2750	19.06	2.09
					3440	23.81	2.54
25°C	1050	7.339	1.15		3500	24.23	2.54
(298.2 K)	1850	12.85	1.83				
	2775	19.23	2.58				
	3420	23.68	2.98				

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[a] Calculated by compiler. Partial pressure of air (absolute).

[b] Solubility in units of ml air (STP) per ml water. Gas volumes not corrected for non-ideality of gas at pressure of measurement.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A pressure vessel is charged up to pressure with gas and liquid and rocked for several hours. After equilibration a sample is removed into a buret where the liquid and gas volumes are measured at atmospheric pressure.

SOURCE AND PURITY OF MATERIALS:

(1) From standard cylinder.

(2) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

δSolubility/Solubility = ±0.03, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Air

(2) Sodium Chloride; NaCl; [7647-14-5] (brines)

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

ORIGINAL MEASUREMENTS:

Eichelberger, W. C.

Ind. Eng. Chem. 1955, *47*, 2223-8.

EXPERIMENTAL VALUES:

		25°C (298.2 K)		45°C (318.2 K)		65°C (338.2 K)	
P_{Air}/psig	P^a_{Air}/MPa	g NaCl/ℓ soln.[b]	Solubility[c]	g NaCl/ℓ soln.[b]	Solubility[c]	g NaCl/ℓ soln.[b]	Solubility[c]
2500	17.33	0	2.36	0	1.985	0	1.76
		30	2.04	30	1.71	30	1.51
		99	1.36	98	1.20	97	1.135
		203	0.77	203	0.75	197	0.705
		305	0.425	304	0.425	250	0.55
						309	0.43
3500	24.23	0	3.05	0	2.55	0	2.30
		30	2.63	30	2.24	30	1.96
		99	1.77	98	1.50	97	1.43
		203	0.98	203	0.945	197	0.92
		305	0.55	304	0.55	250	0.72
						309	0.545

[a] Calculated by compiler. Partial pressure of air (absolute).

[b] Concentration of brine solution given as g NaCl/liter of solution.

[c] Solubility in units of ml air (STP) per ml brine solution. Gas volumes not corrected for non-ideality of gas at pressure of measurement.

[d] These are smoothed values read from graphs by the authors.

COMPONENTS:

(1) Air

(2) Sodium Chloride; NaCl; [7647-14-5]; (brines)

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

ORIGINAL MEASUREMENTS:

Eichelberger, W. C.

Ind. Eng. Chem. 1955, *47*, 2223-8.

VARIABLES:

T/K = 298-338
P/MPa = 7.0-24.2
Concentration

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

		25°C (298.2 K)		45°C (318.2 K)		65°C (338.2 K)	
P_{Air}/psig	P^a_{Air}/MPa	g NaCl/ℓ soln.[b]	Solubility[c]	g NaCl/ℓ soln.[b]	Solubility[c]	g NaCl/ℓ soln.[b]	Solubility[c]
1000	6.994	0	1.10	0	0.91	0	0.83
		30	0.93	30	0.77	30	0.67
		99	0.65	98	0.54	97	0.50
		201	0.355	203	0.34	197	0.31
		305	0.21	304	0.205	309	0.19
1500	10.44	0	1.54	0	1.29	0	1.15
		30	1.315	30	1.105	30	0.97
		99	0.89	98	0.78	97	0.725
		201	0.50	203	0.485	197	0.45
		305	0.285	304	0.28	250	0.34
						309	0.275
2000	13.89	0	1.96	0	1.64	0	1.465
		30	1.69	30	1.41	30	1.25
		99	1.13	98	1.00	97	0.94
		203	0.64	203	0.62	197	0.58
		305	0.36	304	0.355	250	0.45
						309	0.36

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A pressure vessel is charged up to pressure with gas and liquid and rocked for several hours. After equilibration a sample is removed into a gas buret where the liquid and gas volumes are measured at atmospheric pressure.

SOURCE AND PURITY OF MATERIALS:

(1) From standard cylinders.

(2) Raw brine from Syracuse plant of Solray Process Division.

(3) Distilled.

ESTIMATED ERROR:

δT/K = ±0.1
δSolubility/Solubility = ±0.03
compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Air

(2) Sulfuric acid; H_2SO_4; [7664-93-9]

(3) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Kobe, K. A.; Kenton, F. H.

Ind. Eng. Chem., Anal. Ed. 1938, *10*, 76-7.

VARIABLES:

T/K = 298.15

p_1/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	Temperature T/K	Solvent Volume V/cm^3	Air Volume Absorbed v_1/cm^3	Bunsen Coefficient α/cm^3(STP)cm^{-3}atm^{-1}	Ostwald Coefficient L/cm^{3}cm^{-3}
25	298.15	99.54	0.51	0.0047[a]	0.0051[a]
		49.54	0.27	0.0049	0.0053

The solvent is a mixture of 800 g H_2O

200 g Na_2SO_4 (anhydrous)

40 ml H_2SO_4 (Conc., 36 normal)

Thus the molality of the solution is

m_2/mol kg^{-1} = 0.90 (H_2SO_4)

m_3/mol kg^{-1} = 1.76 (Na_2SO_4)

[a] Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in detail in an earlier paper (1). The apparatus consists of a gas buret, a pressure compensator, and a 200 cm^3 absorption bulb and mercury leveling bulb. The absorption bulb is attached to a shaking mechanism.

The solvent and the gas are placed in the absorption bulb. The bulb is shaken until equilibrium is reached. The remaining gas is returned to the buret. The difference in the final and initial volumes is taken as the volume of gas absorbed.

SOURCE AND PURITY OF MATERIALS:

(1) Air. Source not given. Purity stated to be 99+ per cent.

(2, 3) Sulfuric acid and sodium sulfate. Sources not given. Analytical grade.

(4) Water. Distilled.

ESTIMATED ERROR:

$\delta\alpha/\alpha$ = ±0.02 (compilers)

REFERENCES:

1. Kobe, K. A.; Williams, J. S. *Ind. Eng. Chem., Anal. Ed.* 1935, *7*, 37.

COMPONENTS:

(1) Air
(2) Carbon dioxide; CO_2; [124-38-9]
(3) Sulfuric acid; H_2SO_4; [7664-93-9]
(4) Sodium sulfate; Na_2SO_4; [7757-82-6]
(5) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kobe, K. A.; Kenton, F. H.

Ind. Eng. Chem., Anal. Ed. 1938, *10*, 76-7.

VARIABLES:

$T/K = 298.15$
$p_1/kPa = 101.325$

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/°C$	T/K	Gas Composition volume per cent	Solvent Volume V/cm^3	Air and CO_2 Volume Absorbed v_1/cm^3	Bunsen Coefficient $\alpha/cm^3(STP)cm^{-3}atm^{-1}$	Ostwald Coefficient L/cm^3cm^{-3}
25	298.15	5% CO_2	49.54	0.67	0.0124	0.0135
		95% Air	49.54	0.67		
25	298.15	10% CO_2	49.54	1.17	0.0215	0.0235
		90% Air	49.54	1.16		
25	298.15	20% CO_2	49.54	2.21	0.0410	0.0447
		80% Air	49.54	2.23		

The solvent is a mixture of 800 g H_2O
200 g Na_2SO_4 (anhydrous)
40 ml H_2SO_4 (Conc., 36 normal)

Thus the molality of the solution is

$$m_3/mol\ kg^{-1} = 0.90\ (H_2SO_4)$$

$$m_4/mol\ kg^{-1} = 1.76\ (Na_2SO_4)$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in detail in an earlier paper (1). The apparatus consists of a gas buret, a pressure compensator, and a 200 cm^3 absorption bulb and mercury leveling bulb. The absorption bulb is attached to a shaking mechanism.

The solvent and the gas are placed in the absorption bulb. The bulb is shaken until equilibrium is reached. The remaining gas is returned to the buret. The difference in the final and initial volumes is taken as the volume of gas absorbed.

SOURCE AND PURITY OF MATERIALS:

(1,2) Air and carbon dioxide. Source not given. Purity stated to be 99+ per cent.

(3,4) Sulfuric acid and sodium sulfate. Sources not given. Analytical grade.

(5) Water. Distilled.

ESTIMATED ERROR:

$\delta\alpha/cm^3 = \pm 0.005$ (authors)

REFERENCES:

1. Kobe, K. A.; Williams, J. S. *Ind. Eng. Chem., Anal. Ed.* 1935, *7*, 37.

COMPONENTS: (1) Air (2) Alkanes; C_7H_{16}, C_8H_{18}, and $C_{10}H_{22}$	**ORIGINAL MEASUREMENTS:** Ijams, C. C. Ph.D. thesis, 1941 Vanderbilt University Nashville, TN
VARIABLES: T/K = 298.15 P/kPa = 101.325	**PREPARED BY:** H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
Heptane; C_7H_{16}; [142-82-5]		
298.15	0.224	0.245
Octane; C_8H_{18}; [111-65-9]		
298.15	0.207	0.226
2,2,4-Trimethylpentane or isooctane; C_8H_{18}; [540-84-1]		
298.15	0.226	0.247
Decane; $C_{10}H_{22}$; [124-18-5]		
298.15	0.165	0.180

The Ostwald coefficient value was calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified so that small solvent sample (2 cm^3) could be used with almost 100 per cent recovery of the solvent.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Air. Air Reduction Co. Purity 99.5 per cent.

(2) Alkanes. Purified. Vapor pressure and boiling point also reported in the thesis.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D. *J. Biol. Chem.* 1939, *130*, 545.

COMPONENTS:

(1) Air

(2) 2,2,4-Trimethylpentane or isooctane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Baldwin, R. R.; Daniel, S. G.

J. Appl. Chem. 1952, *2*, 161-5.

J. Inst. Petrol., London 1953, *39*, 105-24.

VARIABLES:

$T/K = 293.15$
$p_1/kPa = 101.325$

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$	Ostwald Coefficient $L/cm^3\ cm^{-3}$
293.15	0.240	0.258

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The liquid is deaerated by passing it through a continously evacuated vessel. The gas is passed through a liquid air trap to remove water and carbon dioxide, then through a long thermostated coil to bring the gas to the temperature of the experiment, then through the liquid until saturation is reached.

The air-saturated liquid is degassed, and the gas is collected and measured

SOURCE AND PURITY OF MATERIALS:

(1) Air. From a compressed air line. Dried and freed from CO_2.

(2) 2,2,4-Trimethylpentane. Source not given.

ESTIMATED ERROR:

$\delta p/p = \pm 0.01$
$\delta\alpha/\alpha = \pm 0.01$

REFERENCES:

COMPONENTS:

(1) Air

(2) n-Dodecane; $C_{12}H_{26}$; [112-40-3]

ORIGINAL MEASUREMENTS:

Rupprecht, S. D.; Faeth, G. M.

NASA CR 1981, NASA-CR-3422, 111 pp.

Chem. Abstr. 1981, *95*, 153333x.

VARIABLES:

T/K = 249 - 373
P/MPa = 1-10

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	P^a/MPa	x_1
248.82	1.03	0.0142
373.15	1.03	0.0161
297.40	2.07	0.0312
373.15	2.07	0.0330
297.65	4.82	0.0722
373.15	4.82	0.0768
297.15	10.34	0.1491
373.15	10.34	0.1579

[a] Total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A 1000 cm^3 chamber is filled with ca. 500 cm^3 of liquid. Gas is added to the desired pressure. The chamber is agitated to attain equilibrium. Temperatures are read via thermocouples and pressures via Heisse bourdon tube gauges. A liquid sample is removed and allowed to de-pressurize at atmospheric pressure. Solubility is calculated from the measurement of liquid and gas volumes of the de-pressurized sample. Residual dissolved gas is considered to be negligible.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm 0.03$, compiler's estimate.

REFERENCES:

COMPONENTS:

(1) Air

(2) Aliphatic alcohols:

1-Heptanol; $C_7H_{16}O$; [111-70-6]

1-Octanol; $C_8H_{18}O$; [111-87-5]

ORIGINAL MEASUREMENTS:

Ijams, C. C.

Ph. D. thesis, 1941
Vanderbilt University
Nashville, TN, USA

VARIABLES:

T/K = 298.15
p/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient $\alpha/\text{cm}^3(\text{STP})\text{cm}^{-1}\text{atm}^{-1}$	Ostwald Coefficient $L/\text{cm}^3\text{cm}^{-3}$
1-Heptanol		
298.15	0.111	0.121
1-Octanol		
298.15	0.108	0.118

The Ostwald coefficient values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactired by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified so that the small solvent sample (2 cm^3) could be used with almost 100 per cent recovery of the solvent.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Air. Air Reduction Co. Purity 99.5 per cent.

(2) Aliphatic alcohols. Purified. Vapor pressure and boiling point also reported in the thesis.

ESTIMATED ERROR:

$\delta T/\text{K} = \pm 0.05$

REFERENCES:

1. Van Slyke, D. D.
J. Biol. Chem. 1939, *130*, 545.

COMPONENTS:

(1) Air

(2) 1,1'-Oxybisethane or diethyl ether; $C_4H_{10}O$; [60-29-7]

ORIGINAL MEASUREMENTS:

Christoff, A.

Z. Phys. Chem. 1912, *79*, 456-60.

VARIABLES:

T/K = 273.15 - 288.15

p/kPa = Atmospheric

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Ostwald Coefficient
$t/^\circ C$	T/K	$L/cm^3\ cm^{-3}$
0	273.15	0.290
10	283.15	0.287
15	288.15	0.286

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modified Ostwald apparatus described by Just (1) and modified by Skirrow (2). The apparatus consists of a thermostated gas buret and an absorption flask.

The modification involes the use of vapor free gas in the gas buret. A correction is made for the vapor pressure of the liquid. A steel capillary tube with a stopcock, which prevents the gas and the liquid vapor from mixing in the buret, is used to connect the absorption flask and the gas buret.

SOURCE AND PURITY OF MATERIALS:

(1) Air. Stated to be dry air.

(2) Diethtylether. Merck and Co. Stated to be pure and anhydrous.

ESTIMATED ERROR:

$\delta L/L = \pm 0.03$

REFERENCES:

1. Just, G. *Z. Phys. Chem.* 1901, *37*, 342.
2. Skirrow, F. W. *Z. Phys. Chem.* 1902, *41*, 139.

COMPONENTS:

(1) Air

(2) 1-Bromoheptane; $C_7H_{15}Br$; [629-04-9]

ORIGINAL MEASUREMENTS:

Ijams, C. C.

Ph.D. thesis, 1941
Vanderbilt University
Nashville, TN

VARIABLES:

T/K = 298.15
P/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α	Ostwald Coefficient L
298.15	0.121	0.132

The Ostwald coefficient value was calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke-Neill Manometric Apparatus manufactured by the Eimer and Amend Co. was used.

The procedure of Van Slyke (1) for pure liquids was modified so that small solvent sample (2 cm^3) could be used with almost 100 per cent recovery of the solvent.

An improved temperature control system was used.

SOURCE AND PURITY OF MATERIALS:

(1) Air. Air Reduction Co. Purity 99.5 per cent.

(2) 1-Bromoheptane. Purified. Vapor pressure and boiling point also reported in the thesis.

ESTIMATED ERROR:

$\delta T/K = 0.05$

REFERENCES:

1. Van Slyke, D. D. *J. Biol. Chem.* 1939, *130*, 545.

COMPONENTS:

(1) Air
(2) 1-Bromo-1,1,2,2,3,3,4,4,5,6,6,6-dodecafluoro-5-(trifluoromethyl)-hexane; $C_7F_{15}Br$; [50279-29-3]

ORIGINAL MEASUREMENTS:

Wesseler, E. P.; Iltis, R.; Clark, L. C. Jr.
J. Fluorine Chem., 1977, *9*, 137-46.

VARIABLES:

T/K = 298

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility[†] of air S_{air}	Solubility[†] of oxygen S_{O_2}	Solubility[†] of nitrogen S_{N_2}
298.15	36.0	10.2	25.8

[†] volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 μℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.
(2) Pennwalt Corp. sample, boiling pt. 120 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$.

REFERENCES:

COMPONENTS:

(1) Air

(2) 1-Chloro-1,1,2,2,3,3,4,4,5,6,6,6-dodecafluoro-5-(trifluoromethyl)-hexane; $C_7F_{15}Cl$; [63243-37-8]

ORIGINAL MEASUREMENTS:

Wesseler, E. P.; Iltis, R.; Clark, L. C. Jr.

J. Fluorine Chem., 1977, *9*, 137-46.

VARIABLES:

T/K = 298

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility† of air S_{air}	Solubility† of oxygen S_{O_2}	Solubility† of nitrogen S_{N_2}
298.15	37.4	10.5	26.9

† volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 μℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Pennwalt Corp. sample, boiling pt. 108 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$.

REFERENCES:

COMPONENTS: (1) Air (2) 1-Bromo-1,1,2,2,3,3,4,4,5,5,6,6,-7,7,8,8,8-heptadecafluorooctane (Perfluorooctylbromide); $C_8F_{17}Br$; [423-55-2]	ORIGINAL MEASUREMENTS: Wesseler, E. P.; Iltis, R.; Clark, L. C. Jr. *J. Fluorine Chem.*, <u>1977</u>, *9*, 137-46.
VARIABLES: T/K = 298	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility† of air S_{air}	Solubility† of oxygen S_{O_2}	Solubility† of nitrogen S_{N_2}
298.15	34.1§	9.8	24.3

§ there is a typographical error in the original paper.

† volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 μℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.	SOURCE AND PURITY OF MATERIALS: (1) No details given. (2) 3M sample, boiling pt. 140.5 °C. ESTIMATED ERROR: $\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$. REFERENCES:

COMPONENTS:

(1) Air
(2) Octadecafluorooctane
(Perfluorooctane);
C_8F_{18}; [307-34-6]

ORIGINAL MEASUREMENTS:

Wesseler, E. P.; Iltis, R.;
Clark, L. C. Jr.
J. Fluorine Chem., 1977, *9*, 137-46.

VARIABLES:

T/K = 298

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility† of air S_{air}	Solubility† of oxygen S_{O_2}	Solubility† of nitrogen S_{N_2}
298.15	37.4	10.5	26.9

† volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 μℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.
(2) PCR sample, boiling pt. 100-105 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$.

REFERENCES:

COMPONENTS:

(1) Air

(2) Octadecafluorodecahydronaphthalene (Perfluorodecalin); $C_{10}F_{18}$; [306-94-5]

ORIGINAL MEASUREMENTS:

Wesseler, E. P.; Iltis, R.; Clark, L. C. Jr.

J. Fluorine Chem., 1977, *9*, 137-46.

VARIABLES:

T/K = 298

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility† of air S_{air}	Solubility† of oxygen S_{O_2}	Solubility† of nitrogen S_{N_2}
298.15	29.8	8.6	21.2

† volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 µℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.

SOURCE AND PURITY OF MATERIALS:

(1) No details given

(2) ISC Chemicals Ltd. sample, boiling pt. 142 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Air (2) 1,1,1,2,4,4,5,7,7,8,10,10,11,13,-13,14,16,16,17,17,18,18,18-Tricosafluoro-5,8,11,14-tetrakis (trifluoromethyl)-3,6,9,12,15-pentaoxaoctadecane; $C_{17}HF_{35}O_5$; [37486-69-4]	Wesseler, E. P.; Iltis, R.; Clark, L. C. Jr., *J. Fluorine Chem.*, <u>1977</u>, *9*, 137-46.
VARIABLES:	**PREPARED BY:**
T/K = 298	C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility† of air S_{air}	Solubility† of oxygen S_{O_2}	Solubility† of nitrogen S_{N_2}
298.15	31.8	8.6	23.2

† volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 μℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.
(2) DuPont sample, boiling pt. 224 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Air (2) L1822 (large mixture of compounds from the electrochemical fluorination of decalin)	Wesseler, E. P.; Iltis, R.; Clark, L. C. Jr. *J. Fluorine Chem.*, 1977, *9*, 137-46.
VARIABLES:	PREPARED BY:
T/K = 298	C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility† of air S_{air}	Solubility† of oxygen S_{O_2}	Solubility† of nitrogen S_{N_2}
298.15	32.0	9.0	23.0

† volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 μℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.
(2) 3M sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$.

REFERENCES:

COMPONENTS:

(1) Air

(2) FC75 (mainly perfluorobutyltetrahydrofuran and perfluoropropyltetrahydropyran)

ORIGINAL MEASUREMENTS:

Wesseler, E. P.; Iltis, R.; Clark, L. C. Jr.

J. Fluorine Chem., 1977, *9*, 137-46.

VARIABLES:

$T/K = 298$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility† of air S_{air}	Solubility† of oxygen S_{O_2}	Solubility† of nitrogen S_{N_2}
298.15	37.7	10.5	27.2

† volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 μℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) 3M sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$.

REFERENCES:

COMPONENTS:

(1) Air

(2) Nitric acid, propyl ester or 1-propyl nitrate; $C_3H_7NO_3$; [627-13-4]

ORIGINAL MEASUREMENTS:

Amster, A. B.; Levy, J. B.

J. Am. Rocket Soc. 1959, *29*, 870-1.

VARIABLES:

T/K = "Room temperature"
p/kPa = 31 - 88

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

Temperature	Air Pressure[1]		Solubility[1]
	p_1/mmHg	p_1/kPa	$10^6 m_1$/mol g^{-1}
"Room temperature"	230	31	1.6
	230	31	1.75
	240	32	1.75
	240	32	1.6
	440	59	3.6
	440	59	3.4
	440	59	3.5
	450	60	3.1
	450	60	3.75
	475	63	3.75
	560	75	3.8
	620	83	5.4
	620	83	5.5
	620	83	5.5
	650	87	5.1
	660	88	5.6
	660	88	5.8

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[1] The compilers read the values of pressure, mmHg, and solubility, moles air per g of liquid, from a graph in the paper. The air partial pressure was obtained by subtracting the ester vapor pressure from the total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of an absorption flask connected by a flexible spiral to a mercury filled capillary (1).

A weighed quantity of liquid is placed in the flask. The gas is shaken with the degassed liquid. The volume of the gas is taken as the volume of the flask minus the volume of the liquid. The solubility is calculated from

$$\text{Solubility/mol } g^{-1} = V\Delta p/WRT$$

V = the gas volume
Δp = the pressure change
T = the temperature
W = the weight of the liquid.

The compilers converted the solubility values above to a Bunsen coefficient $\alpha/\text{cm}^3(\text{STP})\text{cm}^{-3}\ \text{atm}^{-1} = 0.14_2 \pm 0.01_4$ at a temperature of 293.15 K.

SOURCE AND PURITY OF MATERIALS:

(1) Air. Passed through a drying tu tube.

(2) Nitric acid, propyl ester. Source and purity not given.

ESTIMATED ERROR:

δp/mmHg = ± 5
δT/K = ± 2
$\delta m_1/m_1$ = ± 0.15

REFERENCES:

1. Levy, J. B.; Taft, R. W. Jr. Aaron, D.; Hammett, L. P. *J. Am. Chem. Soc.* 1953, *75*, 3955.

COMPONENTS: (1) Air (2) 1,1,2,2,3,3,4,4,4-Nonafluoro-N,N-bis(nonafluorobutyl)-1-butanamine (Perfluorotributylamine); $C_{12}F_{27}N$; [311-89-7]	ORIGINAL MEASUREMENTS: Wesseler, E. P.; Iltis, R.; Clark, L. C. Jr. *J. Fluorine Chem.*, 1977, *9*, 137-46.
VARIABLES: T/K = 298	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	Solubility[†] of air S_{air}	Solubility[†] of oxygen S_{O_2}	Solubility[†] of nitrogen S_{N_2}
298.15	30.7	8.6	22.1

[†] volume of gas absorbed (measured at atmospheric pressure) per 100 ml of fluorocarbon. (Total pressure was the barometric pressure, assumed to be 1 atmosphere by the compiler.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Air bubbled through fluorocarbon in stirred cell. When saturation achieved samples of liquid removed with hypodermic Precision Sampling 50 µℓ Pressure Lok syringe. Five samples taken and chromatographed. Average peak heights compared with those for injections of known amounts of air. Chromatographic column consisted of 13X molecular sieve at 70 °C. Helium was used as carrier.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.
(2) 3M sample, boiling pt. 174 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta S = \pm 2\%$.

REFERENCES:

COMPONENTS:

(1) Air

(2) Animal and vegetable oils

ORIGINAL MEASUREMENTS:

Vibrans, F. C.

Oil and Soap 1935, *12*, 14-5.

VARIABLES:

$T/K = 296\text{-}318$
$p/kPa = 101.3$

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility, cm^3 (273.15 K, 1 atm) air per 100 cm^3					
	Experiments					Av.
Corn oil						
296 - 299	7.28	7.38	7.30			7.32
318	6.98	7.14				7.06
Cottonseed oil						
296 - 299	7.18	7.12	7.23	7.24	7.22	7.20
318	7.12	6.93				7.02
Hydrogenated Cottonseed oil						
318	7.20	7.36				7.28
Steam rendered lard						
318	7.22	7.13				7.17

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Van Slyke manometric method (1).

SOURCE AND PURITY OF MATERIALS:

(1) Air. No information.

(2) Corn oil. Commercial sample bought on the market. Representative of its class.

Cottonseed oil. Commercial sample bought on the market. Representative of its class.

Lard. From a mixture of killing and cutting fats. Steam rendered.

ESTIMATED ERROR:

$\delta T/K = \pm 3$ at room temperature
± 2 at 318 K (45 ^{0}C)
$\delta c/c = \pm 0.04$ (Author)

REFERENCES:

1. Van Slyke, D. D.
J. Biol. Chem. 1924, *61*, 523.

COMPONENTS:

(1) Air

(2) Animal and vegetable oils

ORIGINAL MEASUREMENTS:

Schaffer, P. S.; Haller, H. S.

Oil and Soap 1943, *20*, 161

VARIABLES:

T/K = 313, 333
p/kPa = 101.3

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	cm^3 (273.15 K, 1 atm) Air per 100 cm^3
Cottonseed oil	
313	8.7
Butter oil	
313	10.1
333	9.6
Lard	
313	8.8

The author's solubility unit is $10^2\alpha$ or 100 x Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consists of a reaction flask connected to a water-jacketed gas buret, a mercury leveling bulb, and a differential manometer. The reaction flask is attached to a shaking mechanism in an air bath.

A 50 cm^3 sample of oil is placed in the flask. Heat and vacuum are applied to remove dissolved gases. The sample is cooled to the temperature of the measurement. Air is admitted, a zero reading is taken. The sample is shaken until it takes up no more gas at a pressure of one atm. Three determinations are made at each temperature.

SOURCE AND PURITY OF MATERIALS:

(1) Air. Source not given. Commercial cylinder.

(2) Cottonseed oil. Good grade of commercial product.

Butter oil. Obtained from butter prepared in the lab from fresh cream.

Lard. Good grade of commercial product.

ESTIMATED ERROR:

δT/K = ± 0.5
$\delta\alpha/\alpha$ = ± 0.003 (Authors, error among three determinations)

REFERENCES:

COMPONENTS:

(1) Air

(2) Fats (oils)

ORIGINAL MEASUREMENTS:

Vernon, H. M.

Proc. Royal Soc., Ser. B. 1907, *79*, 366 - 371.

VARIABLES:

T/K = 288, 310, 318
p_1/kPa = 101.3 (760 mmHg)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Oxygen, cm^3(STP)/100 cm^3	Nitrogen, cm^3(STP)/100 cm^3	Carbon Dioxide, cm^3(STP)/100 cm^3	Total Bunsen[1] $10^2\alpha$
	The Air Saturated Fat was Analyzed to Contain			
Olive oil				
288	2.20, 2.23, 2.42 2.28 Av.	5.23, 5.30, 5.27 5.26 Av.	0.19, 0.24, 0.16 0.20 Av.	7.74
310	2.33, 2.36, 2.30 2.33 Av.	5.19, 5.23, 5.15 5.19 Av.	0.17, 0.13, 0.18 0.16 Av.	7.68
Cod-liver oil				
288	2.34, 2.31, 2.22 2.29 Av.	4.95, 5.15, 5.07 5.06 Av.	0.19, 0.25, 0.19 0.21 Av.	7.56
310	2.21, 2.22, 2.22 2.22 Av.	5.05, 5.10, 5.08 5.08 Av.	0.18, 0.24, 0.20 0.21 Av.	7.51
Lard				
318	2.23, 2.40, 2.35 2.33 Av.	5.05, 5.09, 5.18 5.11 Av.	0.12, 0.12, 0.15 0.13 Av.	7.57

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[1] Air Bunsen Coefficient, $10^2\alpha/cm^3(STP)cm^{-3}atm^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

In the observations made at room temperature, the oil was shaken violently with air in a bottle for several minutes, and was allowed to stand 1 to 1½ hours till all air bubbles had risen to the surface. It was then weighed, and about 40 - 50 g of it were sucked into a vacuum flask containing 70 - 100 cm^3 of 0.5 per cent sulfuric acid, which had been well degassed by boiling. The mixture of oil and dilute acid was boiled for ½ hour. The gas was pumped off and analyzed in a Haldane gas analysis apparatus (1).

At the higher temperatures, the oil presaturated at room temperature was heated to several degrees above the temperature of measurment. It was vigorously shaken with air for 2 minutes, warmed again, and shaken for another 2 minutes. It was held for ½ hour in a water bath and then treated as above.

SOURCE AND PURITY OF MATERIALS:

1. Air.
2. Fats. A table of the oil properties is reproduced below.

	Cod-liver	Olive	Lard
Solid.Pt. °C	0 - -10	-6(?)	27-30
Sp. Grav.	0.928^{15}_{15}	0.917^{15}_{15}	0.895^{45}_{15}
I_2 Value	123-168 %	79-88 %	50-70 %

ESTIMATED ERROR: The author mentions that the unsaturated oils take up some O_2, thus the O_2 values may be small.

$\delta\alpha/\alpha$ = ± 0.10 (compiler).

REFERENCES:

1. Haldane, J. S. *J. Physiol.* 1898, *22*, 465.

COMPONENTS: (1) Air (2) Fats (oils)	ORIGINAL MEASUREMENTS: Schmidt-Nielsen, S. *Ann. Acad. Sci. Fenn., Ser. A.* 1927, *29* (No. 12), 7 pp.
VARIABLES: T/K = 293, 323 p_1/kPa = 101 (1 atm)	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

T/K	Solubility/ cm^3(STP) per 100 g	Oxygen Content of the Dissolved Gas Volume %
Cottonseed oil		
293	5.0	32.4
323	6.4	16.2
Cod-liver oil		
293	9.6	21.8
323	9.0	23.5
Herring oil		
293	5.9	10.8
323	5.7	-
Linseed oil		
293	10.1	19.1
323	10.4	10.0
Corn oil		
293	4.7	29.6
323	6.4	11.6
Olive oil		
293	5.0	28.7
323	6.1	15.7
Mineral oil		
293	8.4	30.6
323	8.1	30.5

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The oil is degassed for two hours in a vacuum.

The oil stands for 24 hours with the dry air.

The dissolved gas is removed from the oil by a Barcroft blood gas pump, and the gas volume is measured.

The oxygen content of the dissolved gas is determined.

Except for the mineral oil, these are unsaturated sytems which react with the oxygen. If the oils were allowed to stand for some time with the dissolved air in them, the percentage of O_2 fell, and in some cases only pure N_2 was left. Less oxygen was recovered at 323 K than at 293 K. This is in accord with ideas of autoxidation.

SOURCE AND PURITY OF MATERIALS:

No information.

ESTIMATED ERROR:

ADDITIONAL EXPERIMENTAL VALUES:

Air solubility in hardened whale fat (m. p. 40 - 42 ^{0}C)was:

323 K 10.3 with 82.2 % nitrogen
373 K 6.1 with 83.1 % nitrogen
378 K 6.3 with 91.7 % nitrogen
after 12, 12, and 120 hours, respec.

COMPONENTS:

(1) Air

(2) Oils

ORIGINAL MEASUREMENTS:

Baldwin, R. R.; Daniel, S. G.

J. Appl. Chem. 1952, *2*, 161-5.

J. Inst. Petrol., London 1953, *39*, 105-24.

VARIABLES:

T/K = 273.15 - 373.15
p_1/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α/cm^3(STP)cm^{-3}atm^{-1}	Ostwald Coefficient L/cm^3 cm^{-3}
Oil A1, viscosity 615 centistokes at 100 °F, mean mol wt 670		
293.15	0.0783	0.0840
Oil A2, viscosity 268 centistokes at 100 °F, mean molecular weight 610		
273.15	0.0794	0.0794
293.15	0.0792	0.0850
333.15	0.0835	0.1015
373.15	0.0818	0.112
Oil A3, viscosity 181 centistokes at 100 °F, mean molecular weight 570		
293.15	0.0843	0.0926
Oil A4, viscosity 80.3 centistokes at 100 °F, mean molecular weight 530		
293.15	0.0878	0.0942
Oil A5, viscosity 34.9 centistokes at 100 °F, mean molecular weight 400		
273.15	0.0920	0.0920
293.15	0.0903	0.0969
333.15	0.0919	0.1121
373.15	0.0926	0.1265
Oil B, viscosity 260 centistokes at 100 °F, mean molecular weight 630		
293.15	0.0752	0.0807

METHOD/APPARATUS/PROCEDURE:

1. Degassing. The liquid is deaerated by passage through a continously evacuated vessel. The liquid is saturated with the gas, then degassed again.
2. Saturation of the liquid with the gas. The gas is passed through a liquid air trap to remove water and carbon dioxide, then through a thermostated coil to bring it to the temperature of the experiment, and then bubbled through the liquid for up to five hours.
3. To determine the amount of gas dissolved in the saturated liquid, the saturated liquid is placed in an evacuated vessel and buret system. The gas released by the liquid is transferred to the buret. Five transfer operations recover all but a trace of the gas. The last trace (2 - 5 %) is removed by boiling the liquid.

SOURCE AND PURITY OF MATERIALS:

(1) Air. From compressed air line. Dried and freed from CO_2.

(2) Oils. The oils conform to DTD-472B specifications. The mol wts were determined by f.p. depression in naphthalene to ± 5 %. Other properties are given in 1953 paper.

ESTIMATED ERROR:

$\delta p/p = \pm\ 0.01$
$\delta\alpha/\alpha = \pm\ 0.01$

COMPONENTS:

(1) Air

(2) Mineral oils

ORIGINAL MEASUREMENTS:

Clark, F. M.

J. Franklin Inst. 1933, *215*, 39 - 67.

VARIABLES:

$T/T = 298, 373$

$p_1/\mathrm{kPa} = 101.3$ (760 mmHg)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Per cent Dissolved by Volume Under Atmospheric Conditions[1]		
$t/^{0}\mathrm{C}$	T/K	% Nitrogen	% Oxygen	% Air
Asphaltic Mineral Oil, Saybolt Viscosity/s is 100 at 37.8 ^{0}C and 150 at 100 ^{0}C.				
25	298	6.2	2.1	8.3
100	373	4.64	0.16	4.8
Paraffin Mineral Oil, Saybolt Viscosity/s is 150 at 100 ^{0}C.				
100	373	6.4	1.2	7.6
Mixed Mineral Oil, Saybolt Viscosity/s is 100 at 37.8 ^{0}C.				
25	298	4.6	0.6	5.2
Transformer Type Mineral Oil				
25	298			10.8
100	373			12.7

[1] The per cent volume of gas dissolved is based on gas volumes reduced to 25 ^{0}C and 760 mmHg with oil volumes at the temperature of the test.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The gas is removed from the air saturated oil by displacement with carbon dioxide. The gas is collected over concentrated KOH solution which absorbes the carbon dioxide.

In addition to the data above there are figures in the paper which (i) show air solubility in transformer oil as a function of temperature from -15 to 120 ^{0}C, and (ii) show the rate of air take-up by transformer mineral oil at 80 ^{0}C.

The paper also contains data on the solubility of oxygen, nitrogen, hydrogen and carbon dioxide in transformer mineral oil.

SOURCE AND PURITY OF MATERIALS:

1. Air. No information.
2. Oils. See descriptions in the table above.

ESTIMATED ERROR:

The error in the per cent volume solubility of air may be 5 - 10 %. (compiler)

REFERENCES:

COMPONENTS:

(1) Air

(2) Mineral oils

ORIGINAL MEASUREMENTS:

Gemant, A.

Trans. Faraday Soc. <u>1936</u>, *32*, 694 - 701.

VARIABLES:

T/T = 288 - 293, 353

p_1/kPa = 101.3 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

$t_1/^\circ C$	Oil Mass/g	Oil Specific Volume/g cm^{-1} at t_1	at $80^\circ C$	Air Absorbed V/cm^3(STP)	v^1	Bunsen^2 Coefficient α at t_1	k^3
Silvertown Lubricants, Russian origin, British Standard Specification A.30.							
16	108.95	1.164	1.225	12.48	0.64	0.092	-0.001
Silvertown Lubricants, USA Origin (Kansas and Oklahoma), British Standard Specification A.0.							
18	113.0	1.181	1.243	12.62	0.63	0.088	-0.002
Silvertown Lubricants, Russian Origin, British Standard Specification B.30.							
15	111.35	1.154	1.214	12.04	0.66	0.088	+0.001
Silvertown Lubricants, USA Origin (Pennsylvania), British Standard Specification B.0.							
16	108.60	1.176	1.239	12.00	0.55	0.088	-0.005
Silvertown Lubricants, British Standard Specification A.30.							
20	107.3	1.165	1.224	12.25	0.52	0.092	-0.007
Shell-Mex and B. P., 21 °C viscosity 0.060 poise, 60 °C viscosity 0.022 poise.							
20	106.2	1.211	1.280	14.70	0.45	0.106	-0.022
Shell-Mex and B. P., 21 °C viscosity 2.0 poise, 60 °C viscosity 0.21 poise.							
20	115.3	1.083	1.135	9.80	0.66	0.073	+0.020
Vacuum Oil Co., Mobiloil BB viscosity data.							
20	111.6	1.139	1.189	10.60	0.46	0.078	-0.003

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 130 cm^3 of oil was placed in a glass bulb, weighed, and the oil degassed by vacuum pumping and vigorous shaking for five hours.

The degassed oil was brought into contact with air. The system shaken for 20 minutes and the air uptake measured on a Hg manometer system at the temperature t_1.

In a second experiment the difference in air absorbed between t_1 and 80 °C was directly measured.

The Bunsen coefficient at t_1 and its temperature coefficient over the t_1 to 80 °C temperature interval, k, were given. Thus $\alpha_{80} = (1 + k)\alpha_{t_1}$.

---

[1] v/cm^3 is the additional air absorbed between t_1 and 80 °C.

[2] Bunsen $\alpha/cm^3(STP)cm^{-3}atm^{-1}$

[3] k the Bunsen coefficent temperature coefficient for the t_1 to 80 °C temperature interval.

SOURCE AND PURITY OF MATERIALS:

(1) Air. No information.

(2) Mineral oils. See entries in the table above.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Air

(2) Fuels, see below

ORIGINAL MEASUREMENTS:

Schweitzer, P.H.; Szebehely, V.G.

J. Appl. Phys. 1950, *21*, 1218-24.

VARIABLES:

$T/K = 294$

$P/kPa = 101$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Kinetic Viscosity /centistokes	ρ^a/g cm^{-3}	γ^b/g cm^{-1}	Solubility Constant (%)	$10^2 L^c$
		Diesel Fuel		
4.4			11.98	11.98
		Aircraft Engine Fuel		
1.67	0.780	0.0239	17.20	17.20
0.6350	0.723	0.0191	22.80	22.80
0.6350	0.692	0.0181	25.14	25.14

[a] Density at 294 K.

[b] Surface tension at 294 K. (Authors presumably mean unit to be g s^{-2}.)

[c] Calculated by compiler. Ostwald coefficient (= solubility constant/100). Measurements at 70°F (294 K).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method consisted of shaking a container partly filled with a known amount of liquid and taking accurate pressure measurements before and after equilibration.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta L/L = \pm 0.05$, compiler's estimate

REFERENCES:

COMPONENTS:

(1) Air

(2) Hydrocarbon fuels

Kerosene

ORIGINAL MEASUREMENTS:

Baldwin, R. R.; Daniel, S. G.

J. Appl. Chem. 1952, *2*, 161-5.

J. Inst. Petrol., London 1953, *39*, 105-24.

VARIABLES:

T/K = 273-293

p_1/kPa = 101.325

PREPARED BY:

P. L. Long
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α/cm^3(STP)cm^{-3}atm^{-1}	Ostwald Coefficient L/cm^3 cm^{-3}
100 Octane fuel C, density $^{20}_{4}$ 0.7096		
293.15	0.243	0.261
100 Octane fuel D, density $^{20}_{4}$ 0.7188		
293.15	0.235	0.252
Kerosene, density $^{20}_{4}$ 0.822		
273.15	0.139	0.139
293.15	0.136	0.146

	Olefins	Aromatics	Naphthalenes	Paraffins
100 octane fuel C	2 %	2-3 %	22 %	73-74 %
100 octane fuel D	1.5 %	12 %	14 %	72.5 %
kerosene	3 %	22 %	53 %	22 %

In addition the 100 octane fuels C and D contained 4.0 and 4.8 cm^3 tetraethyl lead per imperial gallon, respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

1. Degassing. The liquid is deaerated by passage through a continously evacuated vessel. The liquid is saturated with the gas, then degassed again.

2. Saturation of liquid with gas. The gas is passed through a liquid air trap to remove water and carbon dioxide, then through a thermostated coil to bring the gas to the temperature of the experiment, and then bubbled through the liquid up to five hours.

3. To determine the amount of gas dissolved, the saturated liquid is placed in a vessel attached to a calibrated buret. The vessel and buret are initially evacuated. The gas released by the liquid is transferred to the buret. Five operations and transfers recover all but a trace of the gas. The last trace (2 - 5 %) is removed by boiling the liquid.

SOURCE AND PURITY OF MATERIALS:

(1) Air. From compressed air line. Dried and freed from CO_2.

(2) 100 Octane fuels C and D. Molecular weight estimated to be 100. Composition as above.

Kerosene. Mean molecular weight measured, obtained 165. Composition as above.

Other liquid properties in paper.

ESTIMATED ERROR:

$\delta p/p = \pm 0.01$
$\delta\alpha/\alpha \quad \pm 0.01$

REFERENCES:

COMPONENTS: (1) Air (2) Aviation fuels, Kerosenes	ORIGINAL MEASUREMENTS: Derry, L. D.; Evans, E. B.; Faulkner, B. A.; Jelfs, E. C. G. *J. Inst. Petrol.* 1952, *38*, 475-525.
VARIABLES: T/K = 289 K	PREPARED BY: R. Battino

EXPERIMENTAL VALUES:

Fuel No.	Specific Gravity[a] 60/60°F	$\alpha^b/\text{cm}^3(\text{STP})\ \text{cm}^{-3}\text{atm}^{-1}$
	60°F (288.7K)	
14	0.7990	0.1452
15	0.8120	0.1376
16	0.8030	0.1322
17	0.7890	0.1398
18	0.7820	0.1353
19	0.7665	0.1528
20	0.8285	0.1231
21	0.8080	0.1391

[a] At 288.7 K.

[b] Bunsen coefficient. Paper reported percentage solubility which they defined as 100α.

continued on following page

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used an apparatus similar to that described in CRC Method F-16-245 (1) for the determination of the air content of gasolines.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) The properties of the fuels are given in table II in the original paper.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$, compiler's estimate.

REFERENCES:

1. CRC Handbook, 1946 ed., p. 222.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Air (2) Aviation fuels, Kerosenes	Derry, L. D.; Evans, E. B.; Faulkner, B. A.; Jelfs, E. C. G. *J. Inst. Petrol.* 1952, *38*, 475-525.

EXPERIMENTAL VALUES:

continued

Fuel Number	$\alpha^a/cm^3(STP)\ cm^{-3}atm^{-1}$ 0°F (255.4K)	60°F (288.7K)	65°F (291.5K)	108°F (315.4K)	120°F (322.0K)
14	0.161	0.145			0.155
16	0.136	0.132			0.143
19			0.152		
22			0.147		
23			0.132		
21			0.139		
18	0.141		0.135	0.135	
20			0.123		

[a] Bunsen coefficient. Calculated by compiler from a "solubility coefficient", k, where $\alpha = 7.60k$.

COMPONENTS:

(1) Air

(2) Hydrocarbon fuels and oil

ORIGINAL MEASUREMENTS:

Logvinyuk, V. P.; Makarenkow, V. V.; Malyshev, V. V.; Panchenkov, G. M.

Khim. Tekhnol. Topl. Masel. 1970, *15* (5), 27-9.

Chem. Technol. Fuels Oils (Eng.trans.) 1970, *15*, 353-5.

VARIABLES:

T/K = 293.15
p_1/kPa = 101.325

PREPARED BY:

S. A. Johnson
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Bunsen Coefficient α/cm^3 (STP) cm^{-3}atm^{-1}		Ostwald Coefficient L/cm^3 cm^{-3}
Hydrocarbon fuel, T-1, density ρ_4^{20}/g cm^{-3} = 0.816			
293.15	0.139		0.149
Hydrocarbon fuel, TS-1, density ρ_4^{20}/g cm^{-3} = 0.775			
293.15	0.148		0.159
Hydrocarbon fuel, T-6, density ρ_4^{20}/g cm^{-3} = 0.84			
293.15	0.132		0.142
Hydrogenated fuel, density ρ_4^{20}/g cm^{-3} = 0.832			
293.15	0.132		0.142
Oil, MK-8, density ρ_4^{20}/g cm^{-3} = 0.855			
293.15	0.091		
	0.093		
	0.094		
	0.095		
	0.093		
	0.093	Av.	0.100

The compilers calculated the Ostwald coefficients.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The details of the apparatus and procedure are described in reference (1) which was not available to the compilers.

The liquid is saturated with air to equilibrium at 20 °C and atmospheric pressure. The gas saturated oil in poured into another apparatus and vacuumized, liberation of the gas being carried out as described in (1) After returning the apparatus to atmospheric pressure, the volume of the liberated gas is measured.

SOURCE AND PURITY OF MATERIALS:

No information other than density data in the table above.

ESTIMATED ERROR:

$\delta\alpha/\alpha$ = ± 0.06 or less (Authors)

REFERENCES:

1. Gogitidze, L. D.; Logvinyuk, V. P. Makarenkov, V. V.; Panchenkov, G.M. Malyshev, V.V.; Yakovlevskii, V. V. *Method of Evaluating the Operating Properties of Jet Fuels and Lubricating Materials (in Russian)*, *Mashinostroenie* [See *Izv. Vyssh. Uchebn. Zaved. Mashinostr.*] 1966

REFERENCES (Continued) 2. Borisov, V.D.; Gogitidze, L.D.; Logvinyuk, V.P.; Makarenkov, V.V.; Malyshev, V.V.; Panchenkov, G.M.; Yakovlevskii, V.V. *Apparatus for the determination of the amount of gas dissolved in a fluid*, See *Chem. Abstr.* 1966, *65*, 16041d.

COMPONENTS:

(1) Air

(2) Lubricating Oils, see below

ORIGINAL MEASUREMENTS:

Schweitzer, P. H.; Szebehely, V. G.

J. Appl. Phys. 1950, *21*, 1218-24.

VARIABLES:

T/K = 294
P/kPa = 101

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Kinetic Viscosity /centistokes	ρ^a/g cm^{-3}	γ^b/g cm^{-1}	Solubility Constant (%)	10^2L^c
		HEAVY LUBRICATING OIL		
823-974	0.882	0.0299	7.75	7.74
823-974			8.14	8.14
762-974			8.15	8.15
762-974			8.24	8.24
762-974			8.61	8.61
562-670	0.883	0.0308	8.62	8.62
325-411	0.880	0.0301	9.05	9.05
249-346	0.869	0.0293	9.11	9.11
88.7			9.18	9.18
		LIGHT LUBRICATING OIL		
17.5	0.870	0.0274	9.70	9.70
17.5	0.870	0.0274	9.95	9.95
13.5	0.938	0.0259	10.72	10.72
17.5	0.867	0.0286	11.30	11.30

[a] Density at 294 K.

[b] Surface tension at 294 K. (Presumably the unit is really g s^{-2}.)

[c] Calculated by compiler. Ostwald coefficient (= solubility constant/100). Measurements at 70°F (294 K).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method consisted of shaking a container partly filled with a known amount of liquid and taking accurate pressure measurements before and after equilibration.

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

$\delta L/L = \pm 0.05$, compiler's estimate

REFERENCES:

COMPONENTS:

(1) Air

(2) Fuel RJ-1

ORIGINAL MEASUREMENTS:

Findl, E.; Brande, H.; Edwards, H.

U. S. Dept. Comm., Office Tech. Ser. Report No. *AD 274 623*, 1960, 216 pp.

Chem. Abstr. 1963, *58*, 6628c.

VARIABLES:

T/K = 310.9 - 533.2

p_1/kPa = 172.4 - 274.4 (25 - 398 psia)

PREPARED BY:

H. L. Clever

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus was constructed of two concentric glass tubes sealed at the end by invar steel caps and silicone O-rings. The caps had attachments for flexible tubes to admit solvent and gas, and to circulate the thermostating fluid.

The inner tube was of *TRUE-BORE* glass tubing. It contained the solvent and a glass ball 0.0083 inch smaller than the tube diameter. The ball was used for both stirring on gas dissolution and viscosity measurements on the gas saturated solution. A steel scale beside the inner tube allowed determination of the solvent volume to within 0.3 per cent.

The thermostating liquid (white minearl oil) circulated in the space between the two tubes.

The solvent was initially saturated with air. The amount of dissolved air was known from a previous Orsat analysis.

The solute gas was contained in a steel bottle at 700 psig maintained at a temperature of 150 ± 1°F. There were two pressure gages. A differential gage between the gas bottle and a reference bottle to measure the pressure drop when gas was admitted to the apparatus, and a Bourdon gage to measure the final total pressure in the cell.

The solvent was added to the cell until the vapor/liquid ratio reached about 0.15. The cell and its contents were heated to the temperature of the measurement. The gas was admitted, and the test cell rocked for 10 minutes more than the time required to reach a stable pressure. The amount of gas dissolved was calculated from the pressure drop in the gas reservoir and the total pressure in the cell. The partial pressure of the gas in the

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: (continued)

cell was calculated taking into account the initial dissolved air, the solvent vapor pressure, and the compressibility of the gas. Both the Ostwald coefficient and the volume of gas at standard conditions per unit weight of solvent were calculated.

The results were presented in large scale graphs. The results on the data sheets are values read from the graphs by the compiler.

Other experimental details and results were in an earlier report of the authors (1).

SOURCE AND PURITY OF MATERIALS:

(1) Air. Stated to be of high purity.

(2) Fuel. The fuel was specified as MIL-F-25558 Grade RJ-1 formerly designated as Shell UMF, Grade C. A table of fuel characteristics was included in the report.

ESTIMATED ERROR:

δT/°F = ± 1

δp/lb in^{-2} = ± 1

$\delta L/L$ = ± 0.02 (minimum), max. ≃ 0.05

REFERENCES:

1. Schlagel, L. A.; Findl, E.; Edwards, H.
Ing Er. Rept. 183, Thompson Products, Inc. Inglewood Lab., Inglewood, CA, USA, Aug 19, 1955.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Air (2) Fuel RJ-1	Findl, E.; Brande, H.; Edwards, H. U. S. Dept. Comm., Office Tech. Ser. Report No. *AD 274 623*, 1960, 216 pp. *Chem. Abstr.* 1963, *58*, 6628c.

EXPERIMENTAL VALUES: continued

Temperature t/°F	Temperature T/K	Air Pressure p_1/psia	Solubility $cm^3(STP)g^{-1}$	Ostwald Coefficient L/cm^3cm^{-3}
100	310.9	16	--	0.116
		17	--	0.120
		63	0.40	0.119
		63	0.52	0.121
		113	0.92	0.115
		113	0.95	0.121
		214	1.68	0.112
		214	1.76	0.120
		313	2.57	0.121
		414	3.47	0.119,0.126
				(0.119)[1]
200	366.5	17.5	--	0.153
		18	--	0.167
		60	--	0.136
		62.5	--	0.169
		113	1.11	0.155
		113	1.14	0.163
		212	2.10	0.155
		212	2.12	0.159
		311	2.99	0.149
		313	--	0.149
		411	4.04	0.157
		412.5	4.03	0.158
				(0.155)[1]
300	422.0	17.5	--	0.264
		59	0.79	0.230
		110	1.61	0.263
		112	1.52	0.241
		207.5	--	0.235
		210	3.07	0.241
		309	4.17	0.235
		310	4.37	0.246
		408	5.67	0.240
		410	5.72	0.242
				(0.240)[1]
400	477.6	102.5	1.50	0.270
		203	3.00	0.275
		303	4.50	0.275
		402.5	5.99	0.280
		403	--	0.275
				(0.275)[1]
500	533.2	87.5	1.43	0.314
		87.5	1.46	0.316
		190	3.08	0.314
		190	--	0.316
		287.5	4.62	0.314
		387	--	0.317
		390	--	0.316
				(0.315)[1]

---

[1] From author's line through the Ostwald coefficient values. psia ≡ pounds per square inch absolute. One lb in^{-2} ≡ 6.89476 kPa.

COMPONENTS:

(1) Air

(2) Jet A(79) fuel

ORIGINAL MEASUREMENTS:

Rupprecht, S. D.; Faeth, G. M.

NASA CR 1981, NASA-CR-3422, 111 pp.

Chem. Abstr. 1981, 95, 153333x.

VARIABLES:

T/K = 295-373
P/MPa = 1-10

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	P^a/MPa	x_1
295.82	1.03	0.0118
373.15	1.03	0.0132
296.65	2.07	0.0239
373.15	2.07	0.0278
298.15	4.82	0.0571
373.15	4.82	0.0635
297.15	10.34	0.1184
373.15	10.34	0.1306

[a] Total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A 1000 cm^3 chamber is filled with ca. 500 cm^3 of liquid. Gas is added to the desired pressure. The chamber is agitated to attain equilibrium. Temperatures are read via thermocouples and pressures via Heisse bourdon tube gages. A liquid sample is removed and allowed to depressurize at atmospheric pressure. The solubility is calculated from the measurement of liquid and gas volumes of the de-pressurized sample. Residual dissolved gas is considered to be negligible.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) 0.8381 sp. gr. at 60°F.
Boiling range is 434.82-600.93K.

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm 0.03$, compiler's estimate

REFERENCES:

COMPONENTS:

(1) Air

(2) Jet A(80) fuel

ORIGINAL MEASUREMENTS:

Rupprecht, S. D.; Faeth, G. M.

NASA CR 1981, NASA-CR-3422, 111 pp.

Chem. Abstr. 1981, *95*, 153333x.

VARIABLES:

T/K = 297-373
P/MPa = 1-10

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

T/K	p^a/MPa	x_1
297.65	1.03	0.0139
373.15	1.03	0.0150
298.15	2.07	0.0289
373.15	2.07	0.0312
297.15	4.82	0.0707
373.15	4.82	0.0733
297.40	10.34	0.1512
373.15	10.34	0.1540

[a] Total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A 1000 cm^3 chamber is filled with ca. 500 cm^3 of liquid. Gas is added to the desired pressure. The chamber is agitated to attain equilibrium. Temperatures are read via thermocouples and pressures via Heisse bourdon tube gages. A liquid sample is removed and allowed to de-pressurize at atmospheric pressure. The solubility is calculated from the measurement of liquid and gas volumes of the de-pressurized sample. Residual dissolved gas is considered to be negligible.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) 0.8095 sp. gr. 60°F. Boiling range 444.26-547.59K.

ESTIMATED ERROR:

$\delta x_1/x_1 = \pm 0.03$, compiler's estimate

REFERENCES:

SYSTEM INDEX

Underlined page numbers refer to evaluation text and those not underlined to compiled tables. All compounds are listed as in Chemical Abstracts. For example, toluene is listed as benzene, methyl-, dimethylsulfoxide is listed as methane, sulfinylbis-. Since nitrogen is usually one of the compounds it is omitted in the listing.

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System Index (cont.)

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REGISTRY NUMBER INDEX

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